2014

Sauk Lake – North Bay Implementation Plan

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CLEAN WATER LAND & LEGACY AMENDMENT

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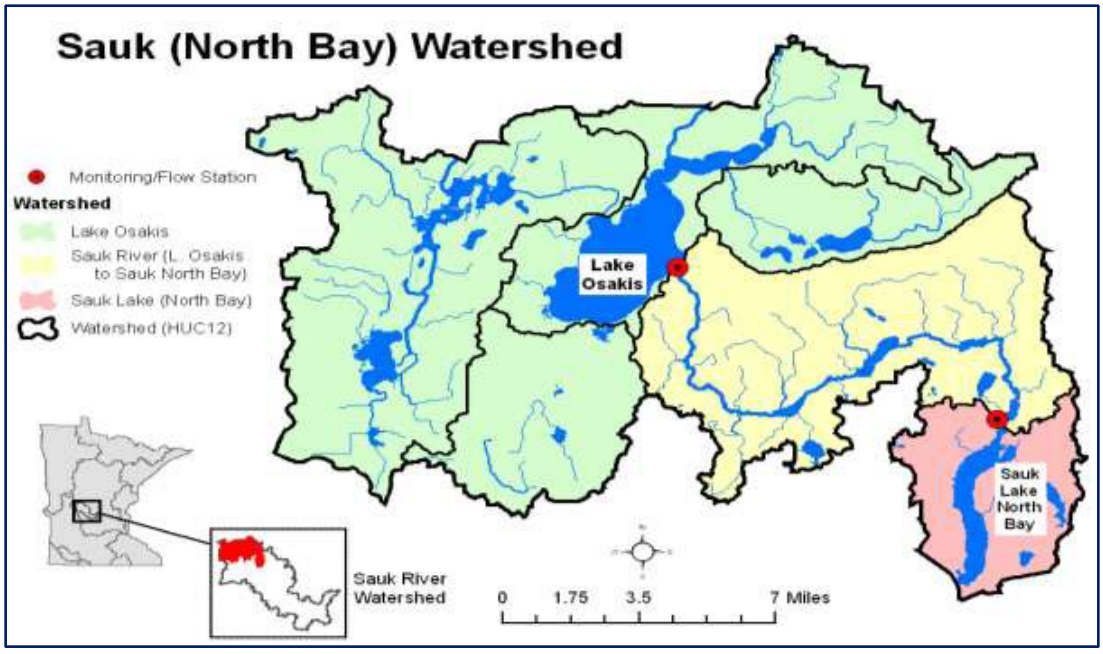
1.0 Introduction

The Sauk Lake North Bay TMDL Study addresses nutrient impairments for the North Bay of Big Sauk Lake (DNR #77-0150-02) located in the Upper Mississippi River Basin in Todd County, Minnesota. The goal of the North Bay TMDL study was to quantify the pollutant reduction needed to meet State water quality standards for nutrients, specifically total phosphorus, for deep lakes in the North Central Hardwood Forests (NCHF) ecoregion. The numeric water quality standard for total phosphorus concentration is a summer average of 40µg/L. Most recent data indicates that the Sauk Lake-North Bay has a summer average total phosphorus concentration of approximately 60µg/L (2002-2007) and does not meet the standard. The TMDL assessment relied upon analyses of flow and stream sampling (FLUX), lake modeling (BATHTUB), and regression equations developed by the MPCA. The specific sources of nutrients, target reductions from each source, and strategies to achieve the reductions will be discussed further in this implementation plan.

The Sauk Lake-North Bay watershed resides in parts of four counties (Douglas, Pope, Stearns, and Todd) covering an area of 348 m2 (557 km2). Of this, 224 m2 (359 km2) consists of the drainage area of Lake Osakis, 90 m2 (145 km2), the drainage of the reach between Lake Osakis and Sauk Lake-North Bay, and 32.9 m2 (52.7 km^2), the drainage of Sauk Lake-North Bay proper (Figure1). The outflow from Sauk Lake-North Bay goes into Sauk-Southwest Bay. The Sauk River runs through four lakes between Lake Osakis and Sauk Lake-North Bay which have an influence on the water quality and hydrograph shape of the river entering Sauk Lake-North Bay. The sub-watersheds of Sauk Lake-North Bay are dominated by agricultural use; primarily corn, soybeans, alfalfa, pasture and animal agriculture. Sauk Lake-North Bay is eutrophic with external and internal loads contributing phosphorus loads to the lake. The external total phosphorus loading from the Sauk River represents 64 percent of the load, the internal loading represents 18 percent, and the remaining 18 percent is from atmospheric deposition, groundwater, local watershed runoff, and stormwater.

The total phosphorus loading to Sauk Lake-North Bay will need to be reduced by 36 percent to achieve the lake water quality goal of 38µg/l (reduced from the standard of 40mg/l to accommodate a margin of safety). This reduction is attained by reducing contributions from internal loading, local watershed runoff, and the main tributary, Sauk River.

