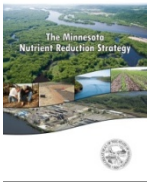
Minnesota Nutrient Reduction Strategy Pilot Project

September 2015

Acknowledgements

Research in the document is based on multiple agencies and researchers across Minnesota who have been working together to develop Minnesota's Nutrient Reduction Strategy. Watershed information can be found in the Minnesota Nutrient Planning Portal which is organized by 81 watersheds across the state.

Minnesota Nutrient Reduction Strategy
http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/nutrient-reduction/nutrient-reduction-strategy.html



Minnesota Nutrient Planning Portal
http://mrbdc.mnsu.edu/mnnutrients/

MINNESOTA NUTRIENT PLANNING PORTAL

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Cover photo of Freeborn Lake by S Seath

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Executive Summary

Nutrient Reduction Strategy

The Minnesota Pollution Control Agency recently released the Minnesota Nutrient Reduction Strategy (NRS) in Sept 2014 to guide the state in reducing excess nutrients in waters so that in-state and downstream water quality goals are ultimately met. The state-level nutrient reduction strategy is meant to establish a large-scale big picture framework, under which fits individualized watershed planning. While the NRS is written initially to establish the large scale framework it acknowledges that for the goals and actions to be effective it will need to be relevant and works at three scales.

- Federal and state planning and program management. This level is strategic and is responsible for managing large-scale goals and results.
- The local scale consists of watershed planning and implementation assistance delivery.
- The third scale is the decision level and consists of nutrient source decision makers, and especially farm managers and city decision makers.

How much reduction is needed?

To do its fair share for the Gulf of Mexico, Minnesota needs a 45 Percent reduction in nitrogen and phosphorus to the Mississippi River compared with loading occurring prior to the year 2000. City wastewater treatment improvements and other rural and urban sources have substantially reduced phosphorus; however, more work is needed to reach the following targets:

- Achieve a progress milestone of a 20 percent nitrate load reduction by 2025 (45 percent by 2040).
- Reduce phosphorus by 45 percent in nearly 500 lakes impaired for eutrophication (algae growth).
- More than 40 percent reduction in phosphorus for many eutrophication-impaired Minnesota rivers.
- Reduce nitrate to meet standards for thousands of wells and some cold water streams.

Nutrient Pilots

The purpose of the Nutrient Reduction Strategy Pilot Projects is to explore some ground-truthing at the local level. In 2013, project partners reached out to local partners across the state to better understand what types of information would be helpful for nutrient planning and how we could enhance watershed scale information exchange. This resulted in the Minnesota Nutrient Planning Portal, a website that synthesizes and organizes information by watershed (HUC 8) in a manner designed to meet the needs of local decision-making for accelerating the pace of nutrient planning across the state.

The Nutrient Pilots Project takes this process a step further and focuses in on three watersheds of the state. The goal was to work with stakeholders from three pilot project areas to document and learn more about their goals, process, social readiness, and outreach efforts. The pilots focus in on subwatersheds in Le Sueur, Root and Cannon River Watersheds. Each of these pilots are embedded in the Minnesota Water Management Framework, the watershed planning approach that assesses, restores and protects waters. This approach sets a 10-year cycle of water assessments, watershed restoration and protection strategy (WRAPS) development at the hydrologic unit code 8 (HUC8)

watershed level, and local water planning (e. g., One Watershed One Plan). We hope that these pilots can provide a snapshot view from 2015 and help to inform and add value to the longer term and larger scale planning processes occurring in these watersheds.

Le Sueur River Watershed – Freeborn Lake Subwatershed Pilot

This document profiles the Le Sueur River Watershed, Freeborn Lake Subwatershed Pilot. We met with local partners (county, SWCD, GBERBA, agribusiness) and landowners during Spring 2015 to promote information exchange about data and tools from the Nutrient Reduction Strategy and to better understand their current goals, process and perspectives. During the meeting, staff and landowners indicated that there is currently more general willingness in the following BMPs delineated in the NRS: Placement and timing of fertilizer application, two stage ditches, terraces/grassed waterways, constructed wetlands, conservation tillage and residue management. Freeborn SWCD has a rich history of networking with landowners in the subwatershed and is partnering on an innovative Soil Health Program that it is promoting cover crops and conservation tillage across the watershed. Like many other watersheds across the state, we learned that citizens have different baseline understanding of nutrient issues in the Freeborn Lake Subwatershed and varying motivation levels to remedy water quality problems. We hope that some of the data provided in this report can help to inform program and policy makers and local planners alike.

"*The more that we can provide the economic side of things to producers, the better*." – Mark Schaetzke, Freeborn SWCD

"*A major impediment to conservation of Best Management Practices is a lack of local staffing at NRCS and SWCDs*." –Local Staff and Landowner Discussion at March 18, 2015 Meeting

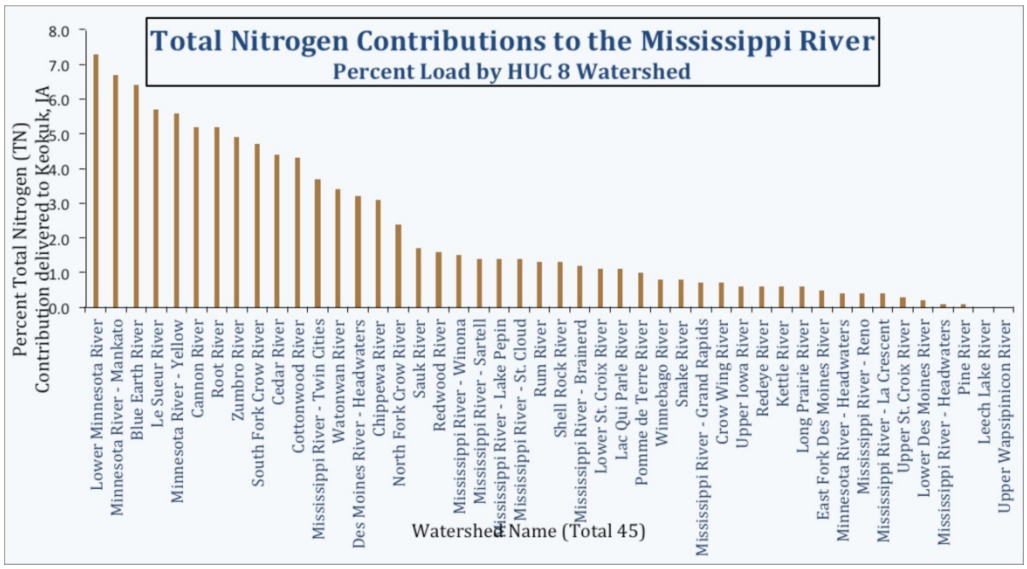
Water Quality Monitoring & Impairments

Water Quality

The Le Sueur watershed is a major source of sediment and nutrients to the Minnesota River. Several agencies and universities have studied the watershed over the past three decades with research continuing. There is a tremendous amount of data available for this watershed and many sections of the river and its streams continue to suffer from many problems, including turbidity, low dissolved oxygen, and excess nutrients.

Nitrogen Load: Mississippi River

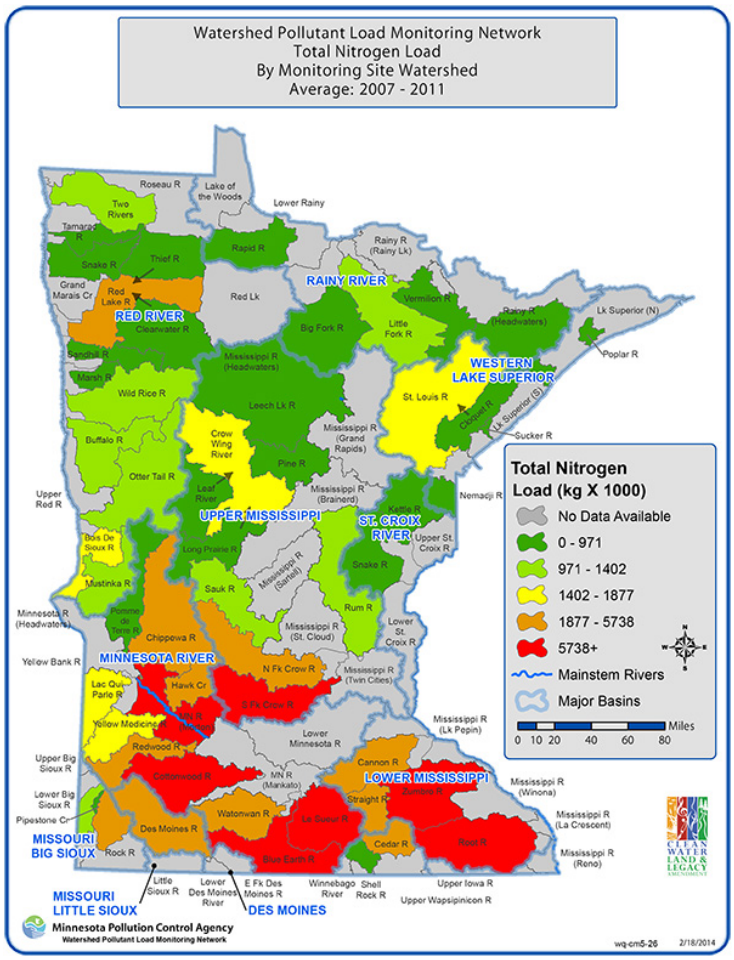
The Le Sueur is a major loader of Nitrogen to the Mississippi River. The Le Sueur River Watershed ranks 4th contributing 5.7% of the load to the Mississippi River at Keokuk, Iowa. Fifteen of the 45 watersheds draining into the Mississippi River from Minnesota each contribute over 3 percent of the modeled load delivered to the Mississippi River in southern Iowa (Keokuk). Combined, these 15 watersheds contribute 73.7 percent of the total nitrogen load delivered to Keokuk from Minnesota. These higher loading watersheds are mostly located in South-central and southeastern Minnesota. The other thirty watersheds each contribute between 0 and 2.4 percent of the load, and are thus considered relatively minor contributors.



Percent contribution of TN delivered to the Mississippi River in Keokuk, Iowa, from each of Minnesota's HUC8 Watersheds which ultimately drain into the Mississippi River.

Nitrogen Load

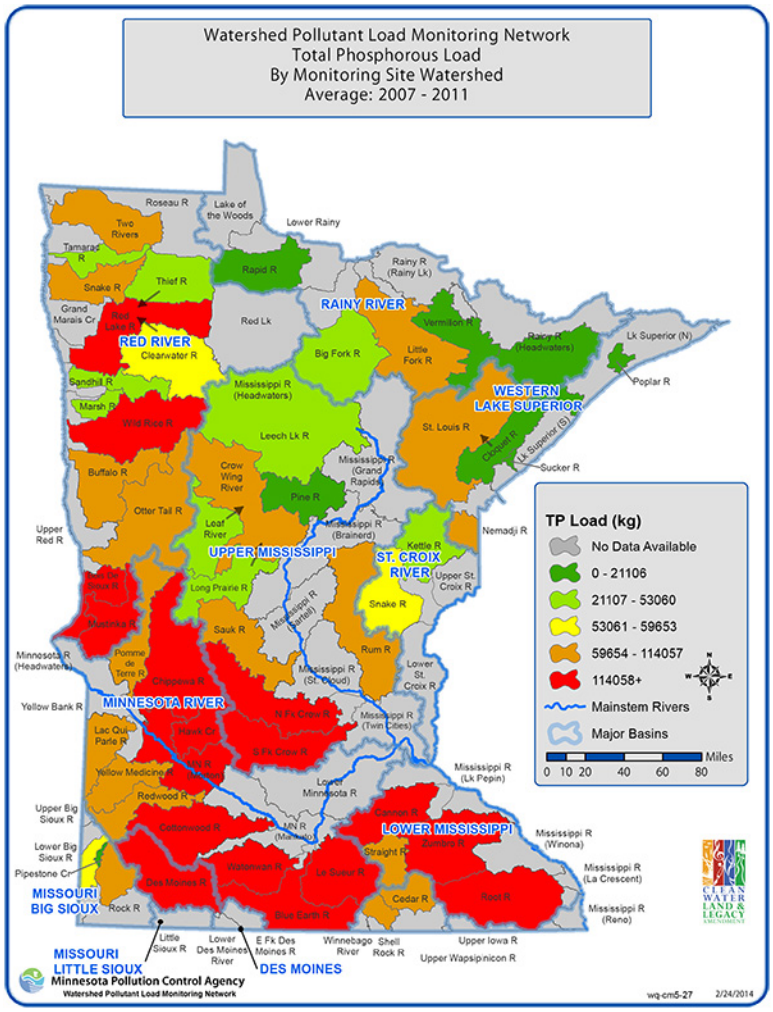
Minnesota Pollution Control Agency's Watershed Pollutant Load Monitoring Network data shows Le Sueur River as a high loader of Nitrogen to the Mississippi River. Higher loading watersheds are indicated in red.



http://www.pca.state.mn.us/index.php/view-document.html?gid=19288

Phosphorus Load

Minnesota Pollution Control Agency's Watershed Pollutant Load Monitoring Network data shows Le Sueur River as a high loader of Total Phosphorus to the Mississippi River. Higher loading watersheds are indicated in red.



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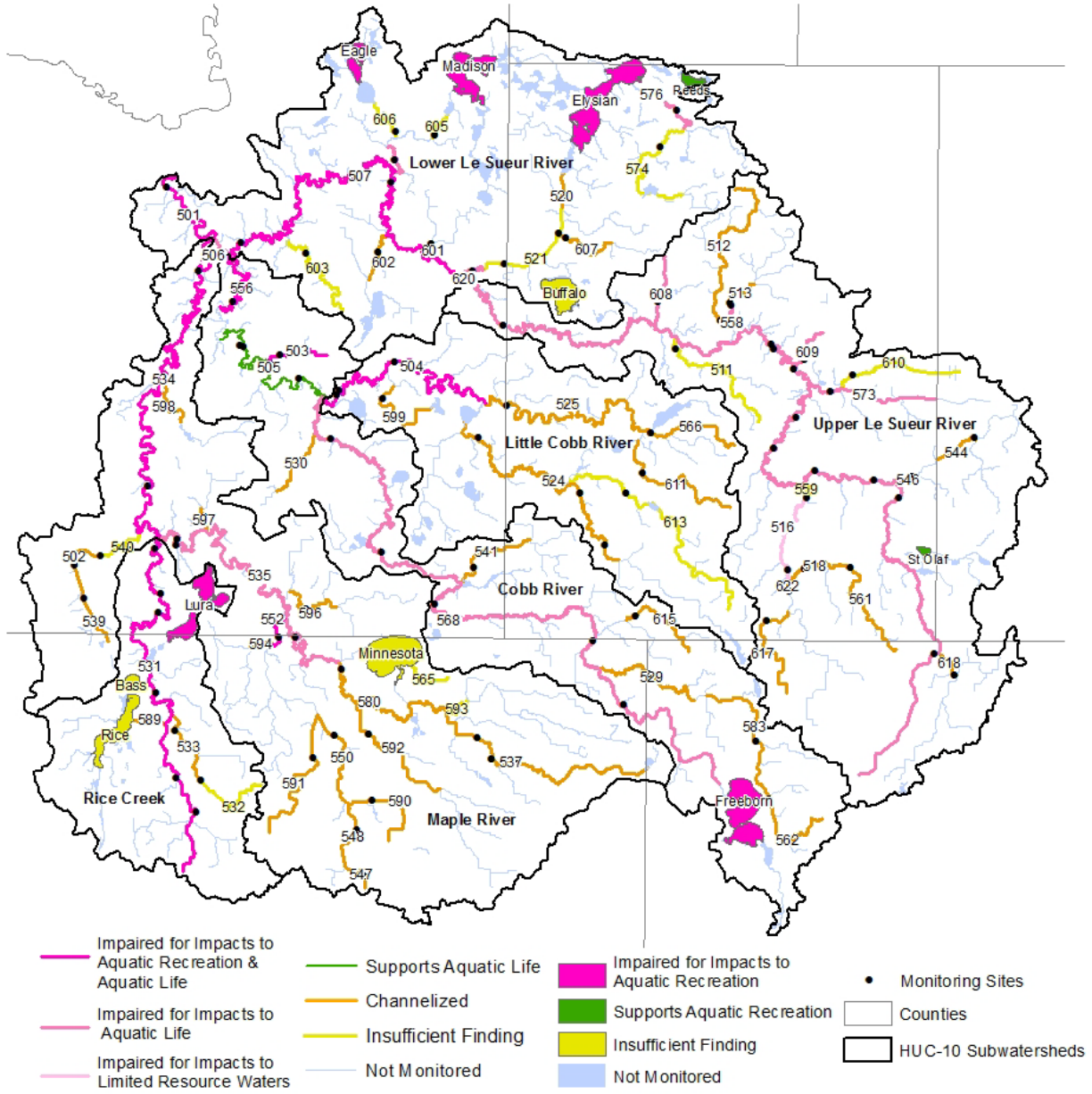
Existing Monitoring Sites & Impairments



Stream and lake impairments were identified throughout the Le Sueur River watershed (in shades of pink). Very few waters were found to support their designated use (in green). Furthermore, more than half of the monitored stream reaches were channelized and cannot be assessed yet because standards are under development for channelized streams (in orange). Some water bodies did not have a robust enough data set to make a scientifically-conclusive finding (in yellow). The monitored lakes are noted by lake name and the monitored stream reaches are noted by the last three digits of the assessment unit identifier (AUID) (Le Sueur River Watershed WRAPS, Le Sueur River Watershed Monitoring and Assessment Report) .

In 2008-2009, 74 of the 136 stream Assessment Unit Identification (AUID) reaches and 9 of the 52 lakes in the Le Sueur River watershed were monitored and assessed as impaired or not supporting at least one of their beneficial uses. Several of the stream reaches and lakes were not able to be assessed due to being channelized or having insufficient data. None of the 54 protected wetlands were monitored in this iteration of the Watershed Approach (Le Sueur River Watershed Monitoring and Assessment Report).

Nutrient Related Water Quality Data

There is a rich amount of water quality data for Le Sueur River Watershed. Additional data can be found in the following documents, databases and websites:

Minnesota Nutrient Planning Portal (website). http://mrbdc.mnsu.edu/mnnutrients/minnesota-major-watersheds

Minnesota Pollution Control Agency. March 2012. Le Sueur River Watershed Monitoring and Assessment Report. http://www.pca.state.mn.us/index.php/view-document.html?gid=17609

Minnesota Pollution Control Agency. June 2010. Assessment of Selected Lakes within the Le Sueur River Watershed (Blue Earth, Waseca, Faribault, Steele, Freeborn Counties). http://www.pca.state.mn.us/index.php/view-document.html?gid=15459

Minnesota Pollution Control Agency. August 2015. Le Sueur River Watershed WRAPS Report (MPCA approval 8/20/2015). http://www.pca.state.mn.us/index.php/view-document.html?gid=22606

Minnesota Pollution Control Agency. Wall, D., D. Mulla, S. Weiss, D. Wasley, T.E. Pearson, B. Henningsgaard. June 2013. Nitrogen in Minnesota Surface Waters.

