Proceedings from the 6th Annual Nutrient Management Conference

Importance of Urban and Non-urban Nutrient Reductions

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February 18, 2020

MINNESOTA POLLUTION CONTROL AGENCY

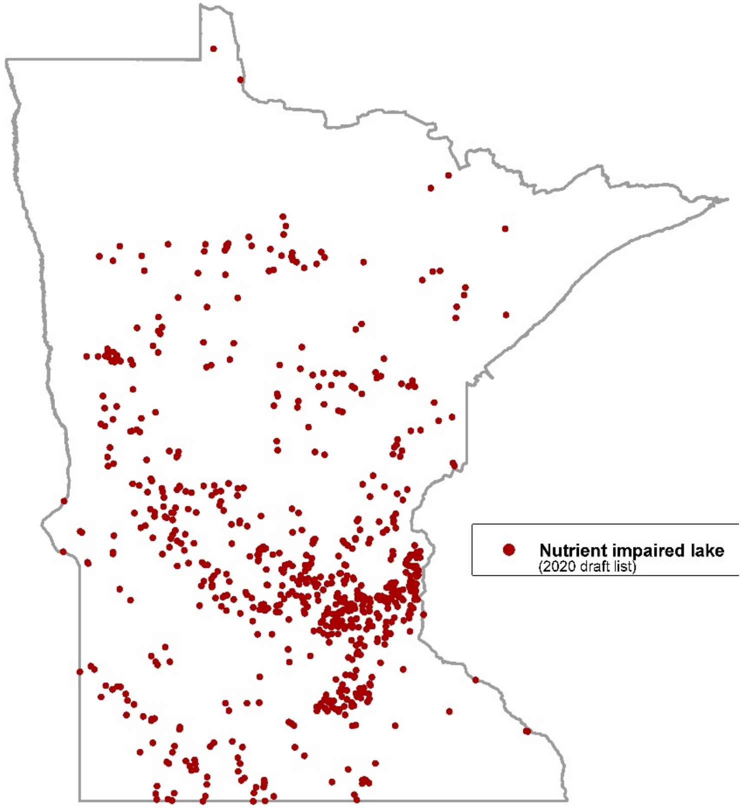
Outline – Nutrients in waters

1. Why important to reduce nutrient losses?
2. Conditions & trends
3. Sources – urban & ag important
4. We’ve made progress, but there’s more we need to do
5. Minnesota’s nutrient reduction strategy addresses both urban and agricultural sources

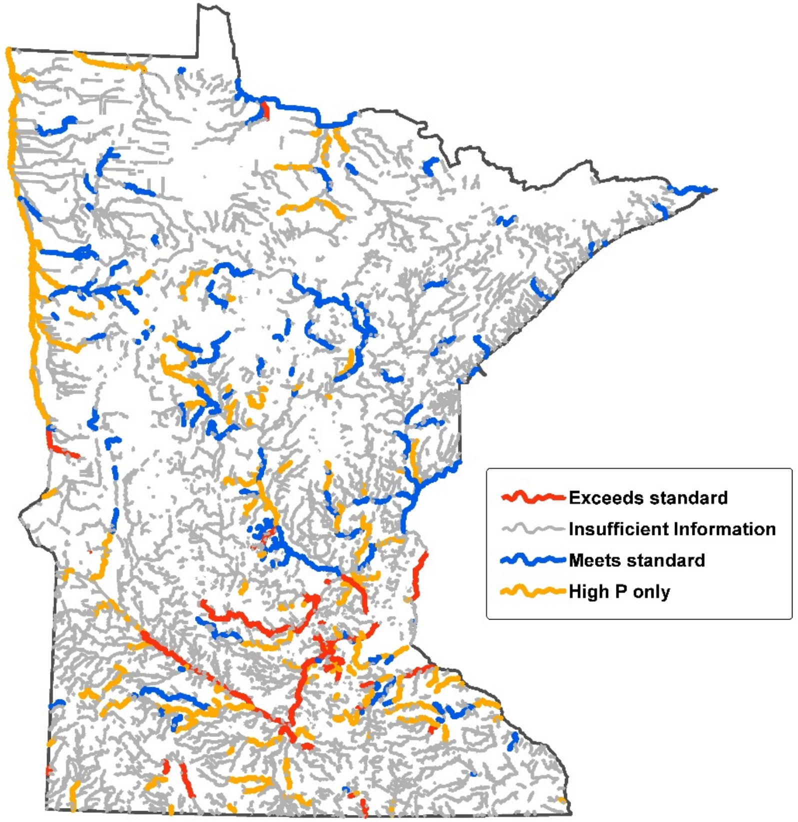
Why important? Local lake & stream impairments

Effects:
- less oxygen for fish
- toxic blue-green algae
- recreation/economic declines

693 lakes impaired

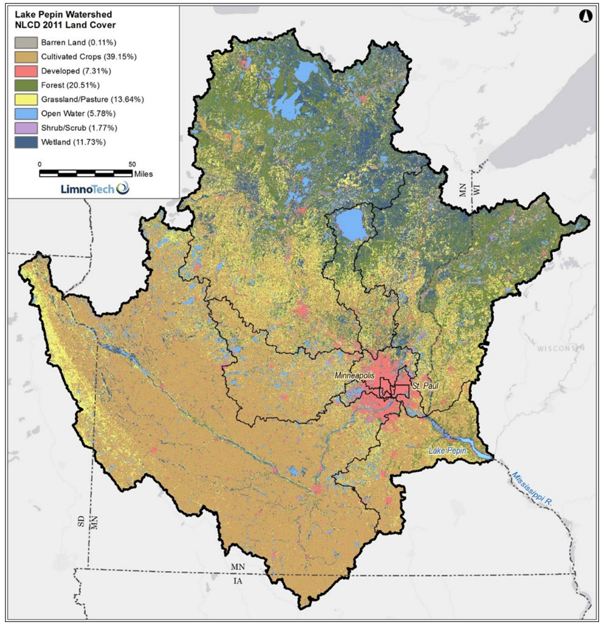


814 river miles impaired



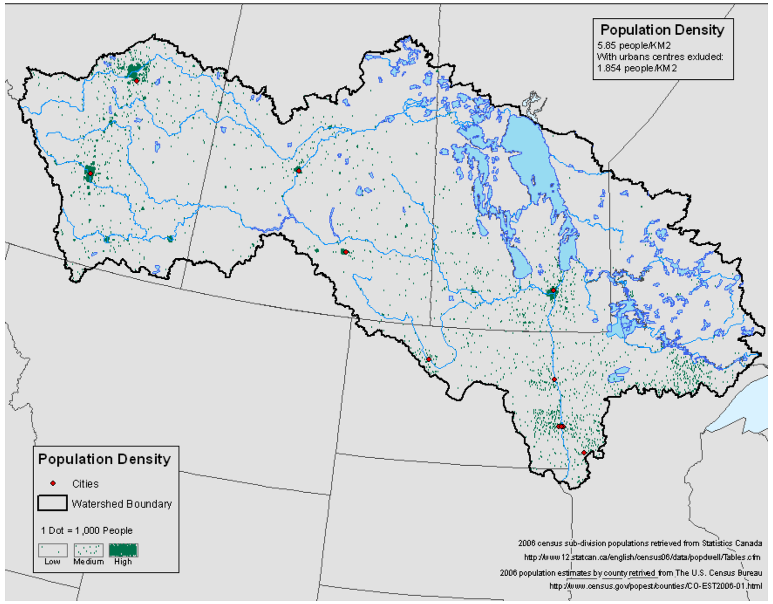
Why important?   Downstream water algae blooms

Lake Pepin
Needs 35% P reduction



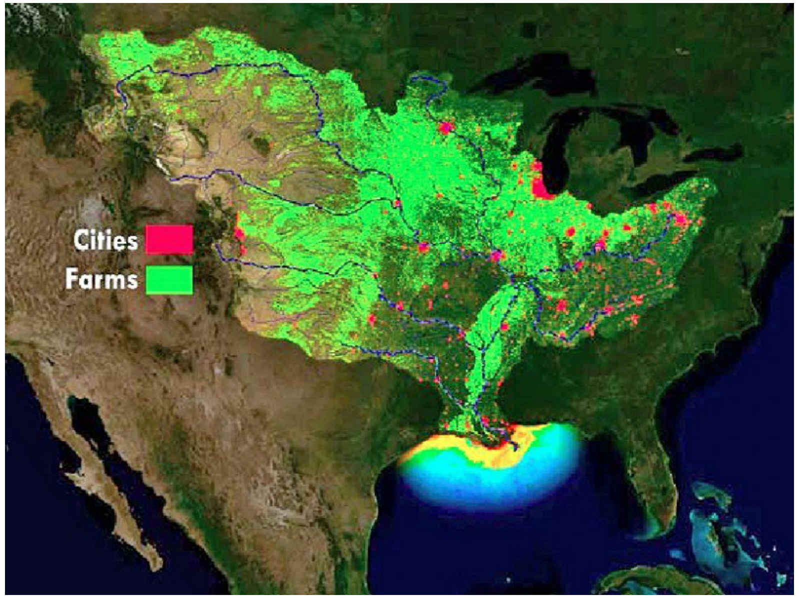
35% from a 2008-17 baseline

Lake Winnipeg
Needs 50% N & P reduction in Red River



50% from a late 1990's baseline

Gulf of Mexico
Needs 45% reduction of both N and P to reduce hypoxic zone to 1/3 current size