Figure 1.



2.0 Sauk Lake-North Bay TMDL Summary

Sauk Lake – North Bay is a deep flowage lake on the Sauk River. Outflow from the lake flows into Sauk Lake-Southwest Bay. The lake area is 1701 acres (688.4 (hectares) with an average depth of 19ft (5.8m) and a maximum depth of 61ft (18.6m). Its watershed area is 135,895 acres (55,000 hectares) creating a lake to watershed area ratio of 1:80. The residence time of Sauk Lake-North Bay is 131 days.

The Sauk Lake-North Bay watershed covers parts of four counties (Douglas, Pope, Stearns, and Todd) encompassing an area of about 348 square miles (557 km^2), of which 224 square miles (34%) consists of the drainage area of Lake Osakis. The remaining area is the drainage area of the Sauk River between Lake Osakis and Sauk Lake-North Bay and the local watershed of Sauk Lake-North Bay. The main tributary for Sauk Lake-North Bay is the Sauk River. There are no other significant tributaries to the North Bay.

The land use for the Sauk Lake-North Bay watershed is primarily tilled agriculture. Agriculture accounts for 71 percent of the land use in the watershed including pasture and grasslands. Wetlands and forest comprise 15 percent, lakes 8 percent, developed areas less than 1 percent. The lake is moderately developed with 377 homes within the first 350ft (100 m) of Sauk Lake-North Bay.

2.1 CURRENT WATER QUALITY

Historic water quality data presented in the TMDL study (pages 8-14) indicates there may be a decreasing trend in total phosphorus since the1980's however Sauk Lake-North Bays still exceeds state standards for total phosphorus concentration and chlorophyll-a (Table 1). No significant trend was determined for transparency since 1987.

The highest summer average concentration was measured (2002-2007) in 2003 which reached over 94µg/L (Table 2). Summer average total phosphorus concentrations have ranged from 41µg/L to 96µg/L between 1980 and 2007, suggesting that the lake has consistently exceeded the state eutrophication standard of 40µg/L for almost 30 years. The water quality in Sauk Lake-North Bay currently does not meet this standard for total phosphorus and is listed as impaired for excessive nutrients which has affected aquatic recreational uses.

Table 1. Class 2B Waters Standard for Deep Lakes -Summer Averages (June- September)

North Central Hardwood Forest Ecoregion	
Parameters	**Deep lakes**
Total Phosphorus (µg/L)	**40**
Chlorophyll-a (µg/L)	**13**
Secchi Depth (m)	**>1.5**

Table 2. Water Quality Data for Sauk Lake- North Bay Summer Averages 2003-2007

Year	Average Total Phosphorus (µg/L)	Average Chlorophyll-a (µg/L)	Average Secchi (m)
2001	65		1.33
2002	81	36	1.60
2003	94	68	1.77
2004	43	38.9	1.84
2005	41	30.1	2.23
2006	44	42.8	1.83

