A Guide to Reviewing Minnesota's Draft Nutrient Reduction Strategy

How were the goals established?

See Chapter 2 of the Draft Nutrient Reduction Strategy (pages 2-1 to 2-5).

Water quality standards establish the water quality conditions needed to support identified beneficial uses of the water. The beneficial uses that nutrients might impact include recreation, healthy aquatic life, and safe drinking water. Planning goals are the expected outcomes associated with identified strategies, and are usually referenced as loading reductions.

Having water quality that supports the identified beneficial uses of Minnesota's water is the policy of the state. Minnesota is also described as a headwater state - meaning that rivers start here and proceed downstream until they reach the oceans. Those same river systems that start in Minnesota have problems in downstream locations. Nutrients added to rivers in Minnesota contribute to downstream threats and impairments. Two areas where downstream impacts are showing up are Lake Winnipeg and the Gulf of Mexico. While those downstream waters have established nutrient reduction targets, those reductions have not been allocated to an individual contributing state such as Minnesota. The Draft Minnesota Nutrient Reduction Strategy identifies what it would take to achieve a fair-share proportional reduction in Minnesota relative to reductions needed downstream. The draft Strategy goals are based on previously established planning goals for these downstream waters

Why are milestones needed?

Because the Mississippi River/Gulf of Mexico goal requires such a large nutrient load reduction (45%), we need to break up the long term reduction goals into interim targets. This draft Strategy focuses largely on how to attain the first milestone of a 35% reduction in phosphorus and 20% reduction in nitrogen (in the Mississippi River at the state border with Iowa). The milestones for the Mississippi River were developed to achieve meaningful environmental outcomes while still being achievable. The expectation should be that these milestones represent progress where final goals are not realistically achievable in the short-term planning horizon. The following considerations were used to develop the combinations of milestones and action strategies:

1. Past reductions observed from river nutrient load monitoring
2. Modeled reductions from past Best Management Practice (BMP) adoption
3. Modeling results of what could be achieved with widespread accelerated adoption of existing BMPs in the future
4. Nutrient reductions large enough to be discernible as real improvements from management changes, rather than variations in monitoring results caused by weather, the range of uncertainty from water sampling and analysis, and other influential factors out of our control
5. Meaningful progress in terms of taking a large step on the way to reaching provisional long-term goals, and additionally making a difference for people using the water

If we take actions to solely address local water quality impairments, will we be doing enough to protect downstream waters?

See Chapter 2 of the Draft Nutrient Reduction Strategy (pages 2-5 to 2-28).

Minnesota aims to be responsible for protecting and improving waters in watersheds that start in our state and influence downstream waters. The draft Strategy was developed to benefit both local and downstream water users.

A question is sometimes raised, "If we only work toward meeting our own nutrient reduction needs in the state, would we also meet our responsibilities to downstream waters?" Starting on the needs in your neighborhood and community is always a good place to begin, but for both nitrogen and phosphorus, focusing only on localized impaired waters will not be enough to drive the changes needed for downstream waters, including downstream waters within Minnesota.

If we just work toward meeting Minnesota's local lake eutrophication standards, we will mostly be influencing phosphorus loads in smaller watersheds, and downstream nutrient reduction goals will not usually be met. However, if we additionally target reductions in each watershed as needed for Lake Pepin, large reservoirs and Minnesota's proposed river eutrophication and sediment/turbidity standards, the levels of needed phosphorus reductions will be consistent with phosphorus reduction goals for the Mississippi River/Gulf of Mexico.

For nitrogen, if we just target reductions where nitrate drinking water standards for surface waters and groundwater are exceeded, we will not meet goals for downstream nitrogen reductions. But reducing nitrate for drinking water protection will result in some level of surface water nitrogen reductions.

In the future, we will also have river nitrate standards for protecting Minnesota aquatic life from toxic effects of nitrate. Meeting these new standards may also lead to significant downstream nitrogen reductions. However, we don't know the nitrate concentration for this standard yet and we cannot at this time count on this future standard for meeting our downstream needs. The draft Strategy's proposed actions to reduce our downstream load will put us in a much better position to achieve our own Minnesota nitrate standards for aquatic life protection once they are established.

Is groundwater protection included?

See Chapter 6 of the draft Nutrient Reduction Strategy (pages 6-23 to 6-24).

For additional background see Chapter 1 (pages 1-11 to 1-13) and Chapter 2 (page 2-5).

The groundwater protection goal from the 1989 Minnesota Groundwater Protection Act is included in the draft Strategy to protect groundwater as a drinking water source. Many of the BMPs to reduce nitrogen into surface waters will also result in lower nitrate levels in groundwater. Fertilizer use efficiency, cover crops, and perennials are all effective BMPs for reducing both groundwater and surface water nitrate. The strategy for groundwater protection and restoration relies largely on Minnesota Department of Agriculture's (MDA) recently revised Nitrogen Fertilizer Management Plan. One element in the MDA plan calls for a collaborative effort to develop a groundwater protection/prevention plan.

Have there been any recent nutrient reductions?

See Chapter 3 for information about monitored progress in the rivers (pages 3-8 to 3-31).

See Chapter 4 for information about estimated progress from BMP adoption (pages 4-4 to 4-18).

In general – We acknowledge recent nutrient reductions after studying information from wastewater effluent discharge reports and documented BMP adoption through government programs. For verification purposes, we compared the sum of local nutrient discharges into waters with the observed river loading based on major river monitoring.

Nitrogen – River monitoring shows very little change in total nitrogen loads since the baseline periods. Documented agricultural BMPs from the federal NRCS EQIP program are only expected to have resulted in slight nitrogen reductions. These reductions were largely considered to be offset by increased wastewater additions resulting from population increases. While we recognized that many other non-documented BMPs occurred since baseline periods, most of these changes are not well documented. Some improvements may have been offset by changes in cropping, tile drainage, and precipitation. Since we were not able to document decreased nitrogen loads from river monitoring and we have limited documentation of how BMPs changed since the baseline, we were unable to justify giving much credit for past nitrogen reductions.

Phosphorus – Monitoring in the Mississippi River south of the Twin Cities shows a marked reduction in phosphorus loads between the baseline period (1980-96) and more recent years (2009-11). While the reductions are more pronounced during low flow years, the overall average load reduction was estimated to be 31%. Based on phosphorus reductions from municipal wastewater treatment improvements, we would expect a 19% average reduction in the Mississippi phosphorus loads since 2000. BMPs adopted through agricultural programs from 2000 to 2012 were estimated to have resulted in an 8% reduction in Mississippi phosphorus loads. The monitored river load reductions of 31% compare closely with a 27% estimated reduction from changes in practices. However, this same level of load reduction is not identifiable at the Minnesota/Iowa border, where long term monitoring has not been as extensive. Additionally, Lake Pepin and Mississippi River backwaters between the Twin Cities and the Iowa border can release phosphorus for many years after upstream reductions are achieved.

What will change in the state as a result of the Strategy?

See Chapter 6 of the Draft Nutrient Reduction Strategy (pages 6-1 to 6-24).

Cropland –The strategy will result in accelerated adoption of cropland BMPs in the short-term and will drive research for improved BMPs into the future. Short-term progress will be made as private industry promotes improved fertilizer use efficiency. Where concerns about economic risk from following University of Minnesota recommendations exist, the state will work with the federal government and the crop insurance industry to explore a nutrient focused crop yield assurance program. We will also work with government programs and improving industry technologies to implement soil conservation

practices on millions of acres. Long term progress will be made through research leading to better cover crops and perennials grown for energy.

Point sources – The draft Strategy will begin the process of converting municipal wastewater treatment systems to also remove nitrogen. Municipal wastewater phosphorus discharges are progressing toward the needed reductions because of existing efforts. Existing rules and programs also are established for stormwater runoff, feedlot runoff, septic systems, and the draft Strategy is recommending continued progress from the existing programs.