45% from a 1980-96 baseline

Why important? Aquatic life nitrate toxicity

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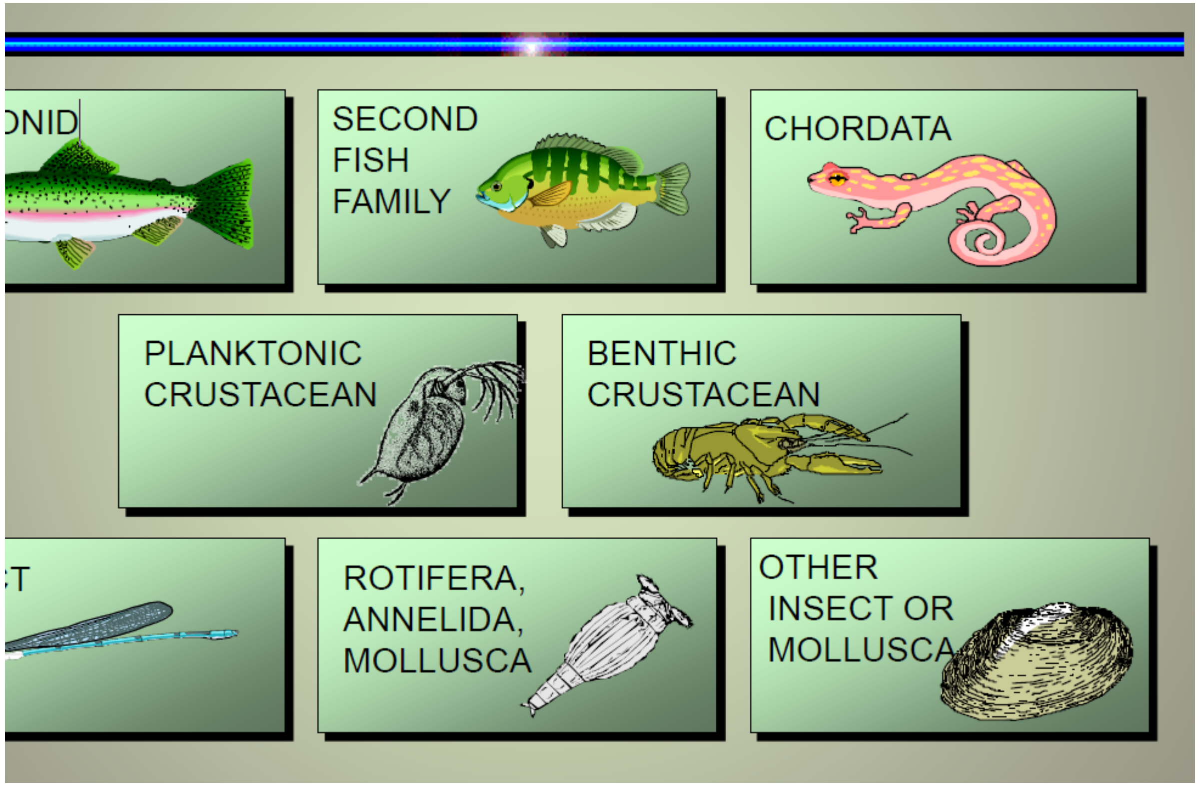


Nitrate as a biological stressor

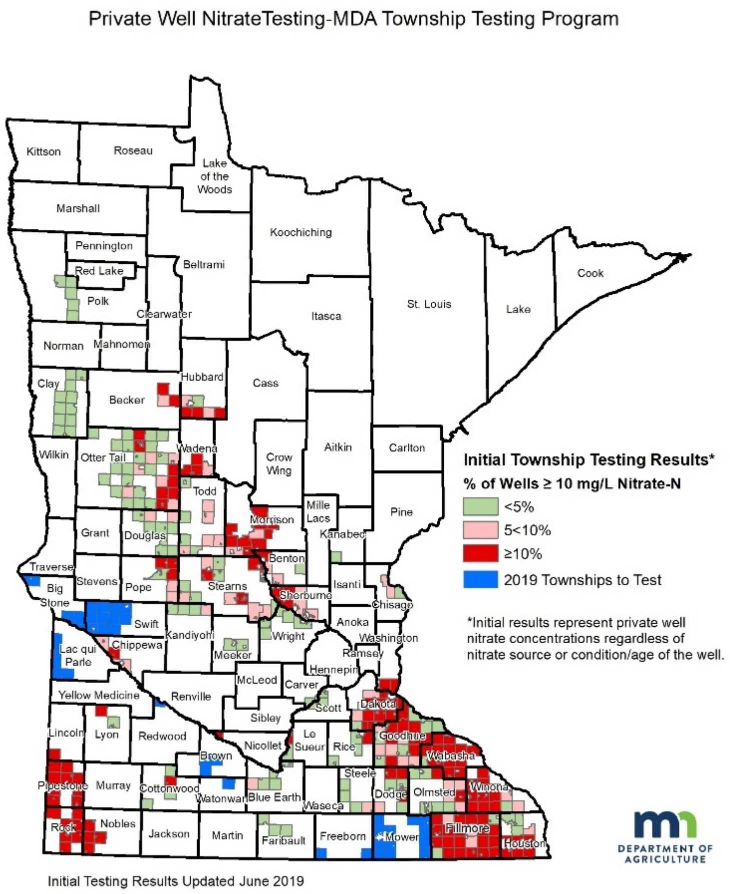
MN stream monitoring shows nitrate as one factor that negatively affects the biological health of our waters

- 286 of 756 (38%) biologically impaired reaches have nitrate as one stressor

Why important? Drinking water – local wells

Private Wells

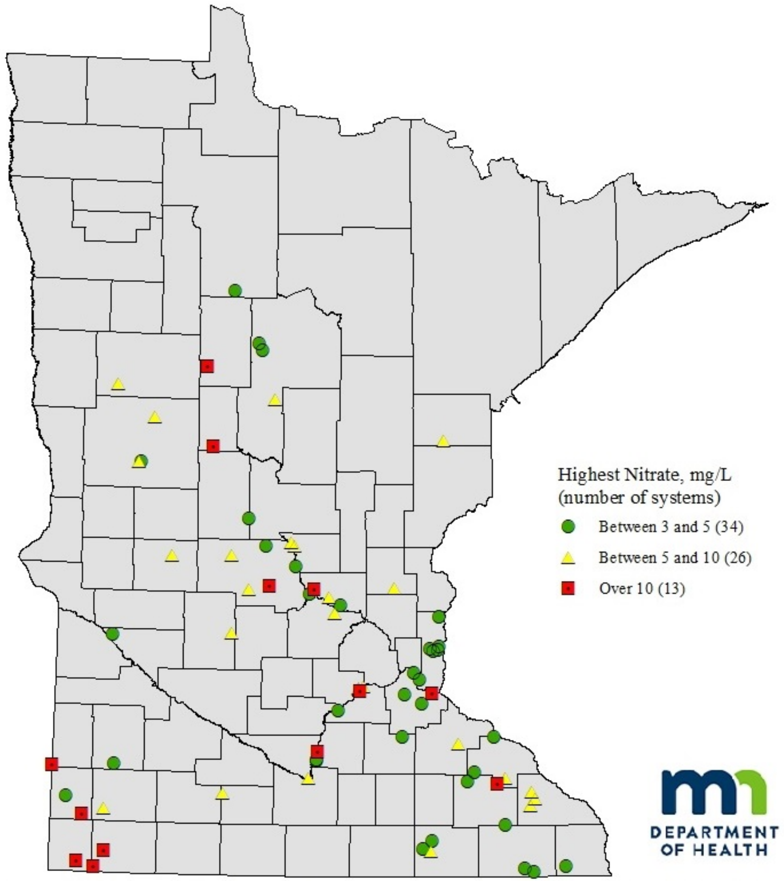
110+ townships have over 10% of wells exceeding nitrate standard