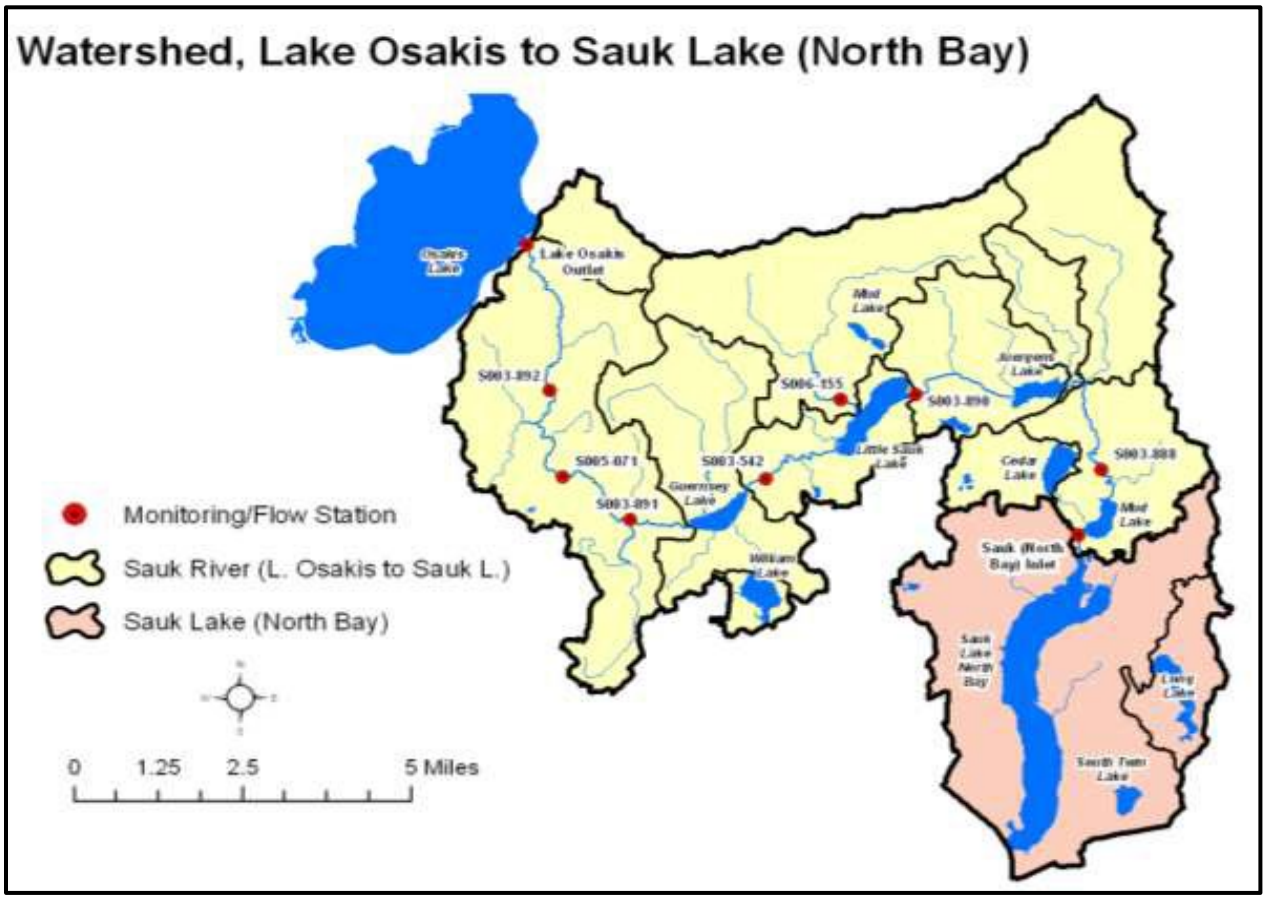
2007	61	45.4	1.07

2.2 PHOSPHORUS LOAD SOURCES

Nutrient loading to Sauk Lake – North Bay is predominantly from external loading. The primary external load is from runoff coming from the Sauk River inlet (64%) and the local watershed (16%). The primary internal load source is sediment-phosphorus release (18%). The remaining 2% nutrient source is from groundwater and precipitation. There are no permitted industrial, or wastewater effluent sources in the Sauk Lake-North Bay watershed.

The Sauk River is the only significant tributary to Sauk Lake- North Bay. It originates at the outlet of Lake Osakis and meanders for approximately 18 river miles (29km^2) through predominantly agricultural areas before flowing into the north bay of Sauk Lake. Along this river stretch (see Figure 2) are 4 river lakes, all of which are shallow, eutrophic, and designated as impaired for aquatic use.

Figure 2. Sauk River Watershed Map



2.3 REQUIRED PHOSPHORUS LOAD REDUCTIONS AND ALLOCATIONS

The TMDL results indicate a phosphorus load reduction of 36% would be required to consistently achieve the State standard total phosphorus concentration of 40µg/L. To achieve this water quality goal, the load allocation was determined to be 13,759 lbs/yr (6240 kg/yr), a reduction of 22 % for the tributary load (Table 2). This equates to an allowable total phosphorus concentration at the inlet to Sauk Lake-North Bay to be at 60ug/l. In the model, calibrated for existing conditions, the contributing total phosphorus load from the local watershed

runoff was 16% of the total. An allocation of 1826 lbs/yr (828 kg/yr) was assigned to the local watershed, a reduction of 60 percent, a value that is considered reasonable and attainable.

After decades of excessive importation of nutrients via the Sauk River, the sediments in Sauk Lake-North Bay has much higher phosphorus content than in pre-settlement times. In the model calibrated for existing conditions, the predicted internal loading was 18% of the total load. To meet the water quality objective of 40µg/l including a margin of safety, and stay within the constraint of 13,759 lbs/yr (6240 kg/yr) set for the tributary allocation, and keeping the reduction for the local watershed near 50 percent, an allocation of 664 lbs/yr (301 kg/yr) was set for internal loading, a reduction of 87 percent (Table 3). The contributing total phosphorus loads from precipitation and groundwater were 152 lbs/yr (69 kg/yr), and 256 lbs/yr (116 kg/yr), respectively. Since there is no practical way to reduce these loads, no load reductions were considered for these sources. Wasteload from industrial and construction stormwater was not considered a nutrient source.

