Minnesota Nutrient Reduction Strategy

DRAFT Update July 2025

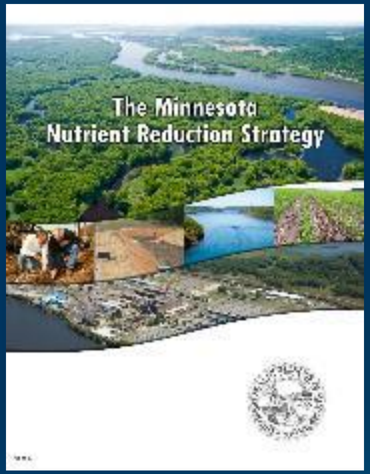
Crop Production Retailers

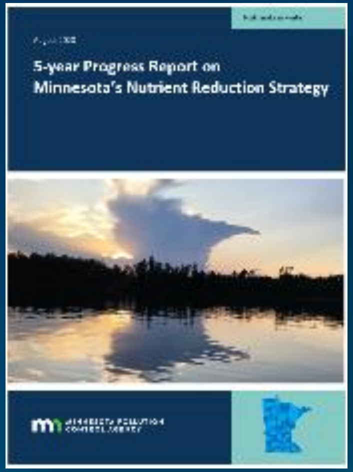
Emphasis on cropland strategies, fertilizer efficiencies, & row crop production elements of the NRS

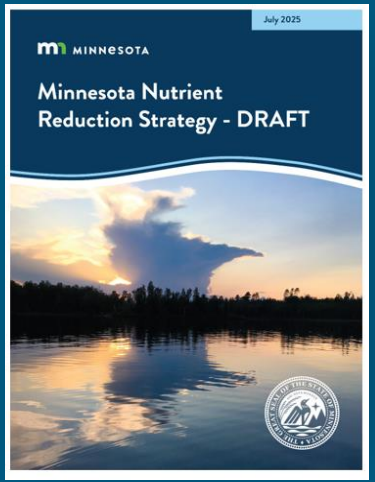
MINNESOTA

August 13, 2025 meeting in Prior Lake

10-year update to Minnesota Nutrient Reduction Strategy







2014
Original strategy

2020
Progress report

2025
Updated & revised strategy

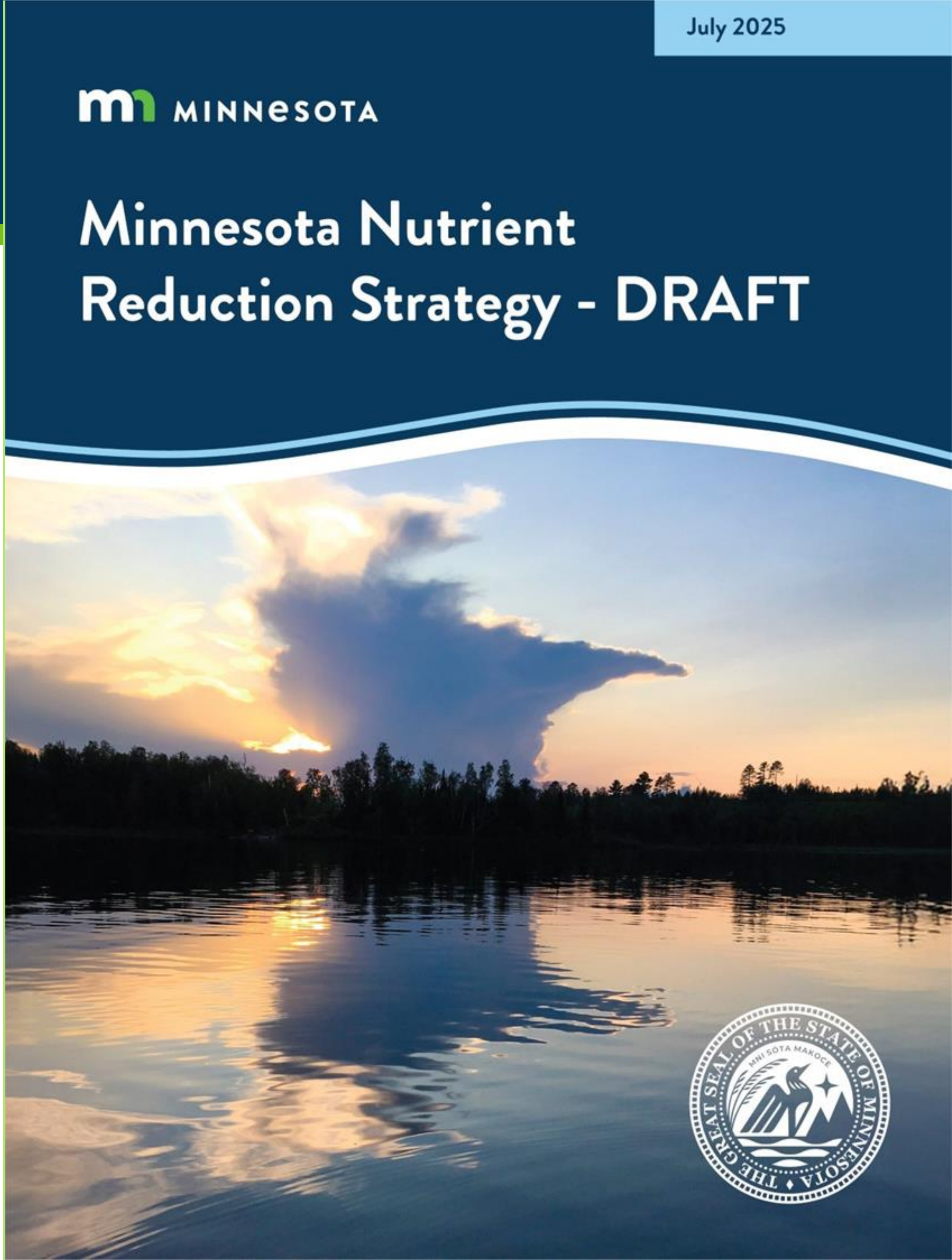
2040
Goals achieved

Recording of July 15
NRS review DRAFT Overview

YouTube

Videos

July 15 Overview draft 2025
Minnesota Nutrient...



Topics today

1. Intro to NRS & its update
2. Reasons for celebration
3. Remaining nutrient reduction needs
4. NRS Chapter 5 – Rural Nutrients
5. What it will take to meet final goals

Your questions

How to review & comment on DRAFT

Today – Where's the problem of excess nutrients?

Minnesota waters

Protect water from excess nitrogen and phosphorus

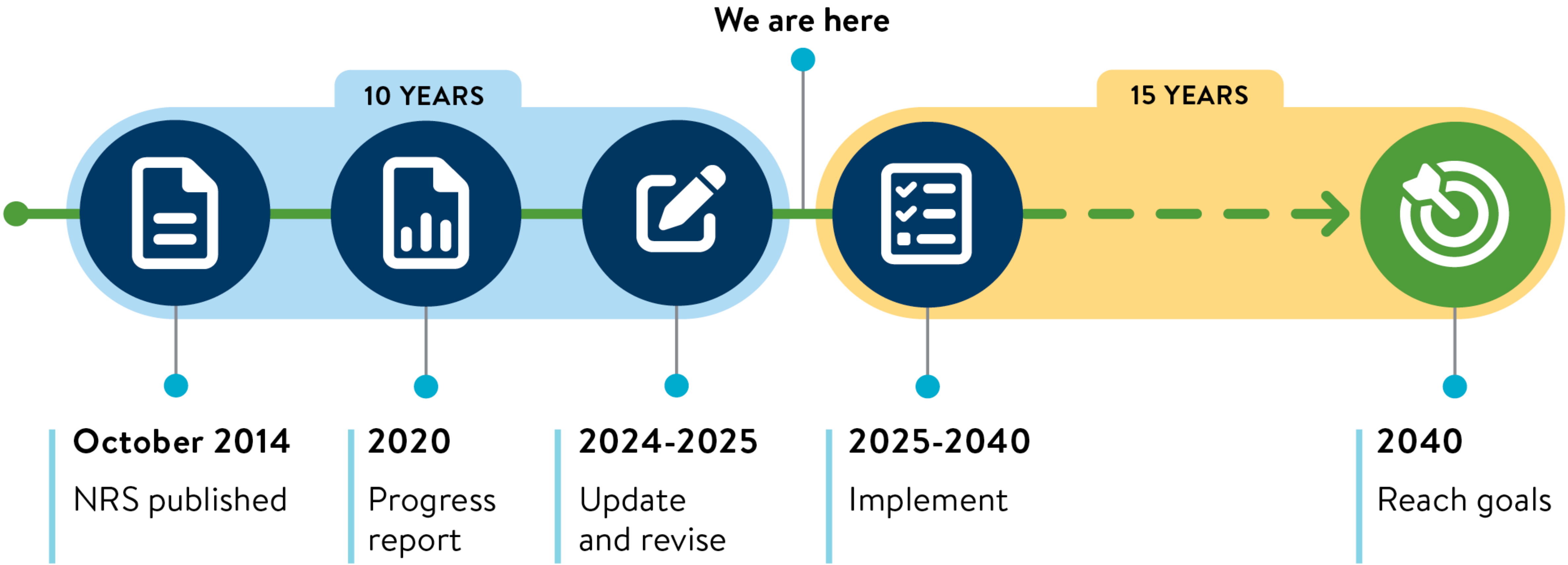
Downstream - south

Reduce the hypoxia/dead zone at the gulf

Downstream - north

Reduce the algae blooms in Lake Winnipeg

10-years into a 26+ NRS timeframe



Building blocks of 2025 Minnesota NRS

Six working groups

River loads, goals & priorities	Urban nutrients	Agricultural BMP science (U of MN)	Agricultural BMP adoption (MDA)	Watershed support/tools	Progress tracking
River loads & trends analysis	Wastewater data analysis	BMP efficiency science	Approaches to scale-up BMPs	Mining WRAPS & 1W1Ps	Water changes dashboard
Priority areas for in-state needs	Wastewater technologies	BMP combination scenarios	BMP socio-economics	Watershed tools survey	BMP adoption tracking
Nutrient sources verification	Stormwater science/data	Research needs identification	Maximum practical BMP increases	Local staff needs assessment	Priority metrics and measures
Goals update	Wastewater N strategies	Nutrient balance on land analysis	Existing programs analysis	Watershed load reduction needs	Permit program dashboard

Contributors

Chad Anderson
Anna Baker
Jack Barland
John Bilotta
Anna Bosch
Emily Brault
Bill Carlson
Brad Carlson
Kristin Carlson
Courtney Cheever
Wendy Chirpich
Laura Christianson
Reid Christianson
Jim Collins
Madeline Conowal
Gregory Curryl
Matt Diebel
Matt Drewitz
Mike Findorff
Carrie Freeman
Jinny Fricke
Ryan Galbreath
Cameron Gaspord
Therese Gilchrist
Tom Gile
Marco Graziani
Justin Hanson
Scott Hanson
Daniel Henely
Tom Hogan
James Jahnz
John Jaschke
Kathi Jo Jankowski
Heather Johnson
Paula Kalinosky
Maddie Keefer
Michael Kelly
Seth Kenner
Jennifer Keville
Jeppe Kjaersgaard
Karl Koller
Kevin Kratt
Tom Kresko
Sharon Kroening
Kevin Kuehner
Tim LaPara
Joel Larson
Corrie Layfield
Bill Lazarus
Chris Lenhart
Marcelle Lewandowski
Melissa Lewis
Jon Lore
Dorothea Lundberg
Chris Lundeen
Joe Magner
Rajinder Mann
Owen McKenna
Tanja Michels
David Miller
Megan Moore
David Mulla
Catherine Neuschler
Danielle Nielson
Braden Orr
Kristen Parry
Sam Paske
Lindsay Pease
Barbara Peichel
Katherine Pekarek-Scott
Jeffrey Peterson
Jeffrey Peterson
Kathryn Phillips
Sarah Porter
Nick Proulx
Carrie Raber
Lisa Reynolds Fogarty
Dale Robertson
Steve Robertson
Carl Rosen
Nikol Ross
Sarah Roth
Derek Schlae
Mike Schmitt
Udai Singh
Glenn Skuta
Brandon Smith
Katie Smith
Michael Soe
Emerson Souza
George Sprouse
Joshua Stamper
Jeff Strock
Kevin Stroom
Judy Sventek
Sara Thurin Rollin
Dana Vanderbosch
Jon Vanyo
Margaret Wagner
David Wall
Hong Wang
Justin Watkins
Jeff Weiss
Steve Weiss
Julie Westerlund
Marcey Westrick
Brad Wozney
MPCA Grants and Contracts Team

Metropolitan Council
University of Minnesota — Driven to Discover®
USGS — science for a changing world
NRCS — Natural Resources Conservation Service

MINNESOTA
POLLUTION CONTROL AGENCY
DEPARTMENT OF AGRICULTURE
DEPARTMENT OF HEALTH
DEPARTMENT OF NATURAL RESOURCES
BOARD OF WATER AND SOIL RESOURCES
ENVIRONMENTAL QUALITY BOARD

2025 NRS Chapter topics

Chapter 1 – NRS first decade

Chapter 2 – Downstream loads

Chapter 3 – In-state lakes, streams & groundwater

Chapter 4 – Urban land and water

Chapter 5 – Rural land and water

Chapter 6 – Watershed work

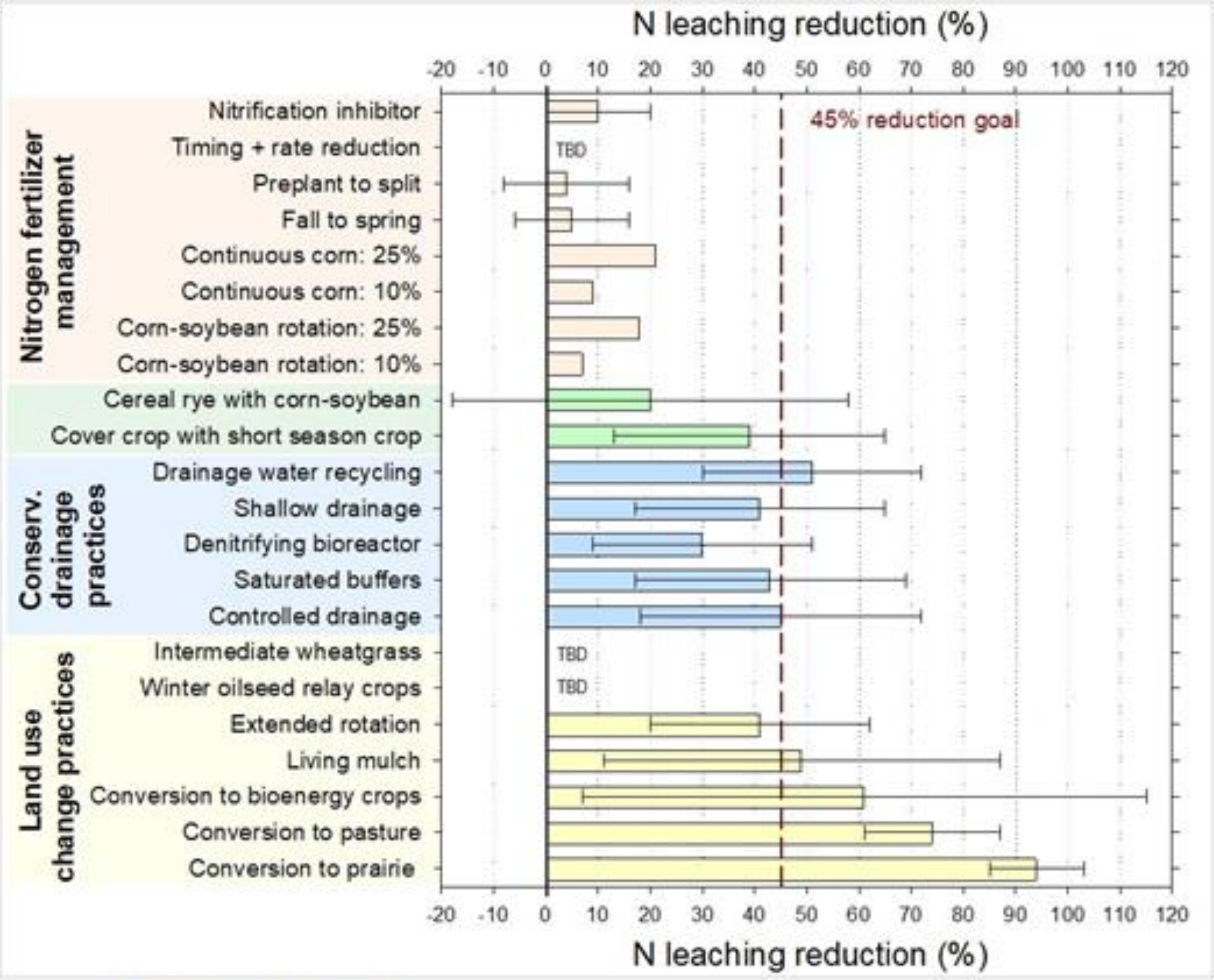
Chapter 7 – Tracking and showing progress

Chapter 8 – NRS roadmap

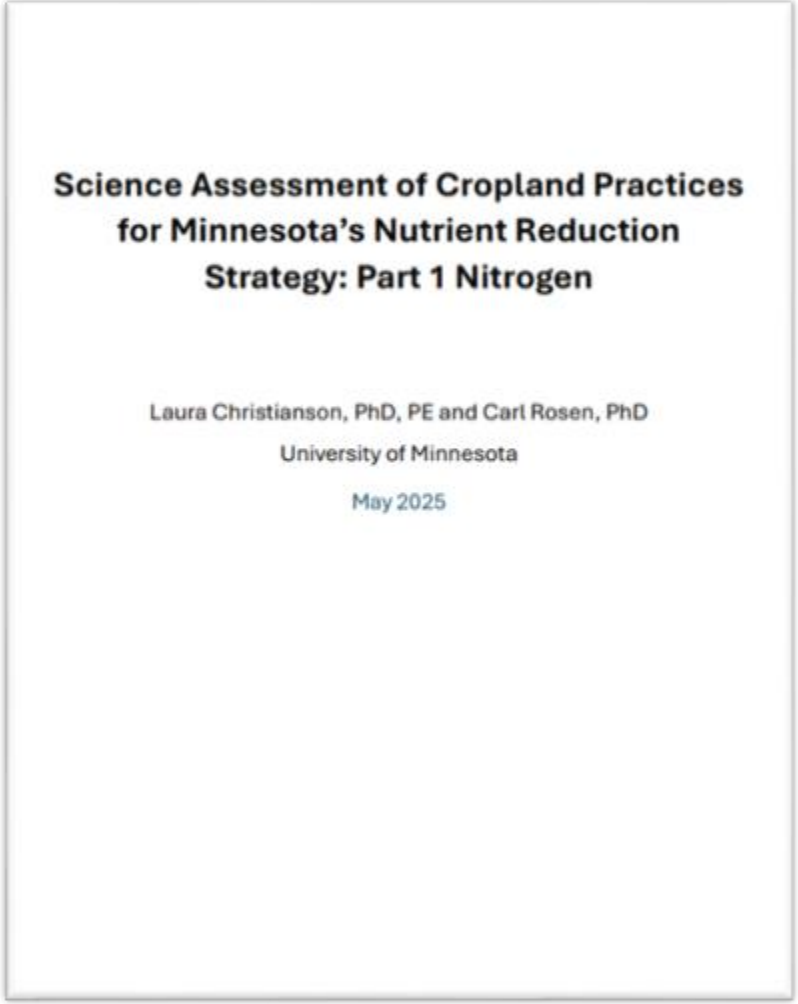
20 Support Documents

- Cropland nutrient practice efficiencies (2 by UMN)
- Wastewater nitrogen (4 by Tetra Tech)
- Nutrient balance on cropland (1 by ARS)
- River nutrient loads, trends, sources (2 by Tetra Tech, 1 by Met Council)
- Streambank and channel erosion (1 by DNR)
- Conservation practice programs (2 by MDA)
- Watershed load reduction targets (2 by MPCA, Limno Tech, Tetra Tech)
- Supporting watersheds with tools and resources (2 BWSR)

Updated science supports more accurate predictions



Source: Christianson and Rosen 2025.