Community water systems

13 with nitrate over 10 mg/l

26 with nitrate 5-10 mg/l

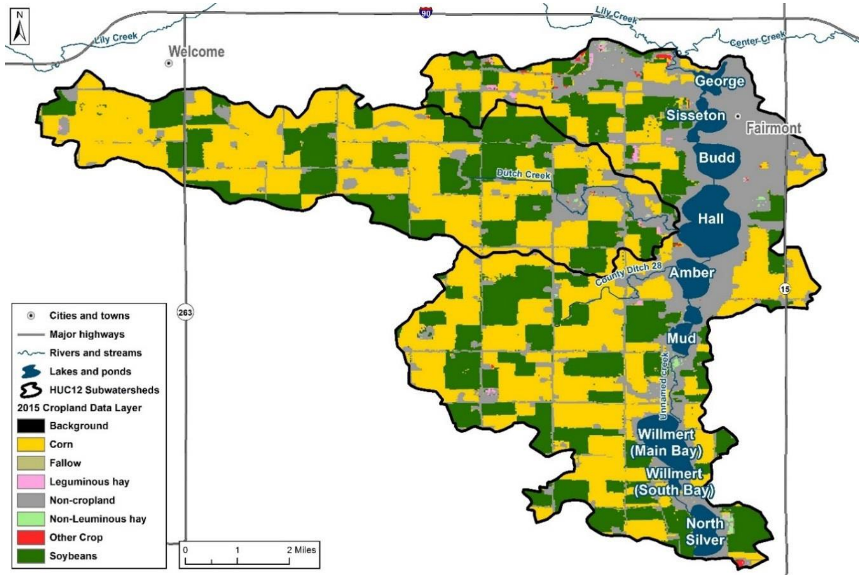


DEPARTMENT OF HEALTH

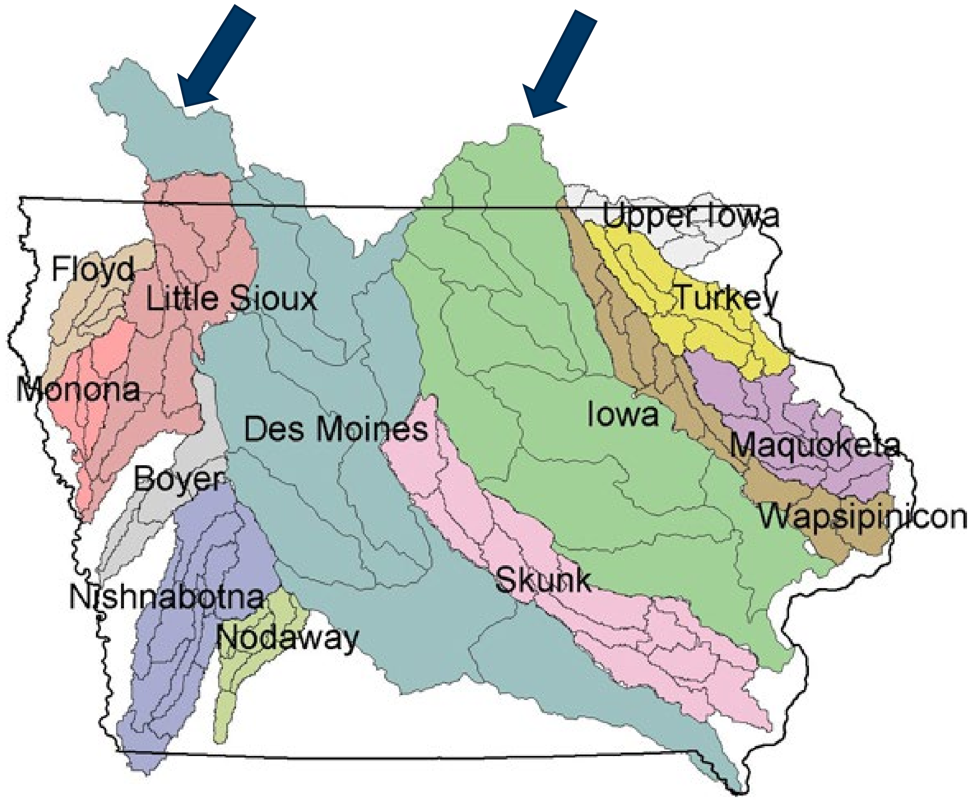
Why important? Drinking water – surface waters

Examples

City of Fairmont, Minnesota



MN headwaters to Iowa Rivers
Des Moines and Cedar Rivers

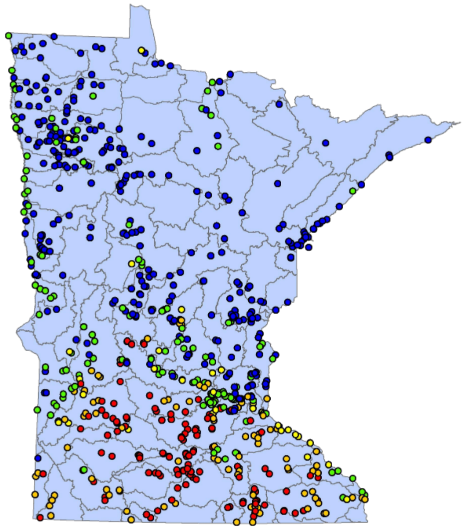


Why important? Economic costs

Examples of economic hits

- lost nutrients to water = lost fertilizer value
- Recreation and tourism in MN & Canada
- Well water treatment for nitrate
- Shell-fish industry in the Gulf of Mexico

Nutrient River conditions and trends



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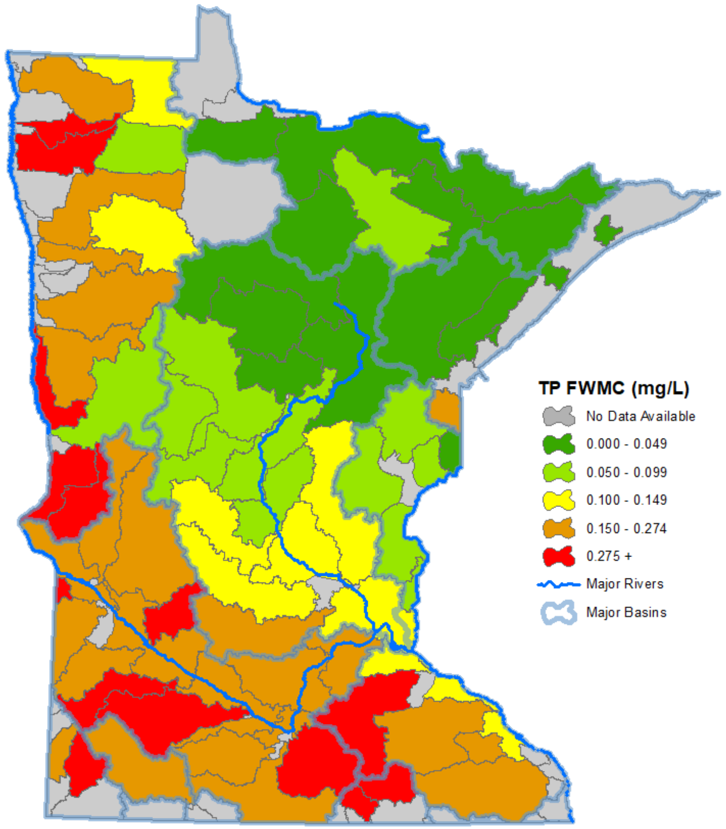
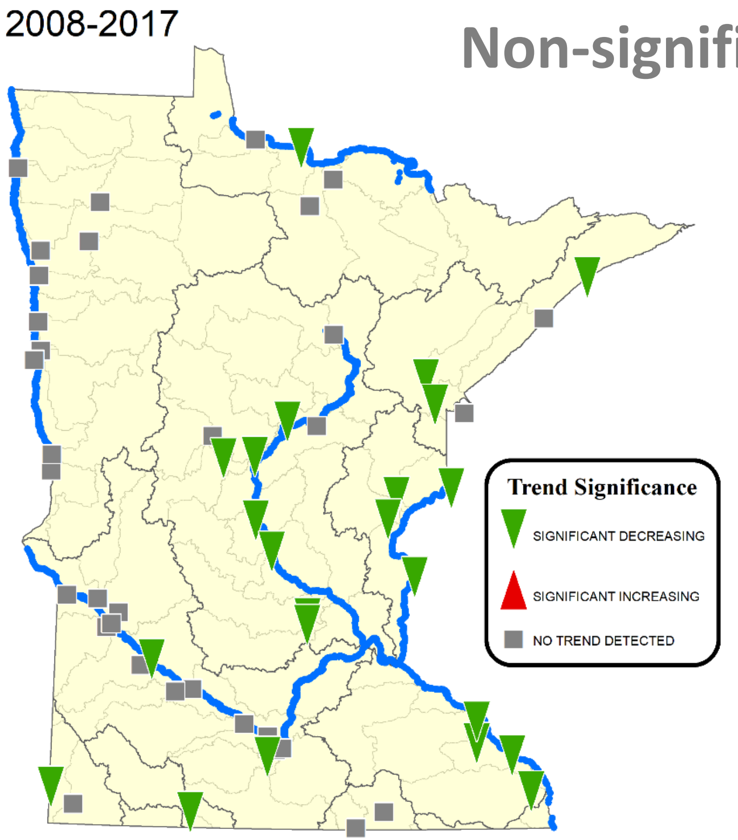
River phosphorus concentration 10-year trends