Table 3. Load allocations by Year and by Day

Loading Capacity Allocated to Existing and Future Non-permitted Sources		
Source	Load Allocation per Year	Load Allocation per Day
Stormwater (Wasteload-industrial)	33.5lbs (15.2kg)	.09 lbs (.04kg)
Internal	664lbs (301kg)	1.81lbs (.82kg)
Atmospheric	152lbs (69kg)	.42lbs (.19kg)
Groundwater	256lbs (116kg)	.71lbs (.32kg)
Sauk River	13,759lbs (6240kg)	37.7lbs (17.1kg)
Local Watershed	1,826lbs (828kg)	5.1lbs (2.3kg)
Margin of Safety	1,193lbs(541kg)	3.3lbs (1.48kg)
Total Load Allocation	**17,882lbs (8110kg)**	**49lbs/day (22.2kg/day)**

Table 4. Current Load Contribution and Reduction Needed

Load Contribution and Percent Reduction			
Source	**Current Load per Year**	**Allocated Load per Year**	**Percent Reduction**
Stormwater (Wasteload-industrial)	33.5lbs (15.2kg)	33.5lbs (15.2kg)	0%
Internal	5,098lbs (2312kg)	664lbs (301kg)	87%
Atmospheric	152lbs (69kg)	152lbs (69kg)	<1%
Groundwater	256lbs (116kg)	256lbs (116kg)	<1%
Sauk River	17,658lbs (8008kg)	13,759lbs (6240kg)	22%
Local Watershed	4,545lbs (2,061kg)	1826lbs (828kg)	60%
Totals	**27,742lbs (12,581kg)**	**16,690lbs (7,569kg)**	**40%**
Margin of Safety		**1,193lbs (541kg)**	
Total Load	**27,742lbs (12,581kg**	**17, 833lbs (8110kg)**	**36%**

3.0 Monitoring Plan to Track TMDL Effectiveness

Future monitoring of water quality in Sauk Lake-North Bay and the major tributary, Sauk River, is necessary to enable assessment of whether progress is being made towards achievement of TMDL goals. Monitoring is also important to improve upon the current understanding of the lake dynamics. A better understanding of the linkages between load sources and lake response will reduce uncertainties associated with model predictions, and allow refinement of load allocations to various sources. Increasing the number of samples collected per season throughout the lake profile (epilimnion and hypolimnion) would improve assessment of progress.

Additional parameters such as iron and sulfate would be beneficial as well. Adding chlorophyll to the parameter list at the Sauk Lake-North Bay inlet site would also benefit the yearly assessment.

After a substantial portion of the implementation work has been completed, effectiveness monitoring should begin and be maintained for a minimum of 3-4 years. The TMDL report recommends the following monitoring strategy.

1) At the sampling location in Sauk Lake-North Bay, site id: 77-0150-02-207
    - 10-12 times per summer (June-September) season:
    - Total phosphorus (epilimnion)
    - Chlorophyll-a (epilimnion)
    - Secchi depth
    - Temperature and dissolved oxygen profile, pH (1-meter depth intervals)
    - 5-6 times per summer season
    - Total phosphorus (hypolimnion)
    - OrthoP (hypolimnion)
    - Total Iron (hypolimnion)
    - Total Sulfate (hypolimnion)
2) At the inlet to Sauk Lake-North Bay site id: S000-552
    - Continuous flow (gaging site with electronic logger)
    - 18-20 times per year:
    - Total phosphorus
    - Chlorophyll-a
    - Temperature, pH, dissolved oxygen, conductivity (with portable sonde), t-tube
    - 9-10 times per year:
    - OrthoP
    - TSS
3) Blue-green toxicity testing if excessive algae blooms occur.

4) Flow monitoring should be done annually at established sites. Flow data will be used to determine water volume and annual loading. Electronic data loggers will be maintained to capture water elevations to be converted to flow/discharge.

Curly-leaf pondweed, which is known to increase eutrophication in North American lakes, is present Sauk Lake-North Bay, but the extent and total biomass can vary from one year to the next. Curly-leaf pondweed is unique compared to native aquatic plants in that it grows under the ice and during the spring when water temperatures are still cold. Ice thickness and snow depth may affect the growth of curly-leaf pondweed by limiting the amount of light reaching the curly-leaf pondweed. Curly-leaf pondweed monitoring should be conducted as part of the

implementation plan to document the coverage and density of curly-leaf prior to and after implementation. If feasible, the pondweed surveys should be conducted the same year that water quality monitoring is conducted.

Estimated Annual Cost for Monitoring: $10,000
Funding Source*:* Grant funds, Lake Associations, general funds

4.0 Implementation Plan

The TMDL implementation plan focuses on reducing external sources of phosphorus to the watershed with additional work to address internal sources of phosphorus loading. Annual overall total load reductions of 17,833lbs/year (8110kg**),** (36 %) in phosphorus loading in Sauk Lake-North Bay is required to meet the total phosphorus growing-season average of 40 µg/L. Load-reduction projects should be implemented following a priority ranking system for the available nutrient reduction strategies. Additional monitoring is also recommended to help determine the removal efficiency of planned watershed measures to reduce phosphorus loading to the lake. This Implementation Plan details the specific activities the stakeholders in the lake's watershed plan to undertake to attain the necessary reduction.