Science Assessment of Cropland Practices for Minnesota's Nutrient Reduction Strategy: Part 1 Nitrogen

Laura Christianson, PhD, PE and Carl Rosen, PhD

University of Minnesota

May 2025

Chapter 5, Support Document 5-1

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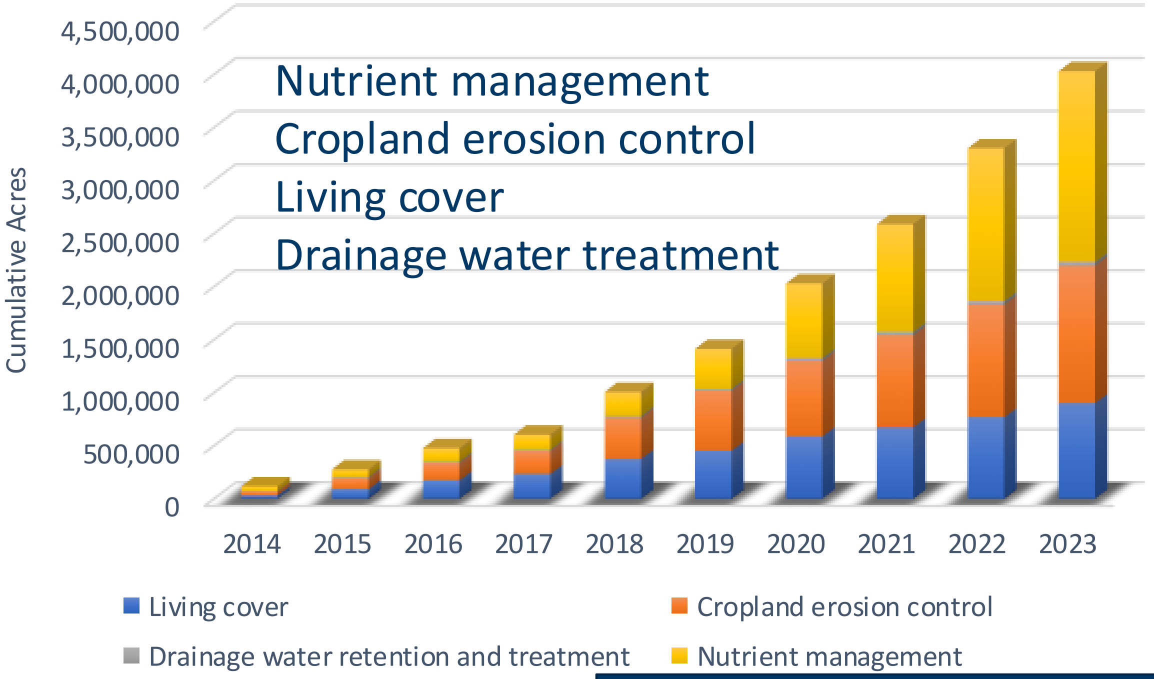
Your questions

How to review & comment on DRAFT

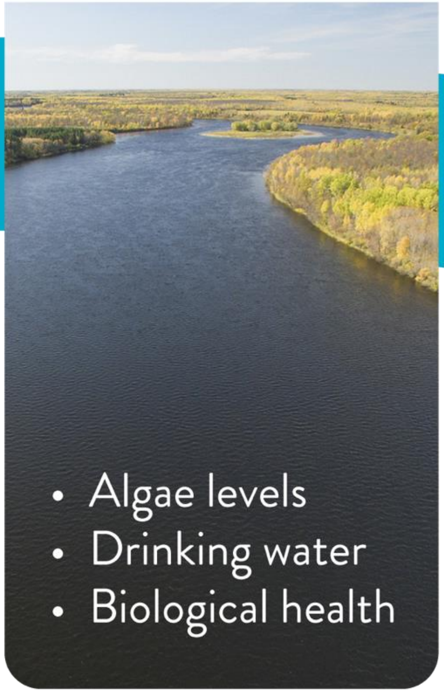
Success with rural and urban practice adoption

- Wastewater phosphorus reduced 76%
- Cropland practices added to over 4 million acres from government programs since 2014

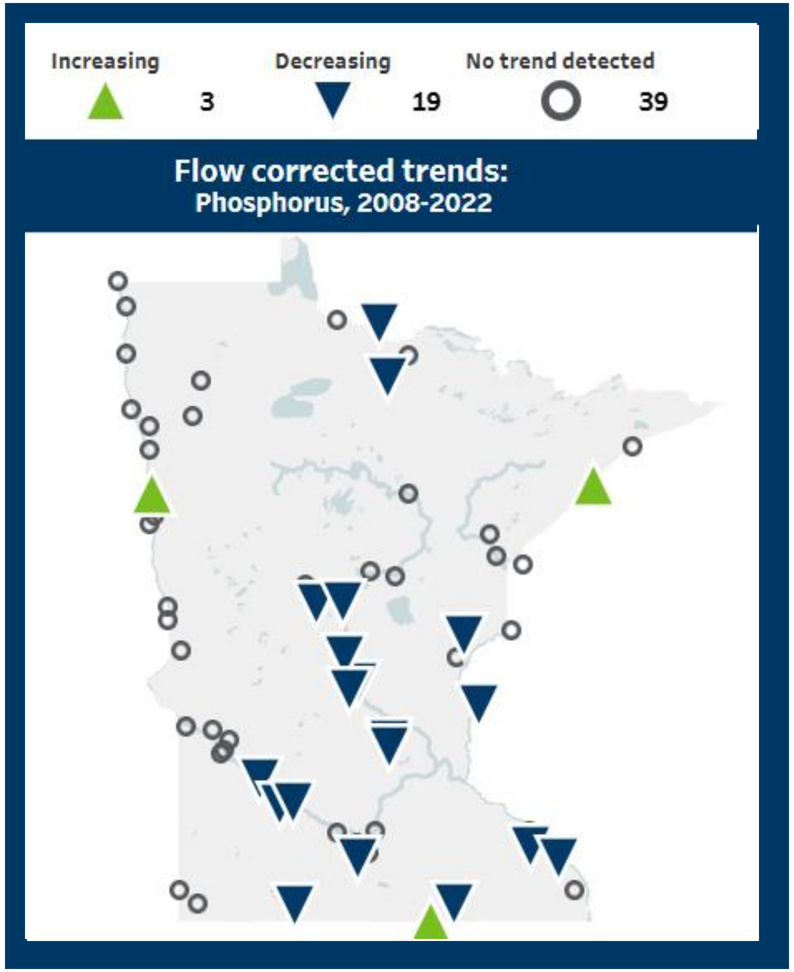


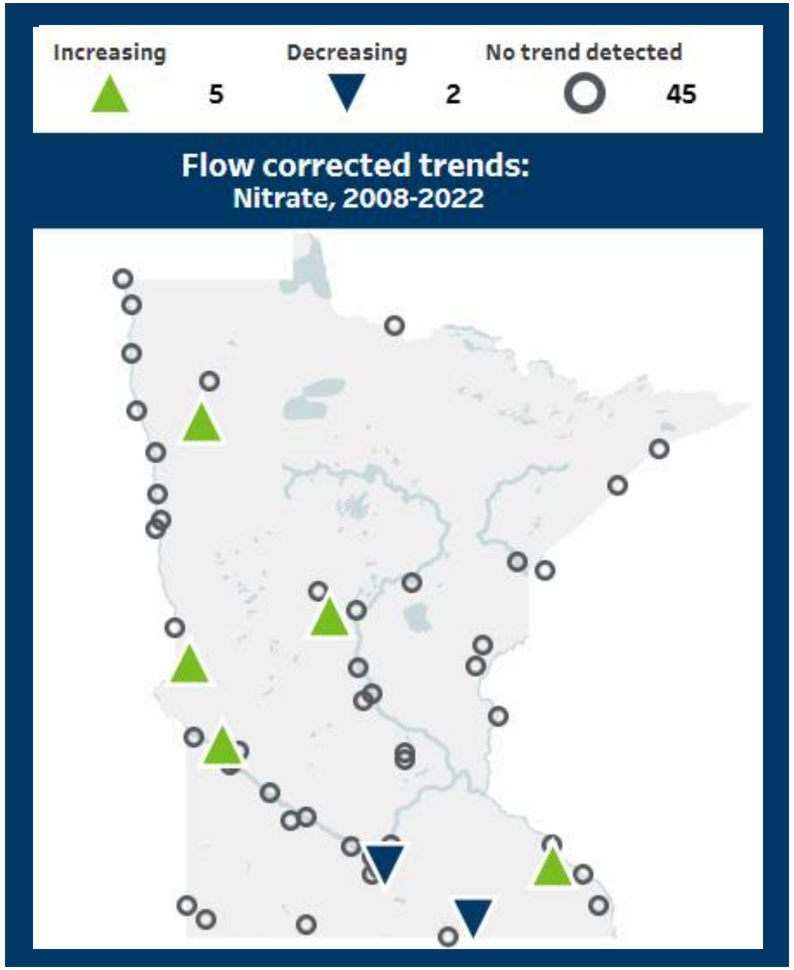
Successes – nutrients reduced in local in-state waters

Improve local waters

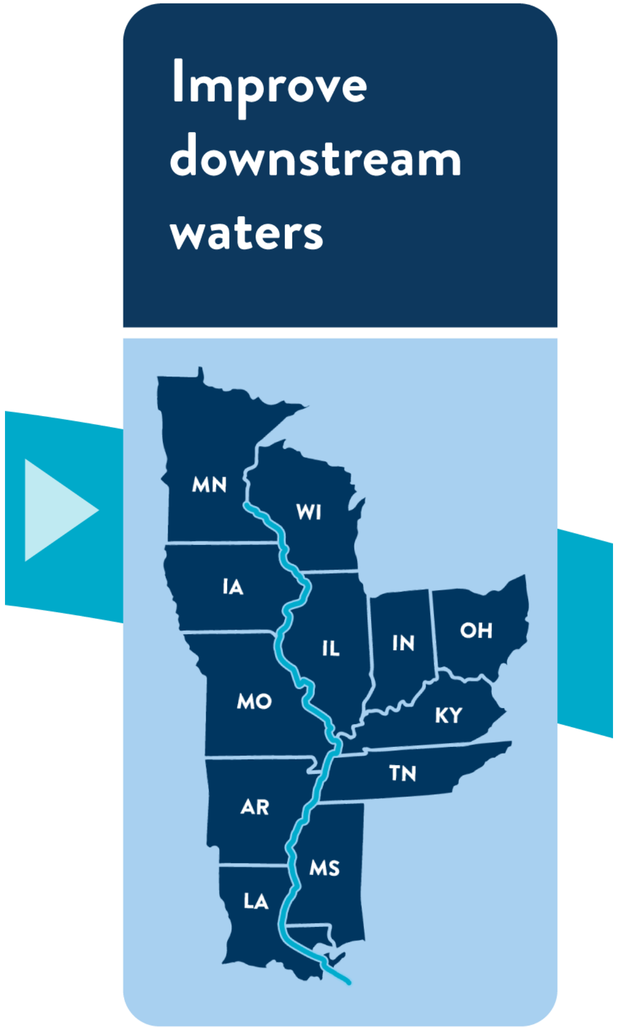


- Algae levels
- Drinking water
- Biological health

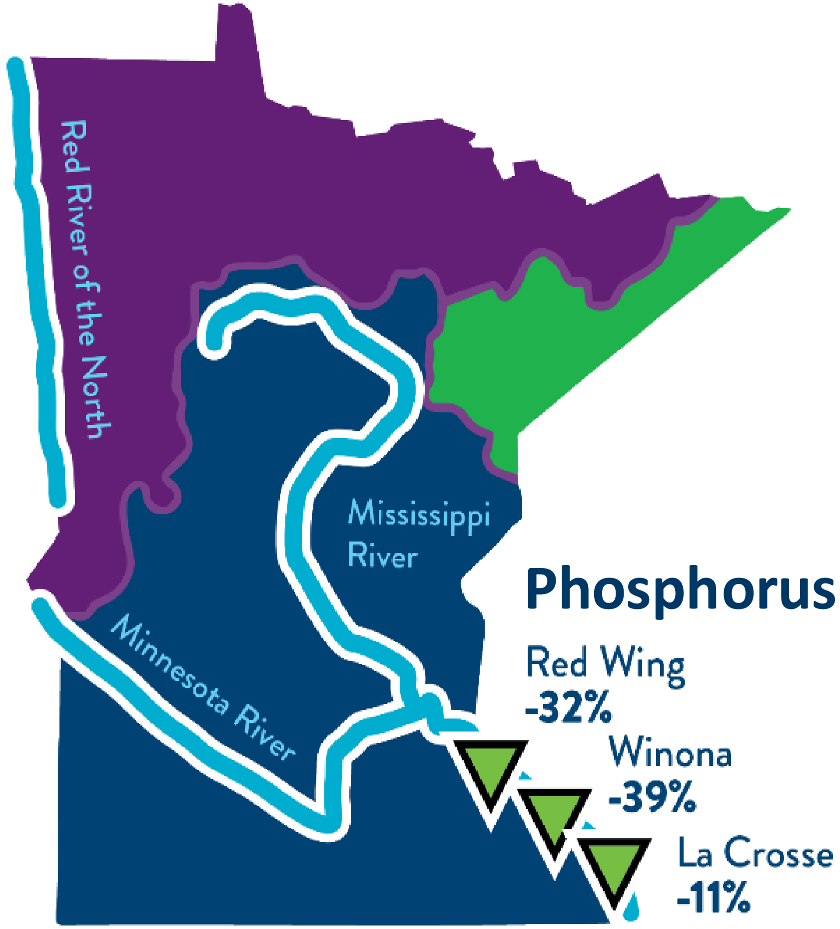




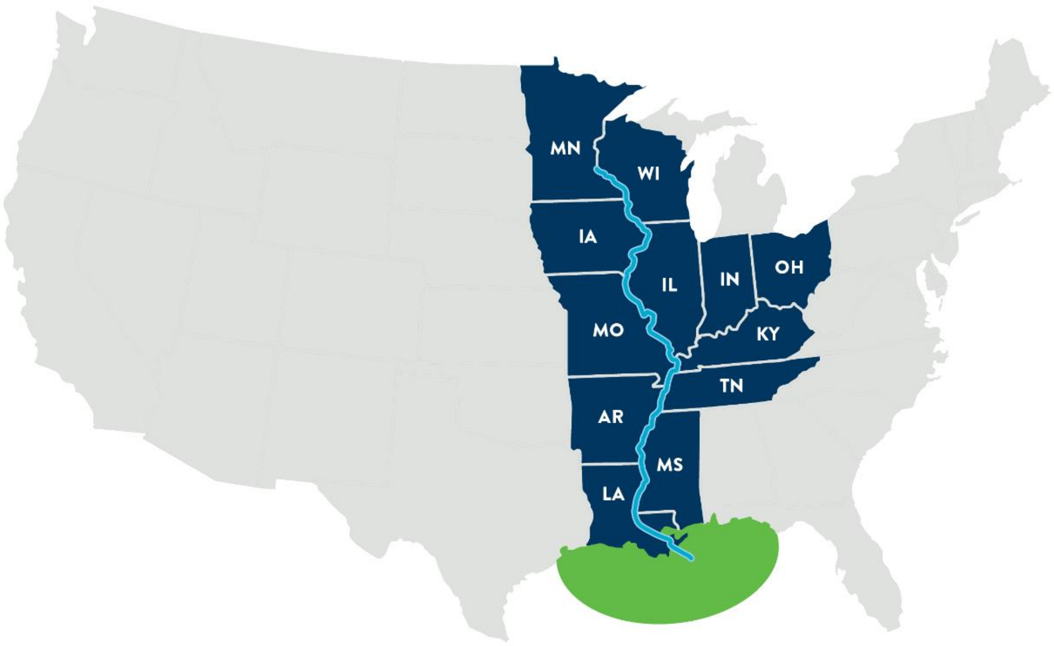
Success – less phosphorus going to the Gulf



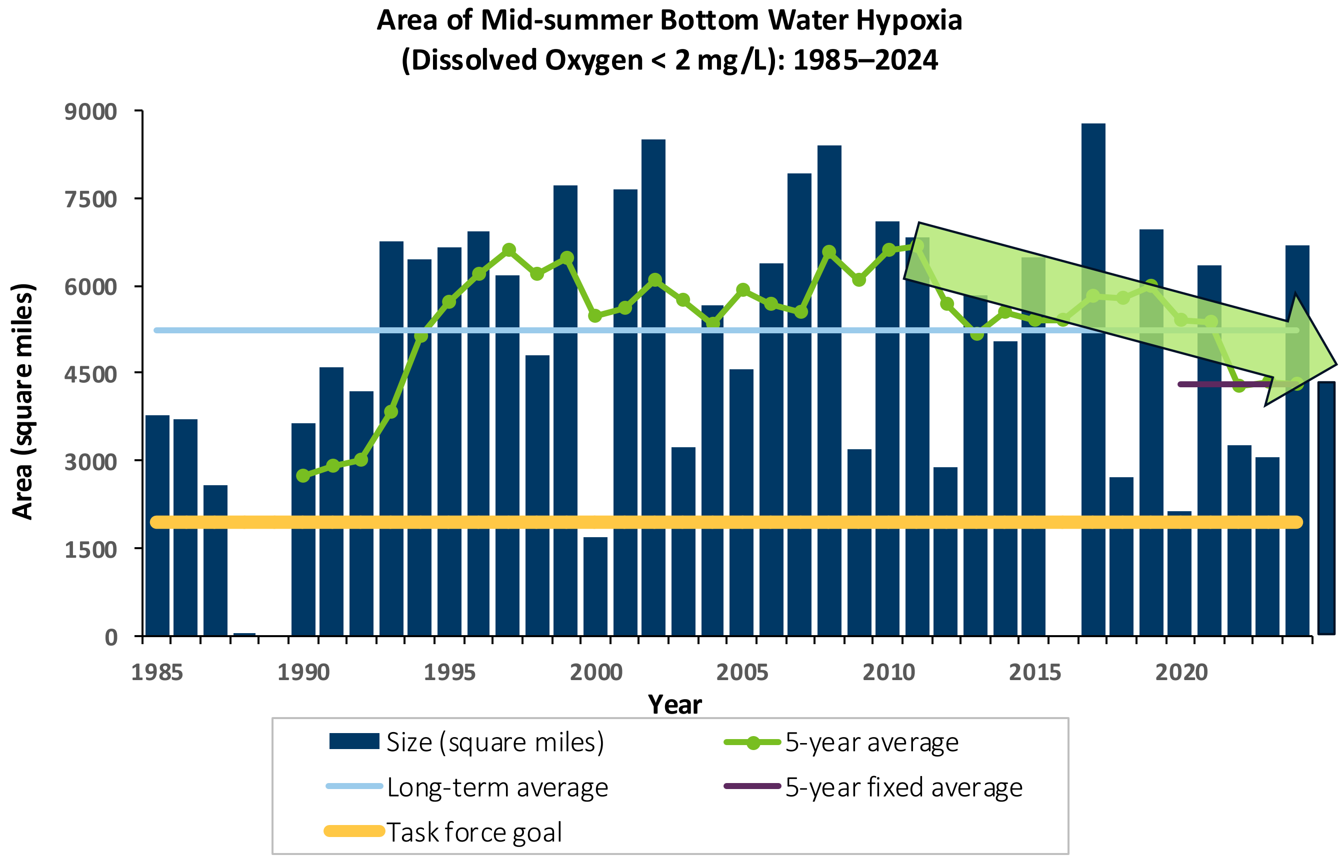
- 32% phosphorus reduction in Mississippi River at Red Wing (right)



Gulf hypoxia zone improving since 2011



Seasonal hypoxia zone



Time to celebrate - Good job, Minnesota!

Cheers to your committed work & accomplishments!