Highest phosphorus in west & south



P decreasing or Non-significant trend



Trend methods correct for river flow variability

Mississippi River phosphorus concentration decreased from 1999-2018 but flow increase makes P load trends non-significant

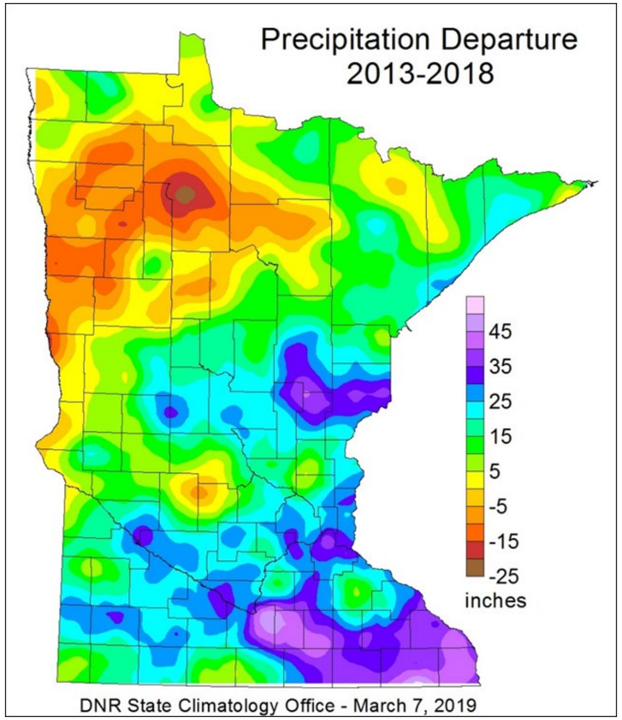
Phosphorus Concentration X Flow = Phosphorus Load

20 - 50% (decrease)

40% (increase)

NS

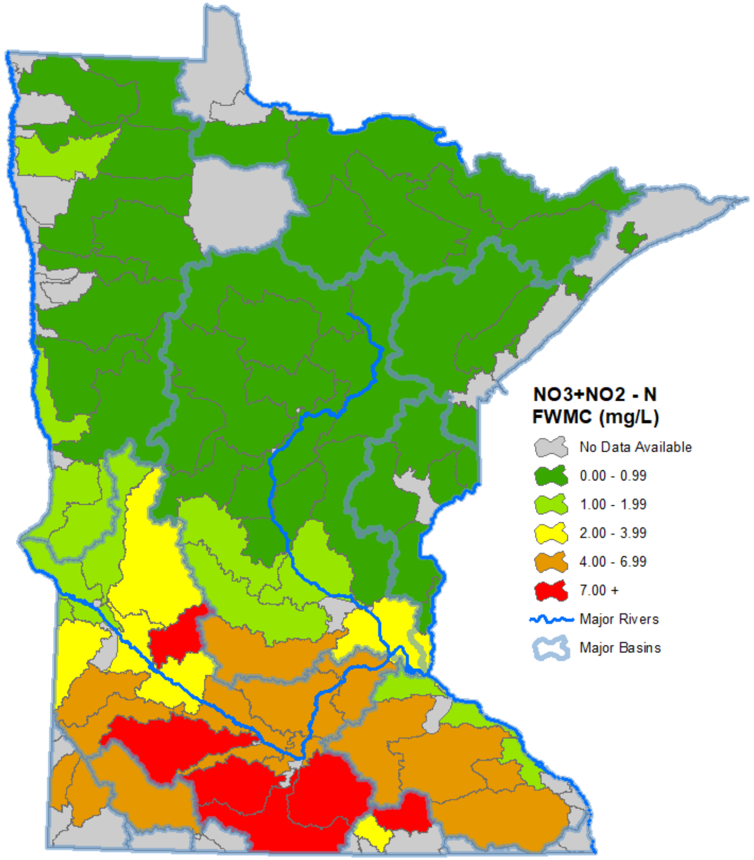
Non-significant trends



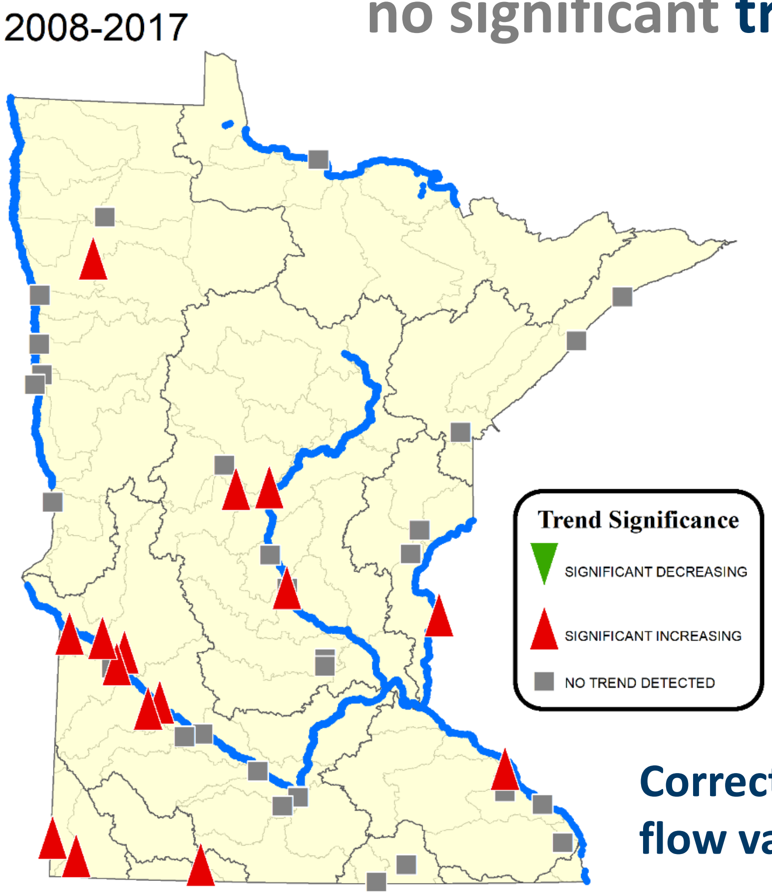
4-7 inches more rain per year in Southern MN