4.1 TMDL and Implementation Plan Process

The activities and Best Management Practices (BMPs) identified in this Implementation Plan will be carried out by the Sauk River Watershed District (SRWD) and stakeholders of the Sauk Lake-North Bay to achieve water quality standards. The SRWD will begin by establishing a Technical Advisory Committee (TAC). The TAC will include stakeholder representatives from the city of Sauk Centre, Minnesota Department of Natural Resources (MNDNR), the Board of Water and Soil Resources (BWSR), the Minnesota Pollution Control Agency (MPCA), the Todd and Stearns County Soil and Water Conservation Districts (SWCD) and Natural Resource Conservation Service (NRCS,) the Todd County Planning and Zoning and Stearns County Environmental Services, and the West Central Technical Service Area.

This implementation project will begin by utilizing technology to determine where high priority runoff areas are within the watershed of Sauk Lake-North Bay. In 2013-14 the Sauk River Watershed District (SRWD) utilized Clean Water Funds to conduct an advanced sub-watershed model utilizing the MPCA's initial HSPF (Hydrologic Simulation Program in FORTRAN) watershed wide model and refining it to a smaller scale. The enhanced model will assist the SRWD and local agencies in developing a more refined focus for BMP implementation efforts thereby improving water quality more effectively. Sharing priority information, data and tracking completed BMP projects with local agencies are critical steps for a successful strategic implementation program. The new web based database and interactive mapping system developed will improve communication with local agencies and targeting restoration efforts.

Information developed from the University of Minnesota for the 39 agro-regions of Minnesota was used as a guide to develop this TMDL Implementation Plan. A list of riparian and upland management practices that appear most appropriate within the Central Till agro-ecoregion, which contains Sauk Lake-North Bay watershed, was developed. BMPs recommended for reducing nutrient and sediment transport under the Vegetative, Primary Tillage, Structural Practices, and Manure Management categories include the following:

Vegetative Practices

- Contour farming/Strip cropping
- Grassed waterways
- Grass filter strip for feedlot runoff
- Forest management practices
- Alternative crop in rotation and cover crops
- Field windbreak

- Pasture management (IRG)
- Riparian restoration
- Conservation Reserve Program (CRP) or Enhancement program (CREP)29
- Reinvest in Minnesota Program (RIM)

Primary Tillage Practices

- Chisel Plow
- One pass tillage
- Ridge till
- Sustain surface roughness

Structural Practices

- Wetland restoration
- Livestock exclusion and management
- Liquid manure waste facilities
- Bank stabilization
- Stormwater retention/infiltration
- Terraces
- Water and sediment control basins
- Side inlets
- Alternative tile intakes
- Controlled drainage
- Pattern tile
- Two-stage ditch design

Livestock and Manure Management

- Manure Management plans
- Feedlot runoff control
- Agricultural waste pit closures

4.2 Implementation Plan- Activities and Cost:

The focus in implementation will be on reducing the annual phosphorus loads to Sauk Lake through structural and non-structural Best Management Practices and projects. Management alternatives and strategies have been developed for Sauk Lake- North Bay to reduce total phosphorus from non-point sources in the watershed. The list below outlines activities and practices that have been used in the Sauk River watershed in the past and/or have been suggested as practices to be considered for reducing phosphorus in the Sauk Lake-North Bay watershed. This section describes various activities that will be undertaken to reduce nutrient loads and runoff volume to the Sauk River and Sauk Lake.

4.2.1 Coordination of Efforts

One of the primary role of the SRWD is serving as a coordinator of water resource activities. The District will continue in that role in the implementation of this TMDL. General activities now undertaken by the District will be continued or expanded as the TMDL is implemented.

- Provide advice and assistance to local communities/landowners on their implementation activities;
- Research and disseminate information on changing BMP technology and practices;
- Recommend activities such as vegetation or fishery management, partnering with the DNR;
- Maintain the watershed models and database;
- Conduct public hearings on proposed projects; and
- Pursue financial assistance funds to share the cost of improvement projects.

Estimated Cost: Ongoing activity
Funding Source: General operating budget

4.2.2 Public Education and Outreach for Water Quality Protection

The District operates an ongoing education and outreach program. An extensive outreach program for the residents of the Sauk Lake – North Bay watershed will be developed to inform these residents of the issues facing Sauk Lake and their roles in addressing these issues. This public education program will promote a community-to-community awareness and clearly identify the contribution from all communities, such as waterfront property owners and agricultural producers. This education program will integrate public relations advertising, marketing, civic engagement, public involvement, technical assistance, and training to optimize nutrient reductions from all phosphorus loading sectors within the overall watershed. The SRWD will explore multiple media options to utilize that will improve communication with the residents of the watershed.