- 35+ large-scale programs
- All 80 watersheds w/strategies
- Practice changes
  - Wastewater P reduced 76%
  - 4 million new cropland acres treated
- In-state water improvements
  - wells, rivers, lakes
- Mississippi River nutrients
  - 32% reduced phosphorus

Yet, we have a long ways to go

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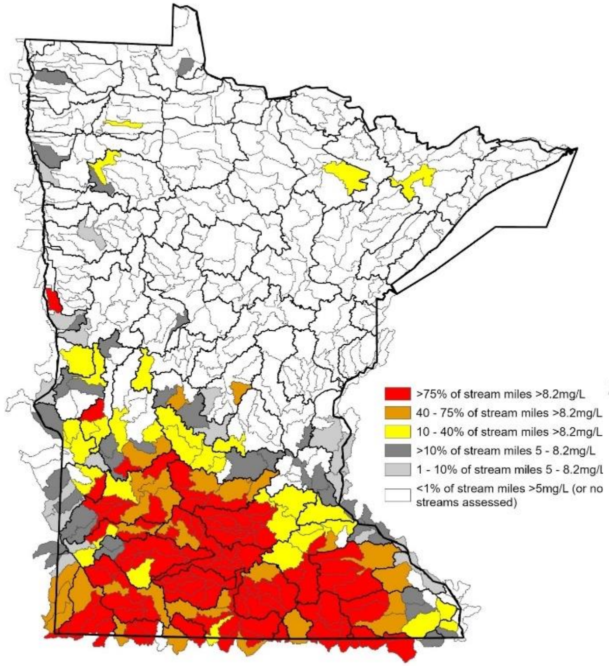
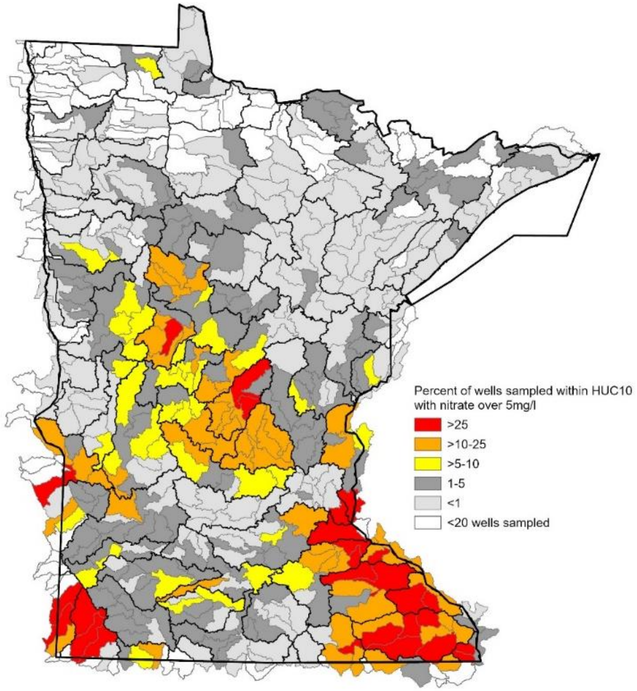
Minnesota is committed to reducing nutrients for our in-state waters

Nitrate concentrations

Stream aquatic life

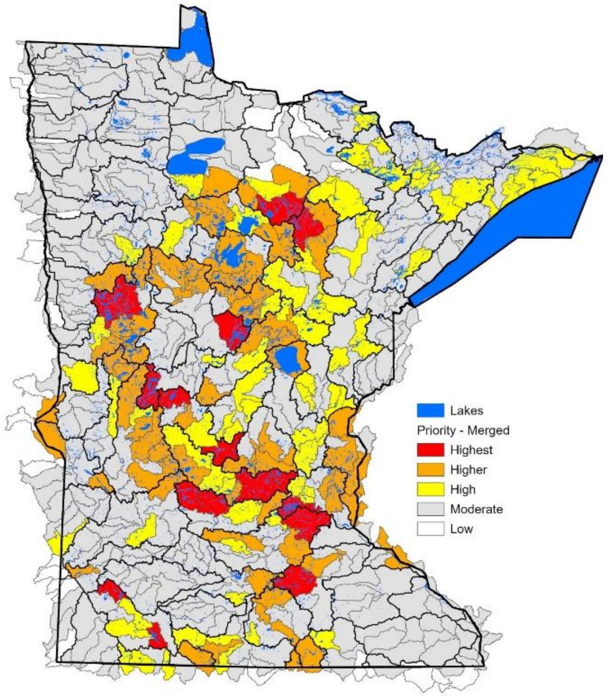


Drinking water wells

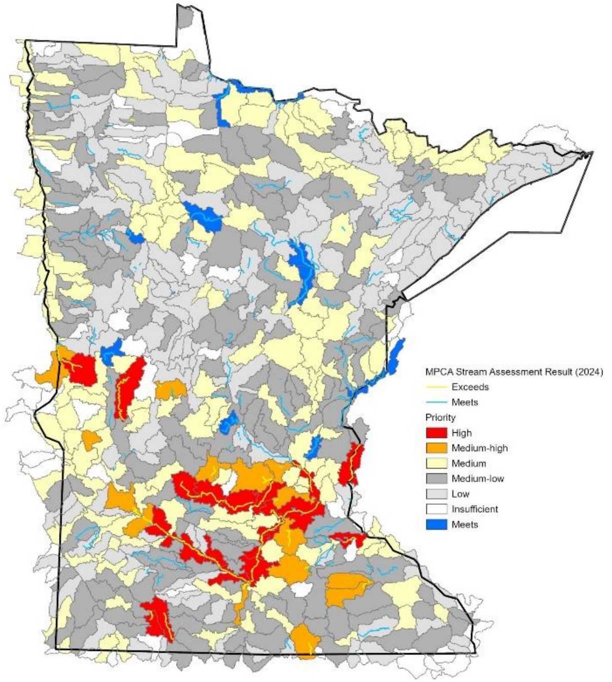


Phosphorus concentrations

Lake restoration & protection



Reduce river eutrophication

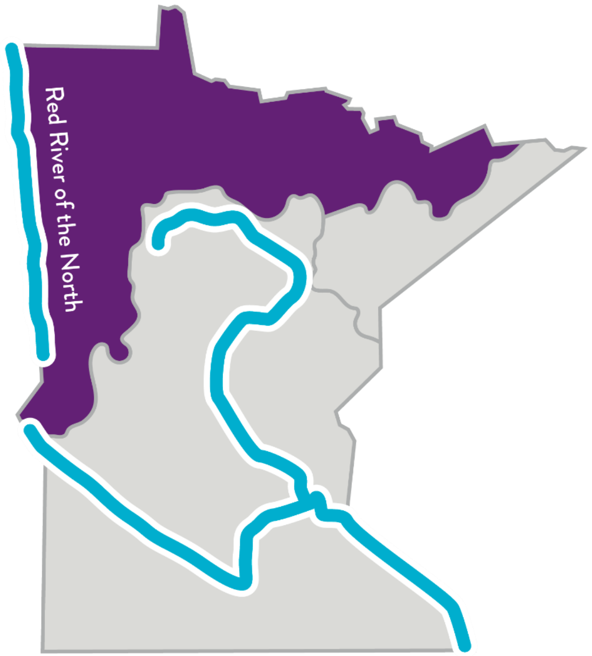


Minnesota is committed to reducing nutrients for downstream

Total nitrogen load reductions still needed

39%

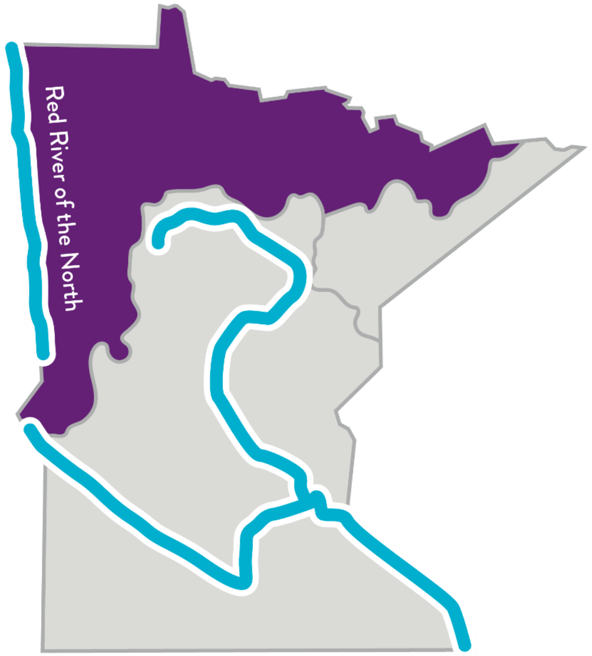
42%



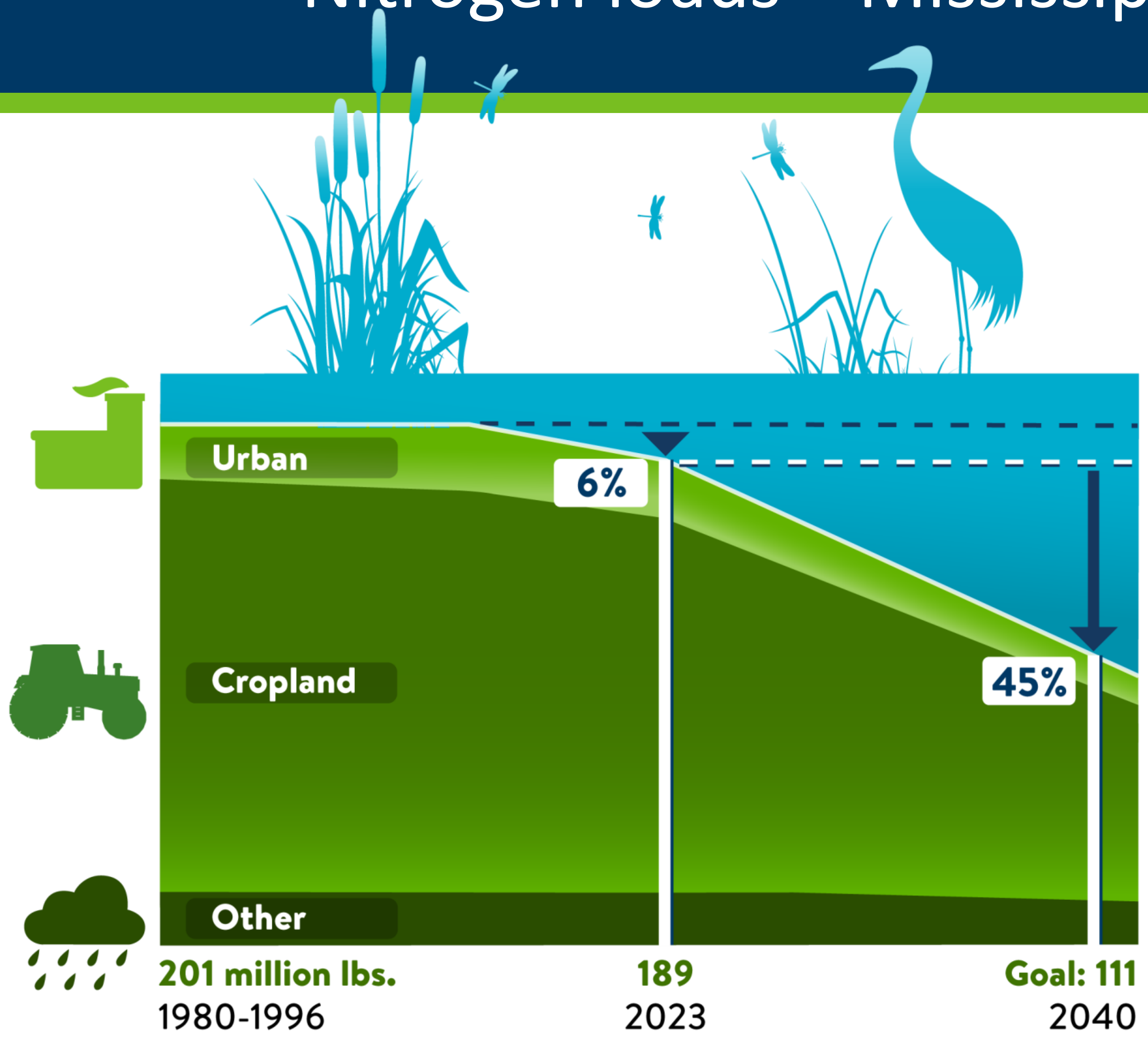
Total phosphorus load reductions still needed

13%

57%



Nitrogen loads – Mississippi River near Iowa state line



Goal remains 45% reduction 1997 to 2040

- 39% more reduction to go

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2025 NRS Chapters

Chapter 1 – NRS first decade

Chapter 2 – Downstream loads

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Chapter 5 – Addressing Rural Nutrient Sources

Science

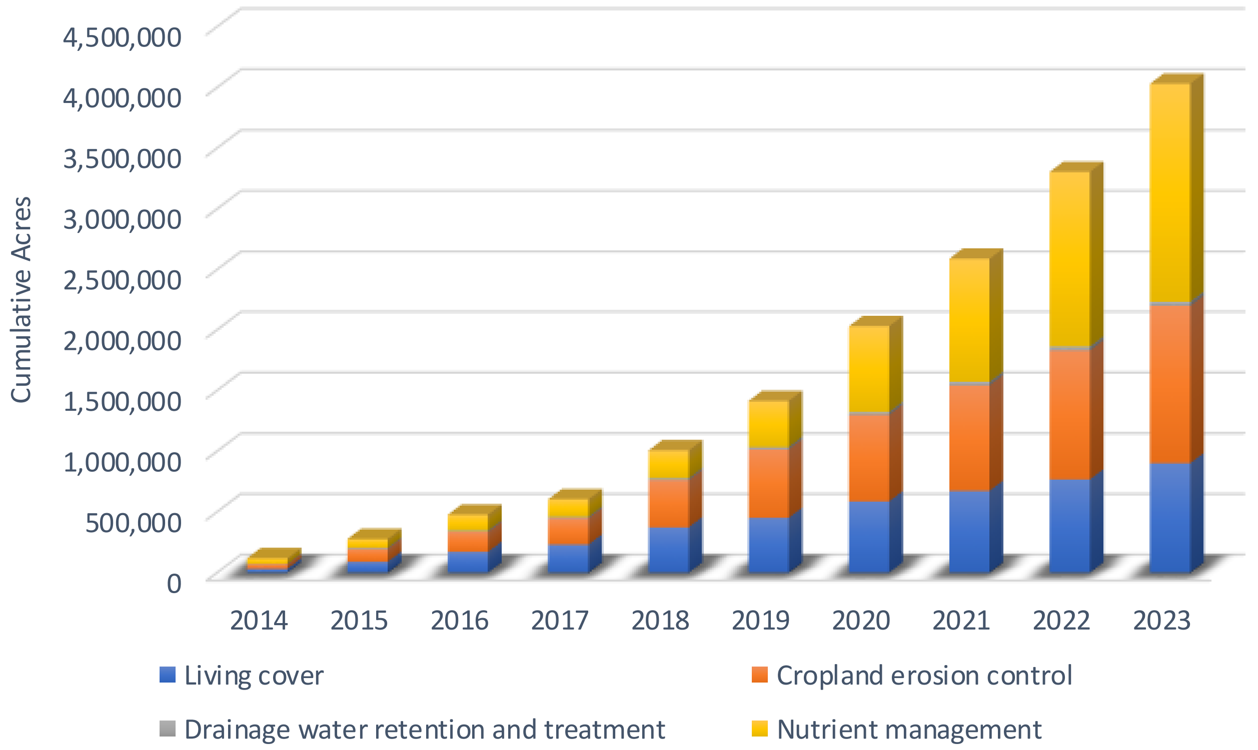
Successes

Next steps

Non-ag rural

Key messages at beginning of Chapter 5 – Rural Nutrients

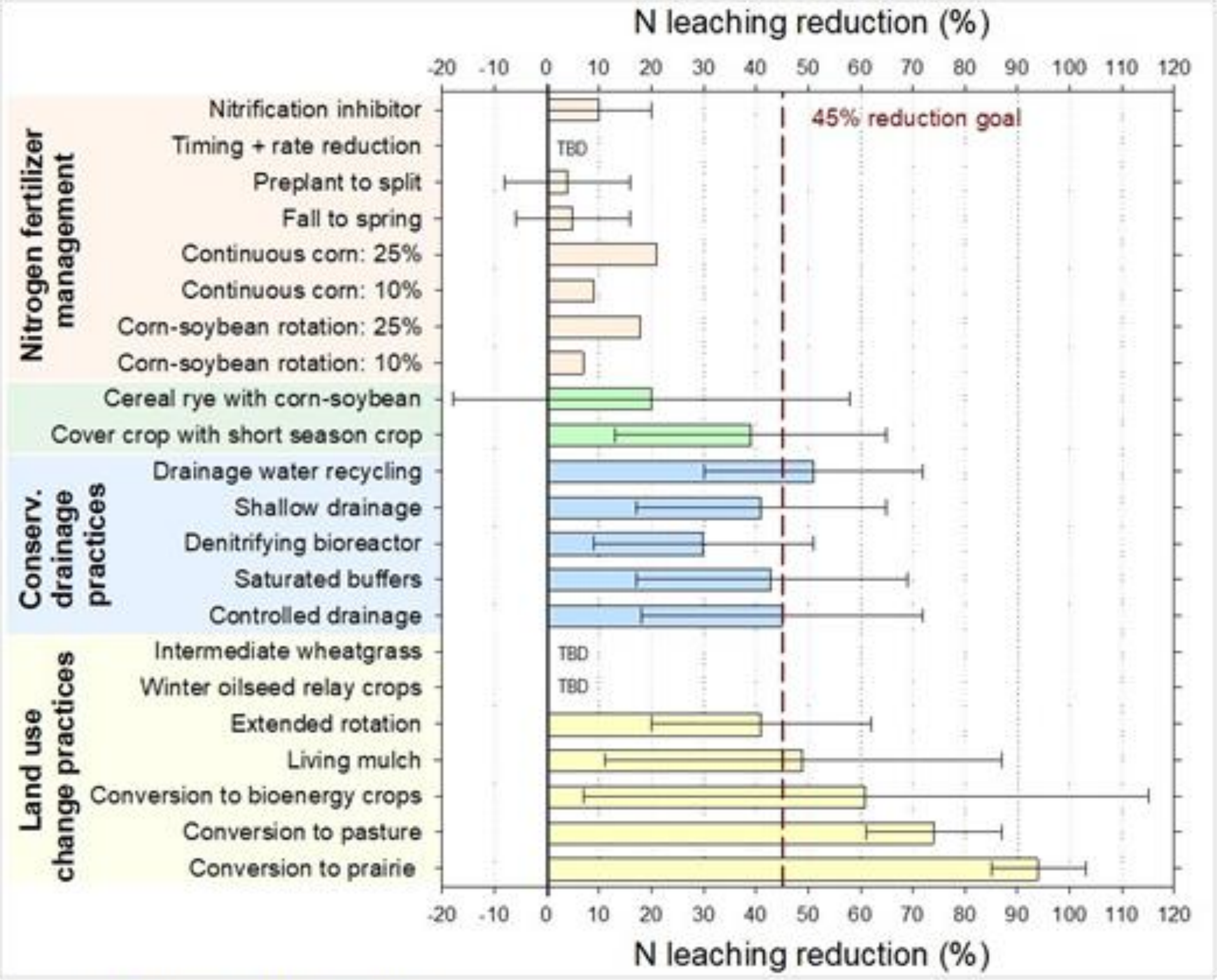
- "Farmers have made good progress, which needs to be maintained and increased."
- "Since 2014, over 4 million acres of land have been treated by new practices adopted through government programs alone (roughly 18% of cropland). These additional practices follow decades of conservation work and improved fertilizer efficiencies."



Key messages at beginning of Chapter 5 – Rural Nutrients

- “Collectively, the large acreages of potential improvement with fertilizer and manure application refinements can make a difference for water quality. However, fertilizer and manure application refinements will not lower nitrate losses to waters per treated acre as much as other practices. Continued work to refine precision nitrogen and phosphorus fertilizer efficiencies on every acre is an important part of the solution.”