River nitrate concentration 10-year trends

Highest nitrate in southern MN

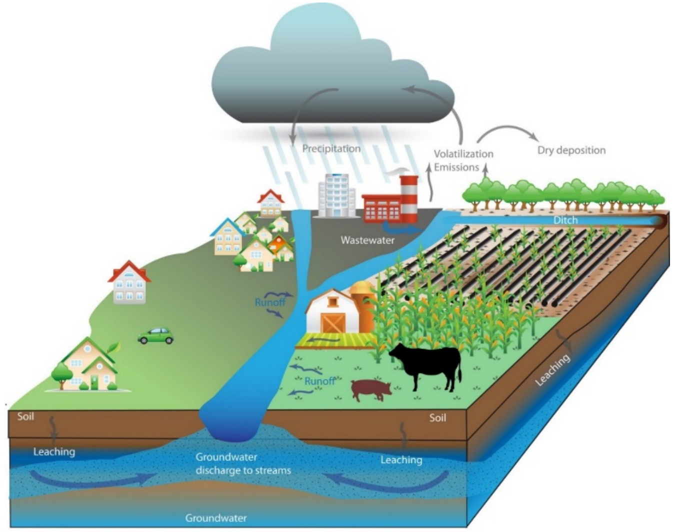


Nitrate increasing or no significant trend



Corrected for flow variability

Nutrient Sources



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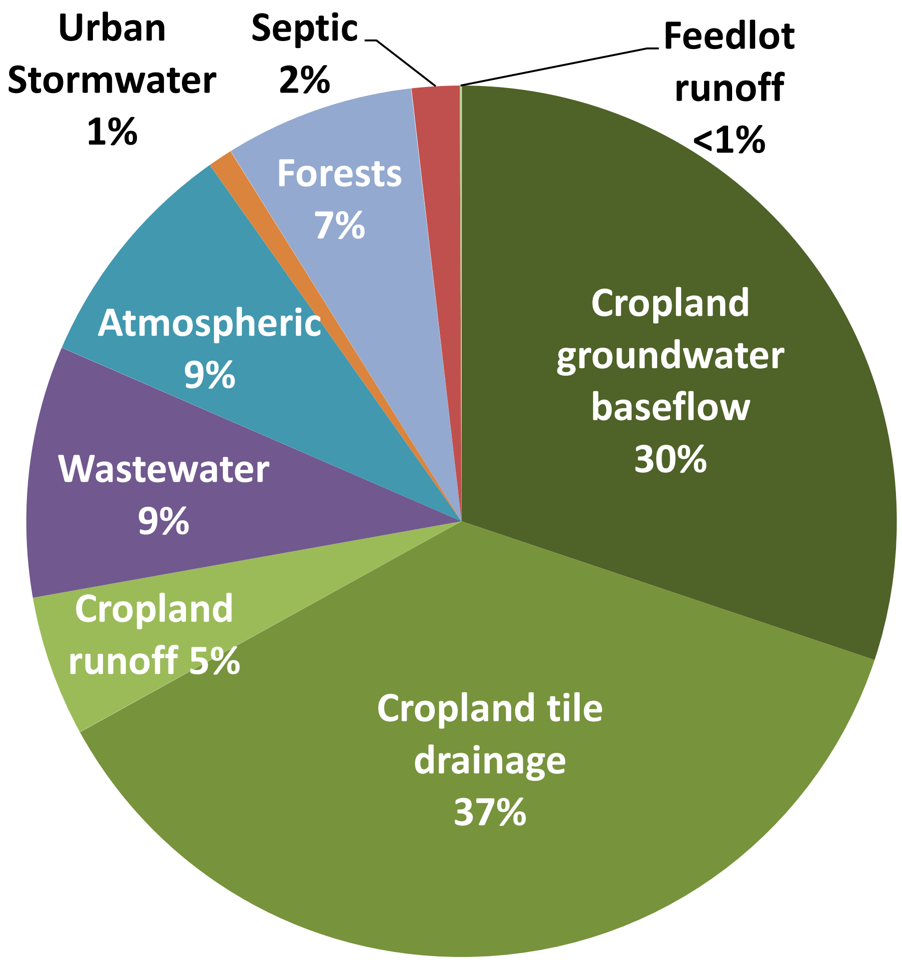
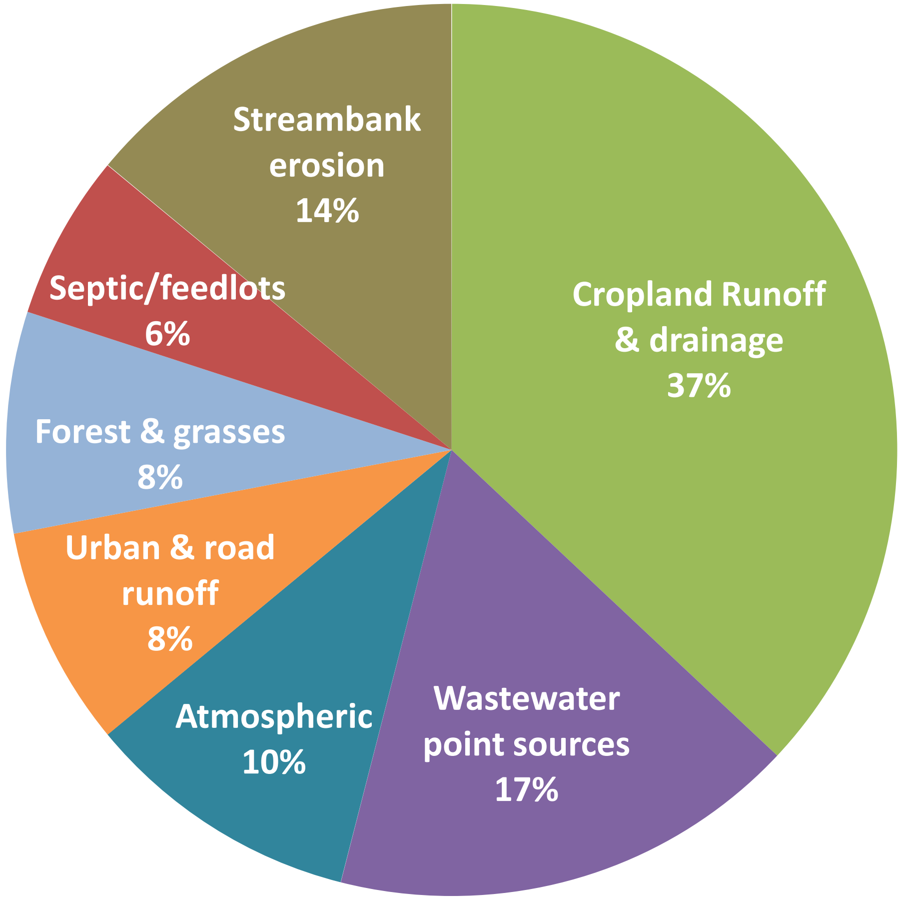
Statewide sources to rivers differ for N & P