The reductions to be achieved through the aforementioned actions will result in water quality improvements that represent progress toward our goals and milestones. We have already seen considerable progress in phosphorus reductions, and more improvement is anticipated. Progress with nitrogen reductions can also be achieved. We will not get all the way to reaching final goals during the first milestone period for the Mississippi River, but we will be able to use existing technologies to substantially reduce nutrient loads. Additional nutrient reductions to achieve our long-term goals will be enabled through new research and development.

Are changes in local watershed planning proposed?

See page 6-3 in Chapter 6 of the Nutrient Reduction Strategy.

For additional background, see Chapter 1 (pages 1-7 to 1-11).

The aim of the draft Strategy is to increase state level program support and create readiness at the local or HUC8 planning level. The draft Strategy is also designed to create awareness at the HUC8 watershed level of downstream needs, so that local planning efforts not only consider nutrient reductions needed for waters within the watershed but also for needs downstream of the watershed. Each watershed is being asked to, at a minimum, consider reducing nutrient exports from their watershed by a level which is proportional to downstream milestones.

How can BMP adoption be stepped up?

See Chapter 6 of the draft Nutrient Reduction Strategy (page 6-11).

Since the level of BMP adoption needed to achieve the nutrient reduction targets is much more than current efforts for some programs, those programs have been identified in the draft Strategy and are being asked to find new ways to accelerate and optimize BMP adoption and effectiveness. The draft Strategy does not propose a single approach to accelerate BMP adoption, but rather a combination of approaches, including:

- Clearer on-farm expectations through the Agricultural Water Quality Certification Program and regulatory certainty for those who become certified
- Greater assurance that BMP adoption will not cause undue economic hardship for those adopting recommended nutrient management through a nutrient-based crop yield insurance program
- BMP tracking and accountability so that proper crediting for progress can be supported
- Develop new markets and technologies for use of perennials and cover crops
- Involve agricultural producers in identifying feasible strategies
- Increase BMP promotion/education based on producer surveys – targeting especially co-op agronomists and other certified crop advisors
- Emphasize soil health in research and education
- Point source to nonpoint source trading
- Heighten awareness of the water quality needs and goals

Are new regulations proposed?

The draft Strategy identifies the following existing and developing Minnesota regulations which affect nutrient losses to waters:

- Existing water quality standards and proposed river eutrophication standards
- Feedlot manure storage and manure application to cropland regulations
- Phosphorus reduction regulations for wastewater
- Developing draft nitrate standards for aquatic toxicity which will likely affect regulations of wastewater nitrogen discharges and create total maximum daily loads (TMDLs) where waters are identified as impaired
- Lawn fertilizer phosphorus regulations
- Storm water program regulations
- Plans for MDA nitrogen fertilizer regulation development in areas with groundwater nitrate problems and lack of BMP adoption over time
- Protection of existing wetlands
- Regulations for large subsurface sewage treatment systems

The draft Strategy does not recommend new regulations at this time. The results-based focus of the draft Strategy and the adaptive management approach will influence program and policy approaches. Our ability to stay on track to achieve the desired BMP adoption and associated environmental outcomes will inform policy makers about the adequacy of current policy approaches.

Are cropping changes needed?

See pages 6-16 to 6-17 in the draft Nutrient Reduction Strategy.

The strategy acknowledges the limits of nutrient reductions under the current cropping systems. While we can make progress toward reducing nutrients with existing cropping systems through improvements in fertilizer use efficiency and greater adoption of BMPs, we also recognize that to achieve our long-term nutrient reduction goals we will need to:

1. Increase the use of perennials (in particular on marginal cropland and riparian areas).
2. Use cover crops.
3. Further adopt conservation-oriented crop rotations on working lands.

The draft Strategy makes research and BMP implementation recommendations consistent with the long term view of increasing perennials and cover crops.

How is tile drainage addressed?

Tile discharges are identified as a significant pathway for cropland nitrogen losses. Can we reach the needed nitrogen reductions with our existing system of extensive tile drainage?

See Chapter 5 of draft Nutrient Reduction Strategy (pages 5-25 to 5-32).

See also page 6-23 of the Strategy.

Tile drainage creates both challenges and opportunities for reducing nitrogen loads to waters. Tile drainage essentially eliminates nitrate losses which would otherwise occur within the groundwater system as nitrate travels in the subsurface toward surface waters. However, groundwater flow reduction processes do not eliminate all the nitrate losses, so the tile drainage systems also allow an opportunity to capture and remove nitrate by piping the water into constructed/restored wetlands or through systems of tile flow controls. To achieve the milestones, the draft Strategy calls for widespread adoption of wetland treatment - on approximately 1/5 of the lands suitable for such a practice. Additionally, the

draft Strategy also calls for adoption of controlled drainage structures on 1/5 of the tile-drained lands with slopes less than about 1%.

We can only meet milestones and long term goals under the existing tile drainage systems if we adopt a combination of practices to reduce the impact of drainage systems. We will need to install treatment wetlands and controlled drainage structures, in conjunction with managing tiled land for optimal fertilizer and manure application efficiencies. Additionally, in the long-term we will need increases in vegetative root removal of nitrate during spring and fall months on tiled lands.

Where lands are not yet tiled or are near the end of their effective life and are being updated, designs should be used that maximize nutrient treatment. In particular, the draft Strategy calls for a prevention plan to reduce the effects of nitrate entering waters where tile drainage systems are rapidly being installed, such as in the Red River Valley.

Are the proposed nitrogen fertilizer rate reductions possible?

The draft Strategy calls for improved fertilizer efficiency through greater adoption of the well-supported University of Minnesota fertilizer BMPs. Because most farmers have at least partially improved their fertilizer use practices, some ask the question, "Is there really that much room for improving fertilizer applications to be considered a primary BMP for nitrogen reductions during this first milestone period?"

See "Survey of Nitrogen Use on Corn in Minnesota"

The MDA has documented considerable progress in "nitrogen use efficiency" during the past couple decades, which generally means we are growing more corn for each pound of nitrogen fertilizer applied. One recent statewide survey of 1,500 farmers throughout Minnesota showed that farmers who don't apply manure are following the recommended nitrogen fertilizer rates on corn following corn (see report at link above). However, that same survey shows that there is still room for improvement in fertilizer use. One particular area where further reductions can be achieved is corn following soybeans or other legumes. While the survey did not cover fertilizer rates on manured fields, other studies have shown that there may still be room for improvement in taking full nutrient credits for manure applications.

How will we know if this strategy is being followed?

See Chapter 7 in the draft Nutrient Reduction Strategy (pages 7-1 to 7-19).

The draft Strategy recommends a system of accountability for reducing all major nutrient sources, helping drive adoption of existing BMPs, demonstration of newer BMPs, and development of improved BMPs. The Strategy recommends an "Accountability Team" to track progress using existing and proposed measures. Tracking progress will require new tools that will integrate multi-agency datasets and provide for a mechanism to account for BMPs and reductions that are a result of industry or non-government led activities. The Accountability Team will be able to evaluate progress and make course corrections if progress towards milestones and goals is not being achieved.

United States Department of Agriculture (USDA) and the MDA have experience with statistical surveys and census of agricultural production. These surveys could potentially be modified to include greater tracking of nutrient management. Working with private industry and non-governmental programs is a key part of the Strategy and recognizes that success will be largely dependent on their cooperation.

What role did stakeholders have in developing the draft Strategy?

The draft Strategy was developed in partnership with 10 agencies/organizations to provide a draft framework that could be evaluated and improved by stakeholder participation during the review process. Focus groups of experts from the University of Minnesota and several agencies helped to craft the draft proposals. This process was chosen so that stakeholders have something tangible to review.

The ongoing stakeholder review process involves state agency participation at multiple open houses, tradeshows, annual meetings, and conferences.

What kind of input are we seeking during the stakeholder review period?

While comments on any parts of the draft Strategy will be appreciated, we are especially seeking input on the specific strategies identified in Chapter 6 for reducing nutrients. Which are the best strategies/approaches identified in Chapter 6, and what additional options should be considered for achieving greater BMP adoption and nutrient reductions? Additionally, are we emphasizing the right mix of BMP categories as noted in Chapter 5 for achieving our milestones? Ultimately the Strategy aligns actions with goals and milestones. Do you support this combination of actions and outcomes for improved water quality?