Updated science supports more accurate predictions



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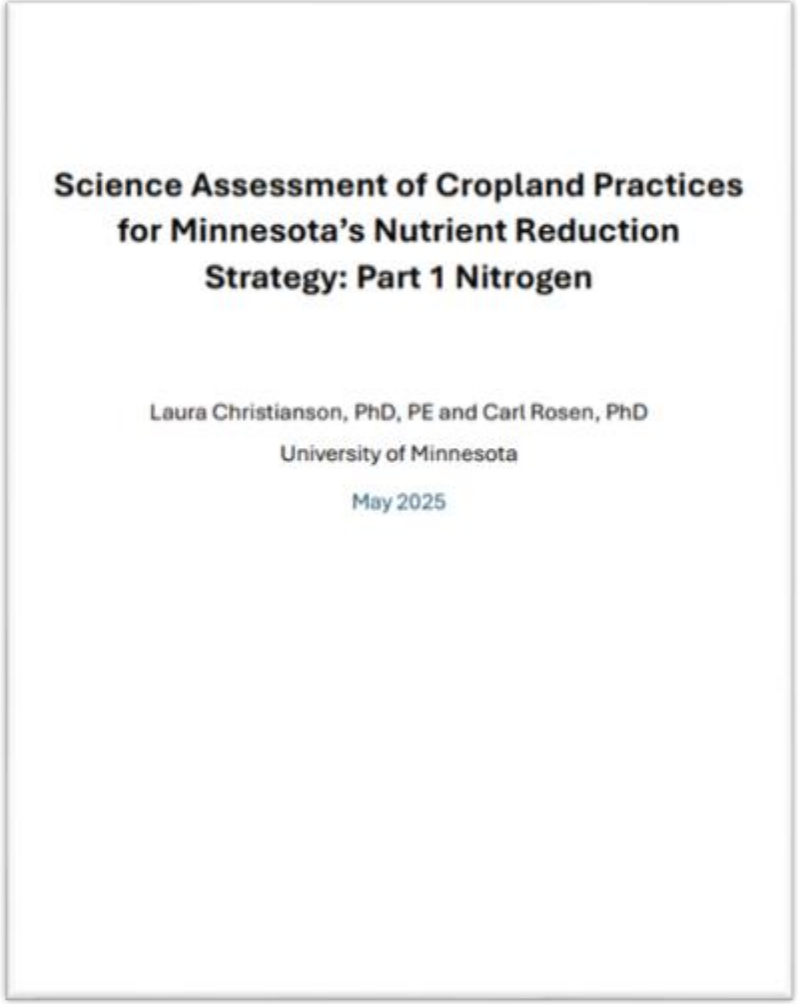
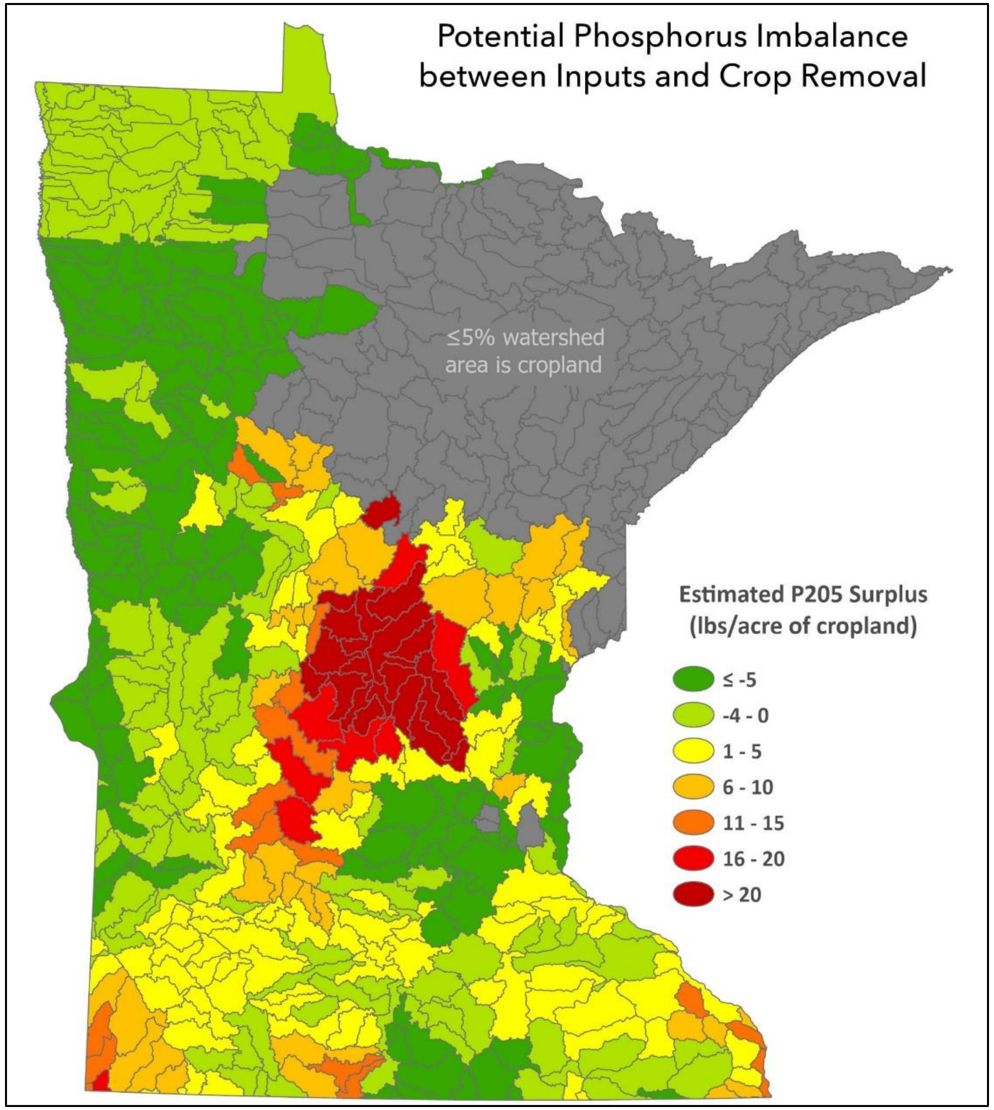


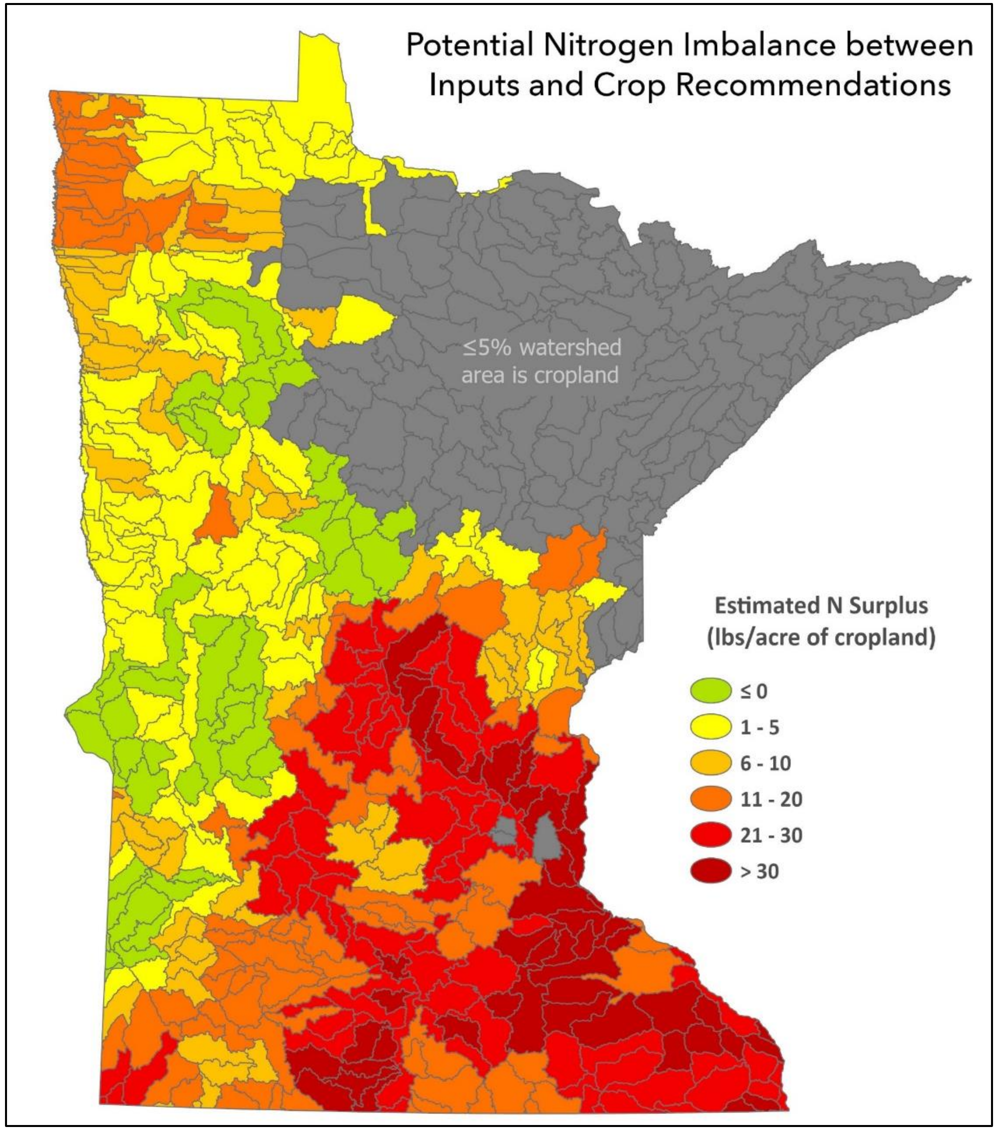
Chapter 5, Support Document 5-1

In-field practices to reduce nitrate leaching

Practice	Nitrate reduction %	Number of site years
(1) In-field nitrogen management		
Corn-soybean rotation: 10% fertilizer rate reduction to achieve maximum return to nitrogen, or MRTN [a]	7%	151
Corn-soybean rotation: 25% fertilizer rate reduction to achieve MRTN	18%	151
Continuous corn: 10% fertilizer rate reduction to achieve MRTN	9%	101
Continuous corn: 25% fertilizer rate reduction to achieve MRTN	21%	101
100% fall to 100% spring pre-plant	5%	15
100% spring preplant to split application	4%	21
Timing modification toward spring and side-dress, plus a rate reduction	TBD	
Nitrification inhibitor	10%	15

7. Fertilizer/manure applications have improved, but still show more potential for improvement in some areas





Agricultural practices that reduce nitrogen losses to waters

Fertilizer/manure mgmt

In-field fertilizer management reduce 5-20%

- Corn/soybean rotation: 10-25% rate reduction
- Continuous corn: 10-25% rate reduction
- 100% fall to 100% spring pre-plant
- 100% spring pre-plant to a spring split
- Nitrification inhibitor

Cover crops

Cover crops reduce 18-35%

- Cover crops & relay crops in general
- Cereal rye in a corn-soybean rotation
- Cereal rye in continuous corn
- Cover crops following short season crops in a cold climate

Cropping systems change

More perennials reduce 40-90%

- Extended rotation (including perennial)
- In rotation: Alfalfa
- In rotation: Small grain (oat)
- Kura clover
- Intermediate wheatgrass
- Conversion to prairie
- Conversion to pasture
- Conversion to bioenergy crops

Tile drainage waters

Drainage water treatment reduce 30-50%

- Controlled damage
- Saturated buffers
- Denitrifying bioreactors
- Shallow drainage
- Drainage water recycling
- Constructed wetlands

More research - Chapter 5 – Rural Nutrients

Find improved ways to manage cropland nutrient additions. To address weather extremes and increase nutrient efficiencies in those situations, more research is needed to fine-tune in-field nutrient management using precision technologies. Minnesota's diverse soils and climate necessitates site-specific approaches for estimating crop nitrogen needs and the best rates and methods of application that can be adjusted to accommodate springtime weather conditions.

Private Sector involvement - Section 5.4.1 and 5.4.2

- Private sector involvement is critical for achieving nutrient goals for local priority waters and for downstream waters. Several public-private partnership projects were started within the past decade. Successful partnerships should be continued and also serve as models for watersheds without such partnerships (see *Public-Private Partnerships for Protecting Minnesota's Water* for more details).
- Private industry has played a strong role with programs such as MAWQCP, and their involvement is critical for other programs assisting farmers. The NRS partners working on implementing agricultural practices should include representatives from the private and nonprofit sectors of the agricultural industry.

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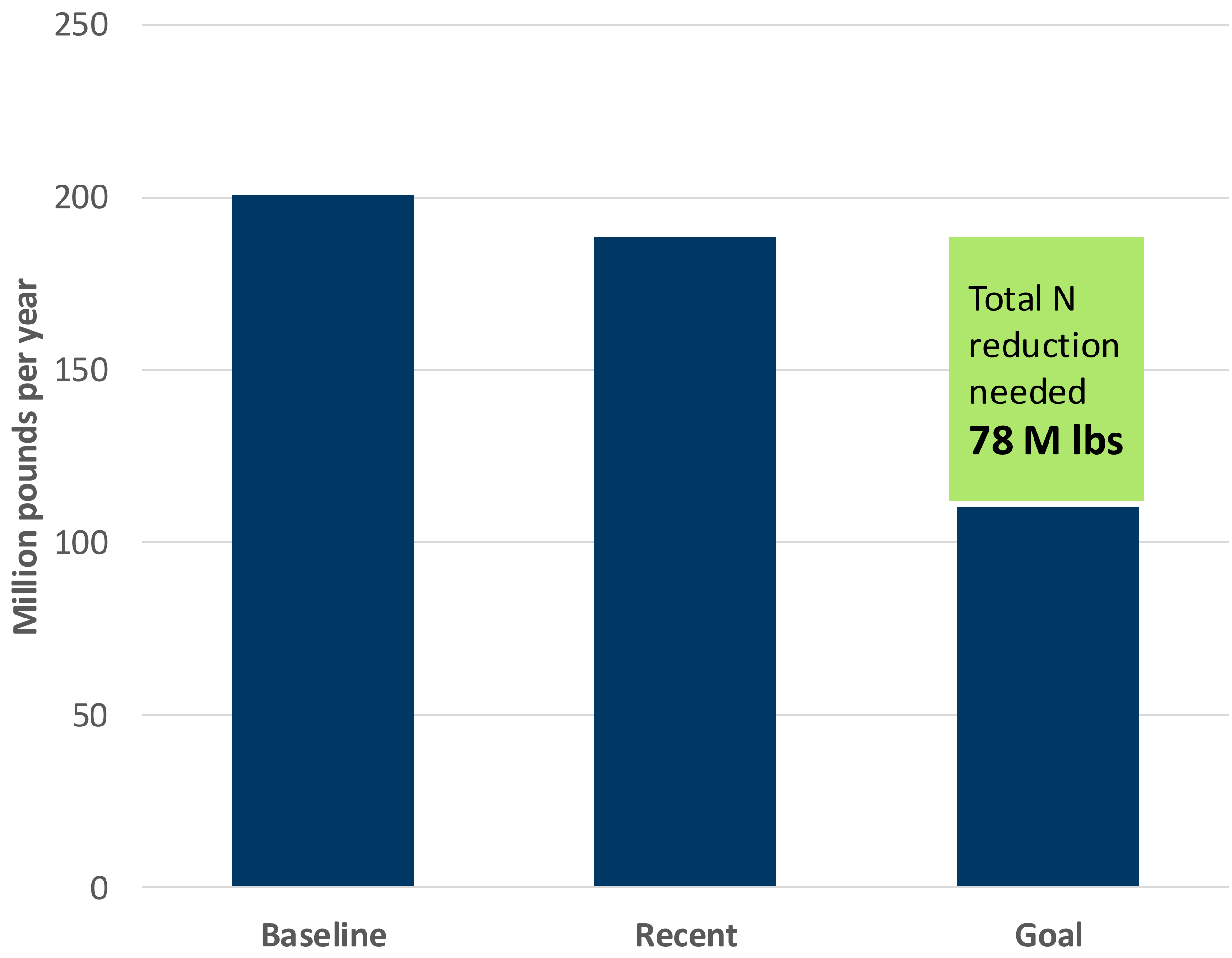
How much urban & rural change to reach nutrient goals?



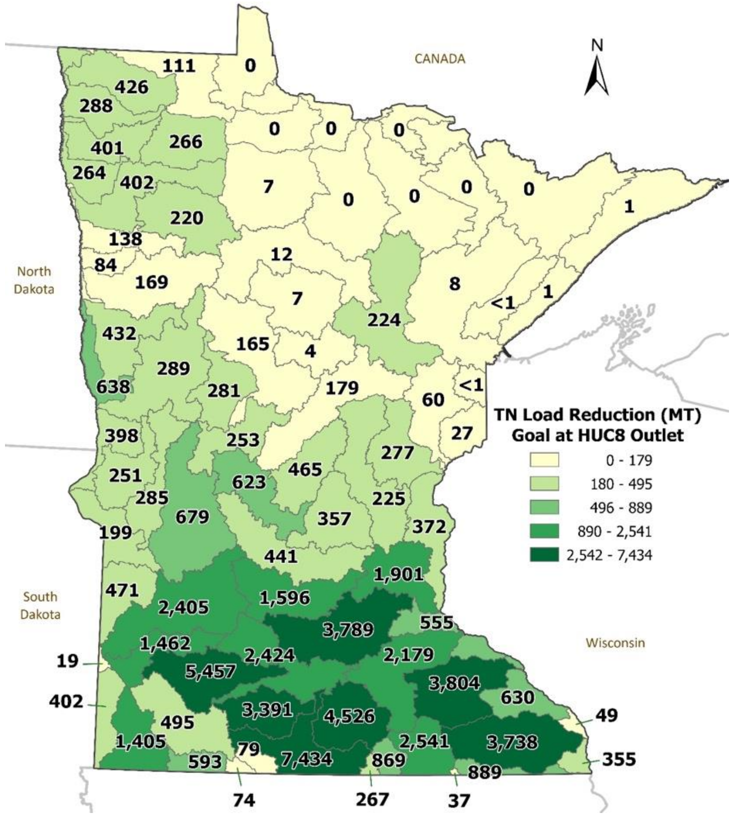
NEW – tools to help prioritize, target, plan & measure progress

Tools and maps

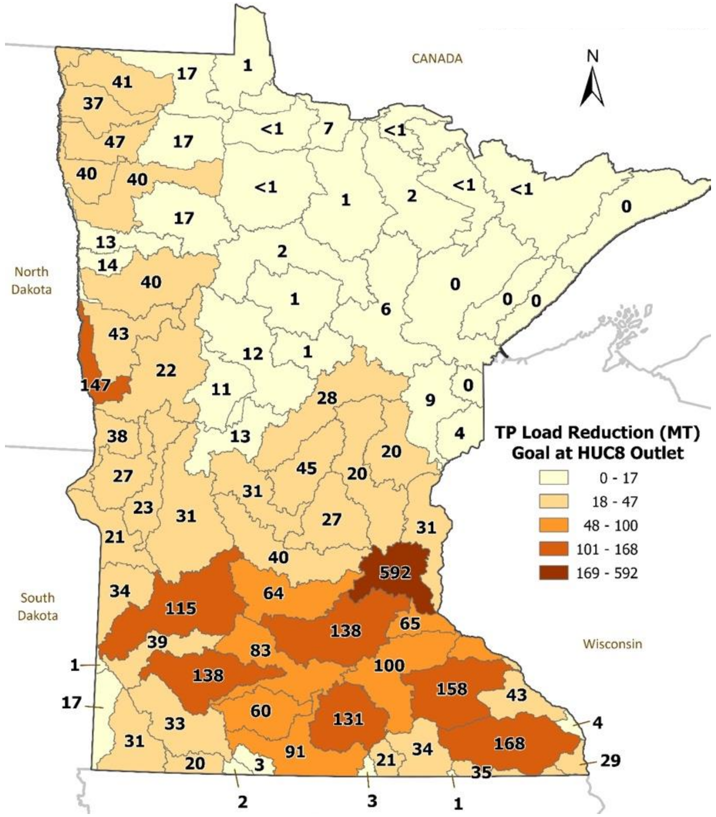
1. Watershed target reductions
2. Priority watershed maps
3. How much we can reduce with BMPs (BEET tool)
4. Where and how much we can achieve with in-field practices
5. Up-to-date science to better predict BMP results

Amounts of nutrients to reduce by watershed

Nitrogen



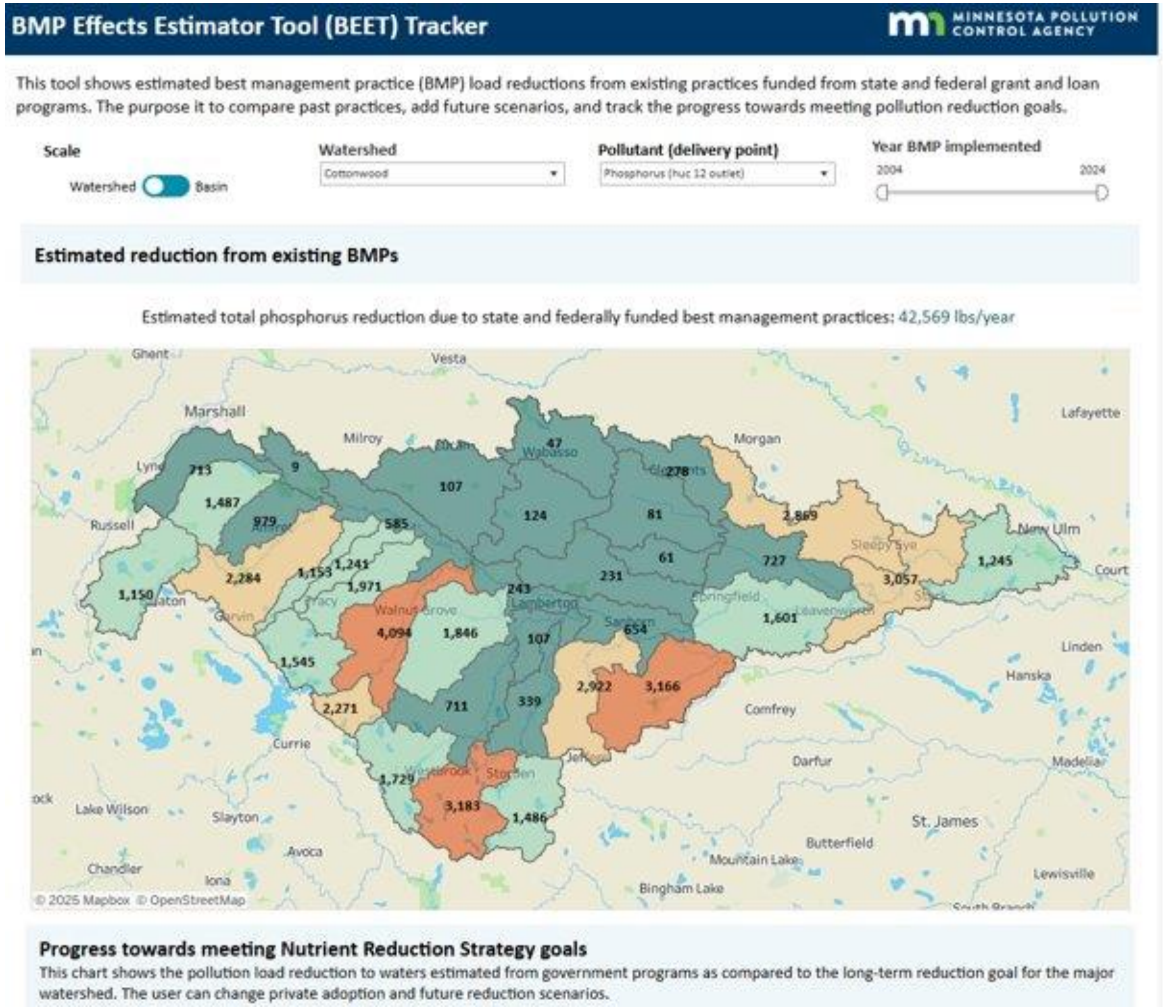
Phosphorus



Chapters 5-7, support document 2-4

BMP Effects Estimator Tool (BEET)