Nitrogen



Source: MPCA & UMN 2013

Phosphorus

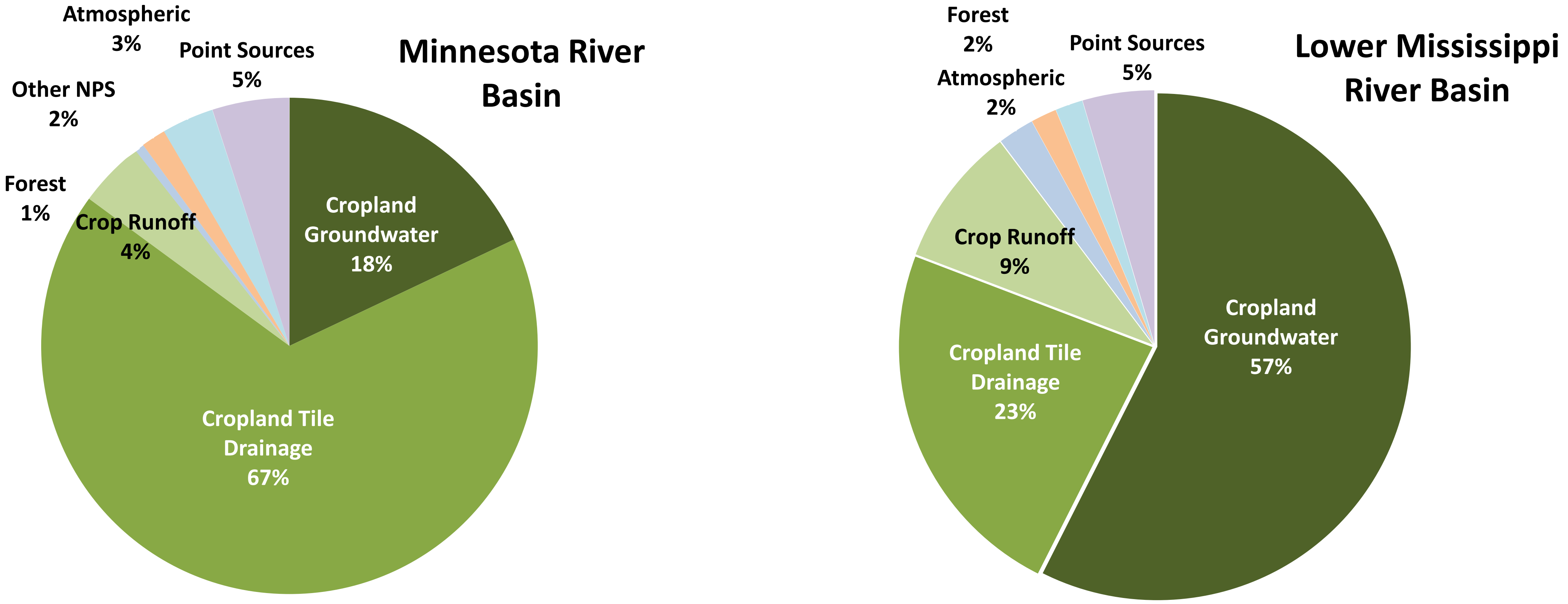


Source: MPCA et al., 2014

From MPCA et al 2013

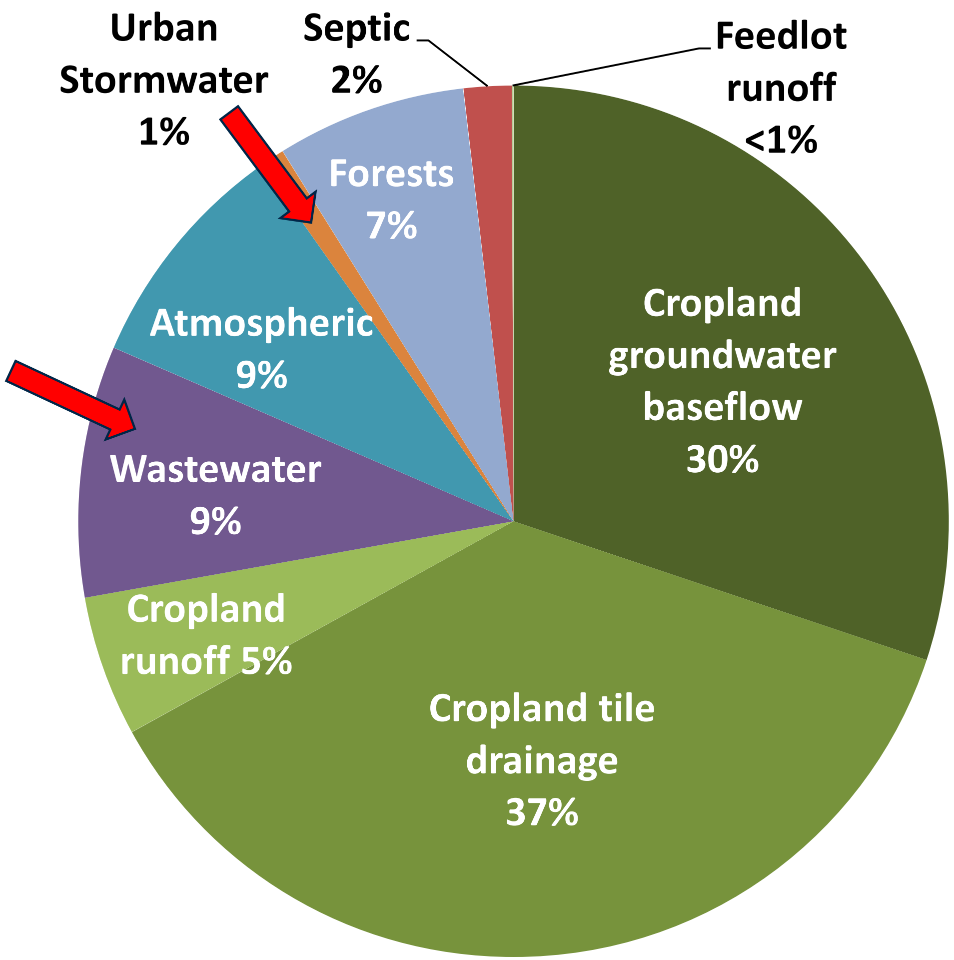
Sources and pathways vary by region

Nitrogen to Rivers



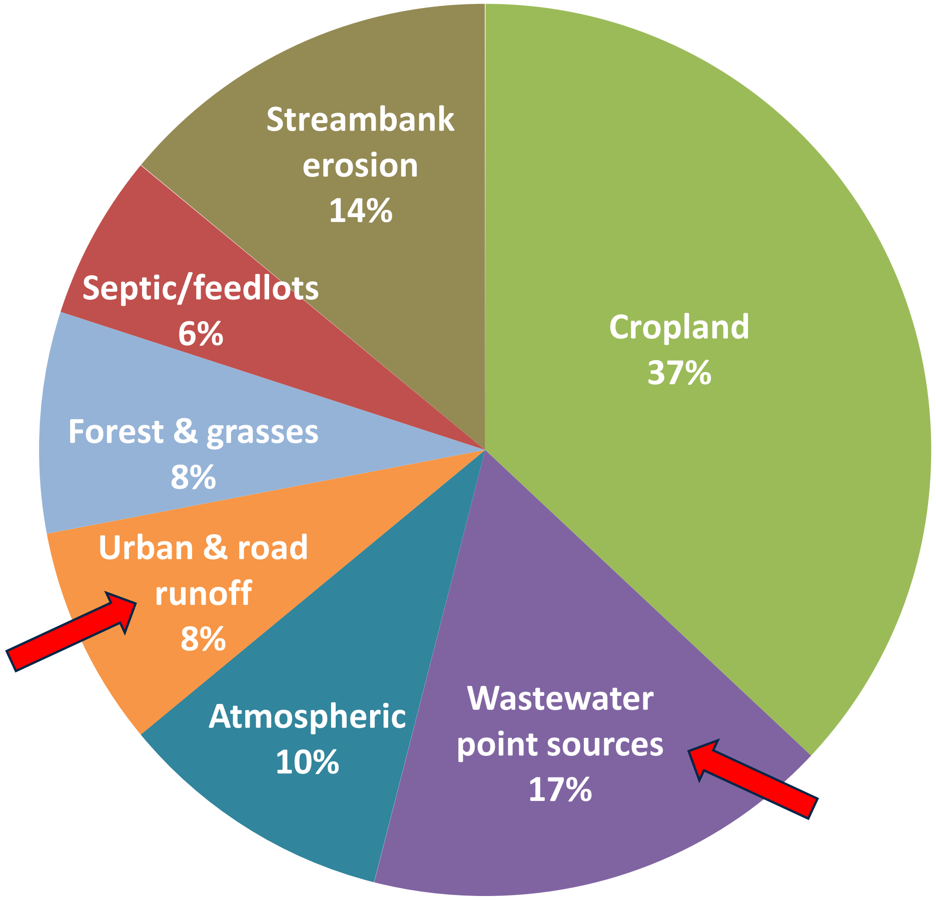
Important to reduce **Urban** sources of N & P