Summary

Minnesota's proposed nutrient reduction strategy

What is the issue?

For years, Minnesotans have been working together through business, citizen and government organizations to reduce water pollution resulting from excess nutrients — primarily phosphorus and nitrogen. Pollution from these nutrients is a substantial threat to Minnesota's lakes and rivers, and aquatic life, as well as downstream waters.

Minnesota is one of 12 states along the Mississippi River developing a cleanup plan for the excess nutrients (phosphorus and nitrogen) impairing waters within the states and causing a hypoxic "dead zone" in the Gulf of Mexico where aquatic life can't live.

Ultimately, the goal set by the Environmental Protection Agency and other states is a 45% reduction in loading to the Gulf of Mexico.

Why is it important?

Minnesota is the headwater state of the Mississippi River and takes that role seriously. The rain and snow that falls on Minnesota is the starting point for major continental rivers, including the Red and Mississippi rivers and Great Lakes. However, by the time it leaves the state, it is contaminated with nitrogen and phosphorus. Just from Minnesota, more than 200 million pounds of nitrogen flows out of the state via the Mississippi River each year.

To address the nutrient issue, 10 Minnesota agencies proposed a strategy that looks at the main causes, solutions, and how best to track our progress.

This plan is simply a conversation starter. To reach the short-term and long-term goals, stakeholder input and local partnerships are critical.

Highlights of the strategy

The foundation of the strategy builds on historical and recent data, setting realistic and achievable short and long term goals, tracking progress and providing for adaptive management from future research and monitoring. The key is setting short-term goals, or milestones, to track progress to the long-term goals.

Targeting implementation activities to priority sources in high-priority watersheds is a potential cost-effective approach to achieve initial nutrient reductions.

It is important to recognize that while prioritization is an effective management tool for directing limited resources, significant reductions to meet the strategy goals cannot be achieved through implementation in a limited number of high-priority watersheds.

Progress has been made in some areas. Since 2000, there was a 27% reduction in phosphorus – 8% from agriculture and 19% from wastewater. To continue this progress, Minnesota needs to step up existing strategies such as continuing wastewater reduction strategies, preparing for future standards and increasing the adoption of agricultural best management practices.

Sources of excess nutrients

Minnesota conducted both nitrogen and phosphorus assessments to identify nutrient source contributions.

- Mississippi River
  - Phosphorus: agricultural cropland runoff, wastewater, and streambank erosion.
  - Nitrogen: agricultural tile drainage and water leaving cropland via groundwater.
- Lake Superior
  - Phosphorus: non-agricultural runoff, wastewater, and streambank erosion.
  - Nitrogen: Wastewater.
- Red River/Lake Winnipeg
  - Phosphorus: cropland runoff and non-agricultural rural runoff
  - Nitrogen: cropland to groundwater

Southern Minnesota is the highest priority for both phosphorus and nitrogen reduction. But prevention of new additions of nutrients to waters is important throughout the state.

Reduction milestones

The milestones are meant to be meaningful and achievable, will balance meaningful environmental outcomes with action strategies and take into account the changing landscape, regulatory environment and changes in best management practices.

- Phosphorus milestones
  - Mississippi River: 35% reduction by 2025
  - Red River: 10% reduction by 2025
  - Lake Superior: 3% reduction by 2025
- Nitrogen milestones
  - Mississippi River: 20% reduction by 2025
  - Red River: 13% reduction by 2025

To show progress, strategy summaries cards were developed to clearly communicate what reductions have been achieved, remaining reductions needed to achieve our progress goals and how much reduction is needed by each sector.

Nitrate and eutrophication water quality standards are important components of the Strategy. Both the existing lake and proposed river eutrophication standards include phosphorus, but they do not include nitrogen. Nitrate toxicity standards to protect aquatic life in surface waters are expected by about 2015.

Full report

To view the full report, visit http://www.pca.state.mn.us/86h6wwa

Nutrient reduction strategy webpage: www.pca.state.mn.us/zihy1146

Contact person

Minnesota's draft nutrient reduction strategy is now open for public comment until December18, 2013.

Submit comments in writing to nutrientreduction.pca@state.mn.us or via mail:

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St. Paul, MN 55155

Executive Summary

Minnesota Nutrient Reduction Strategy

The draft *Minnesota Nutrient Reduction Strategy* (Strategy) will be available for public review and comment from October 7, 2013, to December 18, 2013. The conversation which begins during this comment period will be integrated to strengthen the recommendations contained in the Strategy. Once finalized, this initial iteration of the Strategy will serve as a guide for the reduction of nutrients in waters throughout Minnesota, providing additional data and information for future improvements.

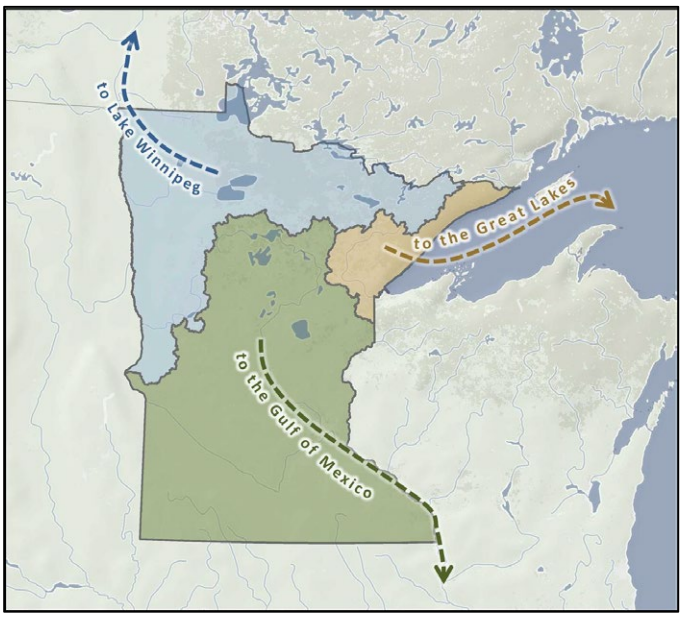


Figure 1. Major drainage basins in Minnesota.

Excessive nutrient levels pose a substantial threat to Minnesota's lakes and rivers, as well as downstream waters including the Great Lakes, Lake Winnipeg, the Mississippi River, and the Gulf of Mexico. A number of federal, regional, and state initiatives drive the need for a statewide nutrient reduction strategy in Minnesota.

At the federal level, the U.S. Environmental Protection Agency (EPA) focus on statewide nutrient reduction planning served as a key driving force for Minnesota's Strategy development. Regionally, Minnesota's involvement in the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force also served as a driving force. In recent decades, nutrient issues downstream of Minnesota have reached critical levels, including the effect of nutrients in the Gulf of Mexico which resulted in a dead zone, eutrophication issues in Lake Winnipeg, and algal blooms in the Great Lakes. Several state-level initiatives and actions highlighted the need for a statewide strategy that ties separate but related activities together to further our progress in making nutrient reductions.

The Strategy guides state-level programs to achieve nitrogen and phosphorus reductions within Minnesota water bodies to enhance the health of aquatic life, improve public health and safety, and increase the recreational potential of Minnesota's numerous lakes, rivers, and streams, as well as the

health of the groundwater supply. In addition, nutrient reductions will also benefit the Gulf of Mexico hypoxia problem and other waters downstream of Minnesota, including Lake Winnipeg and Lake Superior. The theme of the overall Strategy is *A Path to Progress in Achieving Healthy Waters*, which includes the following:

- Defining progress with clear goals
- Building on current strategies and success
- Prioritizing problems and solutions
- Leading to local implementation

Successful implementation of the Strategy will require broad agency support, coordination, and collaboration. An interagency coordination team (ICT), representing ten state agencies, helped develop the Strategy.