Minnesota Pollution Control Agency. September 2014. Minnesota Nutrient Reduction Strategy. http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/nutrient-reduction/nutrient-reduction-strategy.html

Minnesota Pollution Control Agency. August 2015. Final Le Sueur River Watershed TMDL. http://www.pca.state.mn.us/index.php/view-document.html?gid=22607

 Watershed Pollutant Load Monitoring Network - MPCA

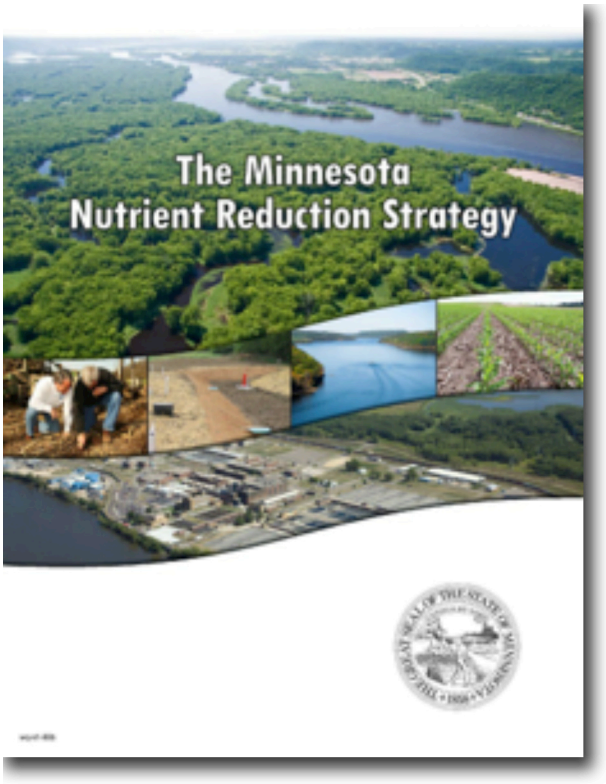
 MN DNR/MPCA Cooperative Stream Gaging Network – USGS, MN DNR, MPCA – Stream discharge and links to Division of Waters Resources, climate information, river levels, water quality information, recreation and commonly used hydrologic terms

 USGS – USGS discharge Information

 EDA Environmental Data Access – Water quality data collected for all MPCA monitoring projects

 EQuIS – Environmental Quality Information System – Water quality data from more than 17,000 sampling locations across the state.

Minnesota Nutrient Reduction Strategy



The goal of the Minnesota Nutrient Reduction Strategy (NRS) is to guide the state in reducing excess nutrients in waters so that in-state and downstream water quality goals are ultimately met. Fundamental elements of the NRS include: Clear goals, building on current efforts, prioritizing problems and solutions, supporting local planning and implementation, and improving tracking and accountability. Successful implementation of the NRS will require broad support, coordination, and collaboration among agencies, academia, local government, private industry, and citizens.

The Minnesota Nutrient Reduction Strategy outlines key measures that could be implemented in urban and agricultural areas in the Mississippi River Basin in Minnesota where phosphorus and nitrogen reductions are needed in order to reduce nutrient loading to Lake Pepin and the Mississippi River. Some best management practices highlighted include: increasing fertilizer use efficiencies through soil testing and application via subsurface banding; increasing living (perennial) cover by using cover crops, increasing riparian buffers and conservation reserve acres; controlling field erosion by using conservation tillage; managing stormwater volume and velocity through wetland restoration and controlled drainage practices; and continued and improved waste management for waste water treatment facilities, septic systems, and feedlots, among others.

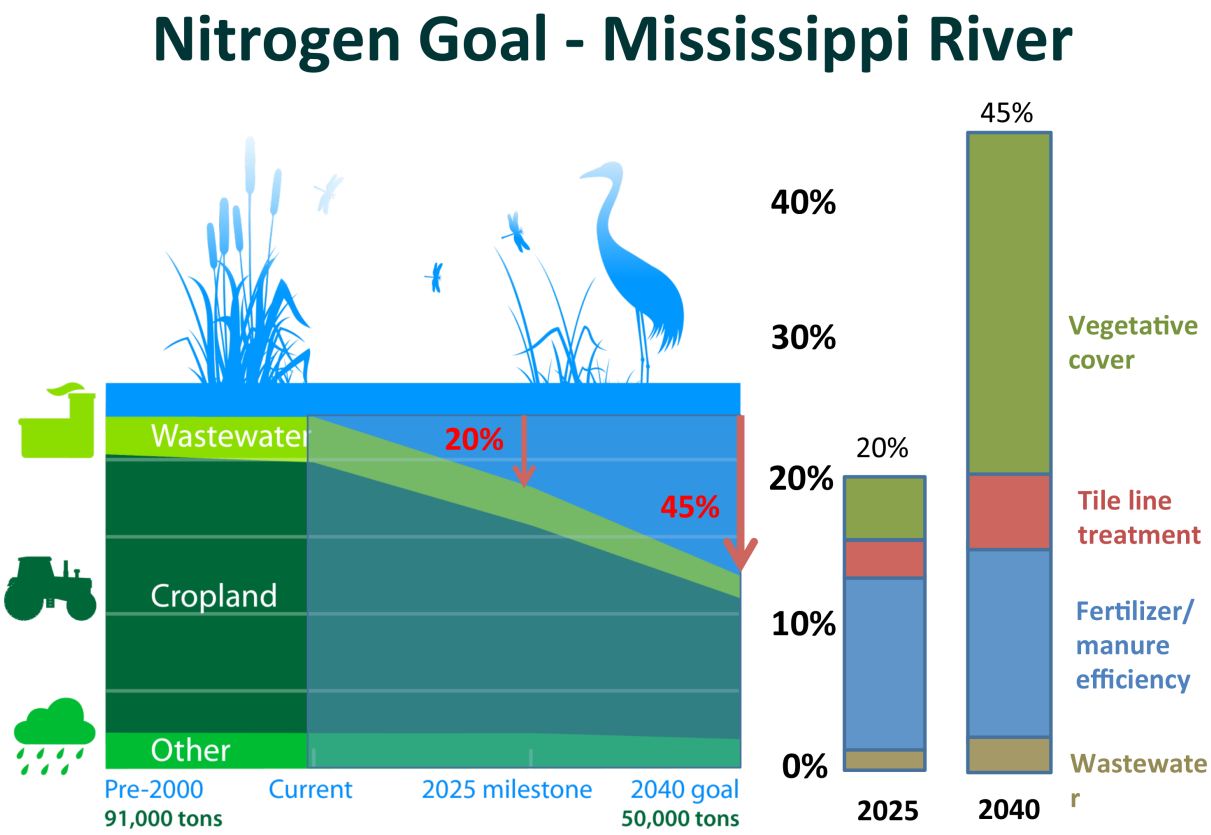
The NRS provides the information and collective objectives needed to address watershed nutrient goals downstream of the HUC8 watersheds. These downstream objectives can then be integrated with needs and prioritized actions within the HUC8 watershed. HUC8 watershed goals and milestones should be

developed so that cumulative reductions from all watersheds will achieve the goals and milestones in waters downstream.

Learn more about the Nutrient Reduction Strategy on the MPCA website.
Minnesota Nutrient Reduction Strategy (wq-s1-80)
Executive Summary (wq-s1-80a)
Nutrient Reduction Strategy - Two-page summary (wq-s1-80q)
Minnesota Nutrient Planning Portal webpage

Minnesota Nutrient Strategy - Mississippi River Nutrient Reduction Goals

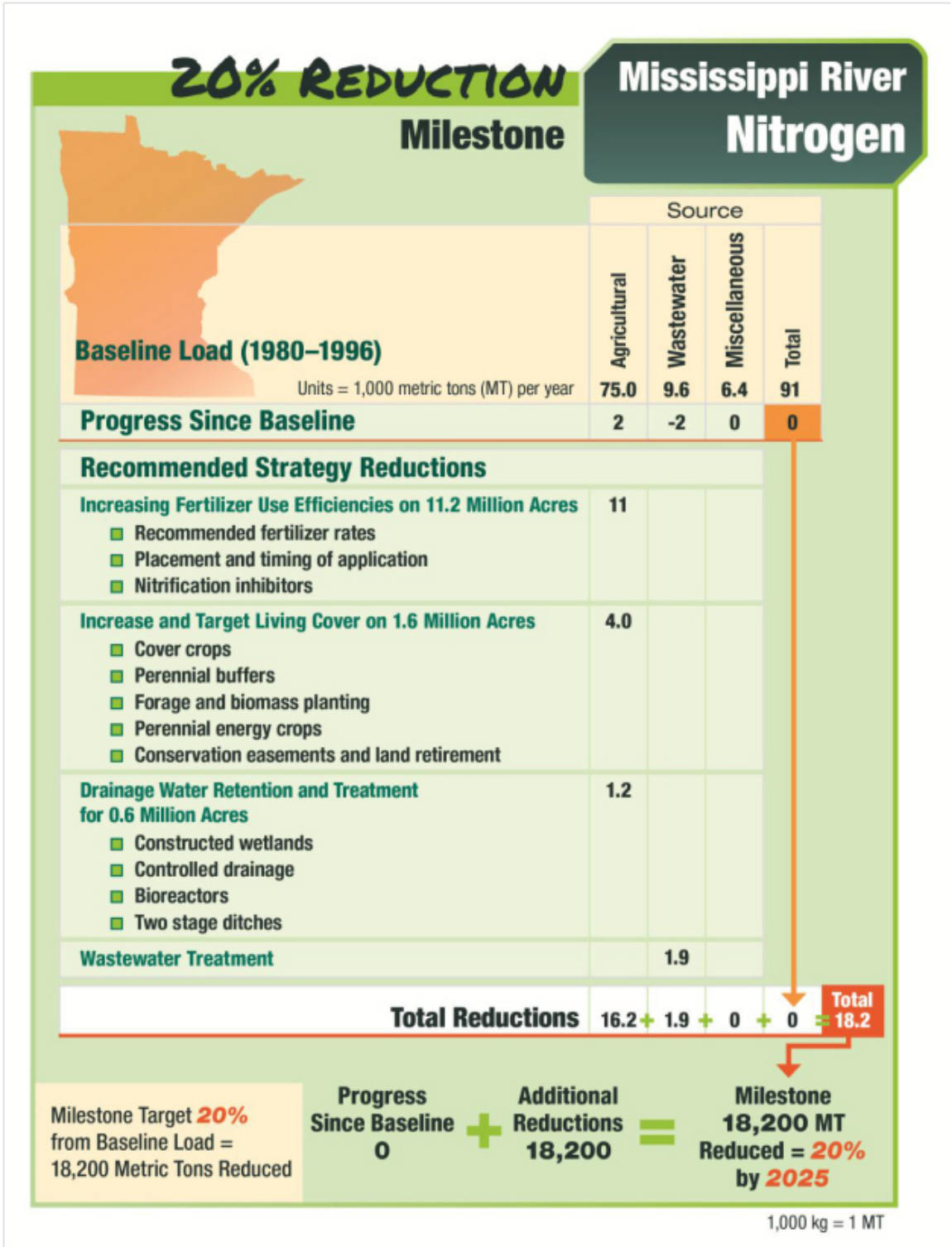
The image below illustrates the Nitrogen Goal for Mississippi River – 20 percent by 2025 and 45% by 2040 (MPCA, 2015)



MPCA

Mississippi River 2025 Milestone – Nitrogen

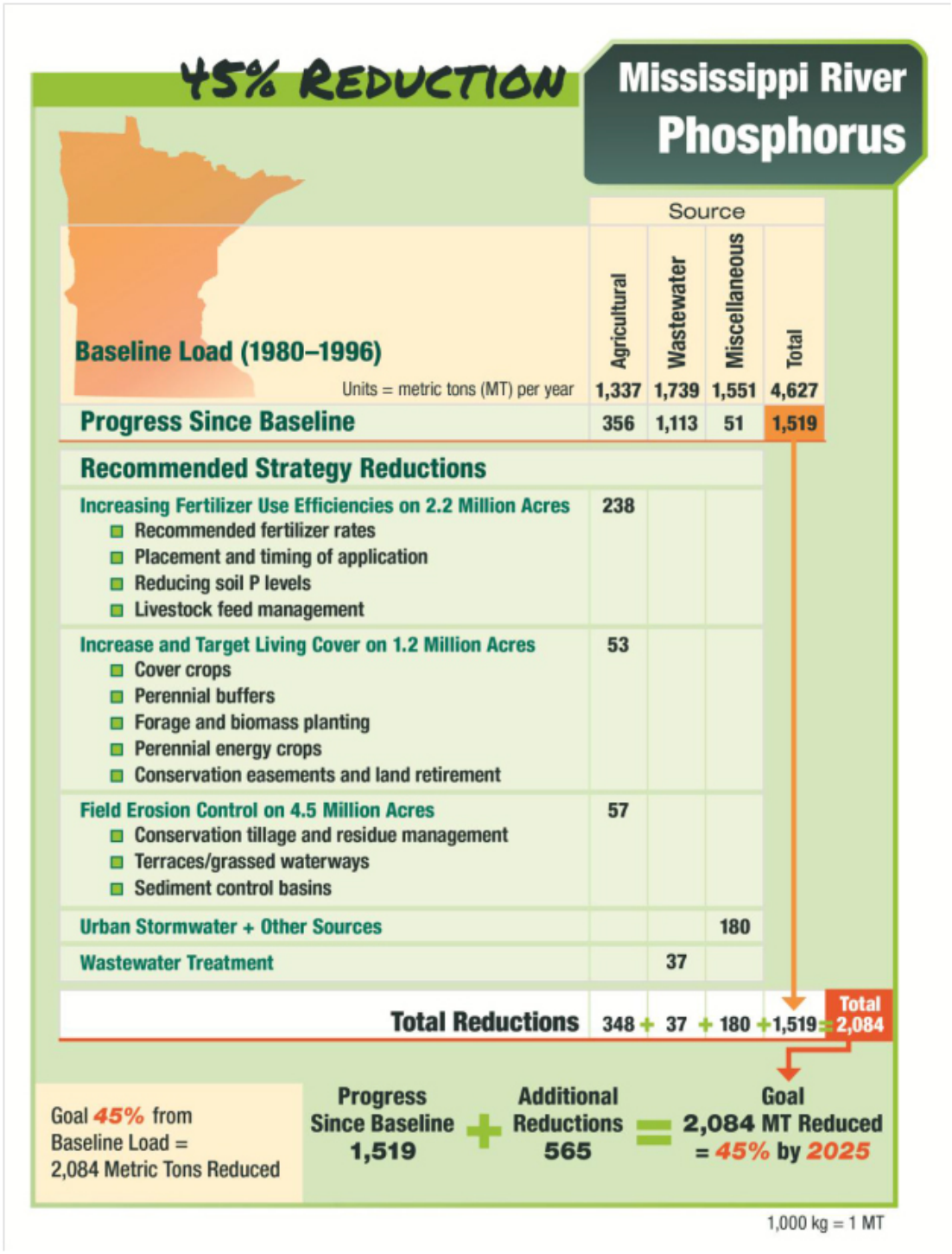
The graphic below illustrates the Minnesota Nutrient Reduction Strategy recommended approach for Nitrogen milestone reductions for the Mississippi River.



MPCA

Mississippi River 2025 Milestone – Phosphorus

The graphic below illustrates the Minnesota Nutrient Reduction Strategy recommended approach for Phosphorus milestone reductions for the Mississippi River.

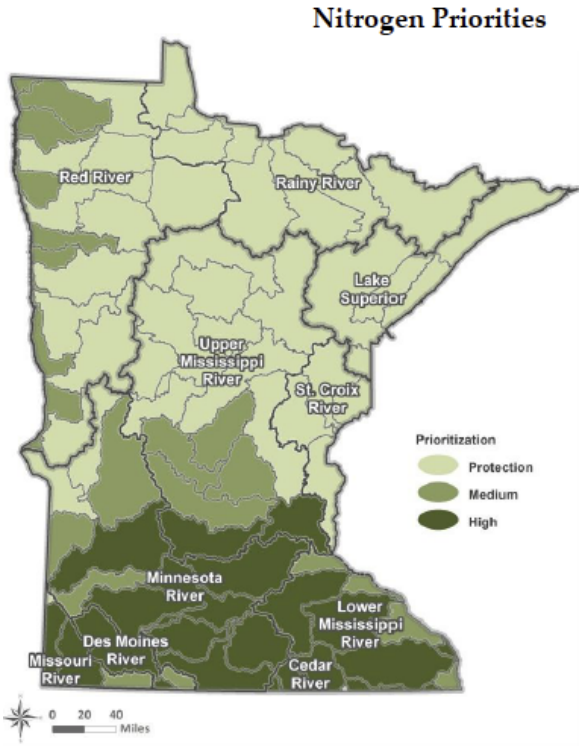

45% Reduction
Mississippi River
Phosphorus
Source
Agricultural
Wastewater
Miscellaneous
Total
Baseline Load (1980–1996)
Units = metric tons (MT) per year
1,337 1,739 1,551 4,627
Progress Since Baseline
356 1,113 51 1,519
Recommended Strategy Reductions
Increasing Fertilizer Use Efficiencies on 2.2 Million Acres
238
Recommended fertilizer rates
Placement and timing of application
Reducing soil P levels
Livestock feed management
Increase and Target Living Cover on 1.2 Million Acres
53
Cover crops
Perennial buffers
Forage and biomass planting
Perennial energy crops
Conservation easements and land retirement
Field Erosion Control on 4.5 Million Acres
57
Conservation tillage and residue management
Terraces/grassed waterways
Sediment control basins
Urban Stormwater + Other Sources
180
Wastewater Treatment
37
Total Reductions
348 + 37 + 180 + 1,519 = Total 2,084
Goal 45% from Baseline Load = 2,084 Metric Tons Reduced
Progress Since Baseline 1,519
+
Additional Reductions 565
=
Goal 2,084 MT Reduced = 45% by 2025
1,000 kg = 1 MT

MPCA

Priority Watersheds

The Minnesota Nutrient Reduction Strategy (NRS) identifies priority watersheds that have the highest nutrient yields (loads normalized to area) and also includes watersheds with high phosphorus levels in rivers. In the maps below, the HUC8 watersheds with highest loads are shaded dark. The darker shaded watersheds are the higher priority watersheds for nitrogen and phosphorus reduction.

The Le Sueur Watershed is indicated as a "high" priority watershed for both Nitrogen and Phosphorus. The NRS is a big picture strategy which sets up the framework for local detailed strategies. The real action and decisions happen at the local level – within the watersheds. Individual watersheds will determine how to specifically achieve the reductions needed in their watershed and for downstream purposes.



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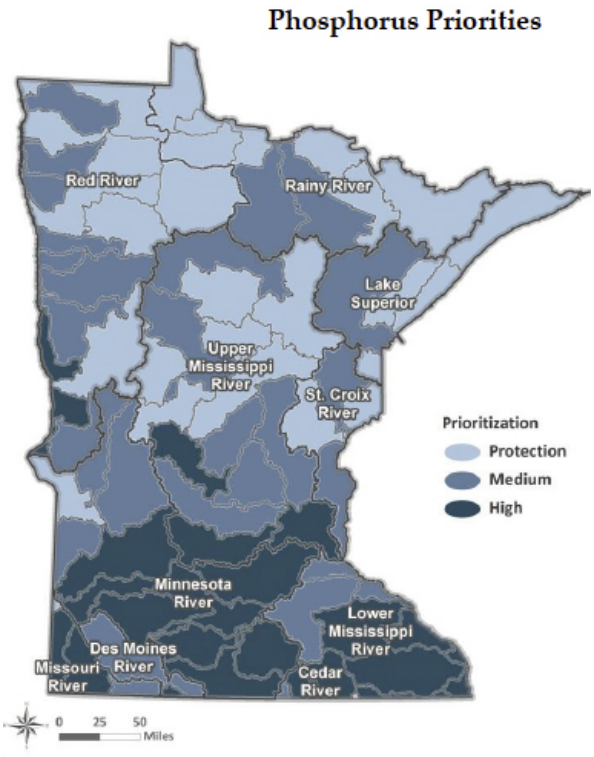
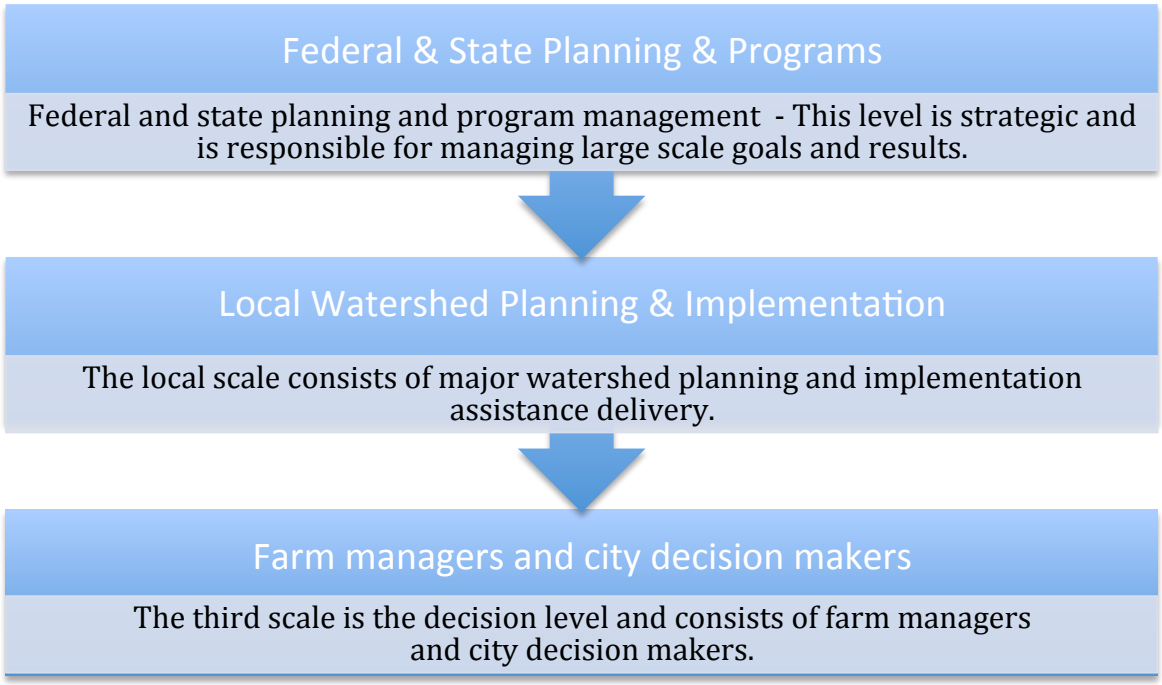


MPCA

Nutrient Reduction Strategy - 3 Scales or Levels of Management

Broadly, the Minnesota Nutrient Reduction Strategy works at three scales. The state-level nutrient reduction strategy is meant to establish a large-scale big picture framework, under which fits individualized watershed planning.