Nitrogen



Source: MPCA & UMN 2013

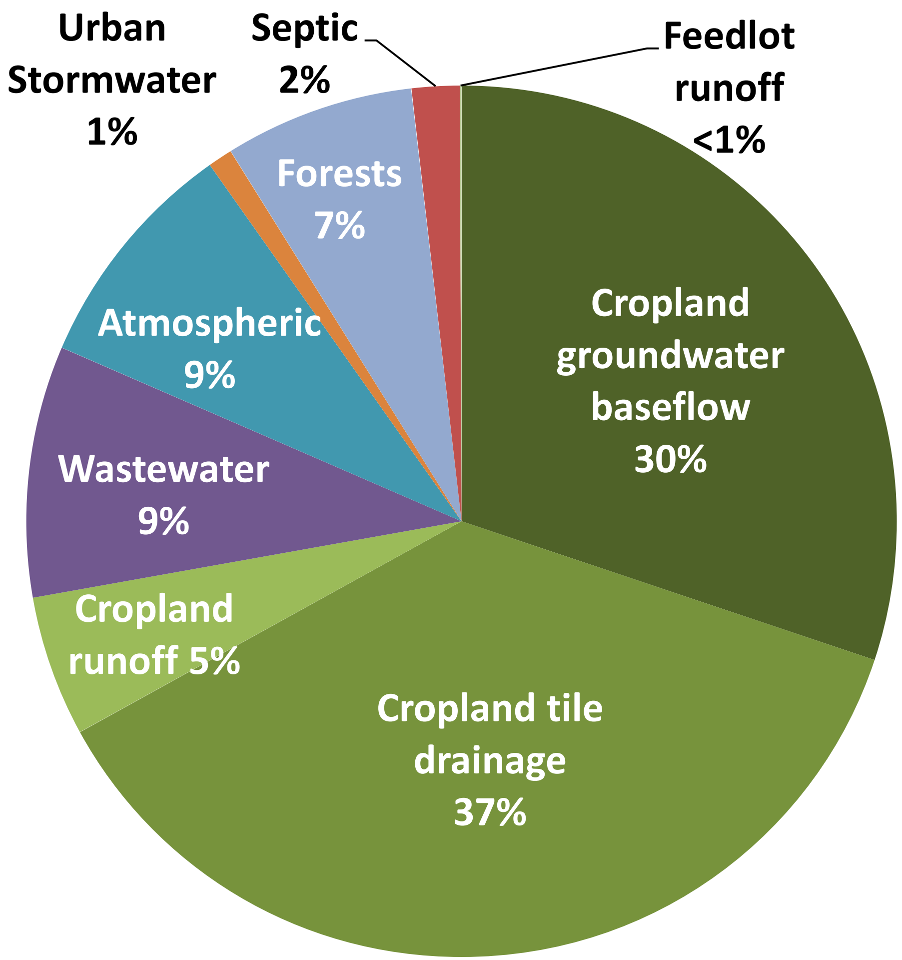
Phosphorus



Source: MPCA et al., 2014

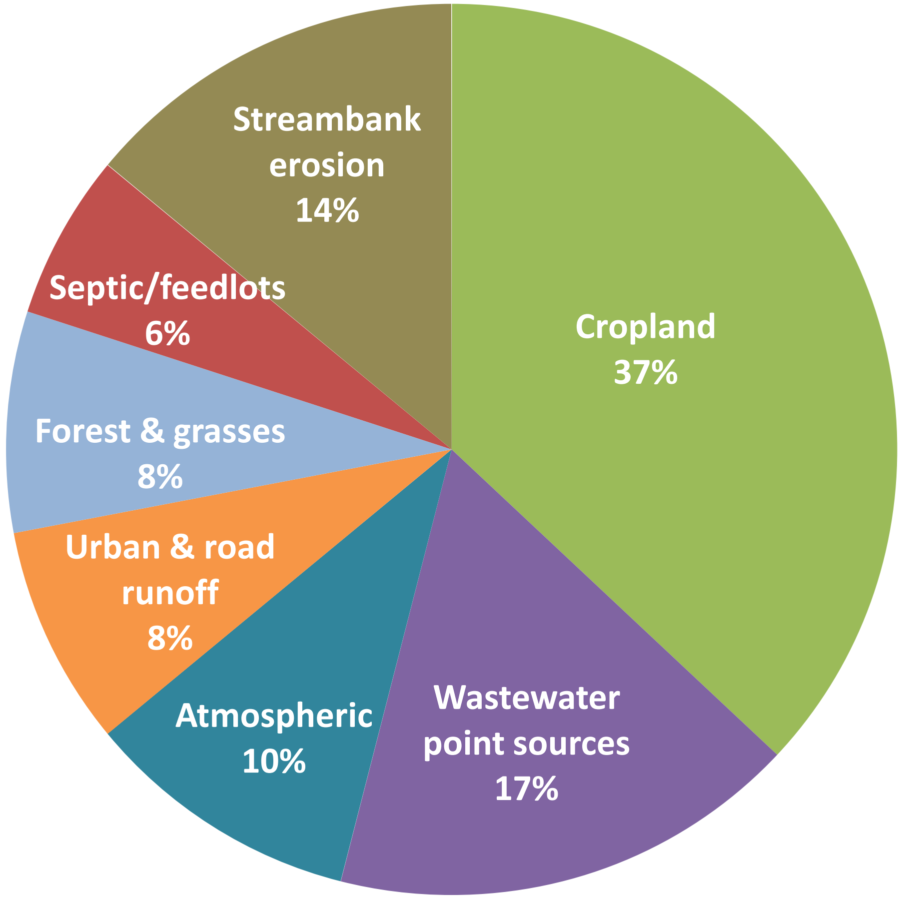
Important to reduce **Cropland** N & P losses

Nitrogen



Source: MPCA & UMN 2013

Phosphorus



Source: MPCA et al., 2014

Progress and needs

1. Why important to reduce nutrient losses?
2. Conditions & trends
3. Sources – urban & ag important
4. We’ve made progress, but there’s more we need to do
5. Minnesota’s nutrient reduction strategy addresses both urban and agricultural sources