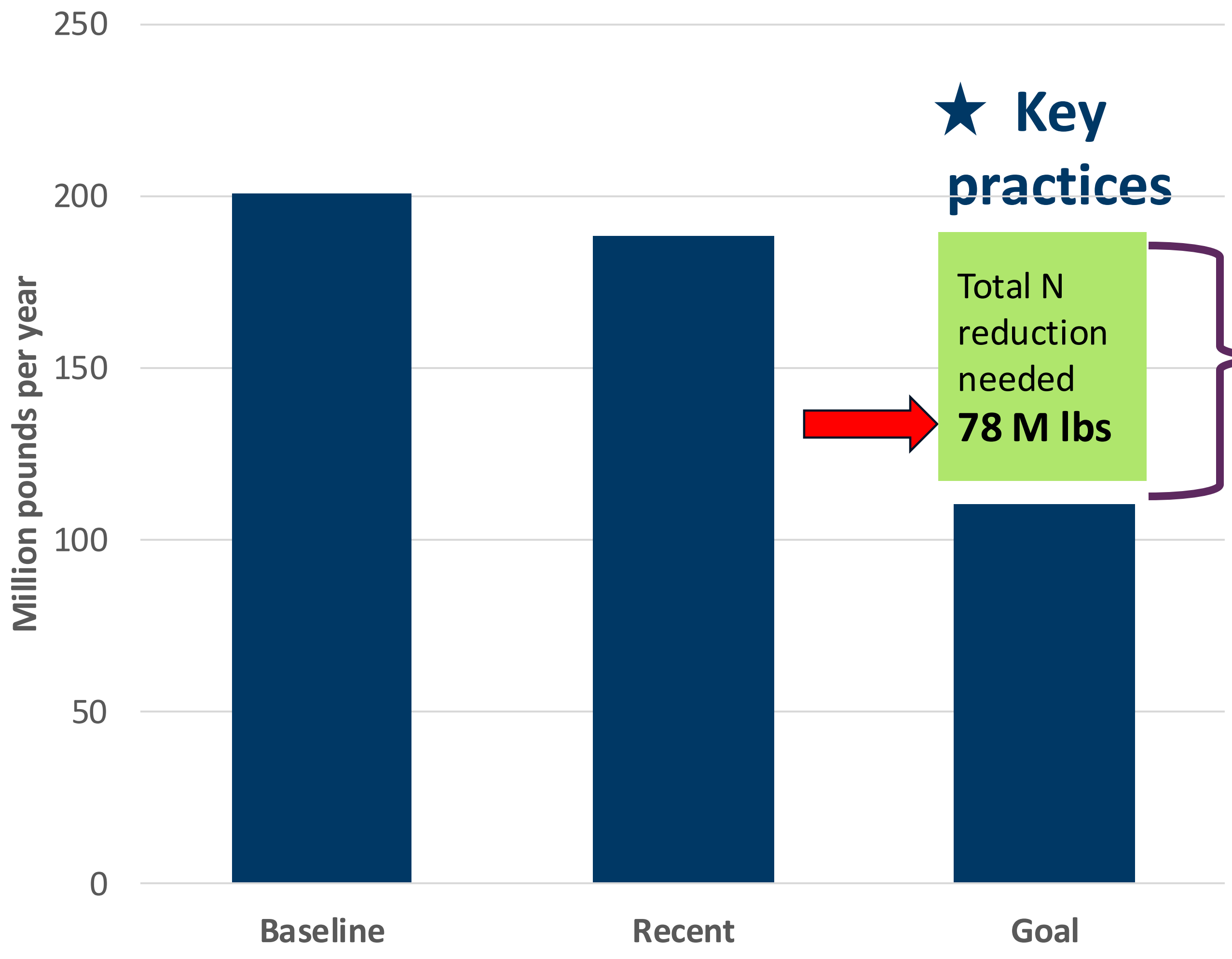
- Quick
- Simple
- Local OR large-scale
- Planning ahead
- Tracking past work



Chapters 2 & 7, also at NRS website

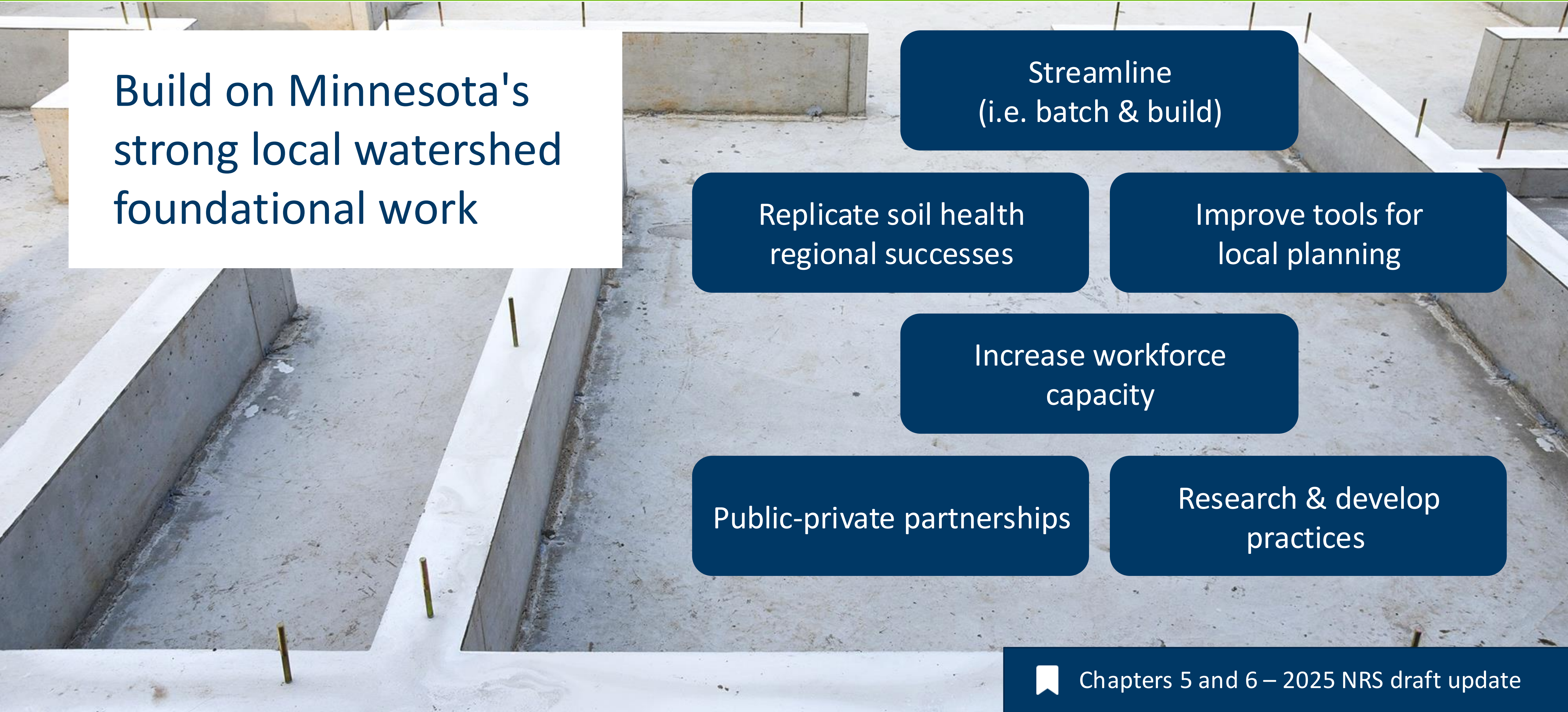
How much urban & rural change to reach nutrient goals?

Example scenario for Mississippi River Basin



Practice type	Acres added (millions)	TN Load reduction (lbs/yr at state line)
More living cover duration	7.8 M	33.4 M lbs ★
Tile water management	3.0 M	13.8 M lbs ★
Urban wastewater N		11.0 M lbs ★
Fertilizer & manure mgmt.	2.8 M	4.4 M lbs
Tillage with more residue	2.0 M	2.0 M lbs
Streambank/flood plains	TBD	7.0 M lbs
Other	TBD	5.0 M lbs
Overland runoff controls	1.2 M	1.3 M lbs
TOTAL	**17 M acres**	**78 million lbs TN**

What it will take: State-level support for watershed work



Build on Minnesota's strong local watershed foundational work

Streamline
(i.e. batch & build)

Replicate soil health regional successes

Improve tools for local planning

Increase workforce capacity

Public-private partnerships

Research & develop practices

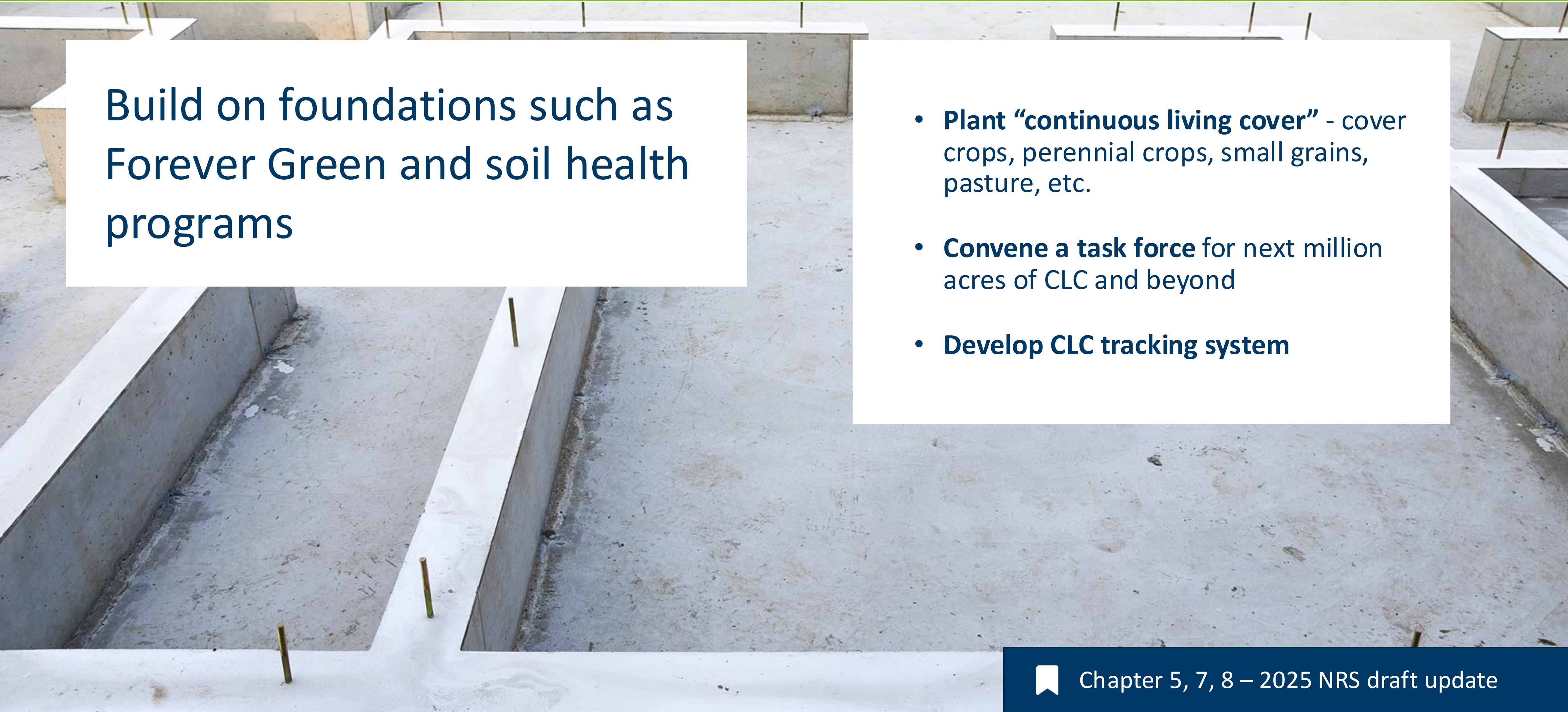
What it will take: State-level support for certification programs

Build on Minnesota's Certification foundations

MINNESOTA WATER QUALITY CERTIFIED FARM™

- Agricultural Water Quality Certification Program
  - Increase from 1.2 million acres to several million acres
  - Add endorsement for nitrogen
- 4R Nutrient Stewardship Certification
  - MN Crop Production Retailers
  - Began in 2020

What it will take - State-level support for continuous living cover



Build on foundations such as Forever Green and soil health programs

- **Plant "continuous living cover"** - cover crops, perennial crops, small grains, pasture, etc.
- **Convene a task force** for next million acres of CLC and beyond
- **Develop CLC tracking system**

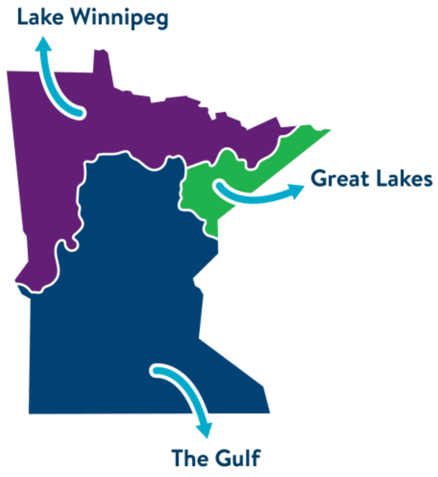
The NRS mentions existing laws, rules & permits

- Manure application permits & rules
- Fall fertilizer restrictions
- Groundwater protection rule for nitrate
- Urban stormwater regulatory program
- Septic system regulatory program
- Urban wastewater requirements
- Minnesota's water management framework - laws
- Lawn fertilizer restriction laws
- Riparian buffer law
- Water Quality Standards

What it will take: Statewide investment for multiple benefits

- Practice costs vary greatly
  - Achieving final goals requires large public investment
- Economics and funding options analysis needed
  - NRS does not show specific ways to fund
- Invest in practices with multiple benefits
  - Agriculture, water nutrients/sediment, soil health, wildlife, flooding, climate, etc.
  - Research, develop and use practices that will address several needs together

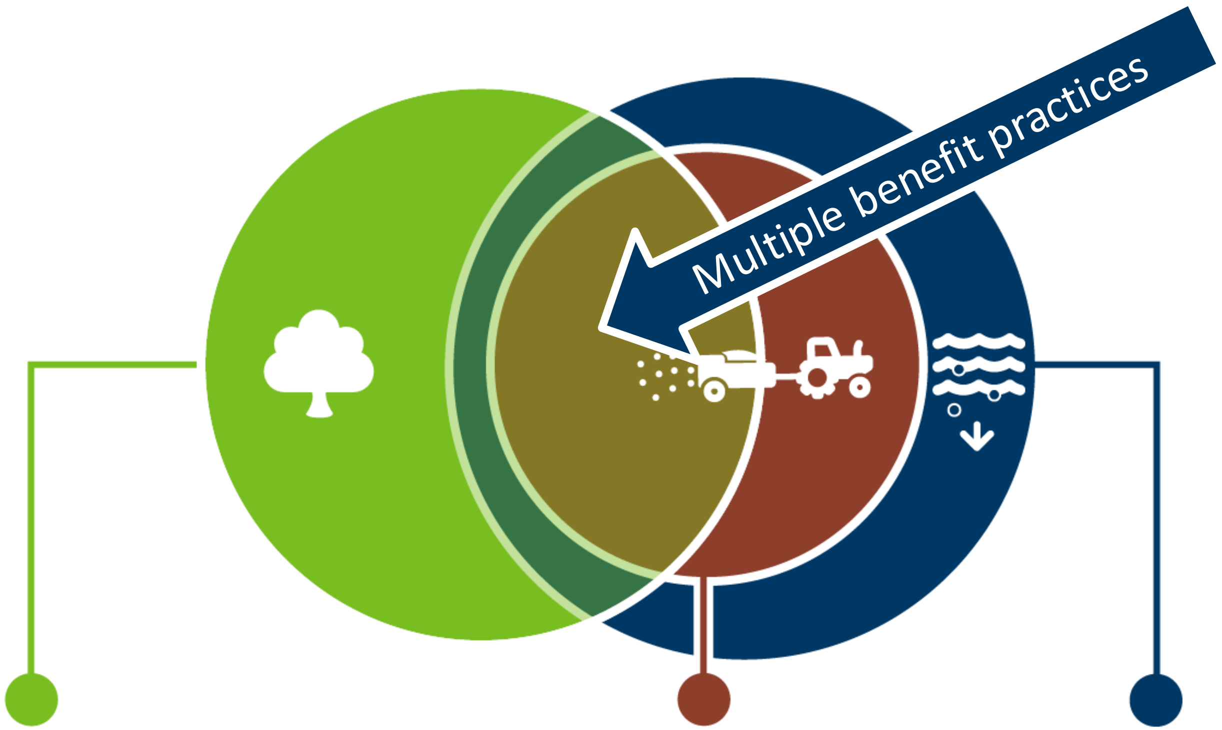
How much will it cost annually to reach nutrient goals?
Example scenario for Mississippi River Basin



Practice type	**Acres added** (millions)	**TN Load reduction** (lbs/yr at state line)	**Annualized cost*** $ per year (millions) Rough estimate
Continuous living cover	7.8 M	33.4 M lbs	**$431 M**
Tile water management	3.0 M	13.8 M lbs	**$118 M**
Urban wastewater N		11.0 M lbs	**$131 M**
Fertilizer & manure mgmt.	2.8 M	4.4 M lbs	**Savings**
Tillage with more residue	2.0 M	2.0 M lbs	**Savings**
Streambank/flood plains	TBD	7.0 M lbs	**TBD**
Other	TBD	5.0 M lbs	**TBD**
Overland runoff controls	1.2 M	1.3 M lbs	**$15 M**
TOTAL	**17 M acre**	**78 million lbs TN**	**$695 M plus costs for TBDs**

*does NOT include: government staff and administration costs

Multiple-benefit practices help justify public costs and effort



Climate Action Framework
- Resilient landscapes
- Reduced emissions
- Stored carbon

Resilient Agriculture
- Soil health & Living cover
- Water storage
- Fertilizer efficiency

Nutrient Reduction Strategy
- Lakes & streams
- Groundwater nitrate
- Downstream to international waters

Effective nutrient-reducing practices* that also offer other benefits include such practices as:
- Conservation crop rotation (e.g., adding small grains or perennials into rotations)
- Using perennial crops on working lands (including rotational grazing)
- Cover crops
- Strip-till (and other reduced tillage methods)
- In-field nutrient management (fertilizer and manure precision/efficiency)
- Drainage water recycling (storing and irrigating drainage waters)
- Wetland construction and restoration

*some practices need more research and development before they can be broadly implemented.