The Minnesota Nutrient Reduction Strategy works at the largest scale but recognizes that it must be relevant at where the action occurs, at the local and farm levels. Boosting state and federal programs is designed to support the local efforts. Action happens at the local level – on the farms and in the cities (Wall et al, 2015).

Minnesota's Watershed Approach

Minnesota is implementing a watershed approach that assesses, restores and protects waters under the umbrella of the Minnesota Water Management Framework. This approach sets a 10-year cycle of water assessments, watershed restoration and protection strategy (WRAPS) development at the hydrologic unit code 8 (HUC8) watershed level, and local water planning (e. g., One Watershed One Plan).

The Le Sueur River Watershed is engaged in MPCA's 10-year watershed planning approach. The MPCA and partner organizations evaluate water conditions, establish improvement goals and priorities, and take actions designed to restore or protect water quality on a 10-year cycle. The Le Sueur River Watershed began the cycle in 2008.

According to MPCA's Le Sueur River Watershed website, the following steps and products have been completed (as of September 2015):

1. **Monitor water bodies and collect data**
   Le Sueur River Watershed Monitoring and Assessment Report

   Assessment of Selected Lakes within the Le Sueur River Watershed (Blue Earth, Waseca, Faribault, Steele, Freeborn Counties)

   Le Sueur River Watershed Biotic Stressor Identification Report

   Summary, Identifying conditions stressing fish and macroinvertebrates, Le Sueur River Watershed

2. **Assess the data**

3. **Develop Strategies**

   Summary, Le Sueur Watershed and Restoration and Protection Strategies (WRAPS)

   Le Sueur River Watershed WRAPS Report (MPCA approval 8/20/2015)

   Final Le Sueur River Watershed TMDL

4. **Conduct restoration and protection projects**
   The website lists a host of implementation activities in progress and/or completed.

Le Sueur River Watershed Restoration & Protection Strategy (WRAPS)

The full Le Sueur River Watershed WRAPS Report provides details about impairments in the watershed. Based on intensive water monitoring, impaired waters are common throughout the Le Sueur River Watershed. Generally, impairments include the following:

- Altered hydrology: Artificial drainage is driving many of the problems in the watershed.
- Bacteria: E. coli and/or fecal coliform can indicate sewage or manure in water and also make the water unsafe for swimming.
- Biology (fish and/or macroinvertebrates): Number and type of creatures are indicators of water's health.
- Dissolved Oxygen: Low levels make it hard to sustain fish.
- Turbidity and Total Suspended Solids: Soil and other particles make the water murky.
- Nutrients: Excess nutrients can cause algae that degrade habitat and recreation.

The Le Sueur River WRAPS document includes a table (Appendix A) that summarizes the major pollutants and stressors, their sources, and the reductions needed for lakes and streams in the Le Sueur

watershed to meet standards. The table below is an excerpt of the nutrient-related goals and strategies.

Nitrogen Goals & Strategies - WRAPS

Le Sueur WRAPS Goals **High Nitrogen (TN) Concentrations**	**Le Sueur WRAPS Strategies** **to Meet 10-Year Target:**
Goal: 45% Reduction in multi-year FWMC (from 9 to 5 mg/L) Years to Goal: 38 10 Year Target: 12% reduction Priority Sources: Upland/field surface runoff (4%) Bank/bluff erosion (2%) Tile drainage water (4%)	• Nutrient management (including manure)/reduced application • Cover crops (best coupled with conservation tillage) • In/near ditch retention and treatment • Saturated buffers • Woodchip bioreactors • Conservation cover (easements/buffers of native grass& trees, pollinator habitat) • Tile system design and use for controlled/less drainage • Treatment wetlands • Restored wetlands

Phosphorus Goals and Strategies - WRAPS

Le Sueur WRAPS Goals **High Phosphorus (TP) Concentrations**	**Le Sueur River WRAPS Strategies** **to Meet 10-Year Target:**
Goal: 60% reduction in multi-year FWMC (from 0.38-0.15 mg/L) Years to Goal: 60 years 10 Year Target: 10% reduction Priority Sources: Upland/field surface runoff (4%) Bank/bluff erosion (2%) Tile drainage water (4%)	• Strategies to reduce TSS from fields • Nutrient (including manure) management/reduced application • Treatment wetlands • Restored wetlands
High Phosphorus Concentrations in Lake Watersheds	**Restoration and Strategies to Meet 10-Year Target:**
Goal: 60% reduction in average seasonal TP Concentration (On average for all lakes) Years to Goal: 40-60 years	• Strategies to reduce TP from fields and tile drainage water sources • Strategies to reduce non-point city,

10 Year Target: 10-15% (depending on lake-watershed ratio: 20% for lakes with large ratio and 15% for lakes with small ratio) Priority Sources: Field surface runoff, malfunctioning septic systems, and tile drainage (10-15%)	residential contribution • Landowner education, nutrients, shoreline, septic systems etc • Restore, maintain lakeshore buffer and inlake native vegetation, control invasive species • Septic (SSTS) system maintenance/replacement • Increase structural set-backs from lake • Enforce construction site erosion control plans • Enforce/establish shoreland rule/buffer ordinance • Reduce/eliminate runoff from livestock "open lots" adjacent lake • Improve feedlot runoff controls • Internal treatments (fish, chemical, dredging) where external phosphorus source have been controlled • Co-develop individualized plans for lakes with strong and invested local working group support (as requested). Plans will be based on strategies presented above

Nutrient Reduction Strategies

Nitrogen Strategies - WRAPS

Le Sueur WRAPS **Restoration and Strategies to Meet 10-Year Target:**
• Nutrient management (including manure)/reduced application • Cover crops (best coupled with conservation tillage) • In/near ditch retention and treatment • Saturated buffers • Woodchip bioreactors • Conservation cover (easements/buffers of native grass& trees, pollinator habitat) • Tile system design and use for controlled/less drainage • Treatment wetlands • Restored wetlands

Phosphorus Strategies - WRAPS

Le Sueur River WRAPS
High Phosphorus (TP) Concentrations
Restoration and Strategies to Meet 10-Year Target:

- Strategies to reduce TSS from fields
- Nutrient (including manure) management/reduced application
- Treatment wetlands
- Restored wetlands

High Phosphorus Concentrations in Lake Watersheds
Restoration and Strategies to Meet 10-Year Target:

- Strategies to reduce TP from fields and tile drainage water sources
- Strategies to reduce non-point city, residential contribution
- Landowner education, nutrients, shoreline, septic systems etc
- Restore, maintain lakeshore buffer and inlake native vegetation, control invasive species
- Septic (SSTS) system maintenance/replacement
- Increase structural set-backs from lake
- Enforce construction site erosion control plans
- Enforce/establish shoreland rule/buffer ordinance
- Reduce/eliminate runoff from livestock “open lots” adjacent lake
- Improve feedlot runoff controls
- Internal treatments (fish, chemical, dredging) where external phosphorus source have been controlled
- Co-develop individualized plans for lakes with strong and invested local working group support (as requested). Plans will be based on strategies presented above

Le Sueur River Watershed – Nutrient Reduction Goals

The tables below summarize the Minnesota Nutrient Reduction Strategy Goals for the Mississippi River Basin and the Le Sueur River Watershed Restoration and Protection Strategy (WRAPS) Goals.

Nitrogen Goals – NRS & WRAPS

Minnesota Nutrient Reduction Strategy Goals – Mississippi River	**Le Sueur WRAPS Goals** **High Nitrogen (TN) Concentrations**
10 Year Target: **20% reduction**	Goal: **45% Reduction in multi-year FWMC** (from 9 to 5 mg/L) Years to Goal: 38 10 Year Target: **12% reduction**

Phosphorus Goals - NRS & WRAPS

Minnesota Nutrient Reduction Strategy Goals – Mississippi River	**Le Sueur WRAPS Goals** **High Phosphorus (TP) Concentrations**
10 Year Target: **12%** (33% already obtained) for a total of **45% reduction**	Goal: **60% reduction** in multi-year FWMC (from 0.38-0.15 mg/L) Years to Goal: 60 years 10 Year Target: **10% reduction**
	Le Sueur WRAPS Goals **High Phosphorus Concentrations in Lake Watersheds**
	Goal: 60% reduction in average seasonal TP Concentration (On average for all lakes) Years to Goal: 40-60 years 10 Year Target: **10-15% reduction** (depending on lake-watershed ratio: 20% for lakes with large ratio and 15% for lakes with small ratio)

Le Sueur River Watershed Network Recommendations

A citizen-led group in the Le Sueur River Watershed has also developed a set of watershed goals described in the *Seven Steps Towards Cleaner Water and River Health.* They were developed by Le Sueur River Watershed farmers and citizens over a series of meetings in 2013.

1 More stormwater management and more in-ditch storage

2. More experimentation and demonstration with temporary water storage

3. More strategically placed buffers and more terraces and grass waterways

4. More communication and education among watershed residents

5. Less red tape

6. More river channel maintenance of major snags

7. More streambank and ravine stabilization

The mission of the Le Sueur River Watershed Network exists to encourage collaboration, empower citizens and nurture a land stewardship ethic amongst those that live, work and recreate in the watershed. For more information, visit the Le Sueur River Watershed Network website: http://lesueurriver.org/

Comparison of Nutrient Reduction Strategies

Minnesota Nutrient Reduction Strategy	Le Sueur WRAPS Strategy	Le Sueur Citizen Advisory Committee - 7 Steps Towards Cleaner Water and River Health
Fertilizer Use Efficiencies		
Recommended Fertilizer Rates (B)	Nutrient (including manure) management/reduced application (P & N)	
Placement and Timing of application (B)		
Reducing soil P (P)		
Livestock feed management (P)	Reduce/eliminate runoff from livestock "open lots" adjacent lake (P) Improve feedlot runoff controls (P)	
Nitrification inhibitors (N)		
Increase and Target Living Cover		
Cover Crops (B)	Cover crops (best coupled with conservation tillage) (N)	
Perennial Buffers (B)	Saturated buffers (N) Conservation cover (easements/buffers of native grass& trees, pollinator habitat) (N)	More experimentation and demonstration with temporary water storage (saturated buffers) More strategically placed buffers and more terraces and grass waterways
Forage and biomass planting (B)		
Perennial energy crops (B)		
Conservation easements and land retirements (B)	Conservation cover (easements/buffers of native grass& trees, pollinator habitat) (N)	
Drainage Water Retention and Treatment		
Constructed Wetlands (N)	Treatment wetlands (P & N) Restored wetlands (P & N)	More experimentation and demonstration with temporary water storage (constructed

		wetlands)
Controlled drainage (N)	Tile system design and use for controlled/less drainage (N)	
Bioreactors (N)	Woodchip bioreactors (N)	More experimentation and demonstration with temporary water storage (bioreactors)
Two stage ditches (N)	In/near ditch retention and treatment (N)	More stormwater management and more in-ditch storage More experimentation and demonstration with temporary water storage (in ditch storage)
Field Erosion Control		
Conservation Tillage and residue management (P)	Strategies to reduce TSS from fields (P)	
Terraces/grasses waterways (P)	Strategies to reduce TSS from fields (P)	More strategically placed buffers and more terraces and grass waterways
Sediment control basins (P)	Strategies to reduce TSS from fields (P)	
Urban Stormwater and Other sources	Increase structural set-backs from lake (P) Enforce construction site erosion control plans (P) Enforce/establish shoreland rule/buffer ordinance (P) Strategies to reduce non-point city, residential contribution (P)	
Wastewater Treatment	Septic (SSTS) system maintenance/replacement (P)	
Other		
Education and Outreach	Landowner education, nutrients, shoreline, septic systems etc (P)	More communication and education among watershed residents

Planning & Programs		Less Red Tape
Lake Specific	Co-develop individualized plans for lakes with strong and invested local working group support (as requested). Plans will be based on strategies presented above (P) Internal treatments (fish, chemical, dredging) where external phosphorus source have been controlled (P) Restore, maintain lakeshore buffer and inlake native vegetation, control invasive species (P)	
River Specific		More river channel maintenance of major snags More streambank and ravine stabilization

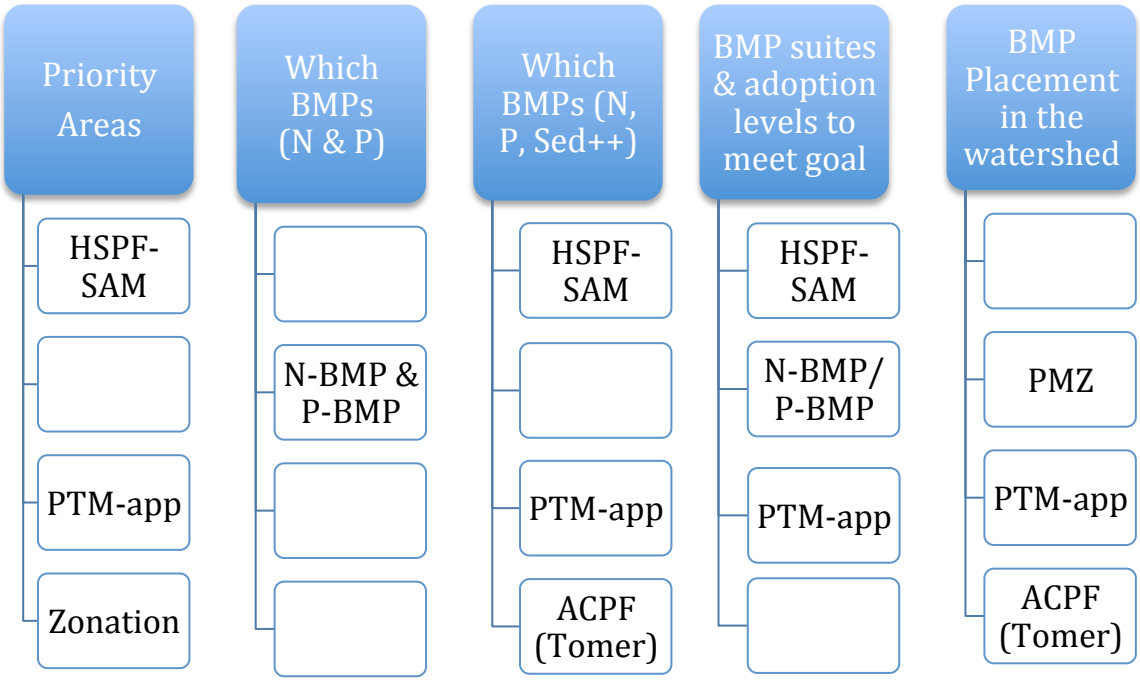
Targeting Tools

Targeting Tools and Models

There are many different modeling tools and economic calculators available or currently in development in Minnesota and across the United States. Appendix B includes a matrix that describes some of these tools for prioritizing and targeting.

Using Tools Together

Each tool and model has different goals and capacities. The chart below illustrates how the tools could be used together to try to frame up nutrient reduction in a watershed.

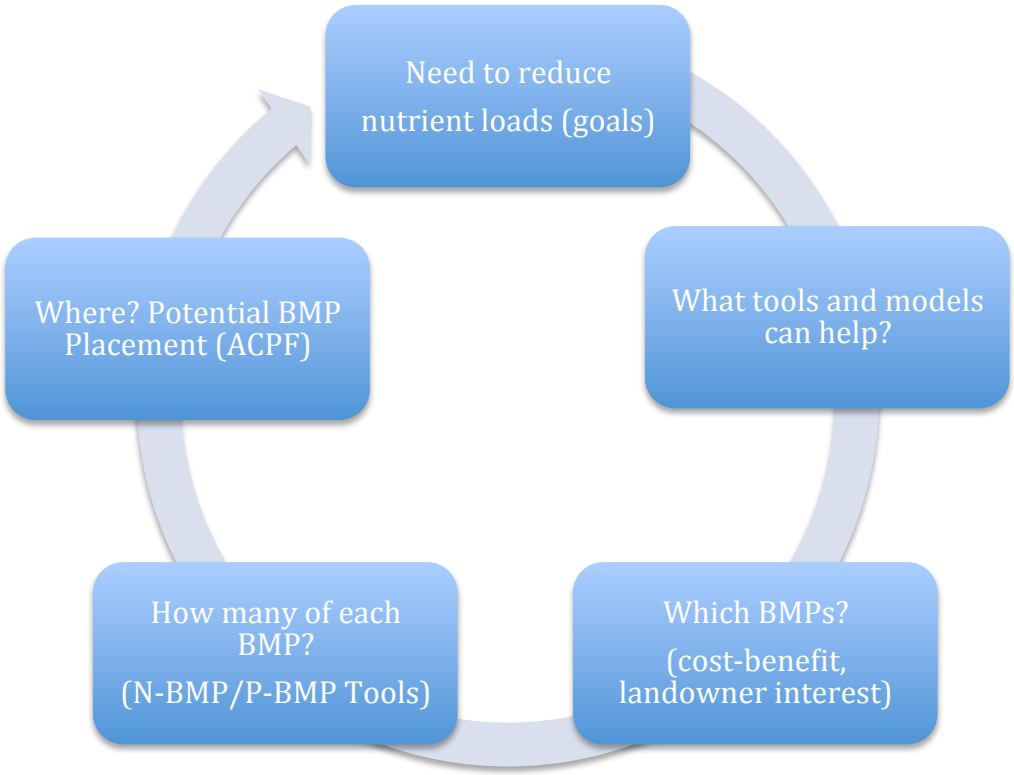


(Wall et al, 2015)

After searching possible tools for this pilot study, the team decided on the following approach due to the availability and promise of these new tools. This pilot project is intended to add some additional information to the broader and longer term efforts underway in Freeborn Lake Subwatershed.

- Priority Area – Determined by local partners based on long term local priorities
- Which BMPs - Used the N-BMP/P-BMP tools
- BMP placement in the Watershed - Agricultural Conservation Planning Framework (ACPF)

Pilot Project Approach



The graphic above illustrates the framework used for this pilot project in the Freeborn Lake Subwatershed.

Need to reduce nutrient loads

The Nutrient Reduction Strategy and local water quality monitoring, studies and goals all point to the need to reduce phosphorus and nitrogen loads in Freeborn Lake Subwatershed.

What tools and models can help?

There are many tools available or in development that can help inform subwatershed planning. For this pilot, we explored using the best tools available during the pilot project time horizon.

Which BMPs?