Goals and Milestones

The Strategy includes goals and milestones for nutrient reduction at multiple scales including basin (e.g., Mississippi River Basin at the state line) and watershed (e.g., 8-digit hydrologic unit code [HUC 8] watersheds) (Table 1). Progress towards goals and milestones can be tracked over time to determine if strategies are successful and where additional work is needed. Several existing efforts establish nutrient reduction targets for large drainages within Minnesota and provide a suitable framework for load reduction goals. In addition, the Strategy includes a groundwater/source water protection goal to address groundwater as a drinking water source.

Table 1. Basin-wide nutrient reduction goals

Basin	Phosphorus reduction goal	Nitrogen reduction goal
Lake Superior [a]	Maintain 1979 conditions	Qualitative – continued implementation of specific nutrient management programs
Lake Winnipeg [b]	10 percent reduction from 2003 conditions	13 percent reduction from 2003 conditions
Mississippi River [c]	45 percent reduction from average 1980–1996 conditions	45 percent reduction from average 1980–1996 conditions
Statewide Groundwater/ Source Water [d]	No goal identified	Qualitative – achieve and maintain drinking water standards

a. Great Lakes Water Quality Agreement of 1978, amended by a protocol signed November 18, 1987.
b. 2003 Lake Winnipeg Action Plan (Manitoba Water Stewardship Division, 2003); Provisional goal, to be revised once the Red River/Lake Winnipeg strategy is complete. Lake Winnipeg Goals are expected to change in the near future, resulting in additional load reduction needs.
c. 2008 Gulf Hypoxia Action Plan; Provisional goal; Includes drainage associated with Missouri, Des Moines, and Cedar rivers.
d. Based on 1989 Minnesota Groundwater Protection Act.

In addition to goals, milestones serve as interim measures of progress. Milestones provide a step-wise approach to meeting basin goals for nutrient reduction and can take into account the changing landscape, regulatory environment, and available best management practices (BMPs). Milestones are an important component of the Strategy due to a variety of factors:

- Adoption of future water quality standards will drive point source reductions in some watersheds; the timing of standards adoption is critical to long-term planning.
- Additional research and successful pilot demonstrations are required for several types of point and nonpoint source BMPs before widespread adoption can be expected.
- Effective nitrogen reductions at wastewater treatment facilities require several years of planning.

The milestones are phased over time, depending on parameter and basin. Table 2 presents the milestones, which are based on reducing basin outlet loads to eventually achieve the goals. Strategies and target dates will be adjusted through an adaptive management process.

Table 2. Milestones

Basin	Pollutant	Phase 1 Milestone	Phase 2 Milestone	Phase 3 Milestone
Mississippi River (Includes the Cedar, Des Moines, and Missouri Rivers)	Phosphorus	Achieve 35% reduction from baseline by 2025 [a]	Achieve 45% reduction goal	Meeting goals, no net increase
	Nitrogen	Achieve 20% reduction from baseline by 2025 [b]	Achieve 30% reduction from baseline	Achieve 45% reduction goal
Lake Winnipeg [c] (Red River Only)	Phosphorus	Achieve 10% reduction goal by 2025	Adapt goals, if necessary, based on international joint efforts with Canada	
	Nitrogen	Achieve 13% reduction goal by 2025	Adapt goals, if necessary, based on international joint efforts with Canada	
Lake Superior	Phosphorus	Achieve 3% reduction goal by 2025	Meeting goals, no net increase	
	Nitrogen	Maintain protection		
Statewide Groundwater/ Source Water	Nitrogen	Meet goals of 1989 Groundwater Protection Act		

a. It is important to note that active phosphorus reduction began with the completion of the *Detailed Assessment of Phosphorus Sources to Minnesota Watersheds* (Barr Engineering 2004) and Phosphorus Strategy adopted by MPCA's Citizens' Board in 2000.
b. While the baseline for nitrogen reduction is established as prior to 2000, no active strategy has been established since that time to coordinate actions.
c. Milestones to be revised upon completion of the Red River/Lake Winnipeg strategy.

This Strategy emphasizes the need to base HUC8 watershed nutrient goals on the downstream needs outside of the HUC8 watersheds, in addition to needs within the HUC8 watershed. HUC8 watershed milestones are derived from the basin milestone, and apply to all HUC8 watersheds within the respective basin (e.g., all HUC8 watersheds in the Mississippi River Basin should reduce nitrogen by 20 percent from baseline conditions). In the future, additional data and analysis might support local milestone goals that are specific for each watershed.

Headwaters to the Mississippi River
Photo Credit: MPCA

Water Quality Standards

Nitrate and eutrophication water quality standards for protection of Minnesota's water resources are important components of the Strategy. Both the existing lake and proposed river eutrophication standards (RES) in Minnesota include phosphorus, but they do not include nitrogen. Eutrophication standards were promulgated for lakes in 2008, and finalization of the RES should occur in 2014. Nitrate toxicity standards to protect aquatic life in surface waters of the state are expected by about 2015.

Phosphorus loading is often directly related to total suspended solids (TSS) in rivers, especially during moderate to high flow events. Minnesota has existing standards for turbidity and plans to replace the turbidity standards with TSS standards. Current turbidity total maximum daily loads (TMDLs) have a TSS surrogate to facilitate the calculation of load allocations.

An evaluation of the data indicates that meeting in-state lake and proposed RESs will likely result in meeting the basin-wide goals for phosphorus reduction. For example, Lake Pepin, a riverine lake on the Mississippi River, requires an approximate 43 percent phosphorus load reduction compared to pre-2006 conditions to meet a proposed site-specific standard for the lake. Lake Pepin's watershed includes over half of Minnesota.

Downstream reduction needs will drive nitrogen reductions (e.g., Gulf of Mexico and Lake Winnipeg). At this time, existing local surface and groundwater nitrogen standards will not drive enough change to protect out-of-state waters due to limited nitrogen impairments in the state.

Promulgation of numeric water quality standards will provide more tools to protect and restore Minnesota's waters and make progress toward meeting goals to reduce Minnesota's contribution of nutrients into downstream waters such as the Gulf of Mexico and Lake Winnipeg. Minnesota's Strategy is being developed in consideration of the state-level programs, efforts, and goals which can aid local governmental units in addressing nutrients within their HUC8 watersheds and thereby achieve these multipurpose goals.

Evaluating Recent Progress

Understanding the progress made since the baseline conditions is a key component of the Strategy. *Recent Progress* is quantified through available program data and helped to define meaningful Phase 1 Milestones.

Sixteen regional, state, or federal programs were identified as key nutrient-reducing programs in Minnesota. Each of these programs provided input on quantifying outputs or outcomes associated with program implementation. Data from the Natural Resource Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP), the Reinvest in Minnesota Program (conservation easements), and Minnesota's eLINK database, which tracks state-funded nonpoint source BMPs, were compiled from 2000 to present. Reductions in wastewater nutrients were also quantified. These programs and the BMPs chosen for quantification are indicators of program implementation and are thus applied as Recent Progress against the reductions needed to meet basin goals and milestones (Figure 2 and Figure 3).

This Strategy addresses the gap between Recent Progress and Phase 1 Milestones.

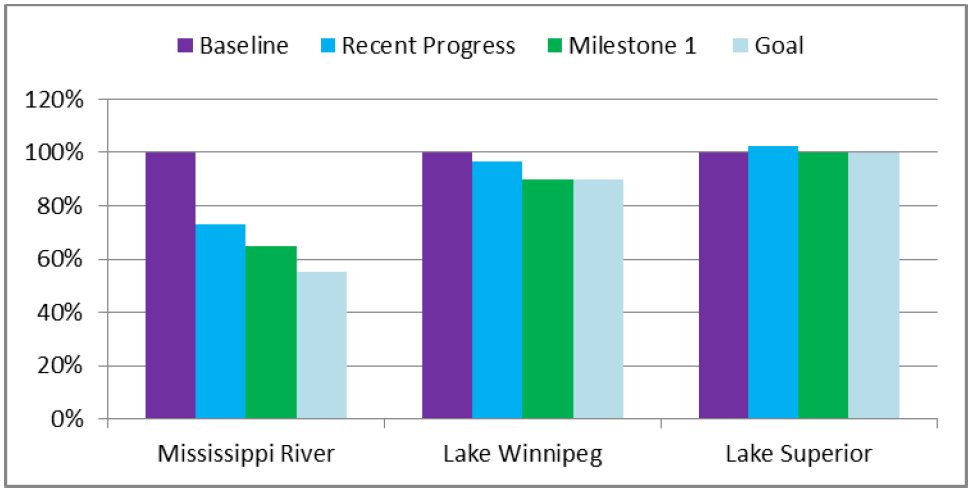


Figure 2. Summary of recent trends in phosphorus source loads by major basin.