Chapters 5 and 8 – 2025 NRS draft update

Topics today

1. Background on NRS & its update
2. Reasons for celebration
3. Remaining nutrient reduction needs
4. NRS Chapter 5 – Rural Nutrients
5. What it will take to meet final goals

How to review & comment on DRAFT

Your questions

How to find the draft NRS

Comments Page

https://mpca.commentinput.com/?id=tFdSVcJQ3

Minnesota Nutrient Reduction Strategy

DRAFT 2025 update

Questions

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Thank you

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Extra slides if needed

Yet, to reach final goals, we need to do **more** with each existing foundational program

Forever Green & Living cover ☆	Work toward widespread cropping systems change
Certification programs (MAWQCP, 4R Certif.)	Expand to multiple millions acres; N endorsement
Funding programs – i.e. Watershed Based Implementation	Continue and expand
Soil health programs & partnerships	Showcase successes & replicate
Watershed Work	Support to increase efficiencies & large-scale implementation
Existing laws, rules, permits	Fully implement and keep current
Research & development	Agricultural practices & co-benefits, economics

Multiple benefits of nutrient-reducing practices

Practices to reduce rural nutrient losses to waters (and the associated NRCS/BWSR practice code number(s) for each)	Water quality: nitrogen	Water quality: phosphorus	Water quality: sediment	Climate: Resiliency to climate extremes	Climate: Greenhouse gas emission	Climate: Carbon storage	Water storage: Reduce high flows, flooding, & bank erosion	Soil health & productivity	Wildlife habitat	Agriculture: Production /profit
Edge-of-field practices for tile water treatment										
Denitrifying bioreactor (#605 [747 interim])	H	L	L	L	L	L	L	L	L	L
Drainage water management (controlled drainage) (#554)	H	L	L	M	L	L	L	M	L	M
Drainage water recycling (stored water used for irrigation) (#447)	H	L	M	H	M	L	H	M	M	H
Wetland construction on tiled lands (#s 656, 657, 658)	H	M	M	M	L	L	H	L	H	L
Saturated buffer (#604)	H	L	L	M	L	L	L	L	M	L
Field erosion controls and tillage										
Improving open tile intakes & side inlets (#s 170M, 171M, 172M, 606, 410)	L	H	M	M	L	L	L	M	L	L
Water and sediment control basin (#638)	L	M	H	H	L	L	H	L	L	L
Grassed waterway in areas with concentrated flow (#412)	L	M	H	H	L	L	H	H	L	L
Contour buffer strips or prairie strips (#332)	M	H	H	H	M	M	L	H	H	L
Residue and tillage management: no-till/strip-till (#s 329, 329A)	L	H	H	H	H	H	H	H	L	M
Residue and tillage management: reduced till (#345, 346, 329B)	L	H	H	M	M	M	H	H	L	M
Living cover duration increase, in-field										
Conservation crop rotation (2+ years conservation crops in rotation) (#328)	H	M	H	H	H	H	H	H	H	L
Contour buffer strips or prairie strips (#332)	M	H	H	H	M	M	L	H	H	L
Converting row crops to perennial crops for food, energy, pasture (#s 327, 327M, 342, 612)	H	H	H	H	H	H	H	H	H	L
Converting cultivated lands to strategically placed perennials (#s 327, 327M, 342, 612)	M	M	M	H	H	H	M	H	H	L
Cover crop (including relay crops, companion crops) (#340)	H	H	H	H	M	M	H	H	M	L
Cover crop following early harvest crops (#340)	H	H	H	H	M	M	H	H	M	L

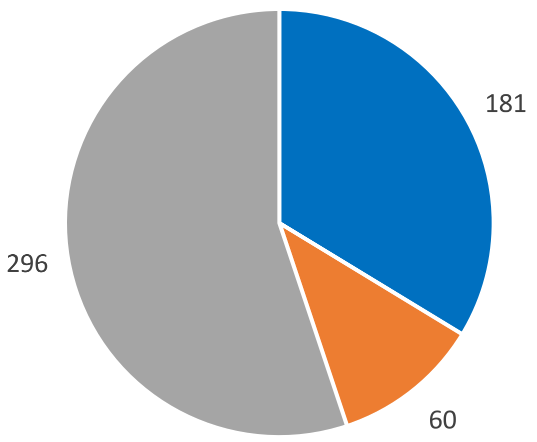
Multiple benefits of nutrient-reducing practices

Practices to reduce rural nutrient losses to waters (and the associated NRCS/BWSR practice code number(s) for each)	Water quality: nitrogen	Water quality: phosphorus	Water quality: sediment	Climate: Resiliency to climate extremes	Climate: Greenhouse gas emission	Climate: Carbon storage	Water storage: Reduce high flows, flooding, & bank erosion	Soil health & productivity	Wildlife habitat	Agriculture: Production /profit
In-field nutrient management										
Manure/fertilizer injection or immediate incorporation (#590)	M	H	L	L	M	L	L	H	L	M
Nutrient rates for optimal economic returns (#590)	H	H	L	L	M	L	L	H	L	H
Precision nutrient management with variable rates (#590+)	M	H	L	M	M	L	L	H	L	M
Improved timing: fall-to-spring or spring preplant-to-spring split (#590)	H	M	L	M	M	L	L	H	L	M
Nitrogen fertilizer type: nitrification and urease inhibitors (#590+)	H	M	L	M	M	L	L	H	L	M
Livestock and grazing management										
Manure storage facility construction to also capture feedlot runoff (#s 313, 784)	L	M	L	M	L	L	L	L	L	L
Grazing to exclude or control livestock access to waters (#472)	L	M	L	M	L	L	M	L	L	L
Grazing and pasture management improvement such as rotational grazing (#s 101, 528)	L	M	H	M	L	L	M	H	L	M
Feed type changes and additions	L	M	L	L	M	L	L	L	L	M
Additions to manure to acidify or stabilize	M	L	L	L	M	L	L	L	L	L
Hydrologic and other types of restoration										
Floodplain reconnection	H	M	L	M	L	L	H	L	H	L
Peatland preservation and restoration	L	L	L	L	H	H	L	L	L	L
Streambank & near-channel stabilization/restoration/protection (#s 582, 584, 580, 410, 000)	L	M	L	M	L	L	M	L	H	L
Restored oxbow	M	L	M	M	L	L	M	L	H	L
Windbreak establishment (#s 650, 380)	L	M	H	M	H	M	L	M	H	L
Adding & preserving trees, including silvopasture & multistory cropping (#s 612, 147M)	M	M	M	M	H	H	M	H	H	L

In-state phosphorus trends – Many more improvements (blue) compared to worsening (orange)

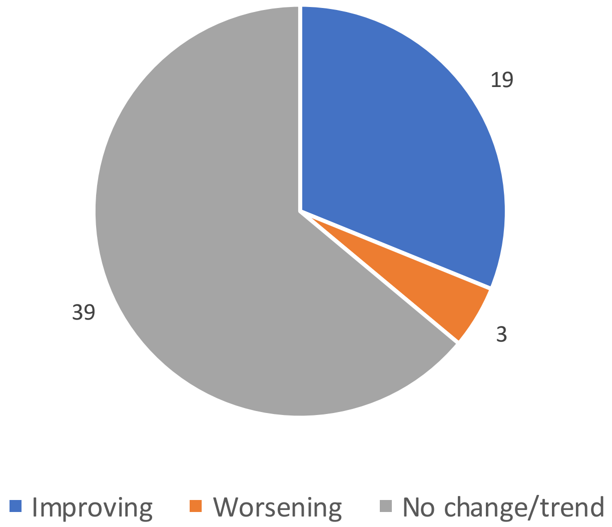
Lakes

Lake phosphorus concentration trends
537 lakes assessed over period of record



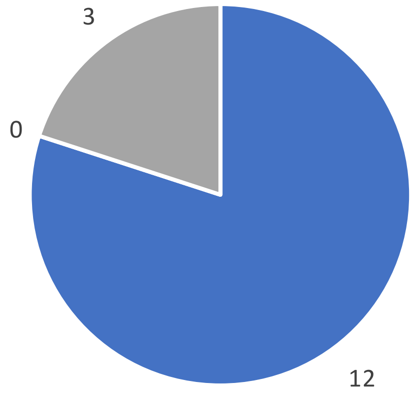
Rivers

River phosphorus concentration trends
60 MN sites (2008-22 FN trends)



Streams in Metro

Stream phosphorus concentrations
15 Met Council sites (2000-21 FN trends)

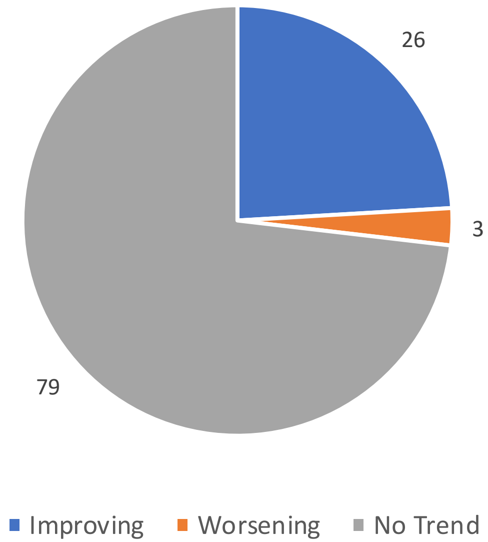


No change
Good
Bad

In-state nitrate trends – mixed results, but more improvements than in past times

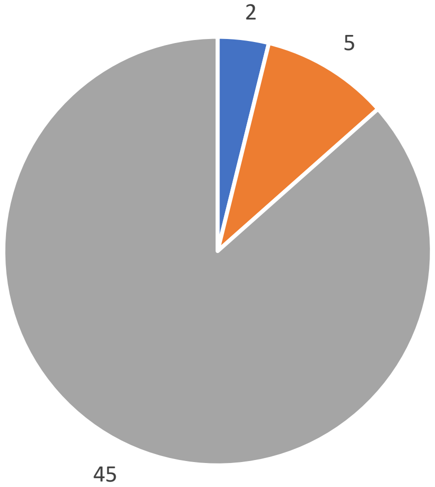
Wells

Nitrate trends in 108 surficial aquifer
108 ambient wells (2007-2013



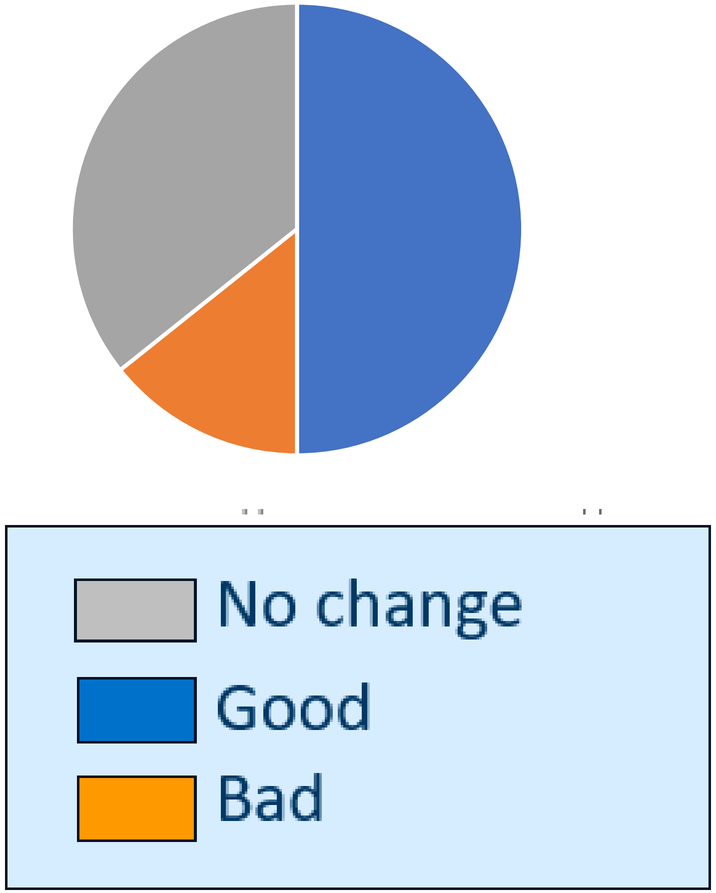
Rivers

River Nitrate Concentration FN Trends
52 sites (2008-2022)



Streams in Metro

Stream nitrate trends - Ag & Urban watersheds
Twin Cities region (2000-21 FN trends)



Practice	Lifecycle cost[a] ($/treated ac/yr)
Drainage water management & treatment	
Denitrifying bioreactor	$21
Drainage water management (controlled drainage)	$14
Drainage water recycling (stored water back onto cropland)	NA
Saturated buffer	$37
Wetland Construction	$62
Fertilizer management and efficiencies	
Fertilizer efficiency practices	Cost savings
Continuous living cover increases	
Conversion of row crops to perennial crops for food, fuel, forage and other working lands	$63 Kernza®
Conversion of cultivated lands to strategically placed set-aside grasses	$252
Conservation crop rotation (at least 2 yrs perennial crops added into rotation)	$32 if Kernza® grown 3/6 yrs in rotation
Cover crop (into corn/soybean)	$45–$65
Cover crop following short season crops	$34
Erosion and overland runoff controls	
Residue and tillage management, no-till/strip-till	
Residue and tillage management, reduced till	Cost savings
Improving open tile intakes	$1.2
Water and sediment control basin	NA
Grassed waterway	NA
Contour buffer strips or prairie strips	NA

- “**The human dimension needs to be understood**. The NRS is science-based. This science includes social science and the human dimension of conservation adoption and behavior change. Money alone cannot solve the water nutrient issues. Achieving a high level of practice adoption requires working with people. Understanding and removing barriers to adoption and engaging farmers and the agricultural community will help Minnesota move toward progress.”

- **Use successful programs.** Minnesota has achieved nutrient reduction through many excellent programs and approaches over the past 15 years. These programs should continue, and they should innovate and adapt to be most effective in the future. Private sector involvement has been important and will be increasingly important.

- **Increase practice adoption**. Proven approaches to scaling up practice adoption have common characteristics: building trusted relationships, local capacity to assist farmers and meet them where they are, flexibility to accommodate diverse farm situations, consistent messaging, strong local leadership, peer networks, and financial incentives.

- **Two scales of work are needed**. The NRS has a two-pronged strategy for further reducing rural nutrients: (1) reduce nutrients in local priority lakes, streams, and aquifers and (2) take steps for landscape-level changes statewide to reduce nitrogen by about 40% in surface and groundwater and also reduce downstream phosphorus.

Key messages at beginning of Chapter 5 – Rural Nutrients

Research and demonstration remain critical. Enough research has been completed in the past to enable Minnesota to move forward in promoting and implementing proven practices. However, to reach the landscape levels of change previously described, more research, demonstration projects, and pilot programs are needed to support existing and emerging cropping systems, technologies, and practices. The research should include confirming and quantifying the multiple benefits provided by nutrient-reducing practices in colder climates.

Key messages at beginning of Chapter 5 – Rural Nutrients

Successful implementation of the recommendations will require adequate funding and commitments by local, state, federal, and private sector organizations. The inertia of the current system, including federal crop insurance programs, lender rules, existing markets, financing, and policy, can significantly affect the adoption rate of needed practices. A long-term, comprehensive approach that considers both state-level and broader societal factors is essential for achieving sustainable agriculture and water quality.

Key messages at beginning of Chapter 5 – Rural Nutrients

Successful implementation of the recommendations will require adequate funding and commitments by local, state, federal, and private sector organizations. The inertia of the current system, including federal crop insurance programs, lender rules, existing markets, financing, and policy, can significantly affect the adoption rate of needed practices. A long-term, comprehensive approach that considers both state-level and broader societal factors is essential for achieving sustainable agriculture and water quality.

Cost-benefit analysis

- The NRS recommends conducting an economic analysis that will inform the development of a strategy for funding the needed practice changes and additions. Recommended parts of the analysis include:

- Building from information in Chapters 4 and 5, assess the total costs to landowners, city residents, and government agencies to implement the practices identified in Chapters 4 and 5.

- Estimating the economic benefits to society of the adoption of the practices in Chapters 4 and 5, including benefits to local and downstream water quality and the additional multiple benefits to society expected from these practices apart from nutrient reduction in waters. Compare the societal benefits to the cost of implementation.

- Identifying funding options for adding the NRS practices to the landscape, including pros, cons, and unintended consequences/risks associated with the options. Make recommendations on the best ways to pay for the practices.

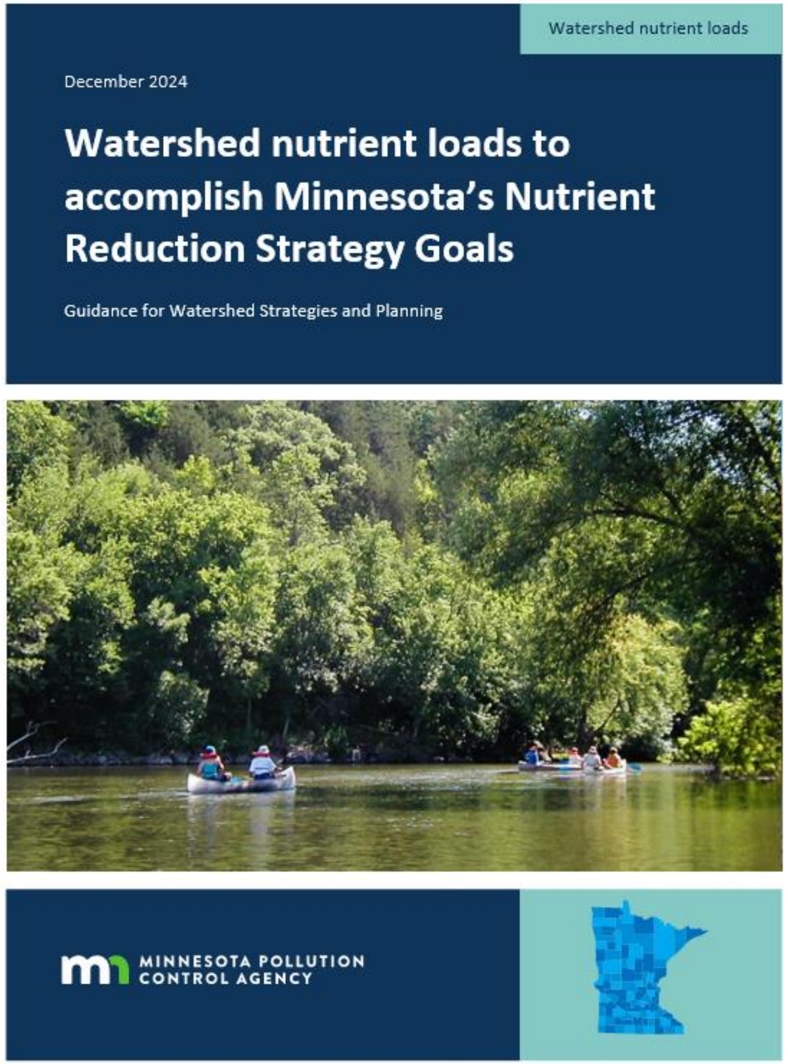
- In summary, for nitrogen fertilizer and manure additions, results from both the nutrient balance assessment and farmer surveys indicate a limited ability to reduce large-scale fertilizer rates by an amount expected to substantially decrease nitrate losses to waters. However, fine-tuning nitrogen rates may still be feasible on about 10% of corn following corn lands and about 27% of corn following soybean acres, based on survey results. These levels seem reasonable, given the 18% nitrogen surplus estimates based on statewide nutrient balances derived from fertilizer sales, manure production, and field-specific cropping information reported in Porter and Conowall (2025b).
- Additional unquantified nitrogen efficiencies may also be gained by other improvements with fertilizer and manure timing, forms, and placement. More research on how to improve in-field nutrient management will be helpful into the future, along with changes to add a longer duration of living cover on cropped landscapes.

- Each acre of cultivated fields would need at least one new practice added to achieve final goals.
- The NRS BMP-Science Team considered the needed magnitudes of adoption (as shown in tables 5-6 and 5-7) to be very challenging, at best, to achieve by 2040. Important steps to work toward large magnitude adoption levels are described in sections 5.2 and 5.3.