Outputs from the N-BMP and P-BMP tools can help to identify which BMPs will be most cost-effective for achieving Nitrogen and Phosphorus reductions. Reflections from local staff and producers in the Freeborn Lake Subwatershed also provide a snapshot of nutrient pollution awareness and openness to particular BMPs as of Spring 2015.

How many of each BMP?

The N-BMP and P-BMP tools enable local resource managers to create scenarios that illustrate percent reduction of Nitrogen or Phosphorus entering surface waters when either a single BMP or a suite of BMPs is adopted at specified levels across the watershed.

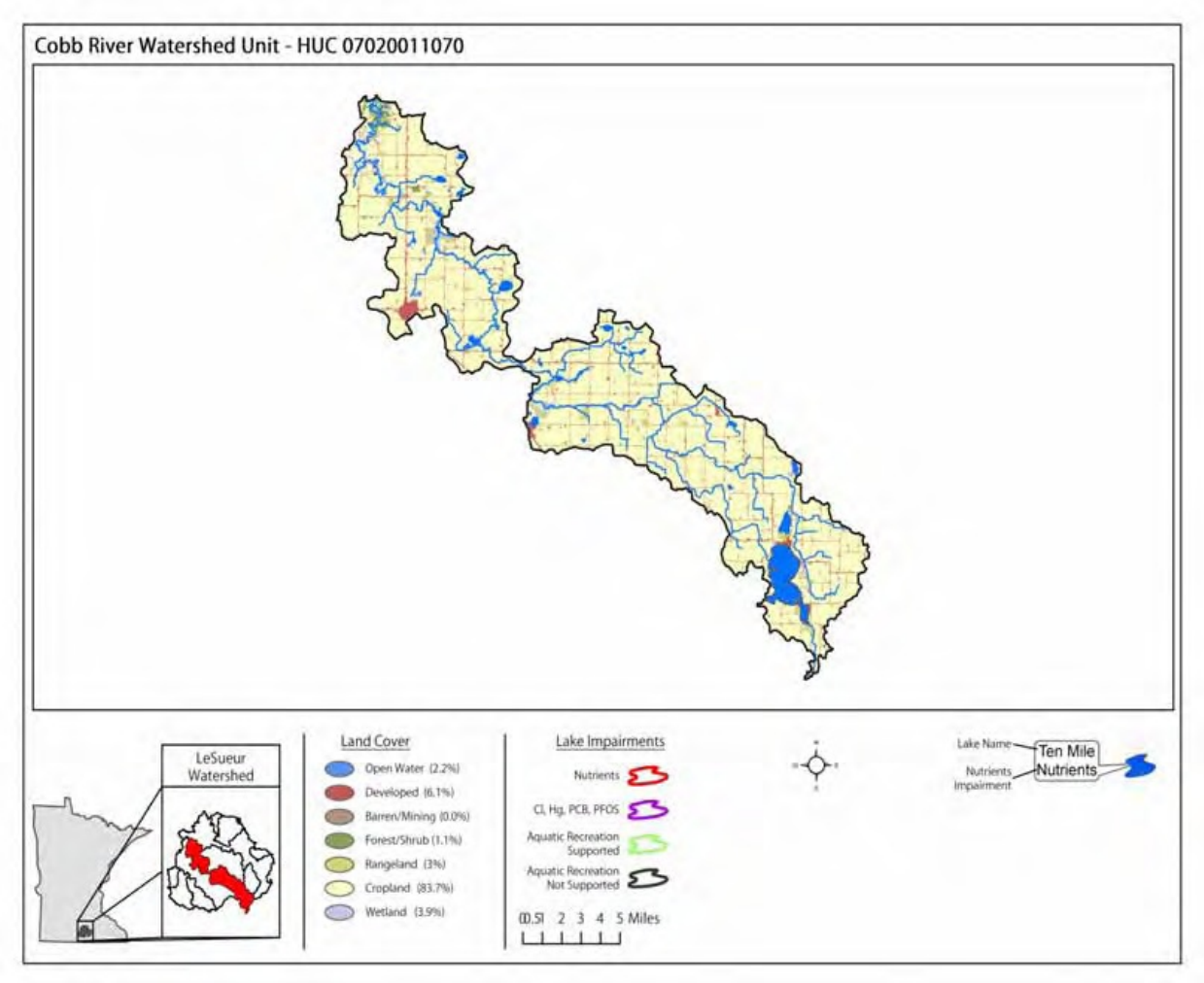
Where? Potential BMP Placement

The pilot project includes a series of maps for Freeborn Lake Subwatershed that illustrate opportunity areas for BMPs from the Agricultural Conservation Planning Framework (ACPF) developed at the National Laboratory for Agriculture and the Environment by Mark Tomer, Sarah Porter and David James.

Freeborn Lake Subwatershed

Freeborn Lake Subwatershed Overview

Freeborn Lake subwatershed is located in Freeborn County. It is part of the broader Cobb River subwatershed. The Cobb River (07020011070) HUC-11 watershed lies roughly within the center of the Le Sueur River watershed. This 114,306 acre watershed represents 16 percent of the Le Sueur River watershed. Cropland is the major land use within this area and only one lake (Freeborn) has been assessed. The Cobb River pours into the Le Sueur River 3.5 miles south of Mankato, MN. Based on 2003 National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) registered feedlot data, there are ten permitted discharge sites and 142 registered feedlots throughout the Cobb River watershed (Le Sueur Monitoring and Assessment Report).



MPCA. Le Sueur Monitoring and Assessment Report.

Freeborn Lake Overview

- Size: 2298-acres
- Shoreline: About 11 miles of shoreline
- Access: There is a developed public access at Arrowhead County Park on the east side of the lake. A second undeveloped State Water Access is located on the east side of the south lake.
- Watershed: About 12 square miles as depicted (this information varies depending on the source).
- Inlets: There is one creek entering through the marsh at the southeast end of the lake and unknown number of tiles and other small drains.
- Outlet: Fixed crest dam elevation 1215.45 feet outlets to the Big Cobb River a tributary of the Le Sueur River.
- Average Depth: The lake level fluctuates with prevailing climatic conditions. The average depth is about 3 feet (Source MN DNR).

MN DNR

Freeborn Lake Outlet Dam

The outlet dam is located on private property and owned by Freeborn County. The dam is deteriorating and has suffered some flood damage.

MN DNR

Water Quality Monitoring Results – Freeborn Lake

Freeborn Lake is a large, shallow lake located approximately seven miles northwest of Albert Lea, Minnesota. The town of Freeborn lies on the northern shore. The lake currently sees limited recreational use and has low water clarity and minimal aquatic vegetation. Freeborn Lake's watershed is small relative to its surface area with a watershed to lake ratio of 4:1. Land use is dominated by cultivated agricultural use. Additionally, the lake itself makes up a larger portion of the watershed as indicated by the high percentage of open water land use.

Monitoring and Assessment Report

MPCA's *Le Sueur Monitoring and Assessment Report* describes Freeborn Lake was sampled for chemistry from May through September of 2008 and 2009. The average TP for Freeborn Lake from both 2008 and 2009 data was 325 micrograms per liter (µg/L). This is well above the assessment criteria for shallow lakes within the WCBP ecoregion. TP in Freeborn Lake spiked in June at 489 µg/L and steadily declined throughout the summer to its lowest level of 228 µg/L in September.

The average chl-*a* for Freeborn Lake over the two-year period was 120 µg/L. This was also well above the assessment criteria for the WCBP ecoregion. Chl-*a* levels spiked in August at 179 µg/L and were at their lowest in the spring (Figure 10). As a result of the high levels of TP and chl-*a,* as well as exceedingly high total suspended inorganic solids, the water clarity of Freeborn Lake is below the range expected for its ecoregion, with an average of just 0.2 meters (0.7 feet). The lake was well-mixed throughout the 2009 monitoring season, which is to be expected for large, shallow lakes. Water temperature remained nearly constant from the surface to the bottom of the lake. DO remained above five milligrams per liter (mg/L) throughout the entire year with the lowest levels appearing in September at approximately seven mg/L.

MN DNR Monitoring

Current information suggests Freeborn Lake fails to meet aquatic recreational use eutrophication standards for shallow lakes (Class 2b) in the Western Corn Belt Plains Ecoregion

- total phosphorous < 90 parts per billion (ppb)
- chlorophyll a, (a measure of algae) < 30 ppb
- Secchi transparency > 2.3 ft).

Summer 2014 Freeborn Lake Minnesota Department of Natural Resources (single day samples)

- total phosphorous = 375 ppb
- chloraphyll a = 353 ppb
- Secchi transparency = 0.5 feet

Freeborn Lake total phosphorous, chlorophyll-*a*, and Secchi averages compared to Western Corn Belt Plain assessment standards Ecoregion

Ecoregion	TP (ug/L)	Chl-a (ug/L)	Secchi (meters)
WCBP & NGP – Aquatic Rec. Use (Class 2B)	< 65	< 22	> 0.9
WCBP & NGP – Aquatic Rec. Use (Class 2b) Shallow lakes < 90 < 30 > 0.7	< 90	< 30	> 0.7
2008 & 2009 Average – MPCA	325	120	0.2
2014 – Summer - MN DNR	375	353	0.5 feet

MN DNR & MPCA

The MN DNR Shallow Lakes Program (and its precursors) have conducted aquatic habitat surveys since 1947. Results for selected water quality parameters are shown below. Water quality results from water samples taken during lake habitat surveys 2007 – 2015.

Parameter	**Water Quality Standard**	**2015**	**2014**	**2012**	**2002**	**1990**	**1956**	**1947**
Total Phosphorus (ppb)	**<90**	216	375	320	190	246	Not available	120
Chlorophyll **a** (ppb)	**<30**	278	353	Not available	Not available	Not available	Not available	Not available
Secchi transparency (feet)	**<2.3**	0.3	0.5	0.3	0.4	0.5	Visible to a bottom at all locations (max 4.5)	0.5

Water Quality Impairments

Based on the trophic status data, Freeborn Lake was classified as hypereutrophic. Additionally, based on the TP and chl-a assessment standards, Freeborn Lake was determined to be non-supporting of aquatic recreational use and was listed as impaired under the 2012 303(d) Impaired Waters List.

Modeling

A MINLEAP model was utilized for Freeborn Lake as a basis for comparing the observed (2009) TP, chl-*a,* and Secchi values with those predicted by the model based on the lake depth and size and the size of the watershed. The observed TP for Freeborn Lake was significantly higher than the predicted value. This simply means that the observed TP was much higher than what was predicted for a lake of its size, depth, and watershed area in the WCBP ecoregion. The model predicted TP loading at 2,537 kilograms per year (kg/yr). This result is likely lower than the actual loading rate since the observed TP was higher than predicted. The areal water load to the lake was estimated at 0.6 meters per year (m/yr) and estimated water residence time is approximately 1.6 years. The complete modeling results can be found in the Monitoring and Assessment Report.

Freeborn Lake Subwatershed - Existing Plans & Policies

Le Sueur River Watershed WRAPS

The Le Sueur River Watershed WRAPS includes Staff identified priority management areas:

- Freeborn - lake and stream restoration, wetlands, water retention/infiltration, vegetative buffers

Lake Watershed Strategies

To protect and restore lakes, strategies should minimize relative pollutant contributions from the watershed, shoreland development, and in-lake. Strategies to minimize pollutant contributions from the watershed focus mostly on Agricultural and/or Stormwater BMPs, depending on the land use and pollutant contributions of the watershed. The MN DNR (2014) supplies detailed information on strategies to implement on the shoreland and in the lake via Shoreland Management guidance (Le Sueur WRAPS).

Protection Considerations

Water bodies that meet water quality standards should be protected to maintain or improve water quality. Furthermore, water bodies that have not been assessed should not be allowed to degrade. Three water bodies were assessed as supporting water quality standards: one reach of the Cobb River, Reeds Lake, and St. Olaf Lake. Several other water bodies have not yet been assessed. The WRAPS strategies are intended to not only restore but also protect waters in the watershed.

The Cobb River reach is currently attaining aquatic life standards likely due to the slope of the stream. The slope is enough to flush excess sediment out of the reach before it impacts aquatic life. Since this reach is in the downstream portion of the subwatershed, implementing strategies in upstream portions of the subwatershed and minimizing degrading impacts will ensure this stream reach continues to support aquatic life (Le Sueur WRAPS).

Freeborn SWCD Annual Plan

Freeborn Soil and Water Conservation District 2015 Annual Plan identifies Freeborn Lake as a high priority resource concern area and delineated as an area needing conservation practices installed.

Objective #1

Protect surface waters from storm water drainage of sediment, nutrients and chemicals (Goal 15 of 20 in County Water Plan) by reducing sediment transport to surface waters or offsite by planning and implementing a variety of conservation practices. Practices will include Water & Sediment Control Basins, Terraces, Waterways and Grade Stabilizing Structures etc. Vegetative seeding will help protect the structural integrity of these practices.

Objective #2

Protect surface waters from storm water drainage of sediment, nutrients and chemicals (Goal 15 in County Water Plan) by working cooperatively with the Greater Blue Earth River Basin Alliance (GBERBA) and local landowners.

Objective #3

Improve storm water runoff quality (Goal 15 in County Water Plan); reduce sediment delivery to water bodies; increase surface water storage capacity and enhance wildlife habitat by enrolling 200 acres in long-term easements for wetland restoration and riparian buffers.

Freeborn County Water Plan

The Freeborn County Water Plan also includes Freeborn Lake as a priority concern and indicates importance of providing recreation opportunities on the lake.

Local Government Priority Concerns:

- City of Freeborn
- Erosion of shoreland on Freeborn Lake
- Poor water quality of Freeborn Lake

Provide Recreational Opportunities on Public Waters

- Work to up-grade public access onto Twin Lakes, Pickerel Lake, Bear Lake, State Line Lake, Geneva Lake, and Freeborn Lake.
- Seek installation and operation of rough fish barriers on State Line Lake, Freeborn Lake, Fountain Lake, Albert Lea Lake, Twin Lakes, White Lake, Pickerel Lake, Geneva Lake and Bear Lake.

MN DNR and Freeborn County Lake Management Planning

The Minnesota Department of Natural Resources and Freeborn County are currently hosting public meetings to discuss the Future of Freeborn Lake. There have been meetings in April, July and August 2015 to discuss potential lake management plan.

Water Quality Improvements – Internal versus External Pollutant Loads

The following is an excerpt from Meeting Notes: *Future of Freeborn Lake* held in Freeborn City Hall in August 2015:

Improvement strategies fall into two categories: those addressing internal pollutant loads; and those designed to reduce impact from external loading. Internal loading can be addressed with lake management efforts that fall within the purview of the MN DNR and Freeborn County. Some questioned the value of attempting lake management prior to reducing the external loading as much as possible. Department of Natural Resources staff believe this is not an either/or choice. Certainly external loading from municipal and agricultural runoff should continue to be addressed via best management practices and water treatments.

Many of the practices to reduce nonpoint source pollutants are largely voluntary and beyond the scope of *Future of Freeborn Lake* the lake planning effort. Nevertheless, staff believe that lake management can substantially reduce the internal cycling of nutrients and relieve some of the lake effects and downstream effects of this nutrient load. Management will need to be more intensive if external loading is excessive, but the external loading is not such that it should preclude improvements with management and rough fish exclusion. Furthermore, Freeborn Lake has intrinsic values that can benefit from management.

Lake Management Plan Development
The MN DNR staff explained legal requirements to implement management; including legal requirements for implementing water management and rebuilding the dam. A lake management plan is required for water level manipulation and an outline of a plan for Freeborn Lake was presented and discussed. Lake management plans are prescriptive and are subjected to public review and public hearing as well as permit requirements.

In order for the project to move forward in 2016, a plan would be developed this fall, available for public review and comment by late fall or early winter. A public hearing on the plan would be held and the results considered by the Commissioner of the MN DNR before a permit to manipulate water levels would be issued. The hearing should take place in late winter. The plan will have specific objectives, management strategies and trigger points that would be used to determine when actions are needed.

Lake Advisory Group
After the initial Freeborn Lake meeting on April 14, 2015 there was a strong response for people to volunteer to stay involved in a lake planning process. Those self-nominating were invited to a follow-up meeting held on July 20, 2015 to initiate a path forward. Rather than formalize any committee structure, for now monthly meetings will be held with this group acting as the citizen's advisory group. If needed in the future, elected officials from the City of Freeborn, Freeborn and Carlston Townships and Freeborn County would be called upon to act as voting representatives on a steering committee taking input for this group. The group discussed meeting goals and objectives, where we go from here, knowing the support for improved water quality and maintaining the interests in wildlife, fisheries, recreation and aesthetics.

Freeborn County and the Department of Natural Resources intend to maintain a permanent lake advisory group that would continue to monitor lake health and review planned management actions. It was agreed to meet monthly on the third Thursday of the month at 6:30 pm at the Freeborn City Hall to create the lake management plan. Lake information and samples of other plans will be posted on the website. To learn more, http://www.co.freeborn.mn.us/367/Future-of-Freeborn-Lake

Freeborn Lake Enhancement Plan - DRAFT 9/18/2015

The plan includes many management objectives and actions to improve fish and wildlife and water quality in Freeborn Lake. Action 6 relates to watershed-based conservation action.

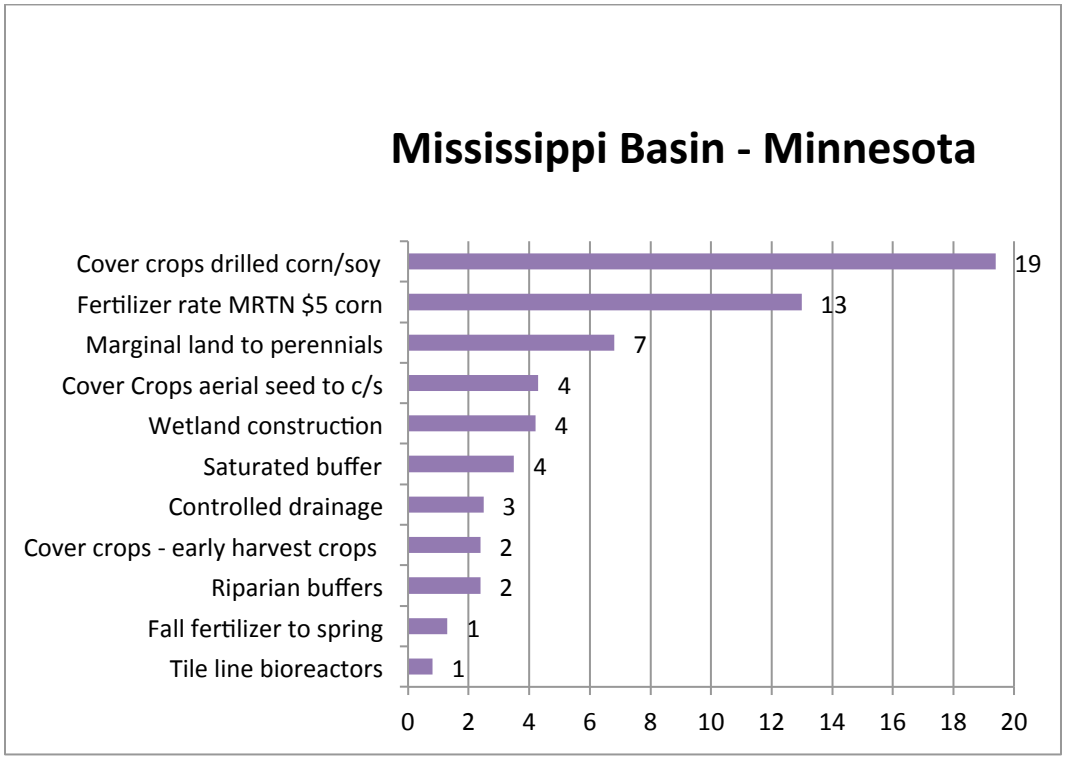
> Action 6: Local, state and federal agencies and non-profit groups target implementation of conservation programs in the watershed of Freeborn Lake. Several programs are available to protect, restore and manage wetlands and grasslands and productive croplands. Efforts should identify and target actions on private land that maximize public benefits for water quality, fish and wildlife habitat, recreation and sustaining agriculture.
>
> Desired Outcomes: Soil and water conservation and protection and restoration of critical habitats are important tools for sustaining water quality. Benefits will accrue to Freeborn Lake through a reduction in water and nutrient inputs, increased fish and wildlife and water-based recreation.