Notes:
Recent Progress is the percent of baseline load remaining after accounting for estimated reductions since 2000.
The Lake Winnipeg Milestone 1 and Goal are expected to change in the near future, resulting in additional load reduction needs.

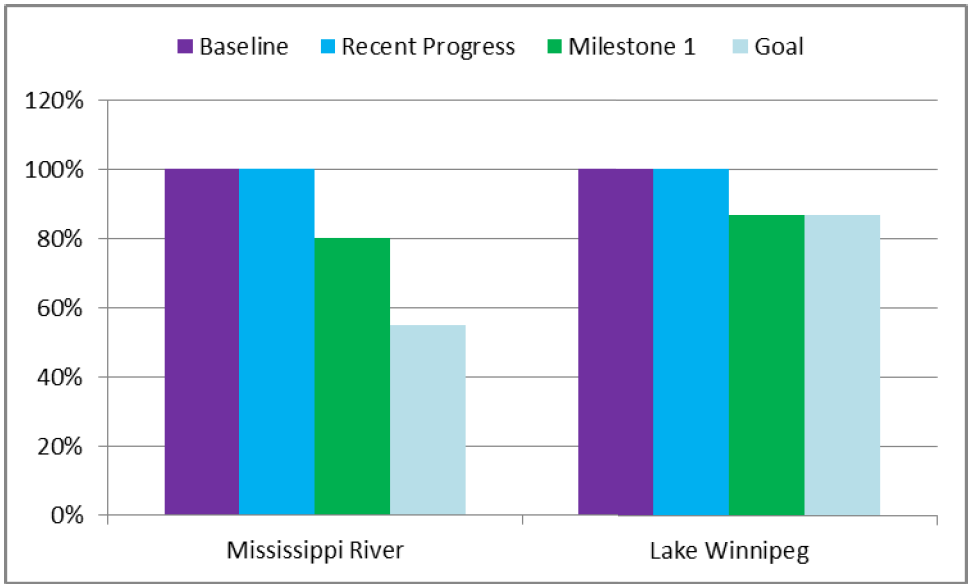


Figure 3. Summary of recent trends in nitrogen source loads by major basin.

Notes:
There is not a reduction goal for nitrogen assigned in the Lake Superior Basin.
Recent Progress is the percent of baseline load remaining after accounting for estimated reductions since 2000.
The Lake Winnipeg Milestone 1 and Goal are expected to change in the near future, resulting in additional load reduction needs.

Priority Management Areas

Priority management areas are based on priority sources and watersheds. Targeting implementation activities to priority sources in high-priority watersheds is a potential cost-effective approach to achieve initial nutrient reductions. It is important to recognize that while prioritization is an effective management tool for directing limited resources, significant reduction targets to meet the Strategy goals cannot be achieved through implementation in a limited number of high-priority watersheds.

Priority sources are based on studies that identified the sources of nutrients in Minnesota water (Barr Engineering 2004; MPCA 2013). Priority sources are determined on the basin scale, although it should be noted that different sources might be more or less important at the local scale. Priority sources could differ depending on the scale at which reductions are needed and could be adjusted through local and regional planning processes. There are also sources that cannot be reliably reduced by local or regional scale implementation activities, including atmospheric deposition and loads from forested areas. Therefore, this initial iteration of the Strategy does not consider these sources as priority sources.

Table 3. Priority sources

Basin	Priority phosphorus sources	Priority nitrogen sources
Mississippi River	Cropland runoff, permitted point sources, and streambank erosion	Agricultural tile drainage and cropland groundwater [b]
Lake Superior	Nonagricultural rural runoff [a], permitted point sources, and streambank erosion	Permitted point sources
Lake Winnipeg	Cropland runoff and nonagricultural rural runoff	Cropland groundwater

a. Includes natural land cover types (forests, grasslands, and shrublands) and developed land uses that are outside the boundaries of incorporated urban areas.
b. Refers to nitrogen leaching into groundwater from cropland land uses.

Priority watersheds represent those watersheds with the highest nutrient yields (loads normalized to area) or contain a large proportion of potentially impaired segments based on the proposed RES. Figure 4 identifies these watersheds.

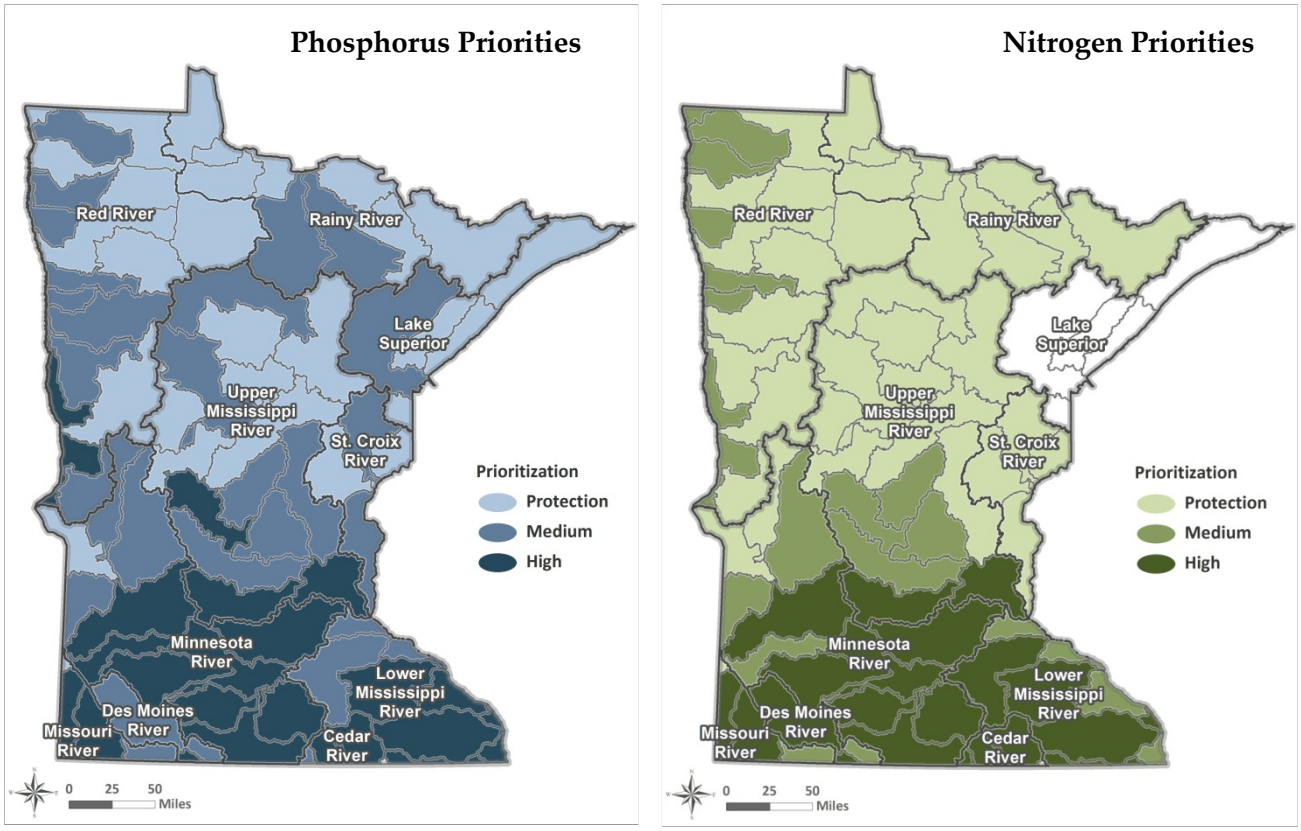


Figure 4. HUC8 watershed priorities (Lake Superior Basin not evaluated for nitrogen).