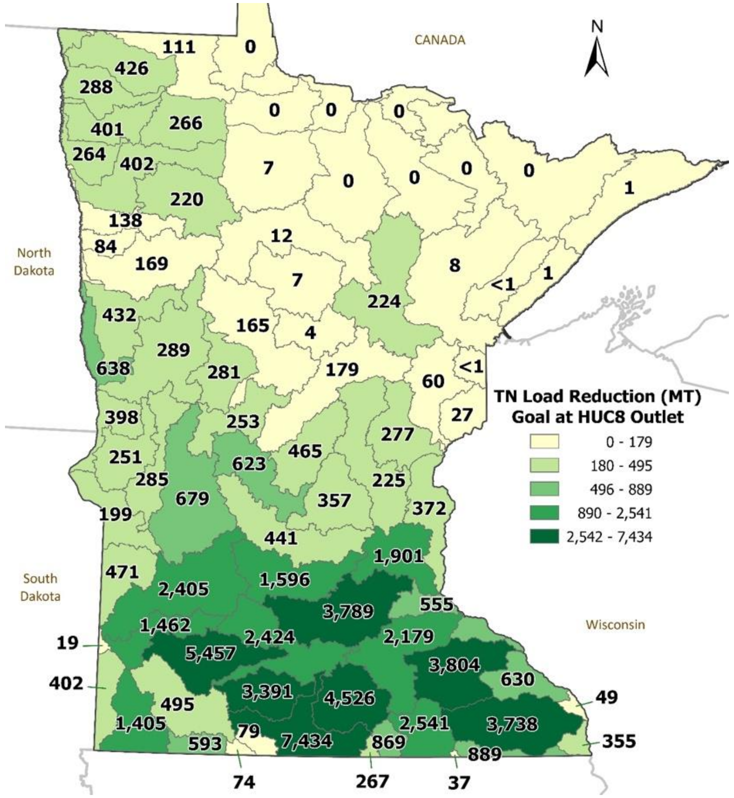
4R Nutrient Stewardship Certification program

- The NRS encourages continued work by private industry to promote nitrogen BMPs through programs such as the Minnesota 4R Nutrient Stewardship Certification program.

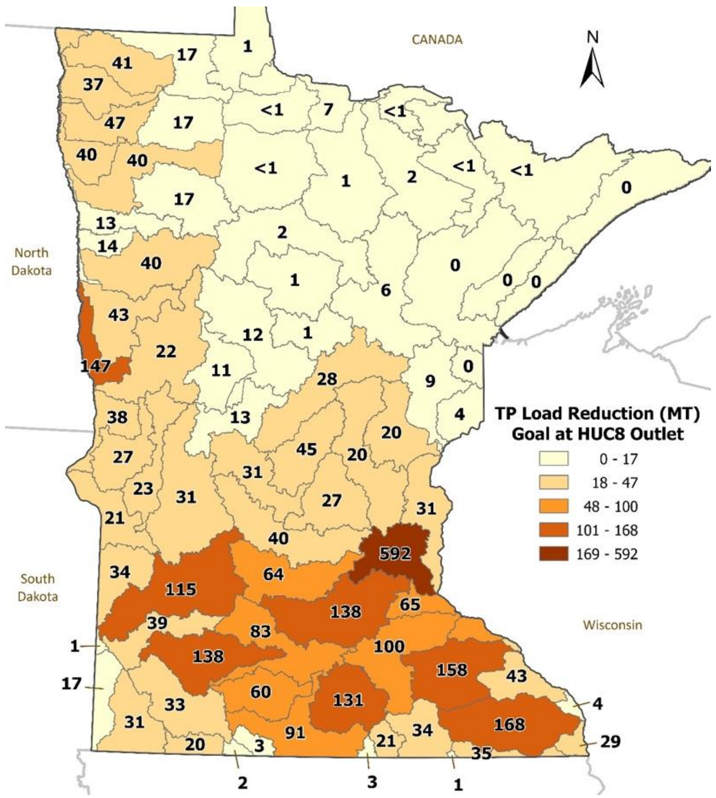
NEW – Watershed planning goals to meet downstream goals north and south



TN Load reduction planning targets



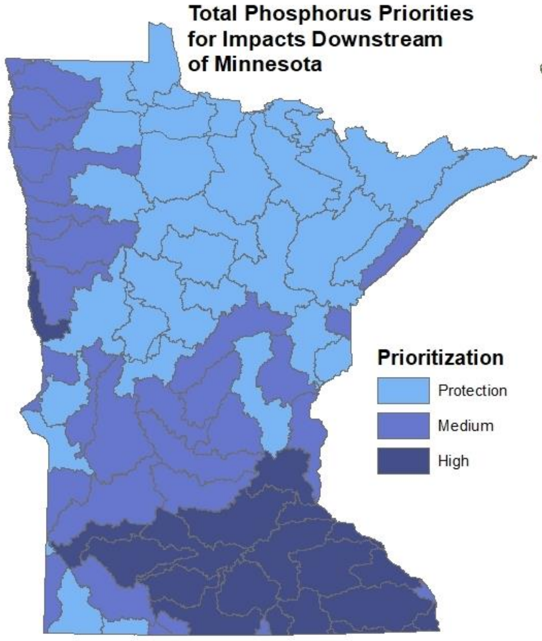
TP Load reduction planning targets



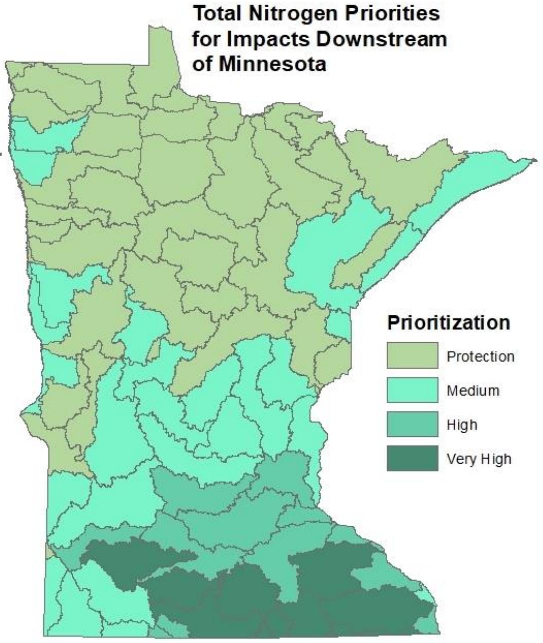
Chapters 2 & 6, support document 2-4

NEW – Priority watershed maps

Updated priority watersheds for downstream needs

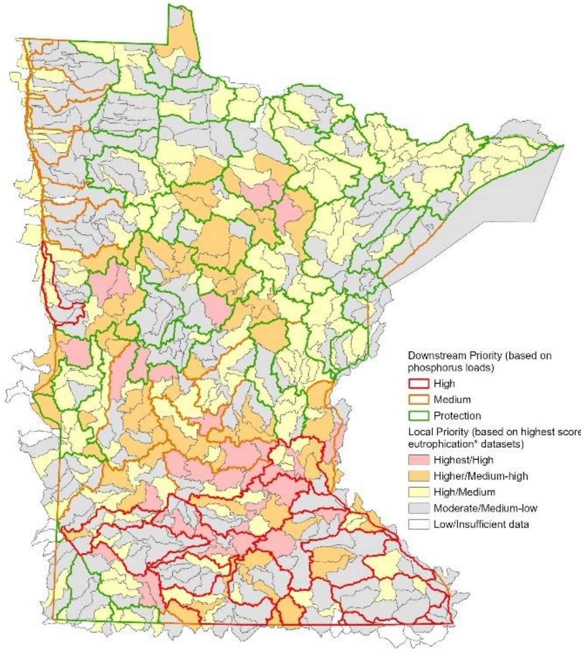


Phosphorus

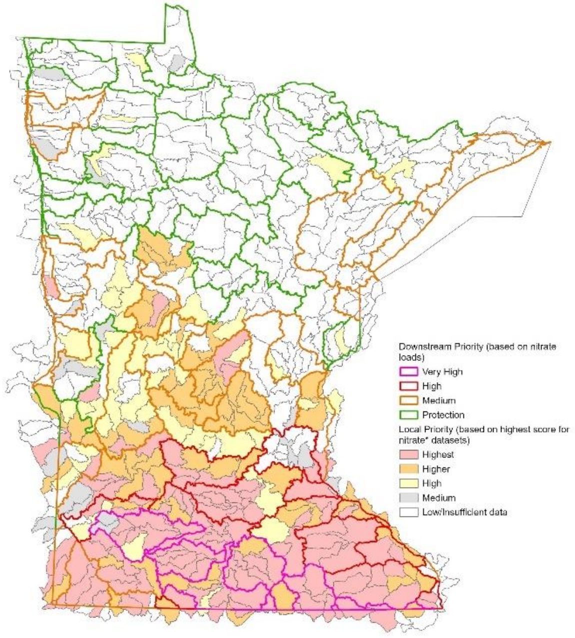


Nitrogen

New priority watersheds for in-state needs



Phosphorus



Nitrogen

Nitrogen and Phosphorus Balance

- **Nitrogen:**
  - Input: Manure Nitrogen + Commercial Fertilizer Sales
  - Output: UMN N Fertilizer Recommendations
- **Phosphorus (P2O5):**
  - Input: Manure Phosphorus + Commercial Fertilizer Sales
  - Output: Crop Phosphorus Removal
- **Timeframe:** 2018-2023

What it will take – Many rural and urban practices

State-level support

Government
- Science
- Goals
- Programs
- Tools
- Tracking

Private sector

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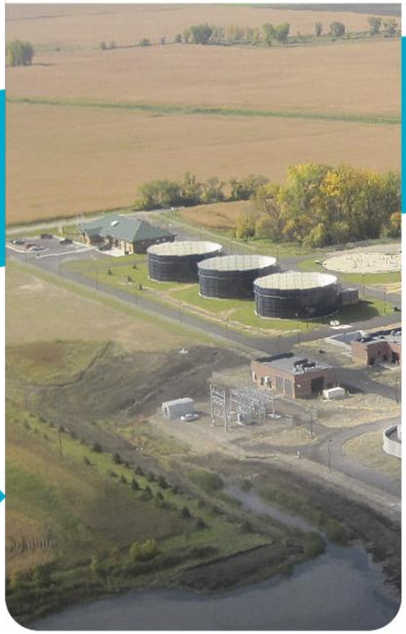
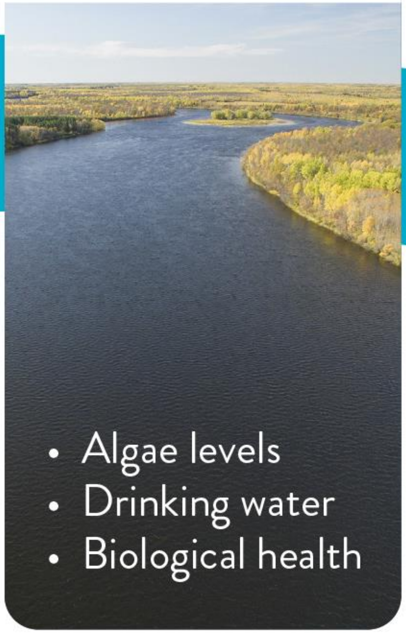
Local watershed work

Rural and urban practice adoption



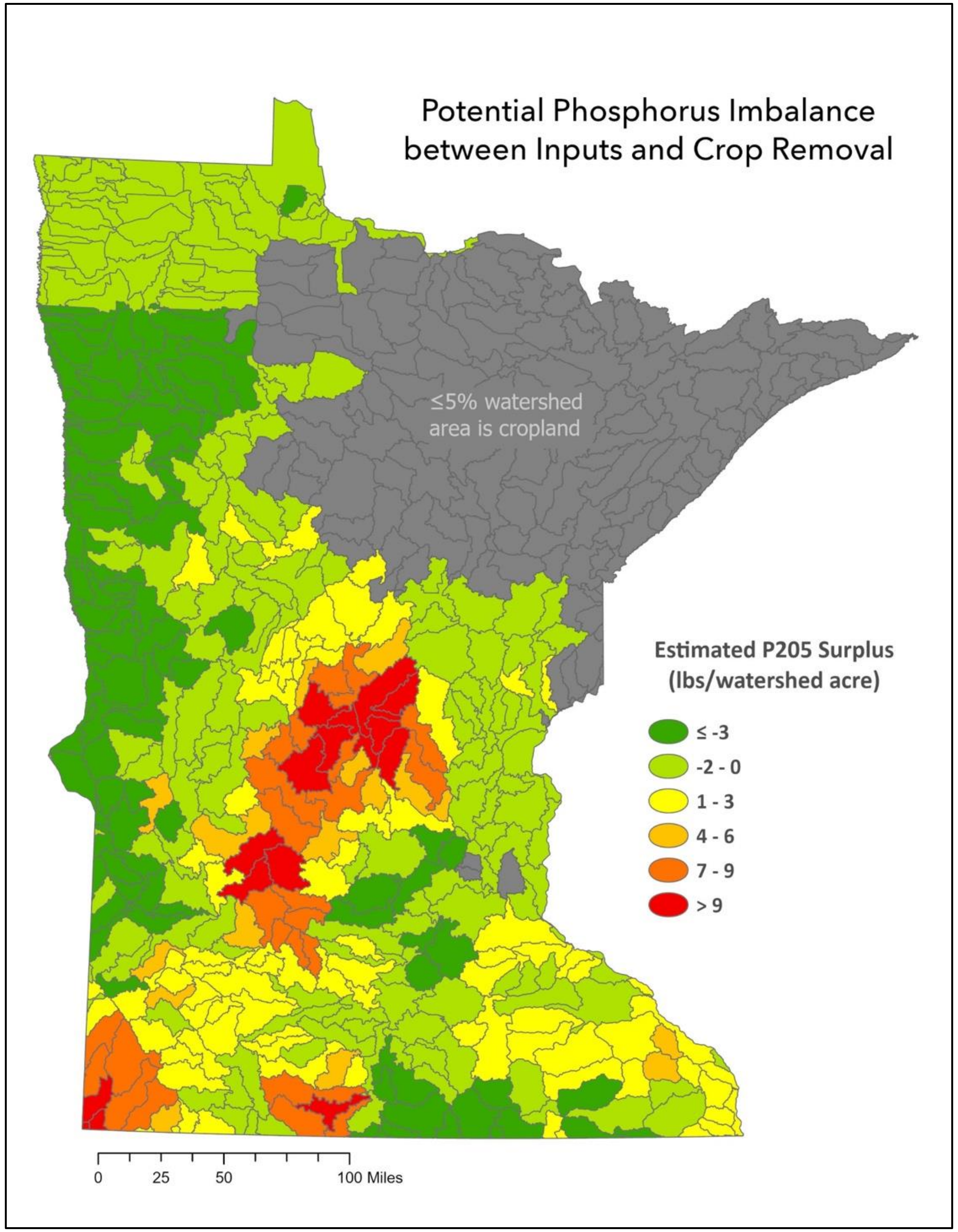
Improve local waters

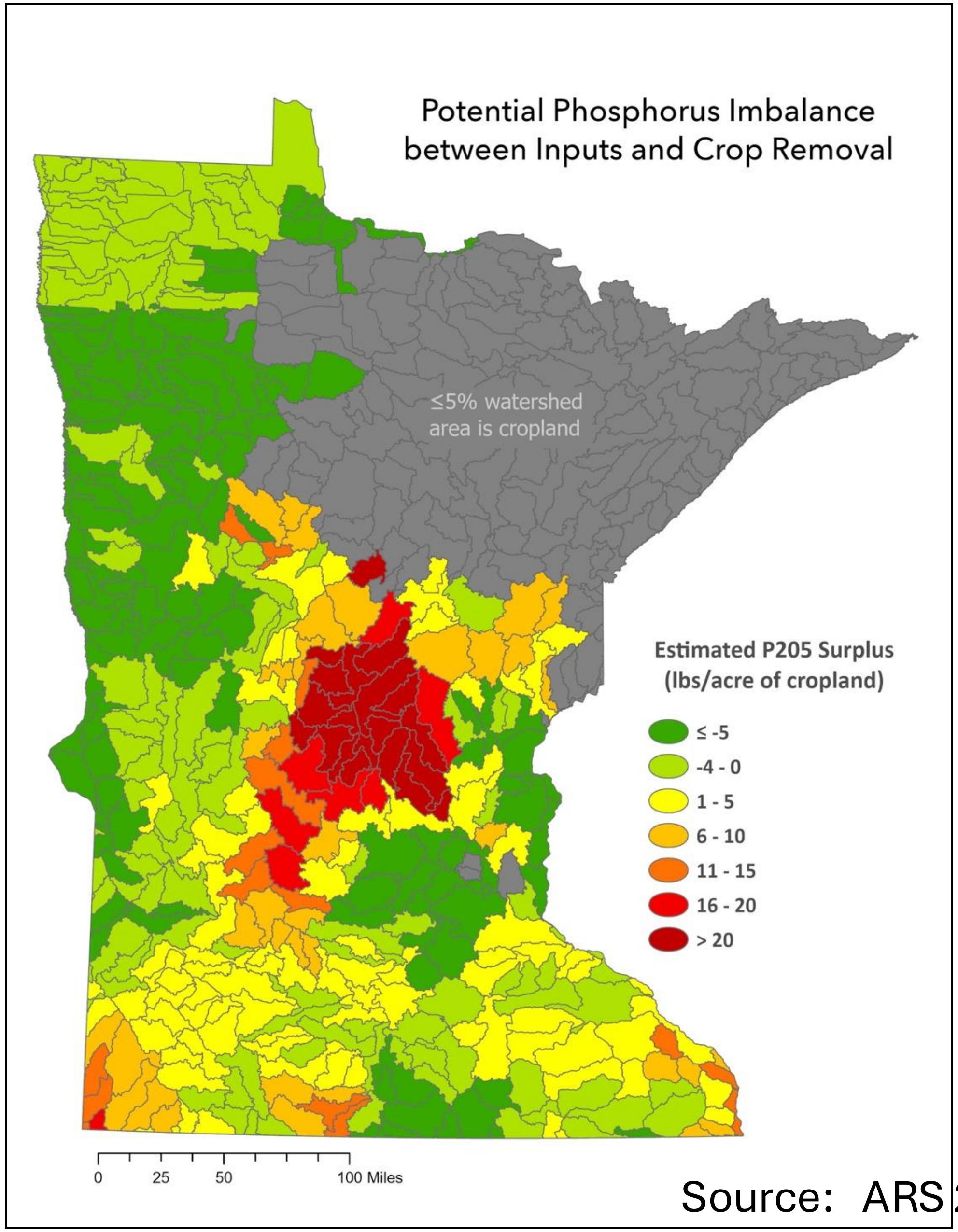


- Algae levels
- Drinking water
- Biological health

Improve downstream waters

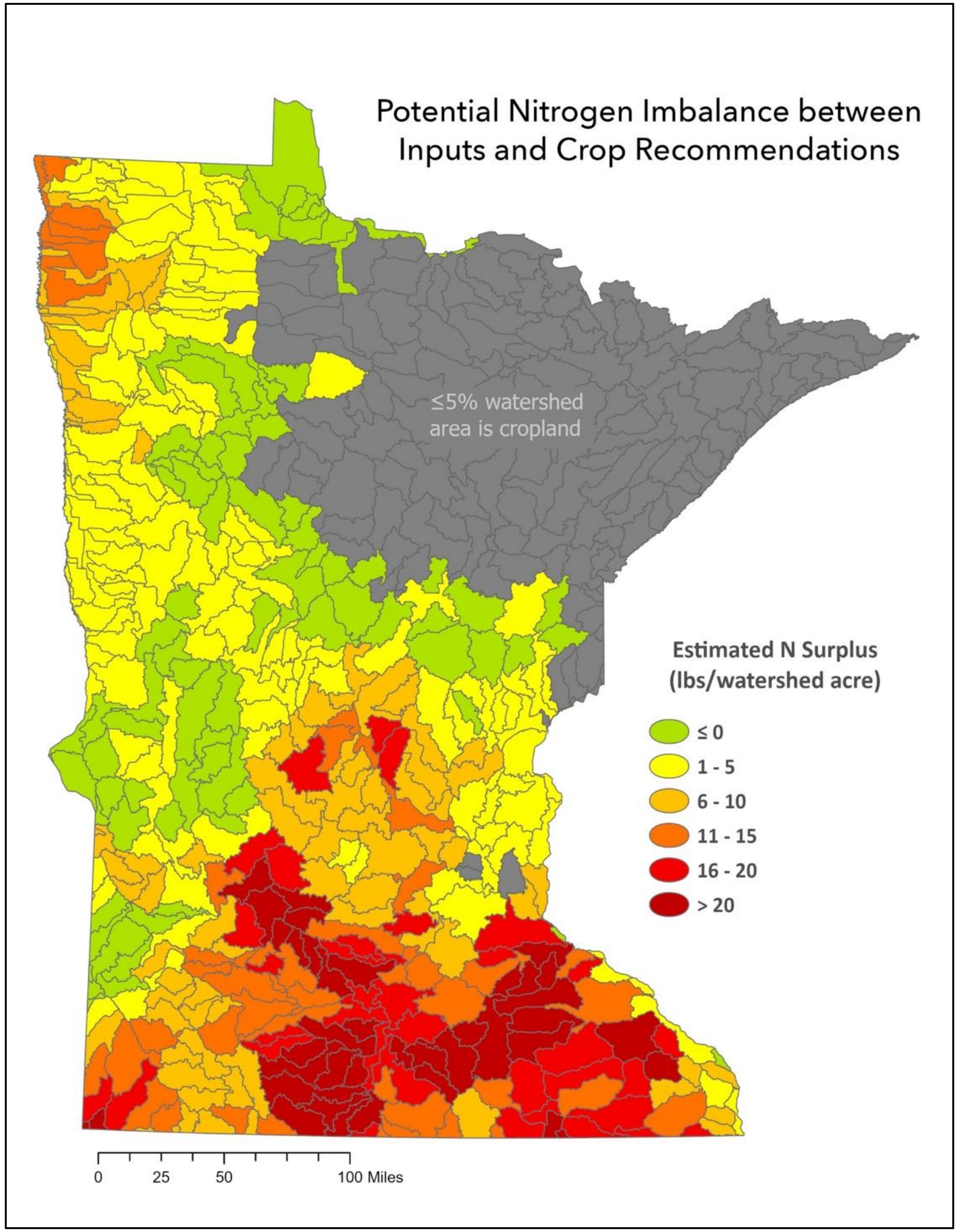
Results: Phosphorus Surplus at a HUC10 Scale