Which BMPs? – Cost Effectiveness

The N-BMP and P-BMP Tools were developed by the University of Minnesota (William Lazarus, David Mulla,et al.) to assist the MPCA and local resource managers to better understand the feasibility and cost of various "best management practices" to reduce Nitrogen and Phosphorus loading from Minnesota cropland. These tools allows water resource managers and planners to approximate the percent reduction of Nitrogen and Phosphorus entering surface waters when either a single BMP or a suite of BMPs is adopted at specified levels across the watershed. The tool also enables the user to identify which BMPs will be most cost-effective for achieving Nitrogen and Phosphorus reductions. The following charts summarize the Nitrogen and Phosphorus reduction potential, cost per pound, cost to benefit ratio and combined benefits of a suite of BMPs delineated in the Nutrient Reduction Strategy (Minnesota Watershed Nitrogen Reduction Planning (Lazarus, et al, 2015).

Nitrogen

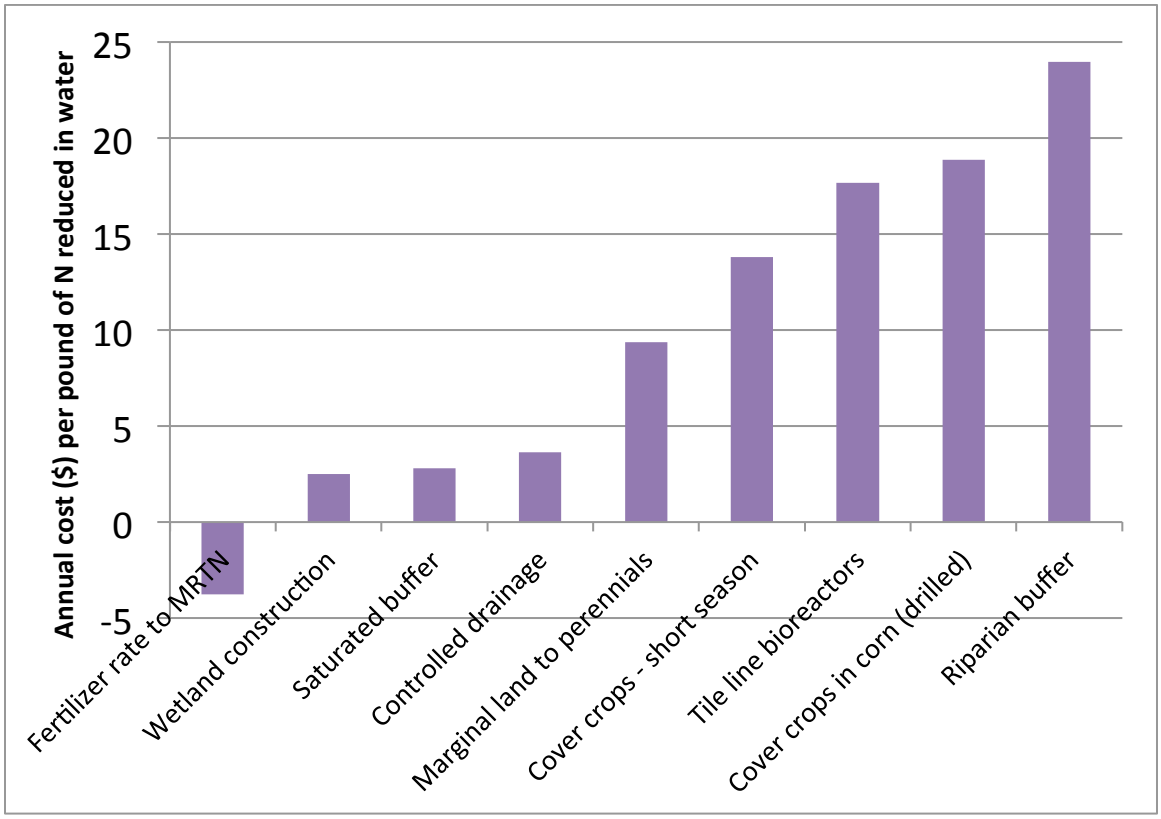
Nitrogen Reduction Potential (%)



% nitrogen reduced to waters in Mississippi Basin *BMPs on 80% of suitable acres

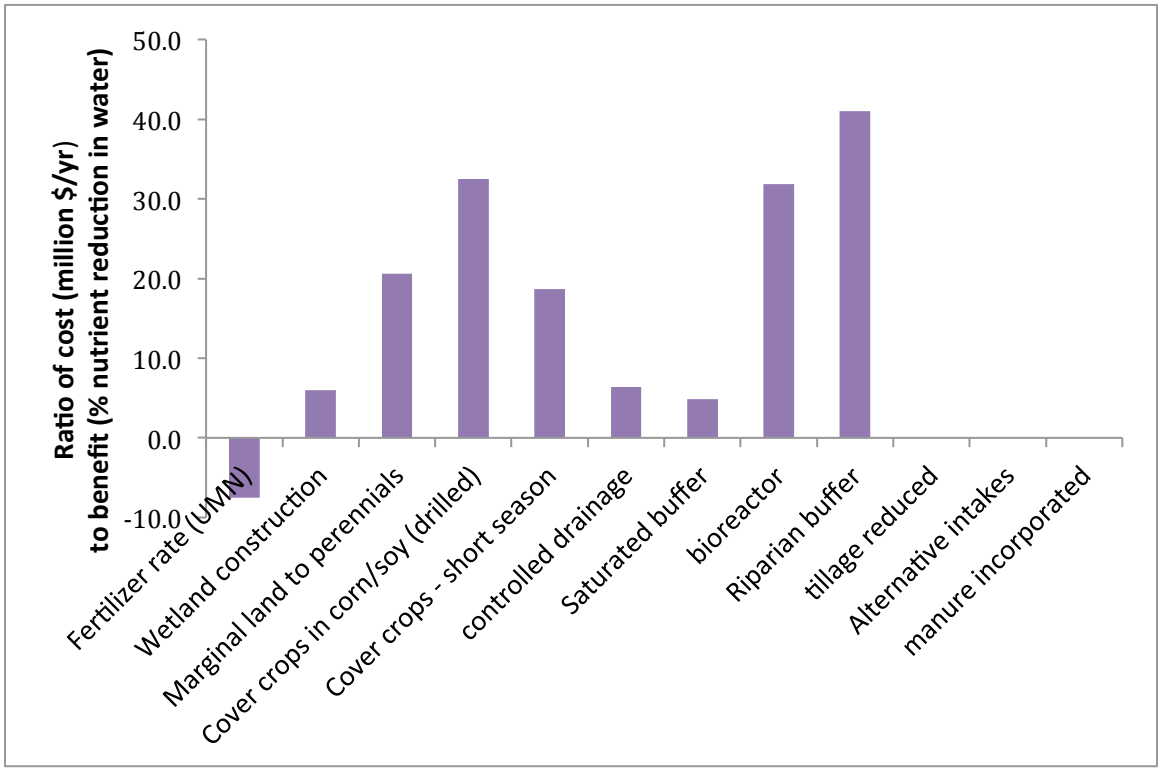
Nitrogen reduction potential in the Mississippi Basin are largest with: successful cover crops (23%); fertilizer efficiency gains (10-20%).

Cost per pound of Nitrogen reduced

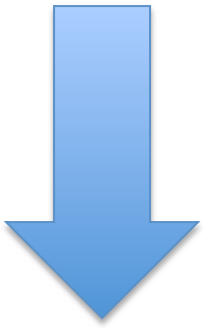


The most cost-effective BMPs for Nitrogen include Nitrogen fertilizer efficiency, wetland construction, saturated buffers and controlled drainage.

Cost to benefit ratio – Nitrogen only

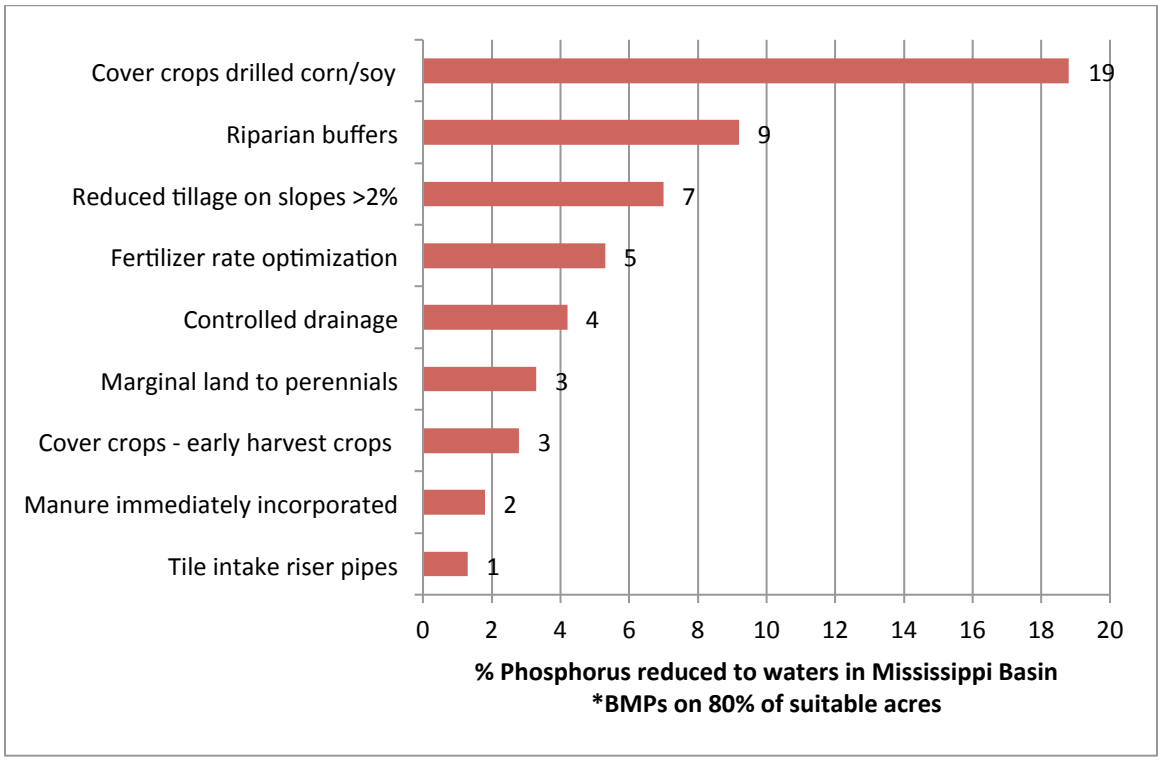


Cost to benefit ratio – Nitrogen only

BMP	Cost benefit ratio (N only)
Fertilizer rate (UMN)	This is free or profitable
Saturated buffer Controlled drainage Wetland construction Cover crops – short season Marginal land to perennials Bioreactor Cover crops in corn/soy (drilled) Riparian buffer	Less expensive $  More expensive $$$

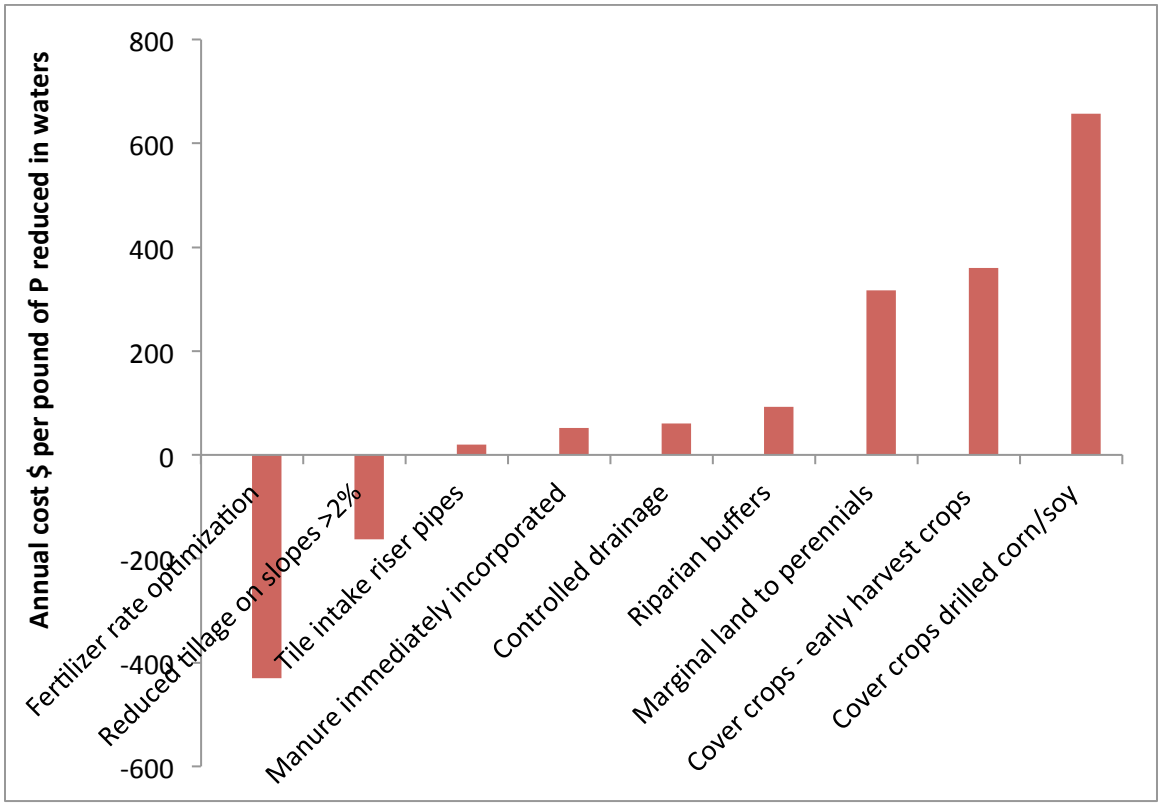
Phosphorus

Phosphorus reduction potential* (%)



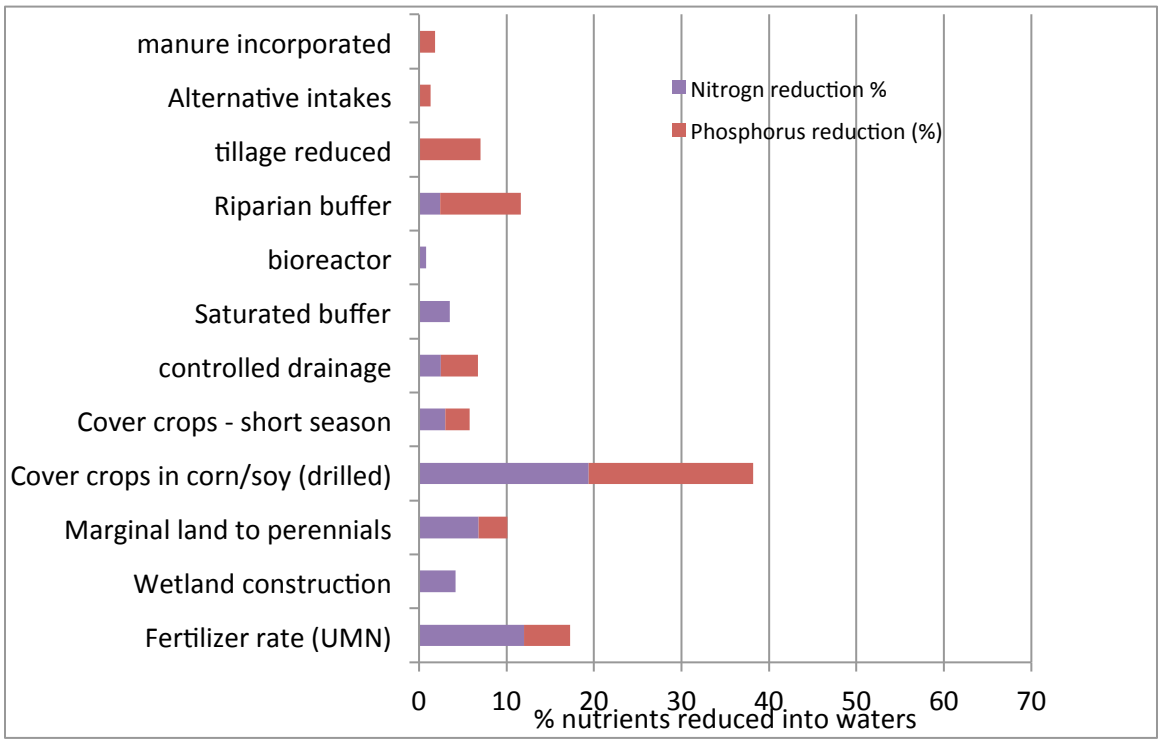
Phosphorus reduction potential in Mississippi Basin largest with cover crops (22%); riparian buffers (9%); reduced/conservation tillage (7%)

Cost per pound of Phosphorus reduced

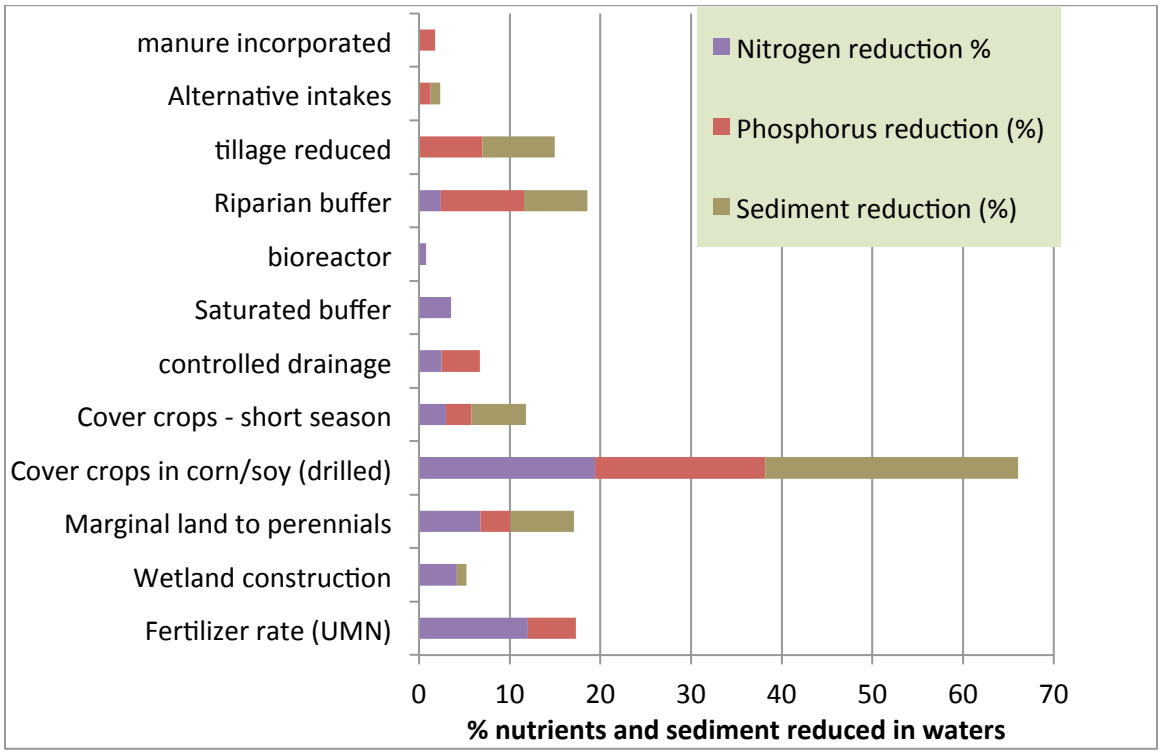


The most cost-effective BMPs for Phosphorus include Phosphorus fertilizer efficiency, reduced tillage, intake riser pipes, and manure incorporated.