Nutrient Reduction Strategies

Development of the Strategy builds on previous implementation efforts in the state. Working toward the milestones over time requires a significant amount of coordination and communication at a statewide level. Infrastructure will be necessary to support coordination and communication among the various partners. The first set of recommended strategies focus on developing and sustaining the necessary infrastructure to support coordinated implementation and communication on progress over time. These recommendations include the following:

- Create accountability team and coordinating mechanism to integrate Strategy with other efforts.
- Develop a statewide Strategy education/outreach campaign.
- Integrate basin reduction goals with watershed planning efforts.
- Integrate Strategy tracking considerations into key program databases and tracking tools.
- Create new statewide nutrient reduction incentives for voluntary or industry-led BMP adoption.
- Develop mechanisms to improve state agency and federal agency data sharing and coordination.
- Commit to an adaptive management plan for the Strategy.

Specific strategies are necessary to increase agricultural BMP adoption, achieve wastewater reductions, address miscellaneous sources, and provide protection to areas under pressure.

Wastewater Strategies

The current Phosphorus Rule has and will continue to address phosphorus reductions in wastewater. The adoption of RES in 2014 is expected to result in additional wastewater phosphorus reductions in certain watersheds.

The history of phosphorus management at wastewater treatment facilities in Minnesota starting in 2000 is a relevant example of a successful program to reduce a pollutant of concern. Several successful techniques utilized in the Phosphorus Strategy (MPCA 2000) are proposed for nitrogen:

- Influent and effluent nitrogen monitoring at wastewater treatment facilities
- Nitrogen Management Plans for wastewater treatment facilities
- Nitrogen effluent limits
- Add nitrogen removal capacity with facility upgrade
- Point source to nonpoint source trading

A 20 percent reduction in wastewater nitrogen loads is anticipated to reach the Phase 1 Milestones for the Mississippi River.

Agricultural BMP Adoption Strategies

To reach the Phase 1 Milestones in 2025, and eventually reach basin-wide goals, additional BMPs, wastewater treatment, and other nutrient-reducing activities will be necessary. The Strategy includes select BMPs and treatment options to guide implementation; however, any combination of BMPs and treatment options which achieve the load reduction goals can be used. As new research is conducted, additional BMPs and treatment options are expected to become part of the Strategy.

Potential agricultural BMPs for this Strategy were identified from the Nitrogen Study (MPCA 2013), the Iowa Strategy (Iowa State University 2013), the AgBMP Handbook (Miller et al. 2012), literature on the Minnesota Phosphorus Index (Moncrief et al. 2006), and the Lake Pepin implementation planning work (Tetra Tech 2009). The Watershed Nitrogen Reduction Planning Tool (Lazarus et al. 2013) was also used to derive various BMP inputs. BMPs were evaluated to determine which would be most likely to help achieve the Strategy nutrient reduction goals. BMPs are grouped into the following four categories:

1. Increase fertilizer use efficiencies (nutrient management practices)

2. Increase and target living cover
3. Field erosion control (for phosphorus reduction)
4. Drainage water retention for water quality treatment (for nitrogen reduction) and for control of erosive flows (to help address phosphorus loads from near channel erosion, ravines, and streambanks)

Suitable acres for each BMP type are determined on a HUC8 watershed scale, and existing BMP implementation is taken into account as part of this analysis. A spreadsheet analysis was conducted to evaluate various BMP scenarios.

Example BMP scenarios to achieve the phosphorus Phase 1 Milestones were developed, paying attention to both effectiveness and cost of BMPs. In general, the conceptual strategy for phosphorus has the following priority order:

1. Optimize fertilizer and manure rates based on soil test-phosphorus (estimated to provide a net savings to producers).
2. Increase use of conservation tillage with 30 percent residue where not already applied (estimated to provide a net savings to producers).
3. Use precision application techniques such as subsurface banding (net cost uncertain).
4. Add living cover BMPs such as riparian buffers, grass waterways, and cover crops that currently have a net cost to producers.

Residue Management Using Strip Till
Photo Credit: NRCS

Table 4. Example BMP scenario for achieving the phosphorus Phase 1 Milestones through cropland BMPs

BMP category	Example BMP	*Mississippi River*		*Lake Winnipeg (Red River Only)*	
		Future adoption rate	Total new acres (million acres)	Future adoption rate	Total new acres (million acres)
Increasing Fertilizer Use Efficiencies	Achieve target soil test phosphorus and use subsurface banding	90%	1.9	0%	0
Increase and Target Living Cover	Riparian buffers	25%	0.3	60%	0.3
	Cover crops	10%	0.3	20%	0.2
	Conservation reserve	3%	0.2	0.6%	0
Field Erosion Control	Conservation tillage	85% of available area; 90.7% net	7.2	53% of available area, 63.5% net	1.4

Notes:

Adoption rates are expressed as a percentage of the total area on which a practice is applicable, with the exception of conservation tillage, which is expressed as a fraction of the area not currently in conservation tillage. A cumulative adoption rate for conservation tillage is also shown.

Acreage from program quantification for 2000–2013 is excluded from total future acres where applicable. Adoption rate percentages are relative to suitable areas and represent the percentage of land in total that would require the BMP. The SPARROW model is assumed to reflect 2000 agricultural conditions.

For the Lake Superior Basin, the goal is a 3 percent decrease in phosphorus loads. Agriculture is estimated to contribute only 6 percent of the total phosphorus load in this basin, and many agricultural BMPs for phosphorus are not particularly useful because of low soil phosphorus concentrations. The needed reduction in the Lake Superior Basin is expected to come from a combination of point source reductions and miscellaneous nonpoint runoff reductions.

Example BMP scenarios to achieve the nitrogen Phase 1 Milestones were also developed. In general, the conceptual strategy for nitrogen includes increasing fertilizer use efficiency through nutrient management, treating tile drainage, and implementing living cover BMPs, which are consistent with the phosphorus evaluation. Table 5 summarizes the results of this analysis.

Table 5. Example BMP scenario for achieving nitrogen Phase 1 Milestone through cropland BMPs

BMP category	Example BMP	Mississippi River		Lake Winnipeg (Red River Only)	
		Future adoption rate	New total acres (million acres)	Future adoption rate	New total acres (million acres)
Increasing Fertilizer Use Efficiencies	Use recommended fertilizer application rates	80%	13.2	95%	6.0
Increase and Target Living Cover	Cover crops	10%	0.3	20%	0.2
	Riparian buffers	25%	0.3	60%	0.3
	Conservation reserve	3%	0.2	0.10%	0
Drainage Water Retention and Treatment	Wetlands and controlled drainage	18%	1.1	25%	0.001

Notes:
Adoption rates are expressed as a percentage of the total area on which a practice is applicable.
Acreage from program quantification for 2000–2013 is excluded from future acres where applicable. Adoption rate percentages are relative to the area for which a given practice is suitable and represent the percentage of land in total that would require the BMP. The SPARROW model is assumed to reflect 2000 agricultural conditions.

Increased adoption of agricultural BMPs is critical to implementing the Strategy and achieving goals and milestones. Recommended strategies to achieve the Phase 1 Milestones include the following:

- Optimization Strategies
  - Develop state and federal program Step Up Plans for select programs.
  - Increase delivery and track implementation of industry-led BMPs.
- Economic Strategies
  - Evaluate potential nutrient-based crop yield insurance program.
  - Develop markets and technologies for use of perennials.
  - Quantify cost-effectiveness of reducing nutrient levels in water.
  - Enhance partnerships with federal partners.
- Education and Involvement Strategies
  - Implement targeted outreach and education campaign.
  - Encourage participation in the Agricultural Water Quality Certification Program.
  - Focus education and technical assistance to co-op agronomists and certified crop advisors
  - Involve agricultural producers in identifying feasible strategies.