Estimated Cost: $5,500 annually
Funding Source: General operating budget and grant funding

4.2.3 Support Enforcement of Existing Regulations

Existing regulations are often sufficient to improve water quality in these watersheds, but a lack of enforcement capabilities of the regulations can result in them being less effective. Enforcement of existing regulations by entities with management authority should be supported. The SRWD will review its current rules and adjust as needed to support water quality.

Estimated Cost: $5,500 annually
Funding Source: General operating budgets of participating agencies

4.2.4 Technical Advisory Committee (TAC)

The District will form a technical advisory committee to provide recommendations on BMPs. Staff from the local agencies will be invited to participate in the TAC to ensure success of the Sauk Lake- North Bay TMDL implementation project. Committee members will consist of, but not limited to, staff from the SRWD, Todd and Stearns County SWCDs, NRCS, West Central Technical Service Area, Todd County Planning and Zoning and Stearns County Environmental Services (SES) and the MNDNR.

Estimated Cost: $1500 annually
Funding Source: General operating budgets of participating agencies

4.3 District Initiated Activities:

The Sauk River Watershed District's focus will be to improve the water quality in the Sauk River and Sauk Lake. The District will undertake the following priority implementation actions to achieve water quality standards in Sauk Lake-North Bay.

4.3.1 Activate the Management Unit Charge

The District will establish a basis for the water management unit charge (MU) and hold public hearings to establish the Sauk Lake (#2) water management unit as described in the 2014-2023 District Comprehensive Management Plan. Funding from the established water management units (or districts) will be used to provide a financial incentive for landowners to participate in implementing BMPs to improve the water quality of Sauk Lake.

Estimated Cost: $50,000
Funding Source: General operating budget and grant funding

4.3.2 Sediment Reduction Initiative

Due to decades of excessive importation of nutrients via the Sauk River, the sediments in Sauk Lake-North Bay have much higher phosphorus content than in pre-settlement times. The TMDL states that an 87% reduction in internal phosphorus loading is needed to achieve the 40ug/L water quality standard. To reduce phosphorus loading to Sauk Lake-North Bay by way of sediment transport the District will pursue grant funds to offer landowners an incentive to enroll in erosion control and sediment reduction programs offered by the Todd and Stearns SWCDs and NRCS, or to implement other sediment reduction BMPs. The District will require landowners to sign a financial agreement and operation and maintenance plan to ensure project integrity is maintained for the life expectancy of the BMP installed.

Estimated Cost: $125,000 annually
Funding Source: **SRWD** General operating budget, SWCD, NRCS and grant funding

4.3.3 Stormwater infiltration Initiative

Even though the majority of the local watershed is developed, there are still opportunities for stormwater infiltration. Where feasible, rain gardens or subsurface filtration and infiltration devices could be used. The SRWD will pursue grant funds to provide a financial incentive for landowners to participate in implementation efforts. The District will require landowners to sign a financial agreement and operation and maintenance plan to ensure project integrity is maintained for the life expectancy of the BMP installed.

Estimated Cost: $10,500 annually
Funding Source: **SRWD** General operating budget, SWCD, and grant funding

4.3.4 Internal Nutrient Load Reductions

Internal nutrient loading needs to be reduced by 87% to meet the TMDL allocations presented in the Sauk Lake-North Bay TMDL study. There are several options for reducing internal loading ranging from chemical sequestering or inactivation of sediment phosphorus to complex infrastructure techniques such as hypolimnetic aeration. Prior to implementation of any strategy to reduce internal loading in Sauk Lake –North Bay, a technical review needs to be completed to evaluate the cost and feasibility of the lake management techniques available to reduce or eliminate internal loading. Following is a brief description of two common techniques that could be considered for controlling internal loading in Sauk Lake-North Bay.

Hypolimnetic Aeration
Aeration efforts in a lake's deepest layer controls internal loads by aerating deep, cold, dense, waters to maintain oxygenated conditions in the hypolimnion and sediment surface. It is the anoxic condition of the hypolimnetic sediments which contribute to the internal phosphorus load. An engineering design and feasibility study of Sauk Lake-North Bay would be necessary to determine the specific requirements for successful hypolimnetic aeration. Safety measures would also need to be considered during winter operation.

Alum treatment
Aluminum sulfate (alum) application is a chemical addition that binds with phosphorus to form a non-toxic precipitate (floc). The alum removes phosphorus from the water column and sequesters it to the sediment where it is no longer available for algal growth by forming a barrier between lake sediments and the water restricting phosphorus release from the sediments. A feasibility study would be required

for it is unclear how long the floc would remain effective before being covered by imported sediment from the Sauk River.

These potential phosphorus reduction efforts will require a permit from the DNR and a treatment plan with specific treatment objectives and activities.