Combined benefits Nitrogen + Phosphorus

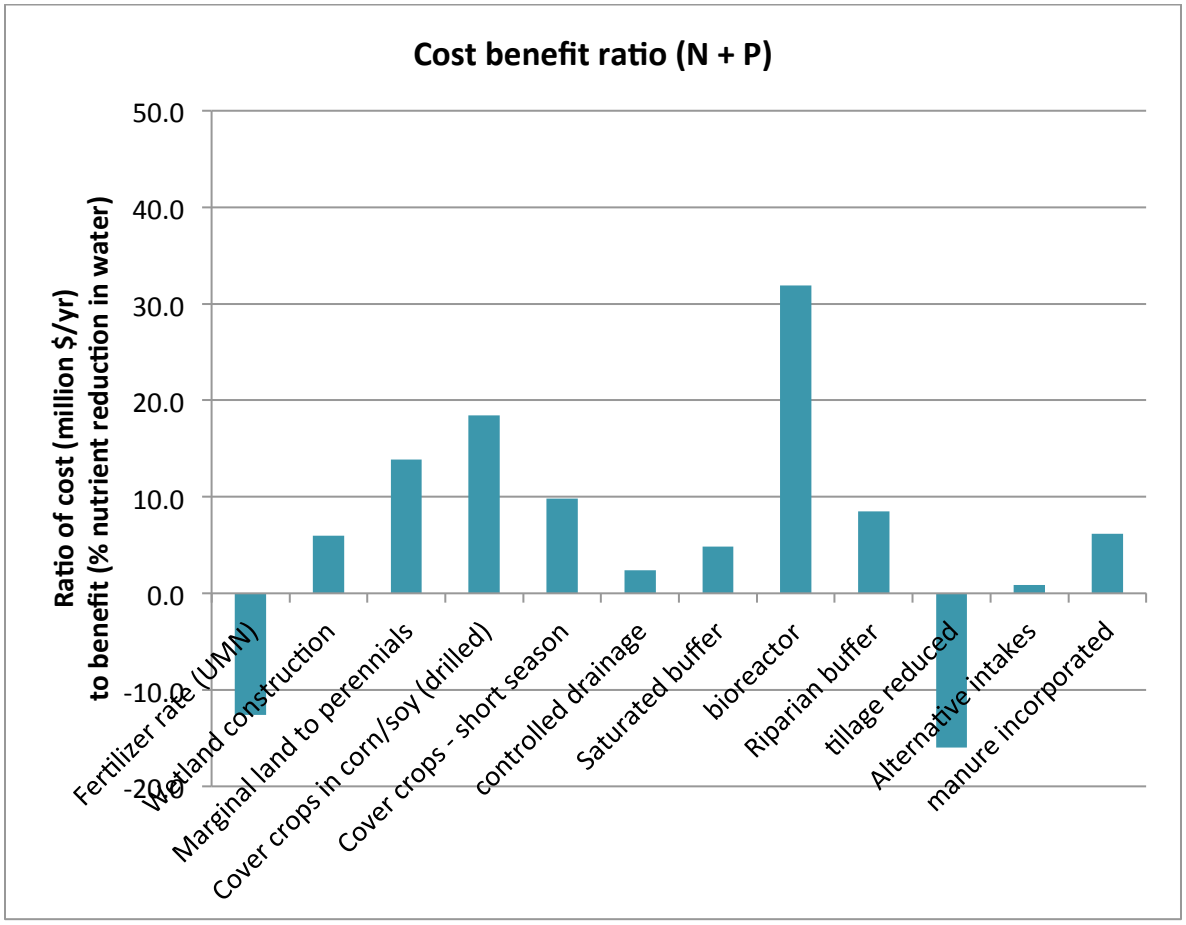


Combined benefits Nitrogen + Phosphorus + Sediment



When multiple benefits are needed, cost-effective BMPs can include cover crops, buffers, perennials on marginal lands, and most other BMPs in the tools except bioreactors.

Cost to benefit ratio – both Nitrogen + Phosphorus



BMP	Cost benefit ratio (N+P)	
Tillage reduced Fertilizer rate (UMN)	These are free or profitable	Less expensive $
Alternative intakes Controlled drainage Saturated buffer Manure incorporated Wetland construction Riparian buffer Cover crops – short season		
Marginal land to perennials Cover crops in corn/soy (drilled) Bioreactor	Treat effectively but more costly	More expensive $$$

Local Staff & Landowner Perspectives

"It has come to many of the agencies in Minnesota that it will not be their actions that will ultimately restore our waters, but the work and actions of the community members who own and use the land that will restore and protect our waters."- Le Sueur PMZ Report, July 2014

Understanding the local context for implementing nutrient reduction is central. The following reports can help clarify landowner and local staff perspectives in the Le Sueur River Watershed:

- Le Sueur River Watershed - Priority Management Zone Identification Report
- Nitrogen use and determinants of Best Management Practices: a study of Rush River and Elm Creek agricultural producers.
- WRAPs – Staff Reflections
- Nutrient Pilot Project – Freeborn County Reflections
- MN DNR Freeborn Lake Citizen Survey

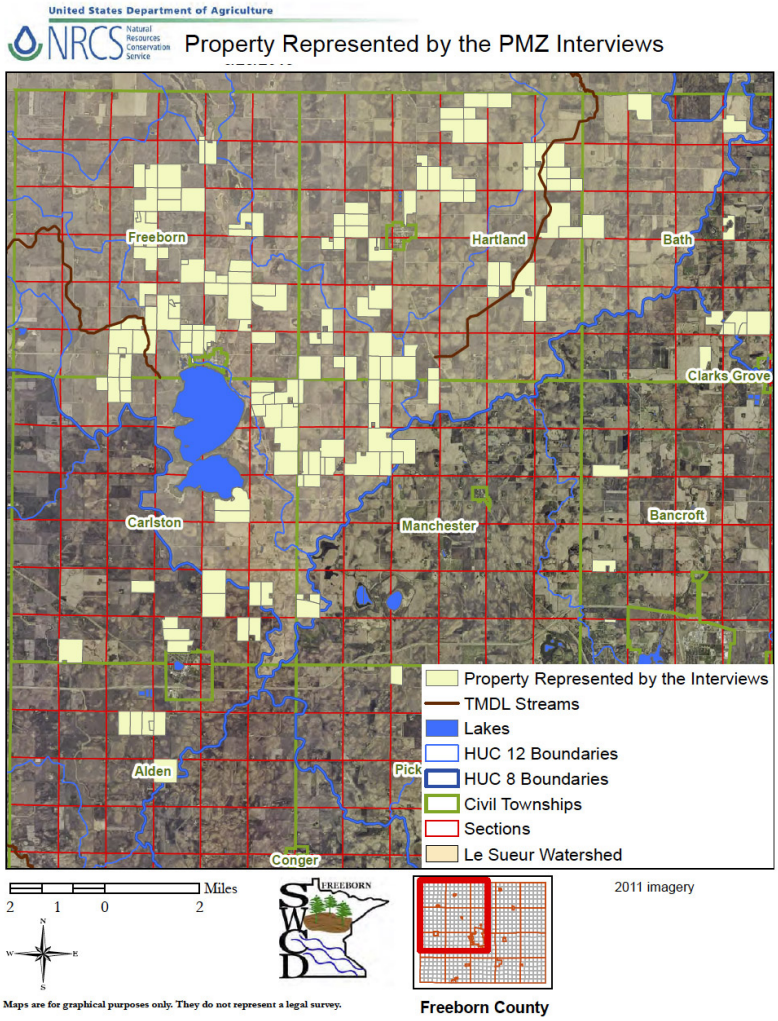
Le Sueur River Watershed - Priority Management Zone Identification Report

MPCA. July 2014. Le Sueur River Watershed - Priority Management Zone Identification Report.

As the MPCA has begun the Total Maximum Daily Load (TMDL) studies the surface waters in Minnesota on a watershed basis, it had become apparent that without local community support from landowners and residents our waters will not be restored and protected. As part of the TMDL study, the MPCA felt that acquiring the local landowner's perspective on water quality issues, erosion concerns, and the potential implementation needs to "fix" the concerns was required to obtain an accurate representation of the watershed."

Freeborn County SWCD utilized the one-on-one interview process in which they provided the landowners maps of their property which helped to illustrate the flow of water over their land. After explaining the TMDL process to the landowner a discussion was formed around a list of survey questions. A list of interview questions included general questions related to overall water quality, concerns, causes of impairments to farm/operator specific questions that went into concerns on their land, their interest in conservation programs and BMPs to opinions regarding tiling, nutrients, and livestock.

Freeborn County SWCD interview process identified thirty-nine (39) potential BMP projects through the course of twenty (20) interviews. A majority of the identified projects included water and sediment control basins, grass waterways, side inlets and inlet filters, cover crops and filter strips. One-on-one alliances can often be the most important ones made. The map below illustrates that many of the interviews are near or within Freeborn Lake Subwatershed.



Freeborn SWCD

Nutrient Management Specific Questions from PMZ in Freeborn County

The following questions are an excerpt from the Le Sueur PMZ, Freeborn SWCD Report.

13. Do you currently do soil tests to apply fertilizers and soil amendments?

Most do some sort of soil test on a multi-year basis. Some use crop removal.

14. Do you apply manure? If so do you test the manure for nutrients?

Most of the larger operations are required to test the manure. The nutrient credit is variable from 50-100%.

15. Do you use any setbacks for spraying pesticides or applying fertilizer/manure?

On paper the answer is yes. However, very seldom do you see increased weed competition next to surface tile intakes or streams due to that area not being sprayed.

16. Do you use trial plots to evaluate different methods?

There is a fair amount of on-the-farm trials going on. No data is more trustworthy and more applicable to your operation than data you collect yourself on your operation. A lot of producers have yield

monitors and can easily determine differences in yields. Some share information with a small group.

Nitrogen use and determinants of Best Management Practices: a study of Rush River and Elm Creek agricultural producers

Nitrogen use and determinants of Best Management Practices: a study of Rush River and Elm Creek agricultural producers. Davenport, M.A., and B. Olson. 2012. St. Paul, MN: Department of Forest Resources, University of Minnesota.

Although the study was conducted in a neighboring watershed (Elm Creek is a subwatershed in the Blue Earth River Watershed), not in the Le Sueur River Watershed, we have heard that the themes and perspectives are very similar across the region so thought that it was worth including.

The purpose of the Nitrogen use and determinants study is to assist watershed planners, commodity groups, and resource professionals in better understanding the determinants of nitrogen best management practices. Specific study objectives were to (1) explore farmer perspectives on farming and water resources, (2) examine the decision making process associated with nitrogen use on farms, and (3) identify drivers of and constraints to on-field and off-field nitrogen best management practice adoption. Data were gathered through a series of in-depth, personal interviews with 30 agricultural producers and two focus groups of water resource professionals in the Rush River and Elm Creek watersheds.

V. What are participants' perspectives on nitrogen best management practices?
To generate discussion around what factors drive and constrain the adoption of best management practices (BMPs), participants were asked to describe their use of BMPs, their perceptions of BMPs, and factors that influence their decisions around the use of BMPs on their farms.

Constraints & Drivers

- In participants' discussion of the BMPs, seven primary categories of constraints to adoption emerged: economics, knowledge, autonomy, market/demand, farm/landscape suitability, weather sensitivity, and effectiveness
- In participants' discussion of the drivers of best management practice adoption, three primary categories emerged: land management, economics, and responsibility.

Familiarity of BMPs

- Two-stage ditches and bioreactors were the BMPs with which farmers were least familiar. Eleven farmers (37%) reported hearing about two-stage ditches. Twenty (66%) farmers reported hearing about bioreactors.

Most Commonly Used BMPs

- Of the 10 BMPs listed for participants, the most commonly used BMPs overall were planting buffer or filter strips (80%) and following the University of Minnesota recommendations for nitrogen application (53%).

Most Popular BMPs

- Planting buffers or filter strips was most popular among participants primarily because of

familiarity/tradition and incentive payments received for low-producing soils.

Least Commonly Used BMPs

- The least commonly used BMPs were installing a two-stage ditch and planting alternative energy crops, neither of which was used by any of the study participants.

Least Popular BMPs

- Installing a two-stage ditch and planting alternative energy crops were the least popular BMPs. Constraints to two-stage ditch installation were land requirements for implementation, cost of construction/maintenance, and lack of familiarity. Constraints to growing alternative energy crops were concerns regarding replacing nutrients harvested, lack of a market, and competing commodity prices.

Le Sueur WRAPS - Staff-Identified Priorities & Challenges

County SWCD, Water Planning, and Environmental staff works directly with the citizens and natural resources of the watershed. Furthermore, these local staff write locally-focused conservation plans and assist landowners with most of the conservation implementation that occurs. For these reasons, the priorities and challenges to local staff can help state agency and other partners focus state financial and technical resources more effectively. Summarized staff priorities and challenges include:

General Feedback from WRAPS

More technical and financial resources should be provided to improve SWCD operations. Limited numbers of staff and turnover is a problem due to inconsistent funding, resulting in loss of producer rapport and significant time put into training new staff.

Local staff must balance the sometimes conflicting interests of citizens, agencies, and local boards. More state level support is needed to protect water resources. State agencies could improve their organization and effectiveness communicating with local staff. The scale of programs/boundaries should be well-planned and flexible to meet local needs.

Freeborn County – Nutrient Pilot Project Meeting

The following section is based on two meetings held in Freeborn County on March 18, 2015. The goals of the meetings were to introduce the Pilot Project and models and to gain feedback from local staff and landowners about nutrient management. Highlights are included below and more detailed notes about the meetings can be found in Appendix C.

Local Staff Feedback

Agency Limitations

- An impediment to conservation BMPs is lack of local staffing at NRCS and SWCD.
- Staff is using out dated technology. NRCS and SWCD should have survey grade GPS to create more efficiency.
- Projects have longer completion times because of low staff numbers.

Regulations & Permitting

- Existing regulations such as MN DNR public waters permit are an impediment to conservation BMPs. These add cost to projects that are designed to improve public waters. Permitting issues include high cost, slow turn around rate, and poor communication with the agency.

Funding

- Amount of available funding for projects is an issue. For example, of the meeting attendees one was an applicant for a RIM buffer and one was an applicant for a RIM wetland restoration. Both were good projects that would have improved the water quality in the watershed but there was not enough funding to secure both of these easements.
- When completing a project, money did not seem to be a huge issue but rather the amount of time it takes to obtain cost-share for projects.

Landowner Perspectives - Landowner Values & Perspectives

The following section on landowner perspectives is based on two meetings held in Freeborn County on March 18, 2015. A snapshot survey of landowner interest in particular BMPs is illustrated in Appendix C.

FERTILIZER USE EFFICIENCIES

University of Minnesota Recommended Fertilizer Rates

Landowners general consensus was that U of MN fertilizer recommendations are too low for this area. They felt that suggested rate recommendations from IA should be used in this area because soil/growing season is more similar to IA than northern MN. Use 0.9 lb N up to average (160 bushels?) then use 1.1 or 1.2 lb N for remainder (200-220 bushels). They set a yield goal and assume a linear relationship from applied N to yield.

Placement and Timing of Fertilizer Application

There was some discussion on split application of Nitrogen between the fall and spring. Discussion of how much nitrogen is lost from fall application until spring. One farmer felt there was almost no nitrogen lost from fall application until spring if soil temperatures remained under 50 degrees Fahrenheit. Also mentioned was the practice of adding additional nitrogen after large rains in the spring leached spring applied nitrogen. One landowner said that many landowners have greatly improved their fertilizer application habits compared to past practice.

There was an assumption expressed that fall N applied at soil temp less than 50 degrees does not have any more loss than spring applied N. Things are dormant under 50 degrees and losses occur in spring. Fall N application is okay on local clay soils. Our soils have a lot of organic N available that could leach out anyway.

Phosphorus

Landowner discussions primarily centered on Nitrogen. There was less discussion of phosphorus compared to nitrogen.

INCREASE AND TARGET LIVING COVER

Survey showed generally medium interest in living cover with perennial buffers, cover crops, and conservation easements and land retirements getting more interest.

Cover Crops
Briefly discussed cover crops as an option to reduce phosphorus from entering surface waters. It was landowners' opinion that there is very limited time for growth of cover crops from the time of cash crops physiological maturity until freeze up. That this limited growth did not produce added value compared to the high price of application. If there was a longer growing season in our region they could see how they would be of value. They recognize there are some success with cover crops in the area but only when cover crops are applied during times when RMA does not allow it. Concern among some farmers that cover crop application while cash crop is still growing would cause competition for moisture. "We are too far north for cover crops. There is not enough time to get a real benefit from them here. Corn is cheap now and it would be hard to get return on investment. There is a potential liability or conflict with crop insurance with aerial application into standing crops."

DRAINAGE WATER RETENTION & TREATMENT

Controlled Drainage
Small discussion on controlled drainage and the suitability of the landscape for those systems in the specific area of Freeborn Co. Most areas that are less than 1% slope already have tile drainage. The assumption is that a conservation/controlled drainage system would have to be a whole new system. Also increased cost of installing system that is not congruent with what is already in place. One landowner concerned about maintenance issues/timing of lifting/lowering boards. Conservation drainage creates a management workload and liability of crop losses.

FIELD EROSION CONTROL
Conservation Tillage
Not much discussion about tillage.

GENERAL REFLECTIONS ON RESEARCH IN NRS
Landowners revisited several graphics presented in the MPCA's power point about the Minnesota Nutrient Reduction Strategy. One of the graphics included a pie chart comparing two watersheds and the source of nitrogen in surface waters. There may have been some perception on the pie chart of finger pointing at the Le Sueur. The pie chart for the Le Sueur showed largest nitrogen source contributor as "Tile Drainage on Cropland". Landowners felt that put a bull's eye on producers in our area and those using tile drainage. They felt it was infeasible to not use tile drainage since it would mean many acres would no longer be suitable for production. They noted differences in the landscape that could account for the differences in the pie chart between the two watersheds shown.

A few landowners felt that even though cropland is a major contributor to nitrogen in surface waters, they feel that the "Other" category needs to be addressed as well to help reduce nitrogen and farmers shouldn't be solely responsible in helping the reduction.

A graphic showing where nitrogen reduction can be accomplished by using the Maximum Return to Nitrogen Value (MRTN) rates suggested by the U of M was disputed because there was no information on what the yield goal was. They felt that since the MRTN rates were suggested throughout the state of MN it was not accurate for this region of MN. Cropland in Southern MN that has higher yielding capabilities and could use higher rates of nitrogen applied to it to reach higher yield goals.

It was the opinion in the small group of farmers that many producers in the area where not using the MRTN recommendations for MN. Some were using their own calculations on how much nitrogen to apply. Some had soil tests done and the ability to use variable rate fertilizer application. Not clear if they were applying the recommendations from agronomists that interpreted the soil tests.

Precipitation versus Tiling

Locals stated that many nutrient losses are due to large rain events that are out of the producers control and noted that it is infeasible to plan for 25 or 100 year rain events. Minnesota River was muddy at time of settlement. Nitrogen washes away during these events and they add more to replace expected losses so that they do not take a yield hit.

Freeborn Lake - Citizen Survey

A Citizen Survey was conducted by the MN DNR and Freeborn County at a *Future of Freeborn Lake* meeting on April 2015. Twenty-five surveys were returned. For the "Most to Least Important" tally, water quality was overwhelmingly supported as the most important. This illustrates general citizen concern about Freeborn Lake water quality.

Rank (A-E)	Needs Improvement --- Couldn't be Better (1) (5) Average Rating
Water Quality	1.09
Wildlife	1.91
Fishing	1.81
Recreation	1.60
Aesthetics	2.48

Le Sueur, Freeborn Lake Subwatershed – Landowner Willingness Studies

The chart below summarizes landowner feedback using the Minnesota Nutrient Reduction Strategy BMPs as a framework.