  - Share nutrient reduction success stories and make awards to watershed heroes.
  - Work with soil and water conservation districts, University of Minnesota Extension, and community engagement initiatives to improve education and involvement.
  - On-farm trials and demonstration projects.
  - Focus demonstration initiatives on soil health, including cover crops.
- Research
  - Improve success rate for cover crop establishment and continue to develop the best and most profitable cover crops.
  - Research on forages for livestock.
  - Increase knowledge base regarding fertilizer use efficiency.
  - Continue to research innovative approaches for removing nutrients from tile drainage waters, including use of saturated buffers, two-stage ditches, etc.
  - Develop approaches that will reduce soluble phosphorus, as well as BMPs which can address both phosphorus and nitrogen.
  - Research use of remote sensing for nitrogen and phosphorus losses to the environment to help develop nutrient-efficient cropping systems.
  - Further development of the Watershed Nitrogen Reduction Planning Tool, including adding a phosphorus component.

Lake Superior
Photo Credit: MPCA

Miscellaneous Source Strategies

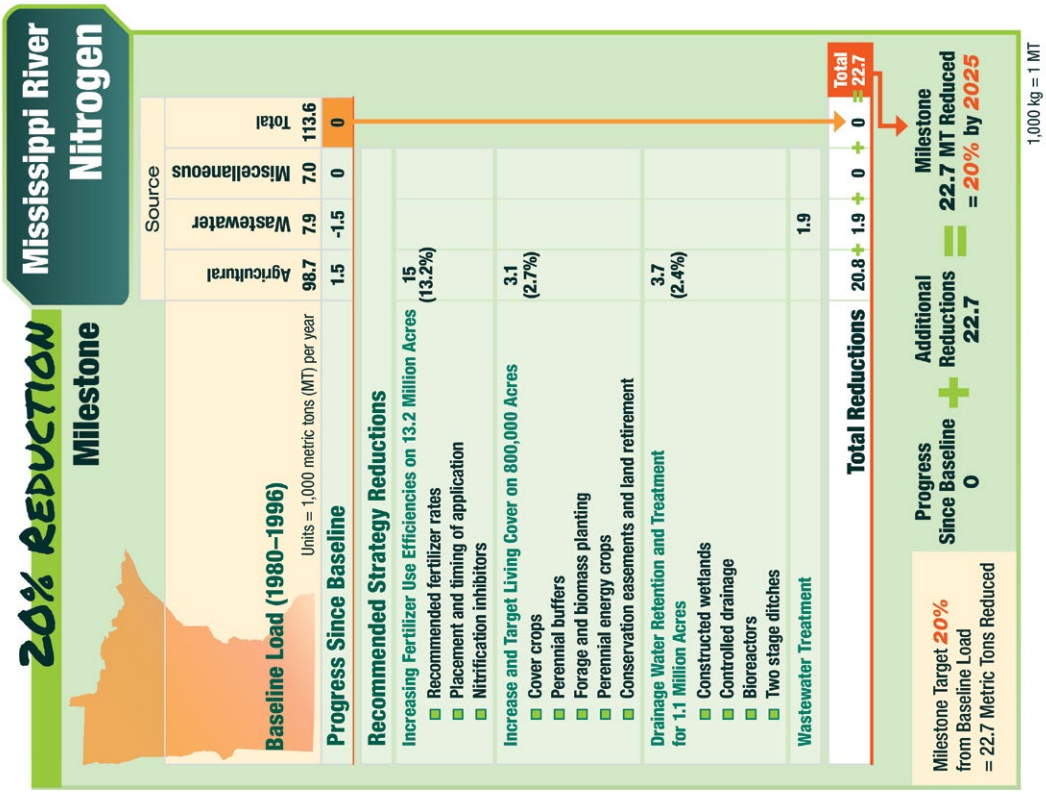
New strategies are not suggested at this time to reduce loads from miscellaneous sources; however, existing programs have strategies in place that allow for systematic reductions in loads from sewage treatment systems, stormwater, and feedlots. A statewide strategy is also under development to address sediment reduction. The statewide strategy will help address sediment-related nutrient load reductions. In addition, implementation of TMDLs, particularly for turbidity-impaired streams, will likely address sediment-bound phosphorus sources that are a result of bank and channel erosion.

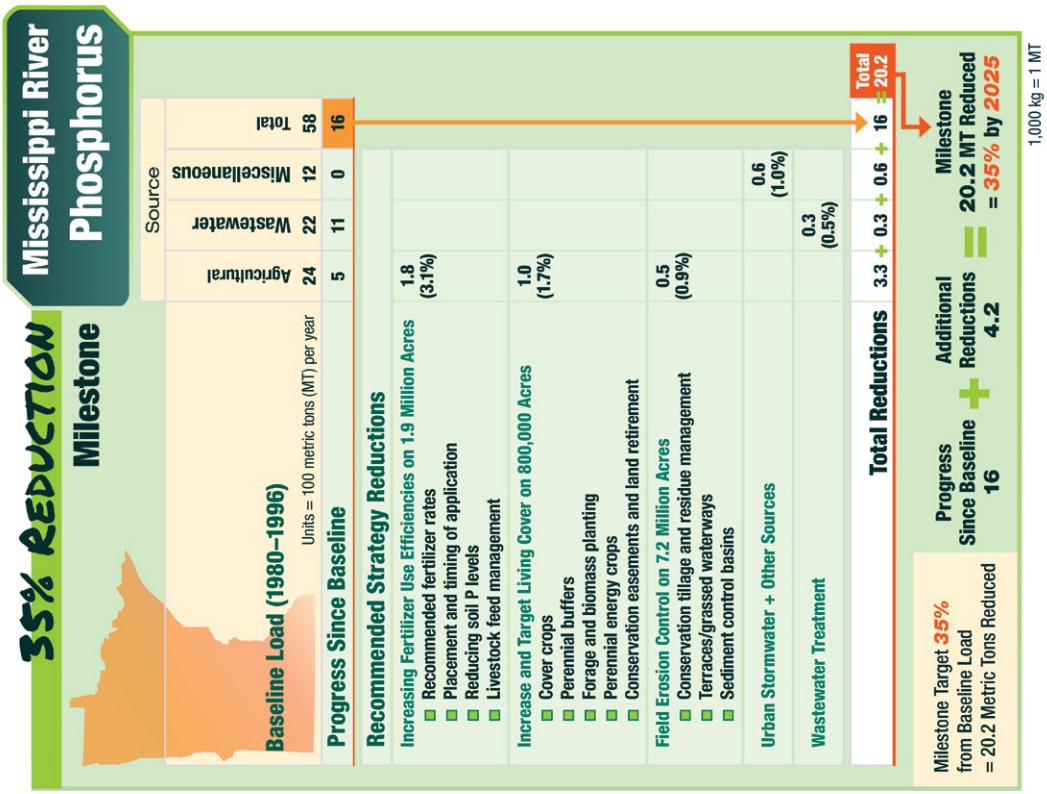
Protection Strategies

Protection strategies are needed in watersheds facing development pressures and changes in agricultural and land use practices, as well as vulnerable groundwater drinking water supplies. The Watershed Approach, as described in Chapter 1, requires protection strategies as part of watershed restoration and protection strategy (WRAPS) development, and therefore should address the potential for increased nutrient loads at a watershed scale. Ensuring that nitrogen and phosphorus reductions are addressed as part of WRAPS development is important. In addition, protection strategies are necessary to address increases in Red River watershed tile drainage and nitrogen loads to Lake Superior.

Strategy Summary

The following figures for the Mississippi River summarize the overall strategies to achieve nutrient reduction milestones. Chapter 5 includes strategy summary figures for all basins. Each of the figures includes suggested reductions by source for each of the BMP categories, as described previously.