Estimated Cost: approx$1,000,000 ($1,300/ac for targeted 750 acres)
Funding Source: WMD and Grant funding and local partners

Additional attention will be given to internal phosphorus load reduction using biological treatment options. Carp and bullhead are bottom feeding fish found in Sauk Lake that disturb the lake sediment, causing phosphorus to be recycled back into the water column. Additional attention will be given to measuring the amount of carp present in Sauk Lake during the next fisheries survey. Possible carp removal will be reviewed after survey results are compiled.

Estimated Cost: $10,500 annually
Funding Source: WMD and Grant funding and local partners

4.4 Partner Initiated Activities:

The SRWD will partner with the Todd and Stearns County SWCDs and NRCS to target nutrient management actions in the high potential delivery areas identified in the 2014 subwatershed HSPF model. These actions may include the following practices:

4.4.1 Agricultural Drainage

An evaluation of the agricultural land drainage networks for the Sauk Lake-North Bay watershed will be undertaken. This assessment will explore the feasibility of reducing the velocity of flow in agricultural drains and ditches to allow particulate nutrients an opportunity to settle out. The use of nutrient traps or settling basins along drains will be explored to determine their effectiveness in reducing nutrient loading. This activity will include a review of the feasibility of acquiring marginal land and constructing new wetlands, or restoring existing wetland areas that could serve as natural filters for drainage water.

Estimated Cost: $65,000 - $100,000
Funding Source: Todd and Stearns County SWCD/NRCS funds, Grant funding and SRWD WMU funds

4.4.2 Vegetative Management and Tillage practices

Vegetative practices include those focusing on the establishment and protection of crop and non-crop vegetation to minimize sediment mobilization from agricultural lands, and decrease nutrient and sediment transport to receiving waters. Conservation tillage techniques, grassed waterways, grass filter strips alternative crop rotations, forest management, and field windbreaks, are designed to minimize exposure of bare soils to wind and water which can transport soil off-site. Maintaining the vegetation allows for greater water infiltration, reducing runoff, and associated nutrient and sediment transport. Partnership programs will be used to help agricultural producers assess the environmental risk of their land management practices.

Estimated Cost: $50,000 annually
Funding Source: Local programs, Grant funding and SRWD WMU funds

4.4.3 Ditch Maintenance

Public, private and roadside ditch cleaning has the potential to contribute significant nutrient loadings and exacerbate stream channel erosion due to increasing discharge rates and erosion of channel material. An assessment of the current and planned ditch cleaning activities along with a review of their best management practices will be completed and evaluated for structural and non-structural improvements. The SRWD will work with Todd County Ditch authority and county Public Works Departments to attain information for public ditches and roadside ditches. For private ditches, the SRWD will work with the DNR and permitting agencies as landowners plan clean outs.

Estimated Cost: $50,000 annually
Funding Source: Local programs, Grant funding and SRWD WMU funds

4.4.4 Livestock Access to Riparian Areas and Waterways

Within the Sauk Lake- North Bay watershed there is large number of livestock operations. Landowners having drainage from confined livestock areas will be encouraged to direct runoff to retention basins, grassed buffer strips, constructed wetlands, or other recommended nutrient-reduction features. Manure accumulated in confined holding areas will be regularly removed and applied to crop or pasture lands during appropriate seasons and at appropriate agronomic rates. Livestock producers in the Sauk Lake-North Bay watershed will be encouraged through enhanced incentives, education, and (when required) regulations to implement measures to protect riparian areas and waterways, such as managing livestock access in riparian areas and providing off-site watering structures. Agriculture extension programs, as well as other partnership programs, will be used to help agricultural producers assess the environmental risk of their operations. These programs will also be used to provide advice on how to prevent the contamination of groundwater and surface water.

Estimated Cost: $45,000 annually
Funding Source: Local programs, Grant funding and SRWD WMU funds

4.4.5 Soil Fertility and Manure Testing

Additional strategies that promote and support annual soil testing will be developed to provide agricultural producers with the tools necessary to make sound agronomic, economic, and environmental decisions. Incentives for agricultural producers conducting soil testing and manure testing will be considered. Enhanced education on the economic and environmental benefits of soil and manure testing will be accomplished through local SWCD and NRCS offices. Education efforts will also be put forth to encourage soil health and stability.

Estimated Cost: $5,000 annually
Funding Source: Local programs, Grant funding

4.4.6 Stream Channel Erosion

New development or redevelopment sites, as well as other construction activity projects, will be designed to maintain or improve the existing hydrology (i.e. reduce peak flows). In addition the SWCDs and the District will utilize the SRWD's 2010 Upper Sauk River Physical Assessment data and its list of priority erosion areas along the Sauk River to address the phosphorus laden sediment being transported to Sauk Lake-North Bay. In-stream structures, such as stream barbs, need to be carefully designed to direct flow appropriately under a wide range of flow conditions and ensure that the solution to one channel stability problem doesn't create another

elsewhere. Floodplain areas will need to be considered when designing a stream BMP. The established natural vegetation in the floodplain also acts to slow flow velocities and encourages deposition and permanent capture of sediment.