Minnesota Nutrient Reduction Strategy	BMP Nitrogen Study (Davenport)	Le Sueur PMZ (Projects Identified)	Snapshot of Current Landowner Interest – Freeborn Lake Pilot Meeting
Fertilizer Use Efficiencies			
Recommended Fertilizer Rates (B)	Most used/popular		Medium willingness
Placement and Timing of application (B)			More willingness
Reducing soil P (P)			
Livestock feed management (P)			
Nitrification inhibitors (N)			Medium willingness
Increase and Target Living Cover			
Cover Crops (B)		Projects Identified	Medium willingness
Perennial Buffers (B)	Buffers & filter strips - Most used/popular		Medium willingness
Forage and biomass planting (B)			
Perennial energy crops (B)	Least used/popular		
Conservation easements and land retirements (B)			Medium willingness
Drainage Water Retention and Treatment		Side inlet, inlet filters Projects Identified	
Constructed Wetlands (N)			More willingness
Controlled drainage (N)			
Bioreactors (N)	Least familiar/popular		
Two stage ditches (N)	Least familiar/popular Least used/popular		More willingness
Field Erosion Control		Side inlet, inlet filters, filter strips Projects Identified	
Conservation Tillage and residue management (P)			More willingness
Terraces/grassed waterways (P)		Projects Identified	More willingness
Sediment control basins (P)		Projects Identified	Medium willingness

Urban Stormwater and Other sources			
Wastewater Treatment			

How many of each BMP? Cropland BMP Watershed Planning
Le Sueur River Watershed – Nitrogen Reduction Scenario (N-BMP Tool) Scenarios

Part of the Minnesota Nutrient Reduction Strategy and the Nitrogen in Minnesota Surface Water Report included an evaluation of the expected reductions to Minnesota waters from individual practices adopted on all land statewide where the practice is suitable for adoption. Two watershed planning tools were created to allow water resource managers and planners to create planning scenarios that depict either a single BMP or a suite of BMPs is adopted at specified levels across the watershed to achieve reductions delineated in Nutrient Reduction Strategy. These cropland BMP Watershed Planning Tools are quick and easy to use:

- N-BMP – Nitrogen BMPs spreadsheet
- P-BMP – Phosphorus BMPs spreadsheet

The N-BMP and P-BMP spreadsheets were developed by the University of Minnesota (William Lazarus, David Mulla,et al.) to enable water resource planners developing either state-level or watershed-level reduction strategies to gauge the potential for reducing Nitrogen and Phosphorus loads to surface waters from cropland, and to assess the potential costs of achieving various reduction goals. The tool merges information on Nitrogen and Phosphorus reduction with landscape adoption limitations and economics. These tools allows water resource managers and planners to approximate the percent reduction of Nitrogen and Phosphorus entering surface waters when either a single BMP or a suite of BMPs is adopted at specified levels across the watershed. The tool also enables the user to identify which BMPs will be most cost-effective for achieving Nitrogen and Phosphorus reductions.

Using the Nitrogen and Phosphorus reduction planning model involves three steps:

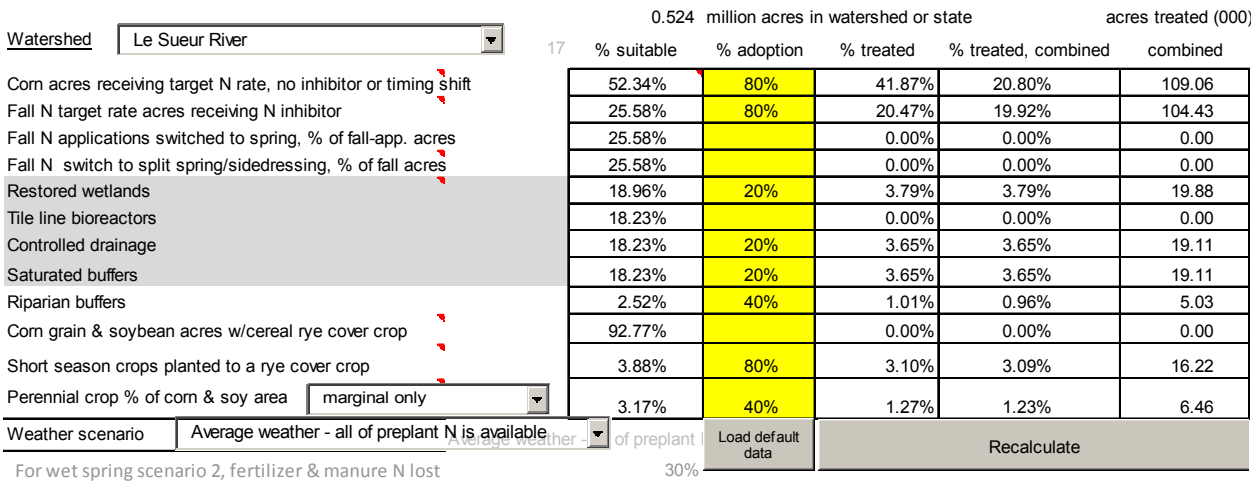
1. The first step is to select a watershed, enter hypothetical adoption rates for each BMP, and compare the effectiveness and cost of the individual BMPs.
2. The second step is to compare suites of the BMPs that would attain any given reduction in the N or P load at minimum cost.
3. The third step is to “drill down” to the details and assumptions behind the models of effectiveness and costs of any particular BMP and make any adjustments to reflect your particular situation.

Spreadsheets and documentation at: http://z.umn.edu/nbmp
More information about the N-BMP tool is included in the:
Nitrogen in Minnesota Surface Water Report
Minnesota Watershed Nitrogen Reduction Planning Tool

Nitrogen – N-BMP Scenarios

Scenario #1

This is on of many scenarios to achieve a 20% reduction in cropland nitrogen loads going into the Le Sueur River.



Watershed: Le Sueur River	0.524 million acres in watershed or state				acres treated (000)
17	% suitable	% adoption	% treated	% treated, combined	combined
Corn acres receiving target N rate, no inhibitor or timing shift	52.34%	80%	41.87%	20.80%	109.06
Fall N target rate acres receiving N inhibitor	25.58%	80%	20.47%	19.92%	104.43
Fall N applications switched to spring, % of fall-app. acres	25.58%		0.00%	0.00%	0.00
Fall N switch to split spring/sidedressing, % of fall acres	25.58%		0.00%	0.00%	0.00
Restored wetlands	18.96%	20%	3.79%	3.79%	19.88
Tile line bioreactors	18.23%		0.00%	0.00%	0.00
Controlled drainage	18.23%	20%	3.65%	3.65%	19.11
Saturated buffers	18.23%	20%	3.65%	3.65%	19.11
Riparian buffers	2.52%	40%	1.01%	0.96%	5.03
Corn grain & soybean acres w/cereal rye cover crop	92.77%		0.00%	0.00%	0.00
Short season crops planted to a rye cover crop	3.88%	80%	3.10%	3.09%	16.22
Perennial crop % of corn & soy area: marginal only	3.17%	40%	1.27%	1.23%	6.46

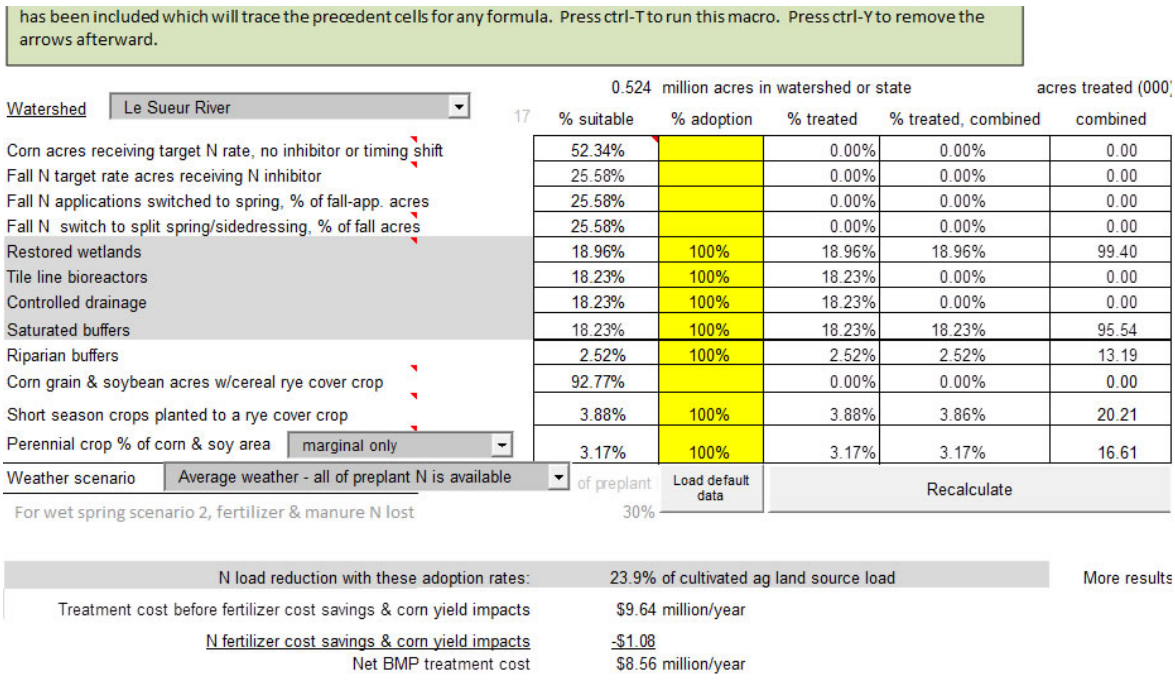
Weather scenario: Average weather - all of preplant N is available — of preplant — Load default data — Recalculate

For wet spring scenario 2, fertilizer & manure N lost: 30%

N load reduction with these adoption rates:	19.8% of cultivated ag land source load	More results
Treatment cost before fertilizer cost savings & corn yield impacts	$3.41 million/year	
N fertilizer cost savings & corn yield impacts	-$2.37	
Net BMP treatment cost	$1.05 million/year	

Scenario #2

This scenario omits any changes in placement or timing of application or fertilizer use efficiencies.



has been included which will trace the precedent cells for any formula. Press ctrl-T to run this macro. Press ctrl-Y to remove the arrows afterward.

Watershed: Le Sueur River	0.524 million acres in watershed or state				acres treated (000)
17	% suitable	% adoption	% treated	% treated, combined	combined
Corn acres receiving target N rate, no inhibitor or timing shift	52.34%		0.00%	0.00%	0.00
Fall N target rate acres receiving N inhibitor	25.58%		0.00%	0.00%	0.00
Fall N applications switched to spring, % of fall-app. acres	25.58%		0.00%	0.00%	0.00
Fall N switch to split spring/sidedressing, % of fall acres	25.58%		0.00%	0.00%	0.00
Restored wetlands	18.96%	100%	18.96%	18.96%	99.40
Tile line bioreactors	18.23%	100%	18.23%	0.00%	0.00
Controlled drainage	18.23%	100%	18.23%	0.00%	0.00
Saturated buffers	18.23%	100%	18.23%	18.23%	95.54
Riparian buffers	2.52%	100%	2.52%	2.52%	13.19
Corn grain & soybean acres w/cereal rye cover crop	92.77%		0.00%	0.00%	0.00
Short season crops planted to a rye cover crop	3.88%	100%	3.88%	3.86%	20.21
Perennial crop % of corn & soy area: marginal only	3.17%	100%	3.17%	3.17%	16.61

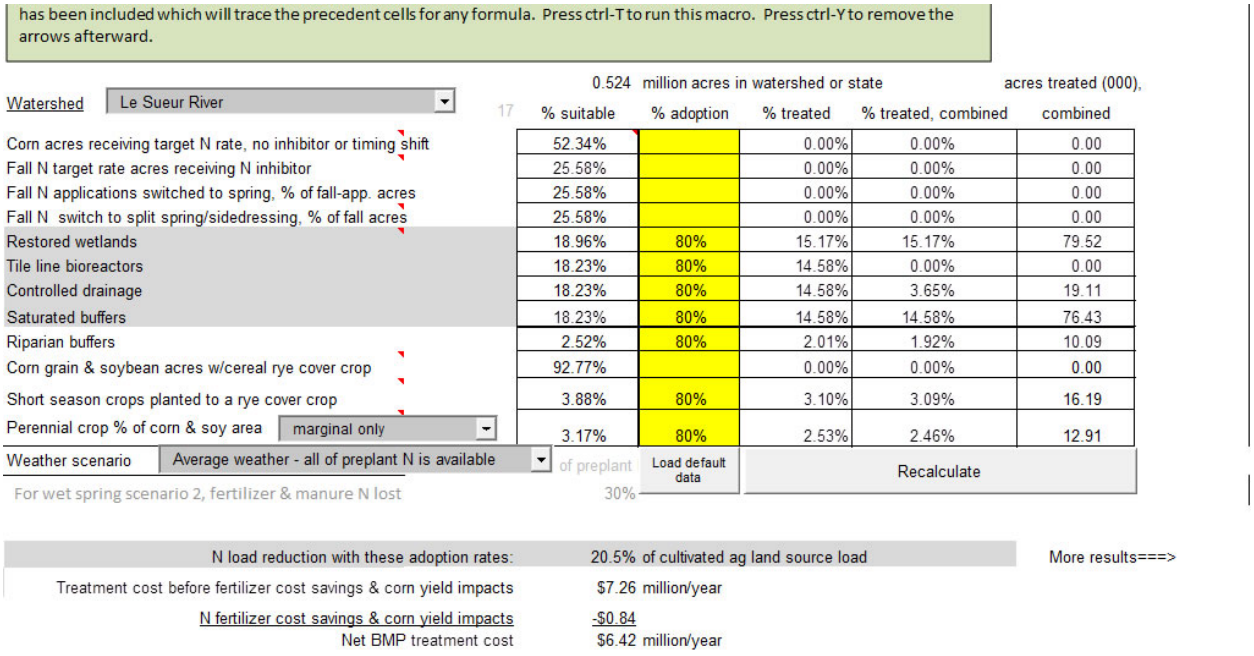
Weather scenario: Average weather - all of preplant N is available — of preplant — Load default data — Recalculate

For wet spring scenario 2, fertilizer & manure N lost: 30%

N load reduction with these adoption rates:	23.9% of cultivated ag land source load	More results
Treatment cost before fertilizer cost savings & corn yield impacts	$9.64 million/year	
N fertilizer cost savings & corn yield impacts	-$1.08	
Net BMP treatment cost	$8.56 million/year	

Scenario #3

This scenario decreases the assumed percent adoption of practices to reach a 20 percent adoption.



has been included which will trace the precedent cells for any formula. Press ctrl-T to run this macro. Press ctrl-Y to remove the arrows afterward.

0.524 million acres in watershed or state

Watershed: Le Sueur River (17)

	% suitable	% adoption	% treated	% treated, combined	acres treated (000), combined
Corn acres receiving target N rate, no inhibitor or timing shift	52.34%		0.00%	0.00%	0.00
Fall N target rate acres receiving N inhibitor	25.58%		0.00%	0.00%	0.00
Fall N applications switched to spring, % of fall-app. acres	25.58%		0.00%	0.00%	0.00
Fall N switch to split spring/sidedressing, % of fall acres	25.58%		0.00%	0.00%	0.00
Restored wetlands	18.96%	80%	15.17%	15.17%	79.52
Tile line bioreactors	18.23%	80%	14.58%	0.00%	0.00
Controlled drainage	18.23%	80%	14.58%	3.65%	19.11
Saturated buffers	18.23%	80%	14.58%	14.58%	76.43
Riparian buffers	2.52%	80%	2.01%	1.92%	10.09
Corn grain & soybean acres w/cereal rye cover crop	92.77%		0.00%	0.00%	0.00
Short season crops planted to a rye cover crop	3.88%	80%	3.10%	3.09%	16.19
Perennial crop % of corn & soy area: marginal only	3.17%	80%	2.53%	2.46%	12.91

Weather scenario: Average weather - all of preplant N is available

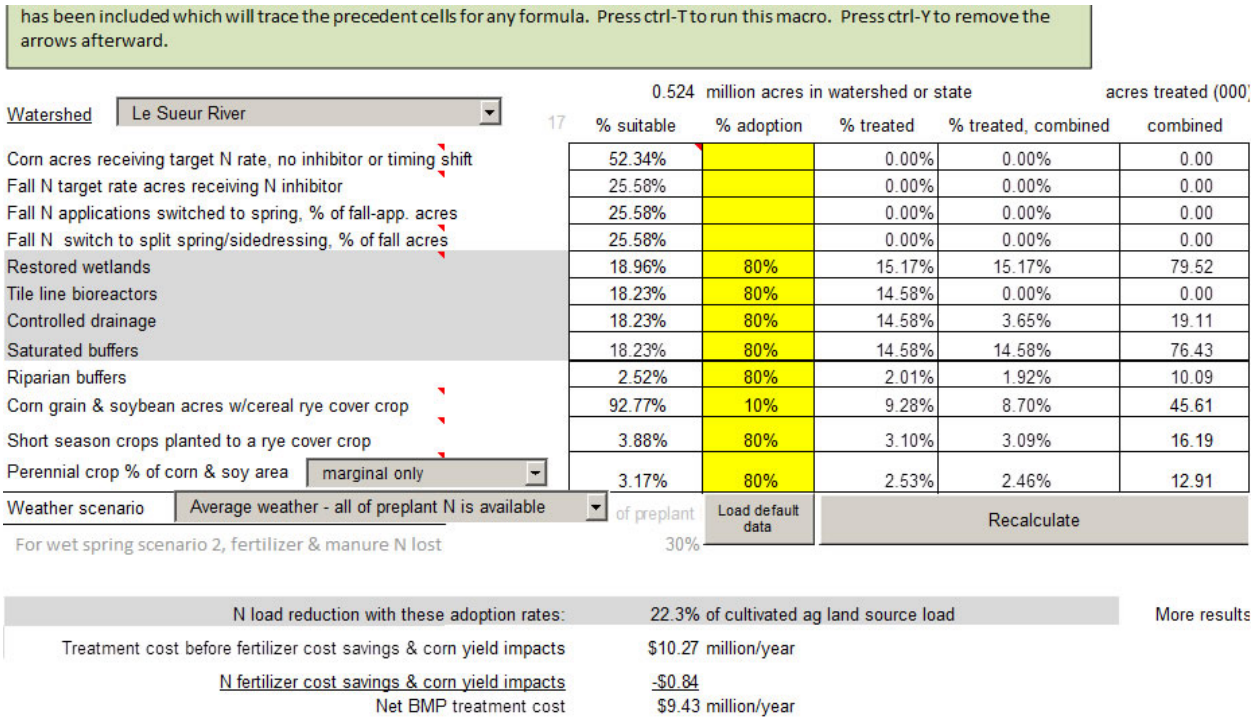
of preplant: Load default data | Recalculate

For wet spring scenario 2, fertilizer & manure N lost: 30%

N load reduction with these adoption rates:	20.5% of cultivated ag land source load	More results===>
Treatment cost before fertilizer cost savings & corn yield impacts	$7.26 million/year	
N fertilizer cost savings & corn yield impacts	-$0.84	
Net BMP treatment cost	$6.42 million/year	

Scenario #4

This scenario is the same of #3 but also includes 10 percent adoption of cereal rye cover crop on corn grain and soybean acres.



has been included which will trace the precedent cells for any formula. Press ctrl-T to run this macro. Press ctrl-Y to remove the arrows afterward.

0.524 million acres in watershed or state

Watershed: Le Sueur River (17)

	% suitable	% adoption	% treated	% treated, combined	acres treated (000) combined
Corn acres receiving target N rate, no inhibitor or timing shift	52.34%		0.00%	0.00%	0.00
Fall N target rate acres receiving N inhibitor	25.58%		0.00%	0.00%	0.00
Fall N applications switched to spring, % of fall-app. acres	25.58%		0.00%	0.00%	0.00
Fall N switch to split spring/sidedressing, % of fall acres	25.58%		0.00%	0.00%	0.00
Restored wetlands	18.96%	80%	15.17%	15.17%	79.52
Tile line bioreactors	18.23%	80%	14.58%	0.00%	0.00
Controlled drainage	18.23%	80%	14.58%	3.65%	19.11
Saturated buffers	18.23%	80%	14.58%	14.58%	76.43
Riparian buffers	2.52%	80%	2.01%	1.92%	10.09
Corn grain & soybean acres w/cereal rye cover crop	92.77%	10%	9.28%	8.70%	45.61
Short season crops planted to a rye cover crop	3.88%	80%	3.10%	3.09%	16.19
Perennial crop % of corn & soy area: marginal only	3.17%	80%	2.53%	2.46%	12.91

Weather scenario: Average weather - all of preplant N is available

of preplant: Load default data | Recalculate

For wet spring scenario 2, fertilizer & manure N lost: 30%

N load reduction with these adoption rates:	22.3% of cultivated ag land source load	More results
Treatment cost before fertilizer cost savings & corn yield impacts	$10.27 million/year	
N fertilizer cost savings & corn yield impacts	-$0.84	
Net BMP treatment cost	$9.43 million/year	

Phosphorus – P-BMP Scenarios

Phosphorus - 12 Percent Scenario

The following lists some of the assumptions for this scenario. Since the Riparian buffers are now required, they are input as a high adoption rate (90%). This scenario includes a high rate of adoption for cover crops that could be used on the early harvest crops. This scenario also includes a few more riser pipes on tile inlets and some more conservation on sloping lands, to achieve the 12% reduction. Please note that this is one of many combinations of BMPs that could achieve 12 percent reduction.