20% Reduction Milestone
Mississippi River Nitrogen
Source
Agricultural
Wastewater
Miscellaneous
Total
Baseline Load (1980–1996)
Units = 1,000 metric tons (MT) per year
98.7 7.9 7.0 113.6
Progress Since Baseline
1.5 -1.5 0 0
Recommended Strategy Reductions
Increasing Fertilizer Use Efficiencies on 13.2 Million Acres
15 (13.2%)
Recommended fertilizer rates
Placement and timing of application
Nitrification inhibitors
Increase and Target Living Cover on 800,000 Acres
3.1 (2.7%)
Cover crops
Perennial buffers
Forage and biomass planting
Perennial energy crops
Conservation easements and land retirement
Drainage Water Retention and Treatment for 1.1 Million Acres
3.7 (2.4%)
Constructed wetlands
Controlled drainage
Bioreactors
Two stage ditches
Wastewater Treatment
1.9
Total Reductions
20.8 + 1.9 + 0 + 0 = Total 22.7
Milestone Target 20% from Baseline Load = 22.7 Metric Tons Reduced
Progress Since Baseline 0
+
Additional Reductions 22.7
=
Milestone 22.7 MT Reduced = 20% by 2025
1,000 kg = 1 MT


35% Reduction Milestone
Mississippi River Phosphorus
Source
Agricultural
Wastewater
Miscellaneous
Total
Baseline Load (1980–1996)
Units = 100 metric tons (MT) per year
24 22 12 58
Progress Since Baseline
5 11 0 16
Recommended Strategy Reductions
Increasing Fertilizer Use Efficiencies on 1.9 Million Acres
1.8 (3.1%)
Recommended fertilizer rates
Placement and timing of application
Reducing soil P levels
Livestock feed management
Increase and Target Living Cover on 800,000 Acres
1.0 (1.7%)
Cover crops
Perennial buffers
Forage and biomass planting
Perennial energy crops
Conservation easements and land retirement
Field Erosion Control on 7.2 Million Acres
0.5 (0.9%)
Conservation tillage and residue management
Terraces/grassed waterways
Sediment control basins
Urban Stormwater + Other Sources
0.6 (1.0%)
Wastewater Treatment
0.3 (0.5%)
Total Reductions
3.3 + 0.3 + 0.6 + 16 = Total 20.2
Milestone Target 35% from Baseline Load = 20.2 Metric Tons Reduced
Progress Since Baseline 16
+
Additional Reductions 4.2
=
Milestone 20.2 MT Reduced = 35% by 2025
1,000 kg = 1 MT

Adaptive Management and Tracking Progress

Establishing a coordinated strategy that provides an efficient and effective pathway to achieving statewide goals is the first step in an iterative process of planning, implementing, assessing, and adjusting. This iterative process is often referred to as *adaptive management*. The Strategy sets out goals and milestones for nutrient load reductions, as well as recommended approaches for achieving the milestones (Figure 5). To ensure that on-the-ground implementation is on pace with the Strategy milestones and goals, it is imperative to have an adaptive management plan that will guide an evaluation of the Strategy's progress over time. The basic components of the Strategy's adaptive management plan are as follows:

- Identify data needed to track progress toward Strategy goals and milestones.
- Create a system or approach for collecting data and information needed to track progress toward Strategy goals and milestones.
- Evaluate trends.
- Adjust the Strategy as necessary.

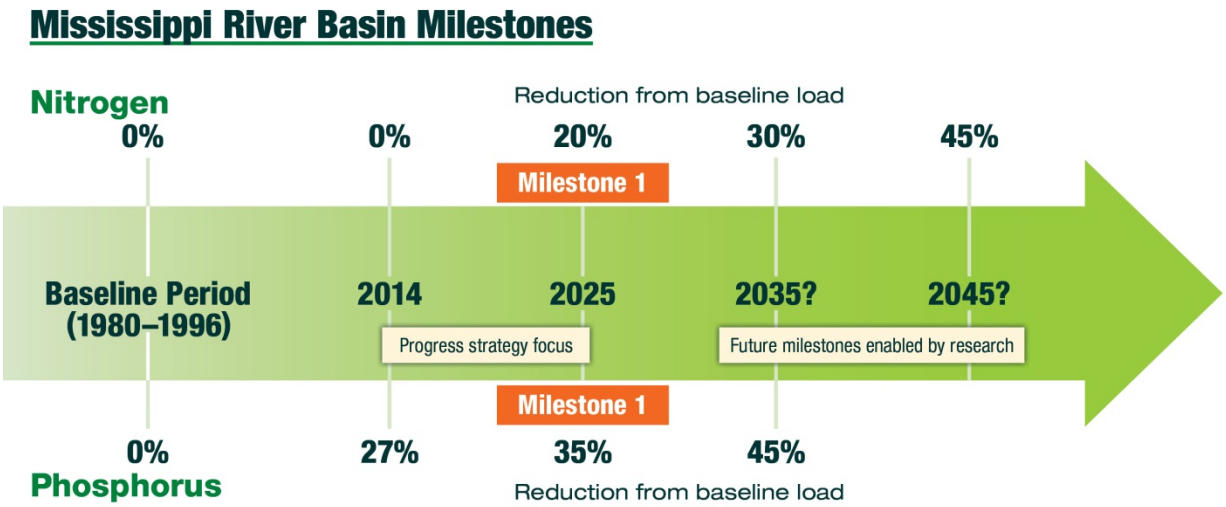


Figure 5. Example adaptive management schedule for the Mississippi River basin.

Implementation tracking will be done through both program implementation and in-stream data. Program implementation data provides early indicator information about nitrogen and phosphorus reductions that, over time, should translate to in-stream nutrient reductions.

Several key programs in Minnesota implement a variety of structural and nonstructural BMPs. Quantifying nutrient reductions for BMPs associated with each program would not be a sustainable and replicable approach to show progress toward Strategy goals over time. A streamlined approach quantifies implementation progress over time, which involves the development and tracking of program measures. The Strategy contains a suite of program measures:

- Implementation of nonpoint source BMPs tracked via eLINK and estimated nutrient load reductions
- Implementation of permanent easements and associated nutrient load reductions
- Implementation of nitrogen fertilizer management BMPs
- Implementation of priority Conservation Reserve Program (CRP) conservation practices and estimated nutrient load reductions
- Implementation of priority EQIP management practices and estimated nutrient load reductions
- Implementation of conservation tillage funded through Agricultural BMP (AgBMP) Loans
- Municipal wastewater phosphorus trends (excerpted from the Clean Water Fund performance measures)

It is important to note that the selected program measures reflect government programs and do not capture industry-led conservation activities. As a result, while the selected program measures are strong indicators of program implementation trends, they are conservative indicators of statewide BMP adoption.

Future water quality evaluations will rely upon the Watershed Pollutant Load Monitoring Network (WPLMN) and efforts to complete statewide water quality modeling. There are many other local, regional, statewide, and national level monitoring programs that will inform water quality evaluations, including those that the new Mississippi River Monitoring Collaborative is conducting. The Mississippi River Monitoring Collaborative is made up of federal and state agencies along the Mississippi River between the Gulf of Mexico and Minnesota.

Although the annual program measures will provide an indication of implementation progress, the water quality outcome measures will provide a more significant yardstick for measuring progress toward Strategy interim milestones over time. Water quality outcome measures include the following:

- Trend in actual load
- Trend in flow weighted mean concentration
- Progress toward meeting eutrophication standards
- Statistical comparisons of baseline loads/concentrations at low, medium, and high flow periods with comparable flow periods during recent years

- Progress toward reducing groundwater nitrate in high-nitrate areas, including those watersheds where nitrate coming from groundwater currently impairs surface waters

The Strategy centers on a series of goals and milestones and targeted actions identified to achieve those goals and milestones over time, with periodic reevaluation and reassessment through adaptive management (Figure 5). Milestone tracking and reporting will occur at 2-year, 5-year, and 10-year intervals. There is currently no integrated tool that will allow for automated tracking of Strategy output and outcome information to assess progress over time. The approach for tracking progress requires the development of a tool to ensure the efficiency and reliability of progress tracking. Developing a tool of this nature will be a multi-agency undertaking that must take into consideration the existing data management approaches used by numerous programs within several agencies.