Estimated Cost: $50,000 annually for implementation
Funding Source: SWCD and NRCS programs, SRWD WMU funds and other grant funds

4.4.7 Structural Practices

Structural practices generally require a more site-specific planning and an engineered design. Most structural practices focus on slowing water down in the watershed to decrease nutrient and sediment loading to the receiving water. An example of this would be a wetland restoration which creates a natural method of slowing runoff and storing it for a period of time, which can improve channel stability and reduce flooding downstream. The calmer conditions of a wetland can effectively settle out nutrient and sediment particles from runoff. Feedlot structures to reduce runoff from open lots will require site specific engineered designs.

Estimated Cost: $150,000 annually, depending on participation
Funding Source: SWCD and NRCS programs, West Central Technical Service Ares, SRWD WMU funds and other grant funds

4.4.8. Septic System Maintenance

A focused educational campaign will be undertaken to provide guidance to homeowners on how to properly maintain septic systems and how to recognize when they are failing. The SRWD will encourage the local governing agencies to conduct mandatory inspection of private sewage treatment systems at the time of sale. The sale of the property would be conditional on a properly functioning system. The SRWD and local agencies will explore the funding options to recover the costs of conducting an ongoing comprehensive septic system field inspection program and maintaining a septic system database.

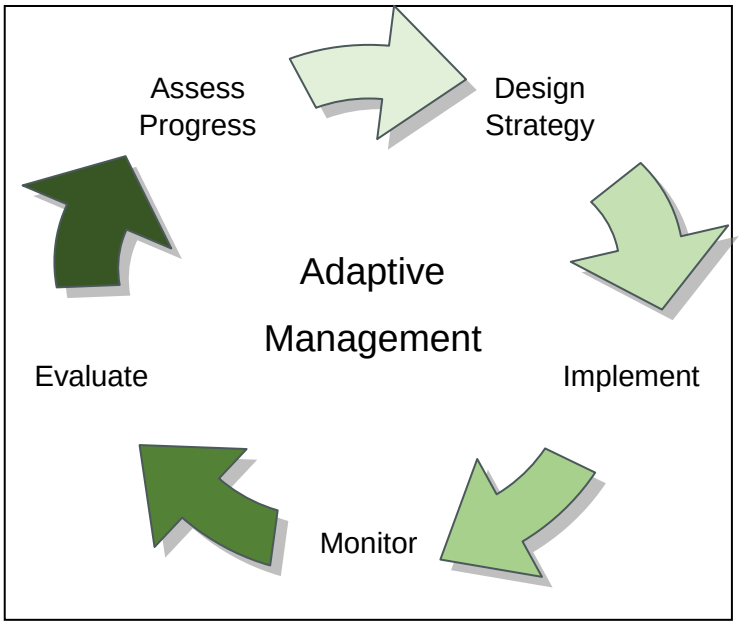
Estimated Cost: $2500 annually
Funding Source: WMD and Grant funding and local partners

When dealing with impairments due to nonpoint sources, no single practice or activity will improve water quality to the point of achieving standards. It will take a number of practices in different areas to improve water quality across the watershed ranging from simple, small-scale fixes, to changes in mindsets when dealing with water and watershed management.

5.0 Adaptive Management

The implementation strategies summarized above will be implemented in order to achieve reductions in phosphorus loading necessary to achieve water quality targets in Sauk Lake-North Bay. Overall, this implementation strategy will be adaptive as projects are completed. The implementation strategies will be reevaluated and updated as new data becomes available. Consideration will be given on how implementation of upstream phosphorus reduction strategies affects downstream phosphorus sources. Because there are no known point sources in the project area watershed, the implementation elements will focus exclusively on non-point source controls.

Figure 3. Adaptive management.



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The implementation activities listed will be ongoing for 20+ years. The nutrient reduction needs for the Sauk Lake-North Bay watershed identified in the TMDL require aggressive goals. Implementation activities will be conducted using an adaptive management approach. Adaptive management is based on assessment, planning, action, monitoring, evaluation and adjustment based on knowledge gained. Changes in water quality standards, technology, research, and weather may alter the course of actions listed in this plan. Continued monitoring and adjustments responding to monitoring results are the most appropriate strategy for attaining the water quality goals established in the Sauk Lake – North Bay TMDL.

The SRWD will coordinate efforts to determine what best management practices would be practical, economically feasible, and environmentally effective in reducing nutrient loading in Sauk Lake-North Bay and its watersheds. BMP cost-effectiveness, combined with information about local water quality impairments and nutrient delivery to the lake and leveraged funding from outside sources, will be used to finalize a priority ranking system for implementing individual nutrient reduction strategies throughout the watershed.