Watershed: Le Sueur River — 0.563 million acres o

Pathway	% existing	% suitable	% adoption	% treated	acres treated (thousands)
Apply U of MN recs					
Target P2O5 rate	0.00%	96.49%		0.00%	-
Fall corn&wheat fert to preplant/starter	35.73%	16.54%	0%	0.00%	-
Use reduced tillage on corn, soy & small gr >2% slopes	20.09%	40.00%	20%	8.00%	45
Riparian buffers, 50 ft wide	4.15%	2.79%	90%	2.51%	14
Perennial crop % of marginal corn&soy land	0.00%	3.34%	0%	0.00%	-
Corn grain & soybean acres w/cereal rye cover crop	0.00%	92.54%	0%	0.00%	-
Short season crops planted to a rye cover crop	0.00%	3.95%	70%	2.76%	16
Controlled drainage	0.00%	17.55%		0.00%	-
Alternative tile intakes	7.58%	22.75%	20%	4.55%	35
Inject or incorp manure	9.58%	1.09%		0.00%	-
Total for all BMPs					
Weather Scenario:	Average weather		Load default data		Recalcu

Cropland P load reduction with these adoption rates:	12.4%	
Treatment cost before fertilizer cost savings	$0.73	million/year
P and N fertilizer cost savings	$0.00	
Net BMP treatment cost	$0.73	million/year

Phosphorus - 16 Percent Scenario

The following lists some of the assumptions for this scenario to reach a 16 percent reduction in Phosphorus. This scenario includes all of the assumptions for the 12 percent as well as more targeting P205 rate (20% adoption), more controlled drainage (10%) and alternative tile intakes (50%), and injecting or incorporating manure (20%). Please note that this is one of many combinations of BMPs that could achieve a 16 percent reduction.

Watershed: Le Sueur River — 0.563 million acres o

Pathway	% existing	% suitable	% adoption	% treated	acres treated (thousands)
Apply U of MN recs					
Target P2O5 rate	0.00%	96.49%	20%	19.30%	109
Fall corn&wheat fert to preplant/starter	35.73%	16.54%	0%	0.00%	-
Use reduced tillage on corn, soy & small gr >2% slopes	20.09%	40.00%	20%	8.00%	45
Riparian buffers, 50 ft wide	4.15%	2.79%	90%	2.51%	14
Perennial crop % of marginal corn&soy land	0.00%	3.34%	0%	0.00%	-
Corn grain & soybean acres w/cereal rye cover crop	0.00%	92.54%	0%	0.00%	-
Short season crops planted to a rye cover crop	0.00%	3.95%	70%	2.76%	16
Controlled drainage	0.00%	17.55%	10%	1.75%	10
Alternative tile intakes	7.58%	22.75%	50%	11.38%	88
Inject or incorp manure	9.58%	1.09%	20%	0.22%	1
Total for all BMPs					

Weather Scenario: Average weather — Load default data — Recalcu

Cropland P load reduction with these adoption rates:	16.3%	
Treatment cost before fertilizer cost savings	$0.98	million/year
P and N fertilizer cost savings	-$1.65	
Net BMP treatment cost	-$0.66	million/year

Potential Targeting Locations

Prioritizing and Modeling Tools

There are many different modeling tools and economic calculators available or currently in development in Minnesota and across the United States. Appendix B include a matrix that describes some of these tools for prioritizing and targeting. After searching possible tools for this pilot study, the team decided to use the Agricultural Conservation Planning Framework due to the availability and promise of this new tool.

Agricultural Conservation Planning Framework

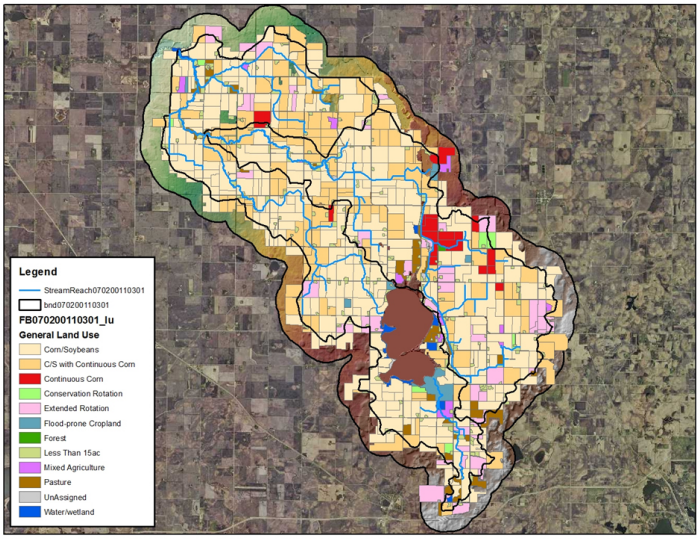
The Agricultural Conservation Planning Framework (ACPF) was developed at the National Laboratory for Agriculture and the Environment by Mark Tomer, Sarah Porter and David James. The ACPF is a set of precision conservation planning tools to help facilitate a "watershed approach" to conservation planning through a participatory process involving landowners. The approach emphasizes the need to improve soil health across a watershed, and provides multiple options to place a variety of structural and vegetative practices to control, trap, and treat water flows within and below fields in locations suited to each type of practice.

The ACPF comprises a set of ArcTools that can identify multiple options for site-specific placement of conservation practices throughout a watershed based on landscape (hydrologic) and soil criteria, which allows local farm producers the discretion to select preferred practices and locations. The ACPF tools have been applied in HUC12 watersheds in four states. Using these precision conservation GIS tools, we can illustrate the flexibility of planning approaches and options that can be provided at the watershed-scale and work with farm operators towards watershed reduction goals.

More information about the ACPF can be found: *Journal of Soil and Water Conservation September/October 2013 vol. 68 no. 5 113A-120.* Combining precision conservation technologies into a flexible framework to facilitate agricultural watershed planning. http://www.swcs.org/documents/filelibrary/15ac/Final_Program_7222015_web_78B3A47472B56.pdf

Freeborn Lake Subwatershed ACPF Maps

ACPF maps for Freeborn Lake Subwatershed are included in Appendix D.



Freeborn County Staff Feedback about Using ACPF

The following points are reflections on examples shared of the ACPF in March 2015. These reflections were shared with research staff developing the ACPF.

ACPF Development

ACPF developers from the National Laboratory for Agriculture and the Environment created another version of the tool after hearing feedback from project partners and addressed many of the concerns in the latest version. Additionally, ACPF developers are currently including more economic data into the ACPF and anticipate completion of this new version by Winter 2015.

Understanding Outputs

If we are to approach landowners we need to have some sort of idea how this information was generated and how specific sites were picked. I have some basic information and can infer some things but would need more robust metadata to better understand the background of each output. This would also help us identify why some poor sites were picked and why some good sites were overlooked.

Data Management

We anticipate that storage space is going to be an issue with these files. These files are large and doing the whole county could potentially bring up storage issues

Waterways

The waterway file looks like you captured every possible waterway that would ever be thought of and this is not helpful for identifying waterways to target because there are too many. The search criteria could be narrowed some to better target.

WASCOBs

We noticed a lot of sites were missed. Consider changing the size of the criteria if the query ran for 5 to 10 acres. We do a lot of WASCOBS with watersheds less than 5 acres. We are also limited by NRCS standards to a maximum watershed size of 40 acres.

Wetlands
We noticed a lot of sites were missing and some were of questionable feasibility. It did generate a manageable number of sites to look at and target however.

Drainage Management
This was the first targeting for drainage management that I saw so that was interesting. Since field sizes are increasing it may be worthwhile to have an acre threshold instead of a percent of field threshold. Our fields are trending larger to 80 or 160 acres. The 10 or 20 acre with drainage management could still be a worthwhile project.

Buffers
The whole thing with buffers got a little too complex. I agree that we should have buffers on all of it but wonder if we should identify the locations that needed it the most and focus on those instead of spending a lot of time on what kind of vegetation should go where.

Freeborn County SWCD – Nutrient Planning Approach

The following is a summary by Freeborn County SWCD staff of their next steps they anticipate for Nutrient Management.

Step 1 – Assess Feasibility of Projects on Existing Project List

Freeborn County SWCD has a list of potential existing projects across their county. This list has been developed through Geographic Information Systems (GIS) analysis and landowner outreach over many years. It was derived in part from the Le Sueur River Watershed PMZ Project where they reached out to landowners, performed interviews to learn more about landowner perspectives on water quality and created a map and list of willing landowners and potential projects. Staff made efforts to contact community members from all areas in the watershed including urban residents, rural residents, lake association members, etc. to obtain as diverse of a perspective as possible on water quality concerns. They noted that this outreach process particularly helped staff to build relationships with local producers.

Freeborn SWCD's approach to prioritizing this project list is to assess the size and feasibility of projects, to identify which projects are a small or a large concern in terms of pollutant contribution. They will prioritize cost share and target the really big pollutant contributors such as large gully erosion areas. This identification will be accomplished through the local application of SWCD/County staff using technical resources, including GIS and watershed modeling to define areas contributing disproportionately to water quality concerns. Freeborn SWCD staff noted that the typical practices that they focus on, such as erosion control, have important nutrient reduction benefits.

One of the challenges Freeborn SWCD noted is available staff time and prioritization of projects. For example, a high priority for them this year is performing landowner outreach, ground truthing and opinion gathering in the Winnebago River Watershed. The Winnebago Watershed is starting the PMZ outreach stage in MPCA's watershed approach and is a focus of staff time and resources at Freeborn County SWCD.

Local staff said that the ACPF Tool would be helpful to clarify where conservation opportunity areas are within the Freeborn County, but noted barriers for using this tool within the Le Sueur River watershed. One is that hydroconditioning is not yet completed across the entire watershed or county. The SWCD staff already has a large workload with surveying and design of their list of existing BMPs. Another barrier is the staff time to run the ACPF tool. The cost, time and expertise needed to run the model and the need to acquire more GIS storage space for results were all noted as challenges.

Step 2 – Community Outreach via Soil Health Team

An important priority for Freeborn County SWCD is continued work partnering with NRCS and other

agencies, landowners, and local businesses on a soil health initiative called Freeborn County Soil Health Team: http://www.freeborncountysoilhealthteam.org/

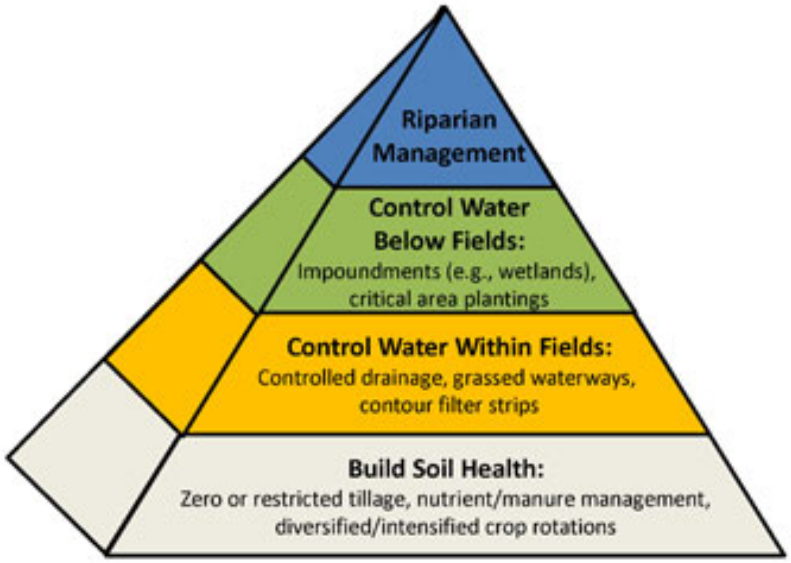
Their Mission Statement is: *to facilitate local collaboration that encourages, educates, and demonstrates how to improve our soil health & water quality while improving productivity, profitability, and sustainability of our natural resources.*

The Soil Health Team is conducting trial plots and has created educational videos and hosted a series of field day events throughout the year to publicize soil health. Pilot projects include tillage-ridge till, aerial planting of cover crops, and test plots that explain cover crops in more detail (mix used, when planted, how planted, cost per acre). Another field day focusing on cover crop education is upcoming this fall (September 23, 2015).

This approach is aligned with the Agricultural Conservation Planning Framework (ACPF) prioritizing scheme that stresses the importance of soil health. The ACPF is a systematic approach to identifying the best options for reducing nutrient losses and erosion within a watershed—whether those opportunities are found in farm fields, along stream corridors, or in other locations. Conservation planning in a watershed is conceptualized as a pyramid. At the base are fundamental practices to improve soil health, such as crop rotations. These practices are then built upon by techniques that control water flows and nutrient losses within fields, outside of (below) fields, and finally along stream corridors (riparian management). https://dl.sciencesocieties.org/story/2015/may/fri/new-toolset-gives-farmers-more-options-for-improving-water-quality

ACPF Prioritization Scheme:

- Build Soil Health: protect soils from erosion, limit excess nutrients, build soil organic matter
- Control Water Within Fields: controlled drainage, grassed waterways, filter strips
- Control Water Below Fields: impoundments, manage “variable source” areas
- Riparian Management: strengthening of ecosystem and nutrient removal



Step 3 – Freeborn Lake Planning

Freeborn SWCD plans to stay informed and help to inform the Freeborn Lake planning process initiated by MN DNR and Freeborn County. This group has sent a mailing to everyone within the Freeborn Lake Subwatershed and invited them to meetings. The group is currently hosting monthly meetings to create a lake management plan. The group is discussing improvement strategies that fall into two categories: those addressing internal pollutant loads; and those designed to reduce impact from external loading. Meeting notes indicate that internal loading can be addressed with lake management efforts that fall within the purview of the MN DNR and Freeborn County. External loading from municipal and agricultural runoff should continue to be addressed via best management practices and water treatments. The group has acknowledged that nonpoint source pollutants are largely voluntary and this is an opportunity area to more clearly illustrate how targeted conservation planning can help reduce these external pollutant loads. Meeting participants have stressed the value of reducing the external loading as much as possible as well.

Other Next Steps to Consider

Use ACPF and other scenario tools to Target Potential Conservation Practices in Freeborn Lake Subwatershed

The Freeborn Lake Enhancement Plan (DRAFT 9/18/2015) calls for the promotion of conservation implementation in Freeborn Lake Subwatershed.

> Action 6: Local, state and federal agencies and non-profit groups target implementation of conservation programs in the watershed of Freeborn Lake

Outputs form the ACPF and other tools could be used to help clarify where conservation opportunity areas are within the Freeborn Lake subwatershed. This is aligned with Freeborn County SWCD's focus on

soil health and conservation project objectives listed in their annual plan. (The types of likely projects will include Water & Sediment Control Basins, Terraces, Waterways and Grade Stabilizing Structures etc., enrolling acres in long-term easements for wetland restoration and riparian buffers).

Clarify Economic Side of Conservation for Producers

There is opportunity for education in the region on cost savings and economic benefit (timing and placement of inputs). Research has shown that more efficient N & P applications can actually be free or profitable for producers. There is promise in the emerging field of precision application as well.

The following cost benefit analysis is an example from Ulrich's *Squaw Creek Watershed, Iowa Study* that could be replicated in the Freeborn Lake Subwatershed.

Reductions, Costs, Cost-Effectiveness

Category	Practice	% Reduction per acre		Est. Cost $/ac/yr	N+P Cost-Effectiveness
		N	P		
Efficient N & P app.	Moving fall anhydrous N fertilizer application to spring preplant	6	0	-35	-5.8
Efficient N & P app.	P rate reduction in fields that have high to very high soil test P	0	17	-12	-0.7
Efficient N & P app.	Reducing N app. rate to MRTN 133 lb N/ac on Corn/Soy, Reducing N app. rate to MRTN 190 lb N/ac on Cont. Corn	10	0	-2	-0.2
Efficient N & P app.	Sidedress all spring applied N	7	0	0	0
Efficient N & P app.	Using a nitrification inhibitor with all fall applied N fertilizer	9	0	-3	-0.3
Cover crops	Fall planted cover crops (rye)	31	29	77.78	1.3
Reduced Tillage	Intensive tillage to conservation tillage (moldboard to chisel plow)	0	33	26	0.8
Cover Crops/ Reduced Tillage	Increasing soil organic matter by 100% (3% to 6%)	10	0	NA	NA
Land Use Change	Corn/Soybean to Pasture and/or Land Retirement	85	75	117.03	0.7
Land Use Change	Corn/Soybean to Perennials/Energy Crops	72	34	139.6	1.3
Land Use Change	Corn/Soybean with extended alfalfa rotations	42	59	70.88	0.7
Edge-of-Field	Controlled Drainage	33	0	0.74	0
Edge-of-Field	Denitrification bioreactors	43	0	29.61	0.7
Edge-of-Field	Grassed Waterways	0	58	38.58	0
Edge-of-Field	Nutrient Removal Wetlands	52	58	9.41	0.1
Edge-of-Field	Riparian Buffers	91	58	6.78	0
Edge-of-Field	Saturated Buffers	50	0	7.52	0.2
Edge-of-Field	Sediment Basins	0	85	5.9	0.1

These are free or profitable

Needed for increasing soil organic matter

Very effective but expensive

These treat both N and P effectively

Consider WRAPS Strategies to address High Phosphorus Concentrations in Lake Watersheds (Restoration and Strategies to Meet 10-Year Target):

Watershed-wide

- Co-develop individualized plans for lakes with strong and invested local working group support (as requested). Plans will be based on WRAPS strategies.
- Landowner education, nutrients, shoreline, septic systems etc
- Enforce construction site erosion control plans
- Septic (SSTS) system maintenance/replacement

Agricultural

- Strategies to reduce TP from fields and tile drainage water sources
- Reduce/eliminate runoff from livestock "open lots" adjacent lake
- Improve feedlot runoff controls

City/Residential

- Strategies to reduce non-point city, residential contribution

Lakeshore

- Restore, maintain lakeshore buffer and in-lake native vegetation, control invasive species
- Increase structural set-backs from lake
- Enforce/establish shoreland rule/buffer ordinance

In-Lake

- Internal treatments (fish, chemical, dredging) where external phosphorus source have been controlled

Education and Involvement Strategies

Freeborn County SWCD has a rich history working cooperatively with local landowners and the Greater Blue Earth River Basin Alliance (GBERBA).

The Minnesota Nutrient Reduction Strategy acknowledges that BMP adoption requires agriculturalproducers to change behavior that is often linked to values, perceptions and awareness of a problem. Freeborn County SWCD PMZ work and outreach has enabled local partners to learn more about producer's perspectives and decision-making processes.

The Minnesota Nutrient Reduction Strategy delineates some strategies for outreach that could be considered in Freeborn Lake Subwatershed. The area could benefit from a targeted outreach and education campaign promoting BMP implementation where is it needed most. Another strategy beyond informing agricultural producers directly would be to work with their trusted advisers (e.g. co-op agronomists and certified crop advisors).

The Lake Planning group has the opportunity to involve producers in identifying feasible strategies for upstream nutrient sources to the lake. As the project proceeds, project partners could more clearly identify phosphorus and nitrogen goals for the Freeborn Lake subwatershed using P-BMP and N-BMP tools and other scenario building methods.

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