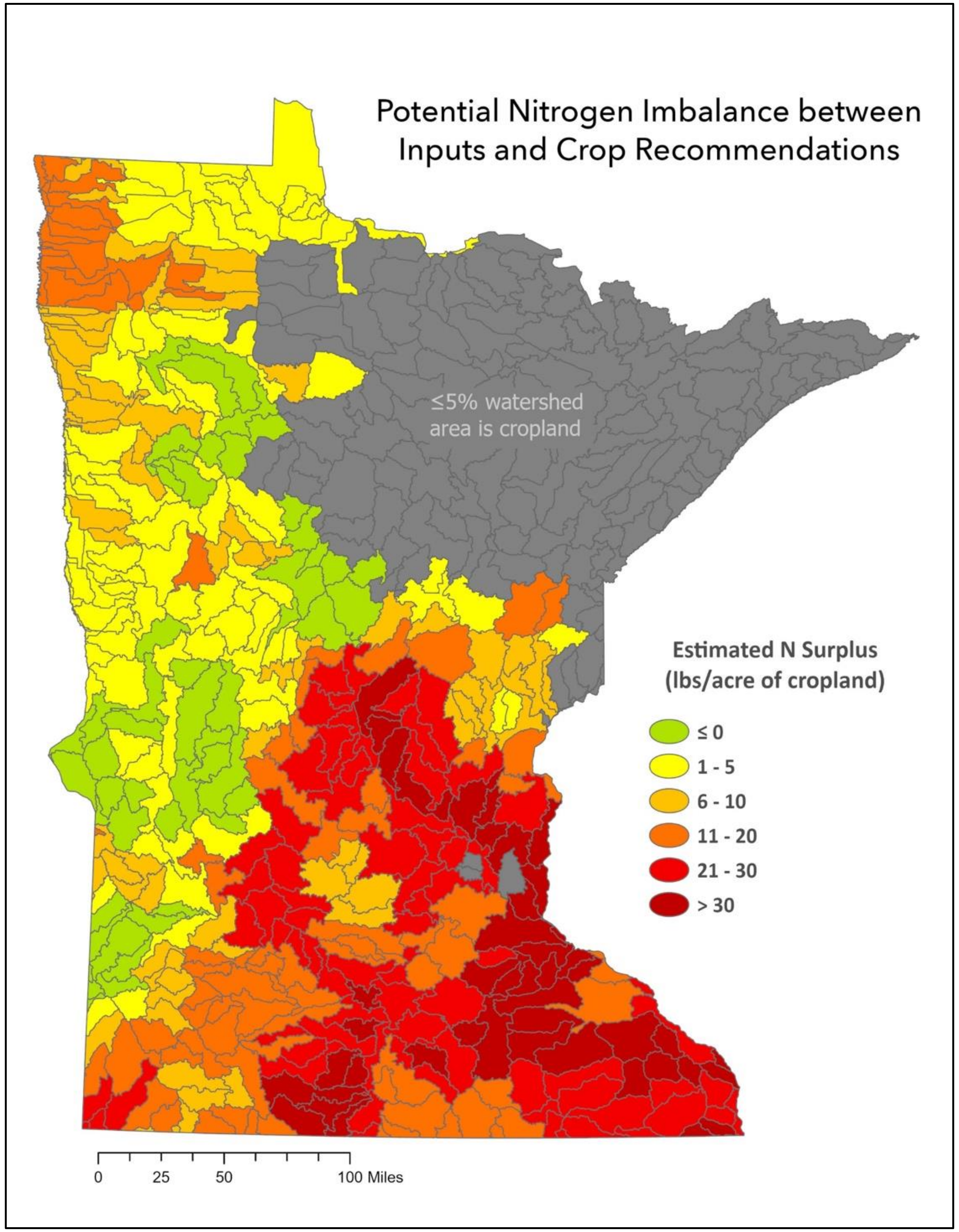




Source: ARS 2025

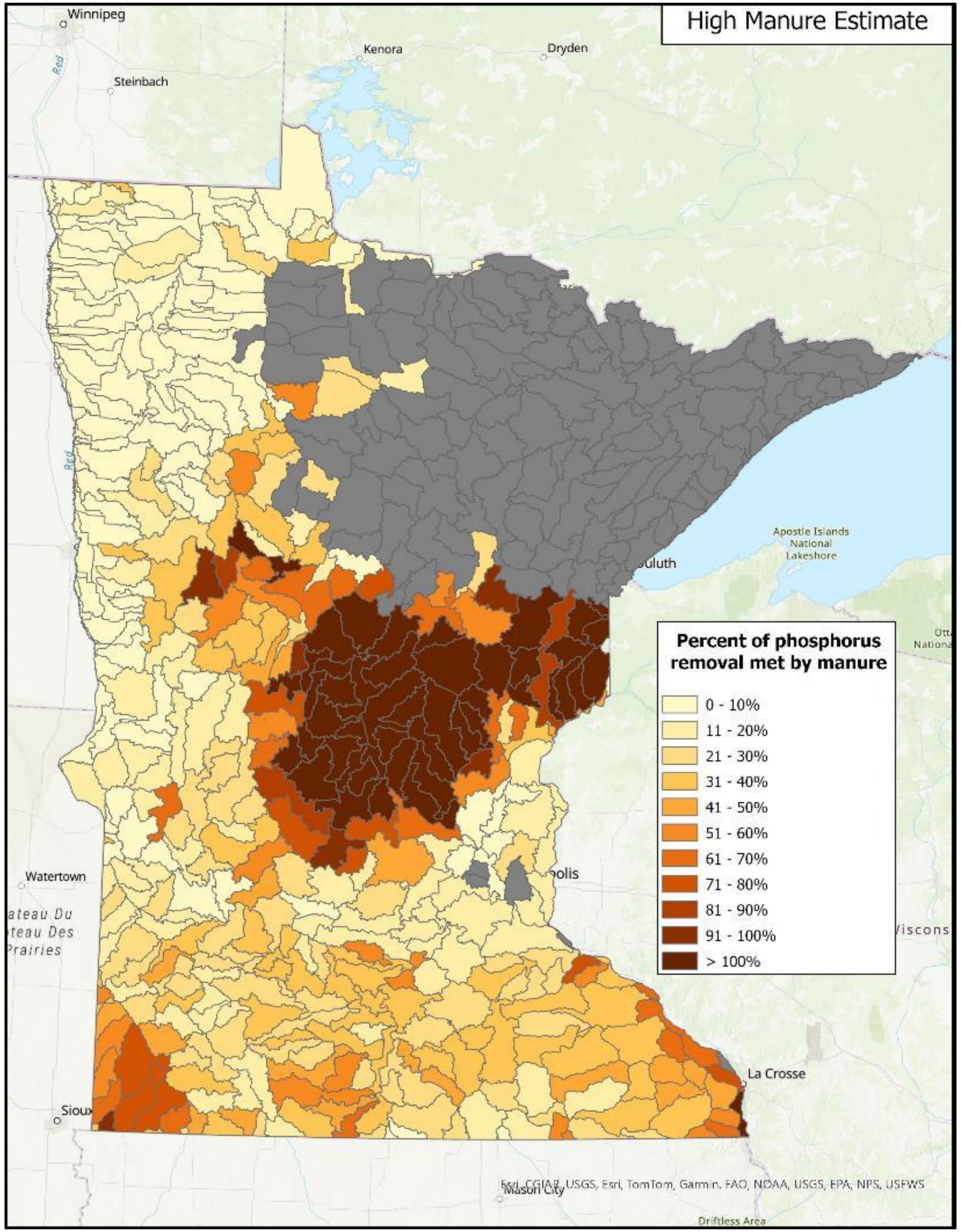
Results: Nitrogen Surplus at a HUC10 Scale





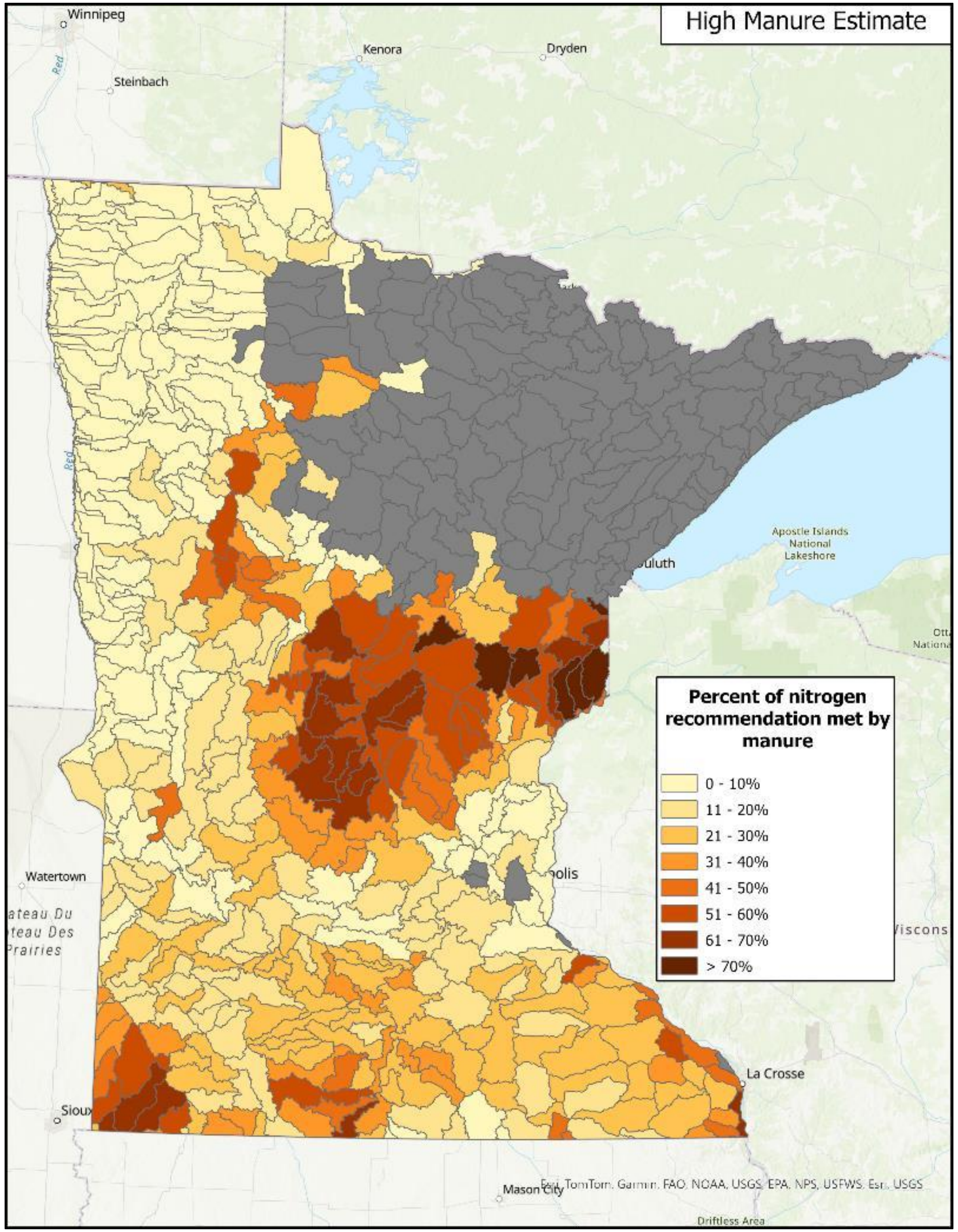
Phosphorus

- Manure supplies **26.8%** of statewide P205 removal.
- Manure summed with commercial fertilizer sales shows **100.7%** of statewide crop P205 removal, indicating a minimal statewide surplus (95.5% at low end, 105.9% at high end)



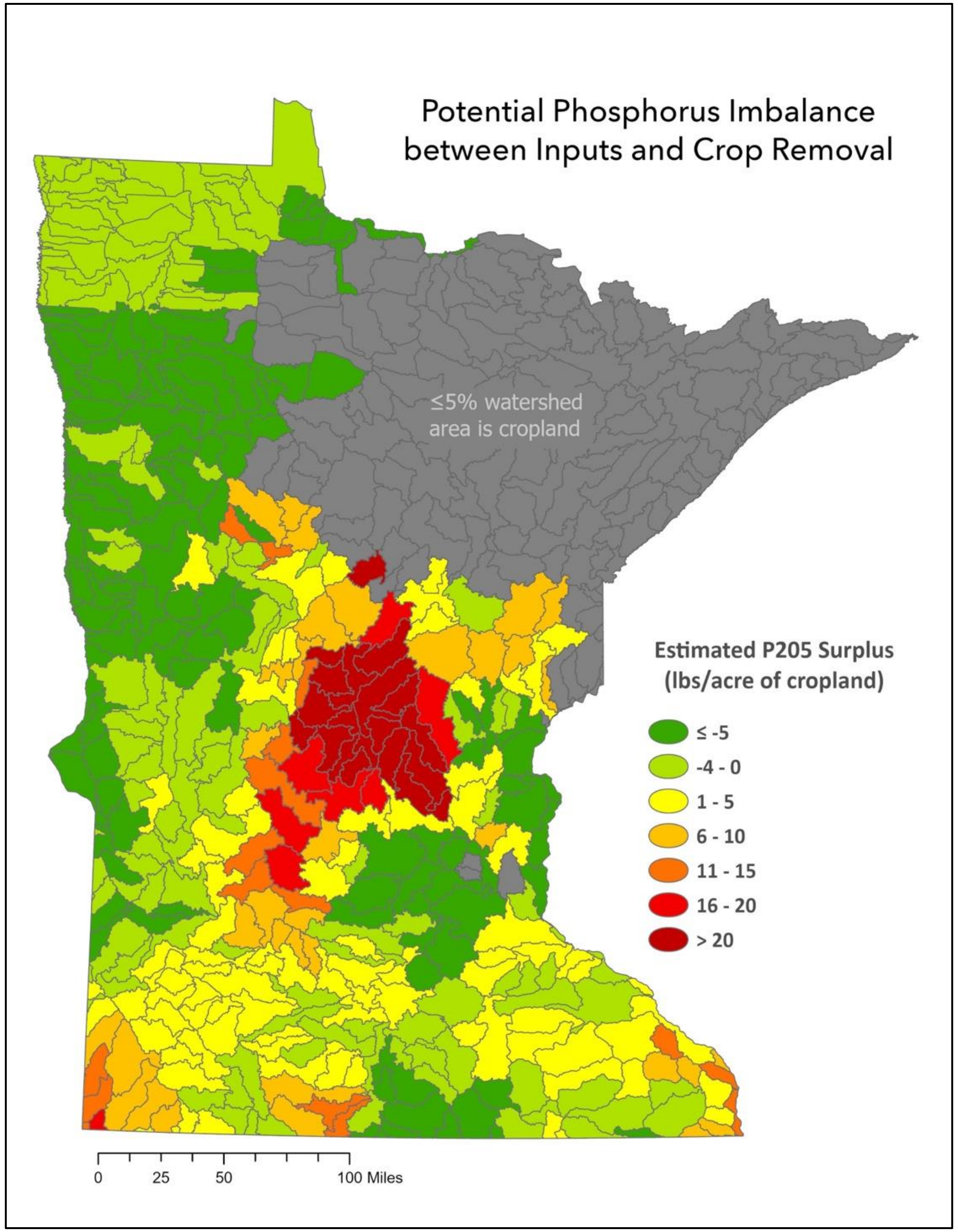
Nitrogen

- Manure N summed with commercial fertilizer N sales, shows a potential surplus of ***144,179 tons*** of N statewide
- ***18.2%*** above statewide crop N recommendations
  - 21.4% high end, 15.0% low end



Phosphorus balance

- Manure summed with commercial fertilizer sales show a nearly equal balance statewide with crop P205 removal (100.7%)

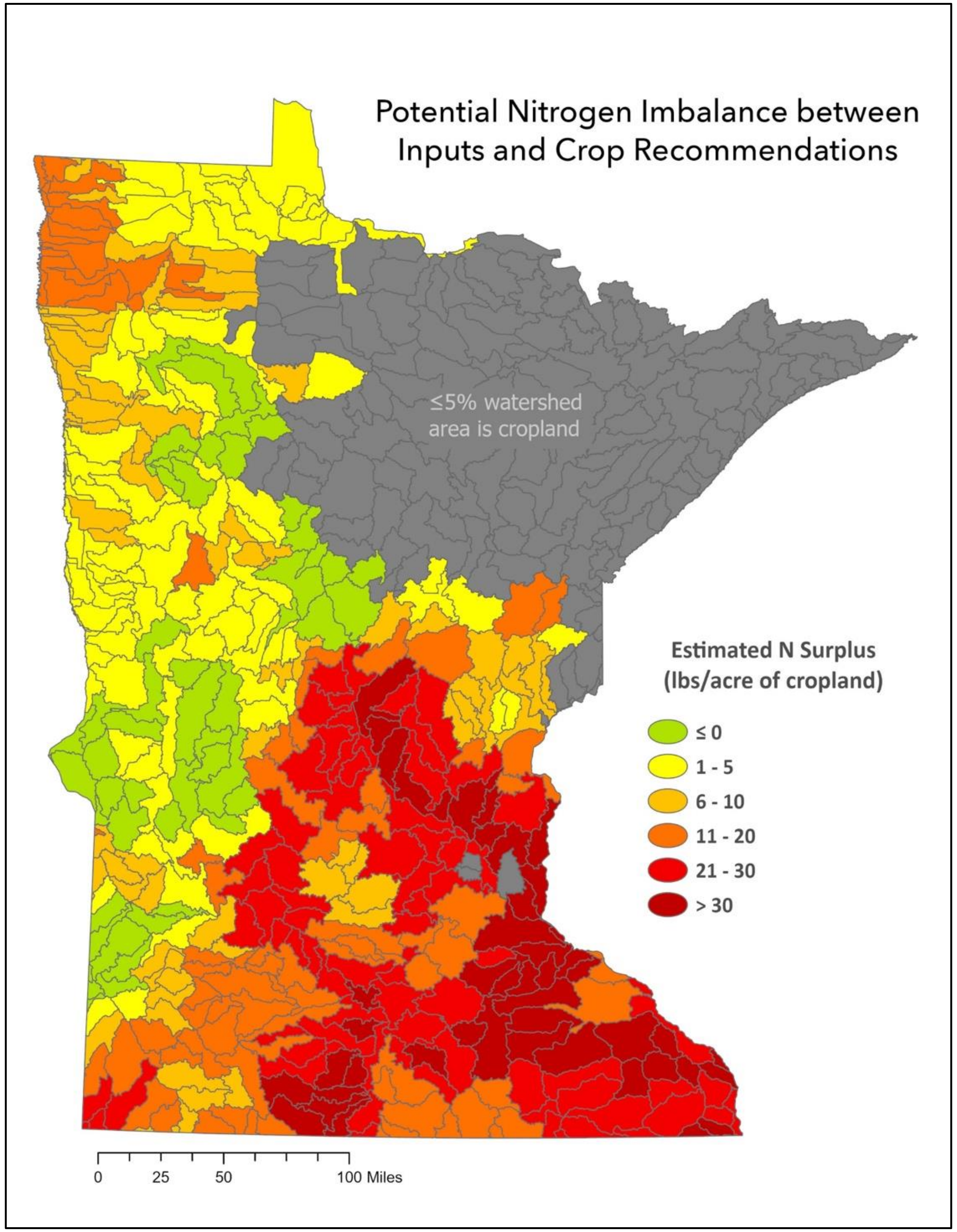


Source: ARS 2025

Nitrogen balance

- Manure N summed with commercial fertilizer N sales, shows a potential surplus of ***144,179 tons*** of N statewide

- Statewide, estimated additions to soil are **18.2%** above UMN crop N recommendations at the high-end of the 0.1 ratio range.



Source: ARS 2025