Agricultural progress

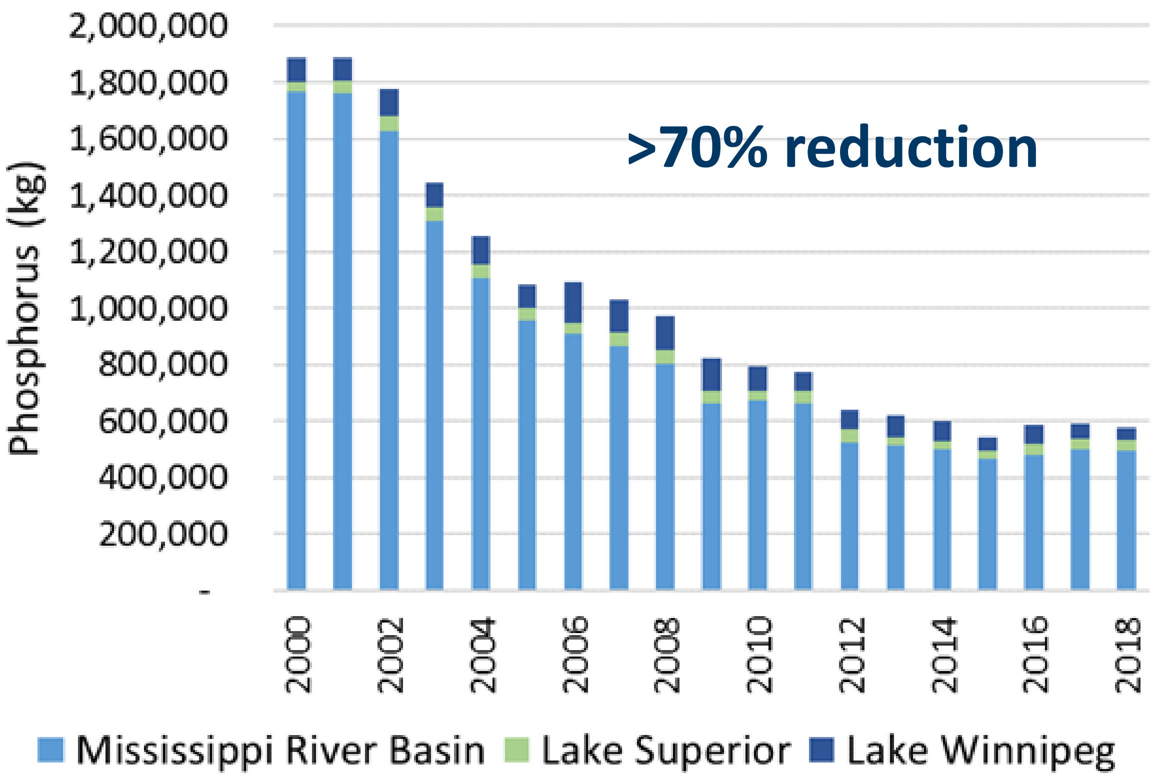
- *sin*

  97-

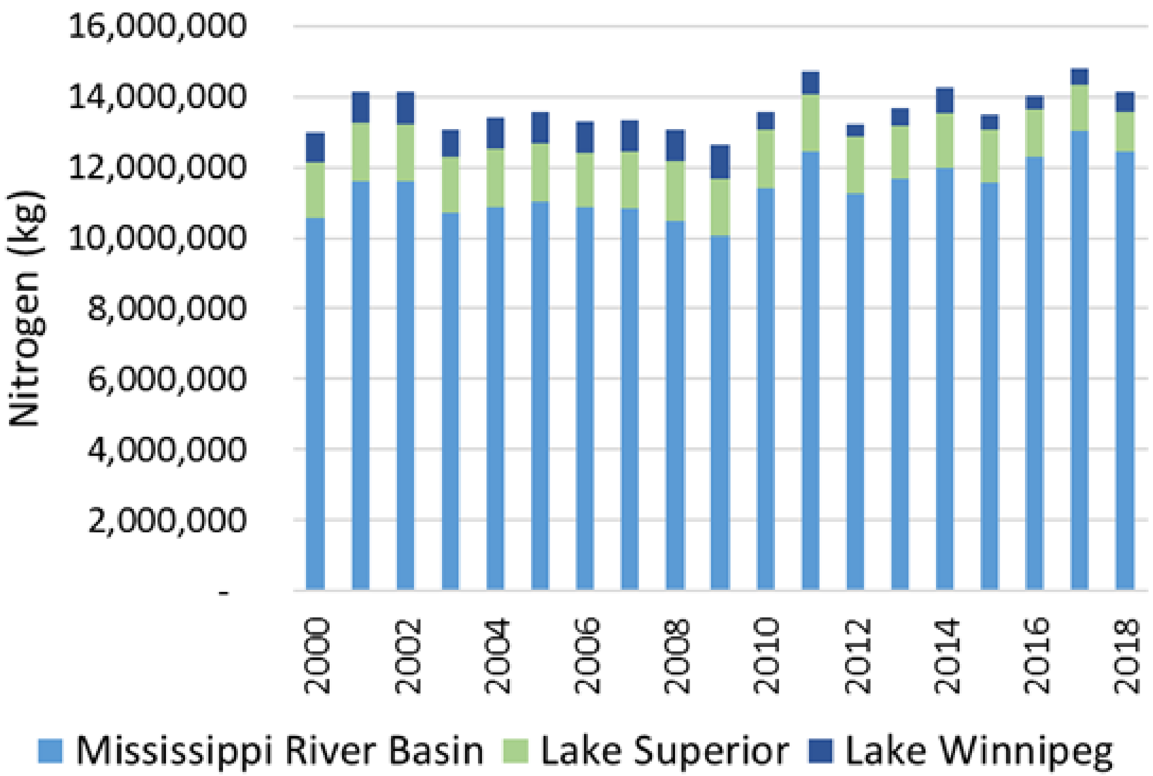
- 40%

Wastewater nutrient discharges – 2000 to 2018

P

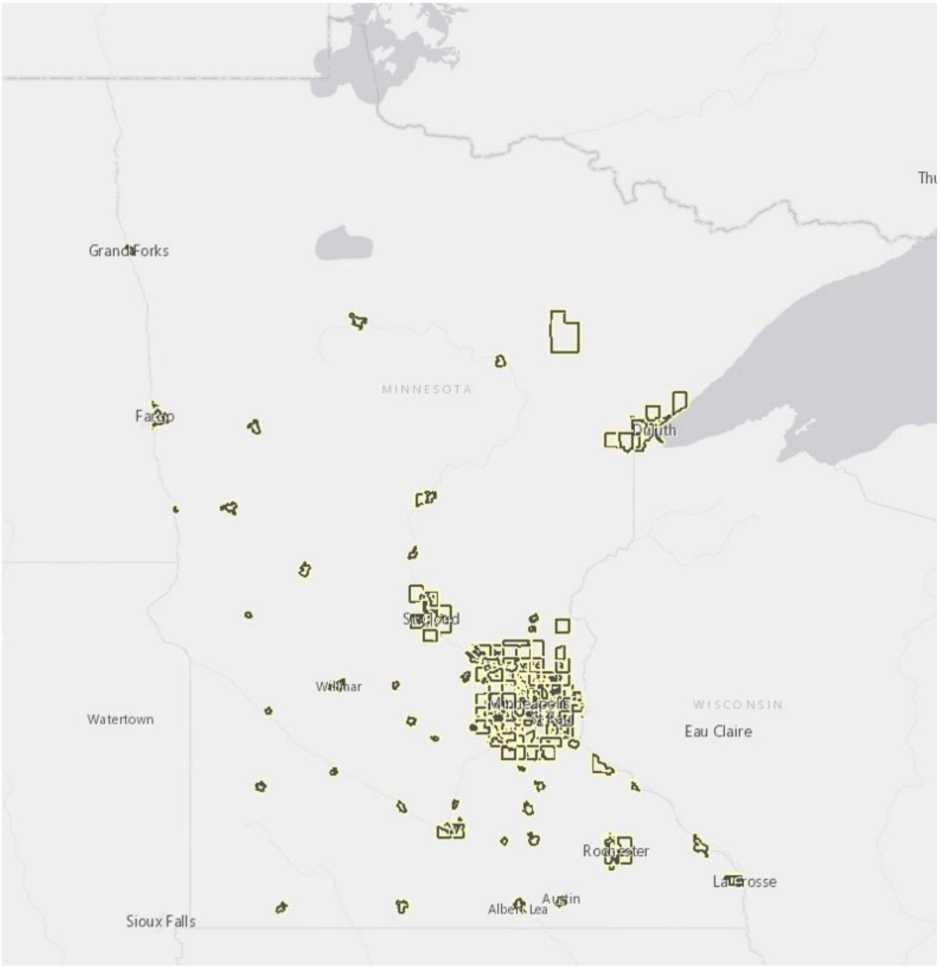


N

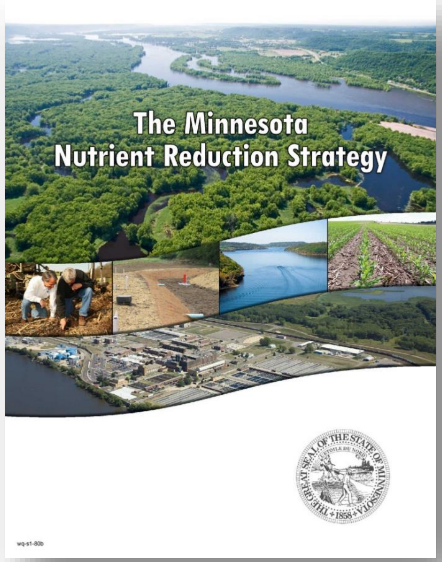


Other urban progress

- Lawn fertilizer phosphorus restricted since 2004
  - Turf N & P fertilizer about 2% of all fertilizer
- Urban stormwater runoff program regulates:
  - 2000-2500 construction projects per year
  - 250+ municipalities
  - >3900 industrial permits



MN Nutrient Reduction Strategy



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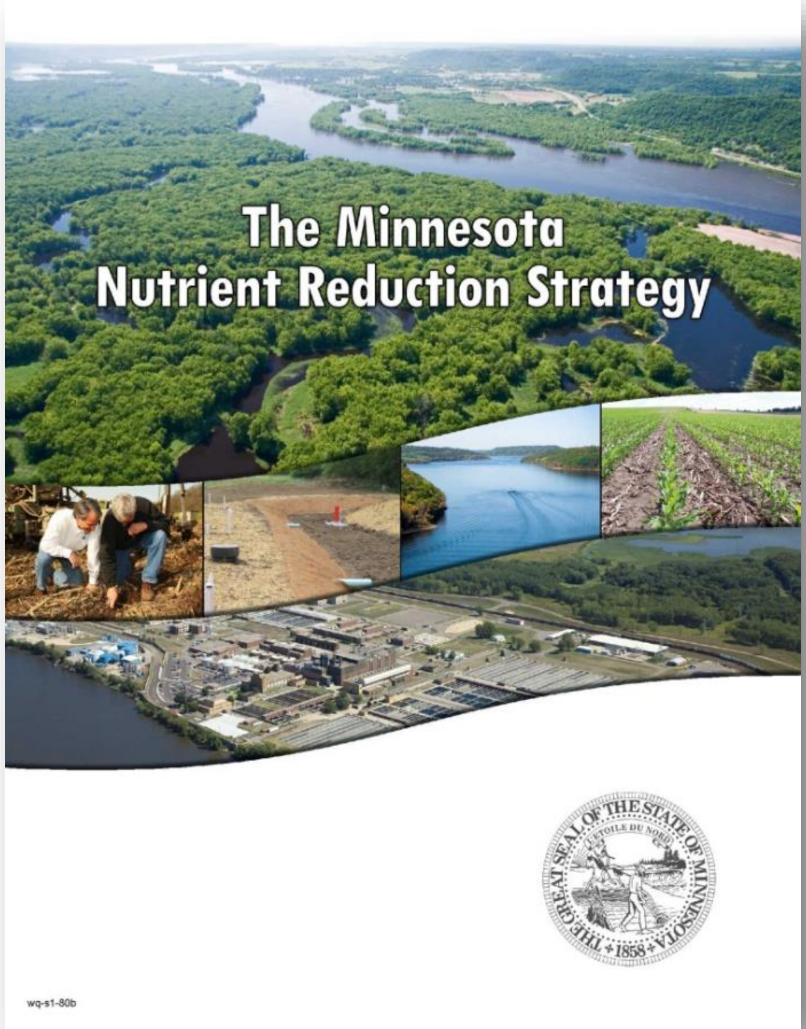
Afternoon breakout session

Minnesota’s Nutrient Reduction Strategy



Minnesota Pollution Control Agency

MINNESOTA DEPARTMENT OF AGRICULTURE

Minnesota Board of Water & Soil Resources

NRCS

FSA FARM SERVICE AGENCY

Minnesota DEPARTMENT OF NATURAL RESOURCES

MINNESOTA MDH DEPARTMENT OF HEALTH

PFA Minnesota Public Facilities Authority

UNIVERSITY OF MINNESOTA Driven to Discover

METROPOLITAN COUNCIL

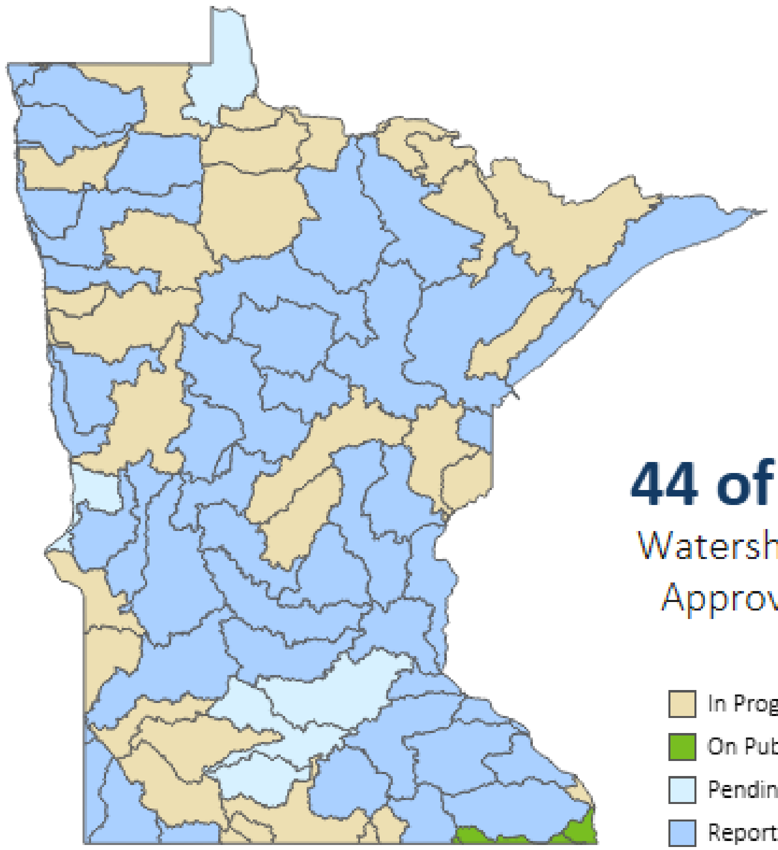
USGS science for a changing world

Finalized in 2014 by 11 orgs.

Public review in 2013

https://www.pca.state.mn.us/water/nutrient-reduction-strategy

Most watersheds have completed strategies or in-progress



44 of 80
Watersheds
Approved

- In Progress
- On Public Notice
- Pending Approval
- Report Approved

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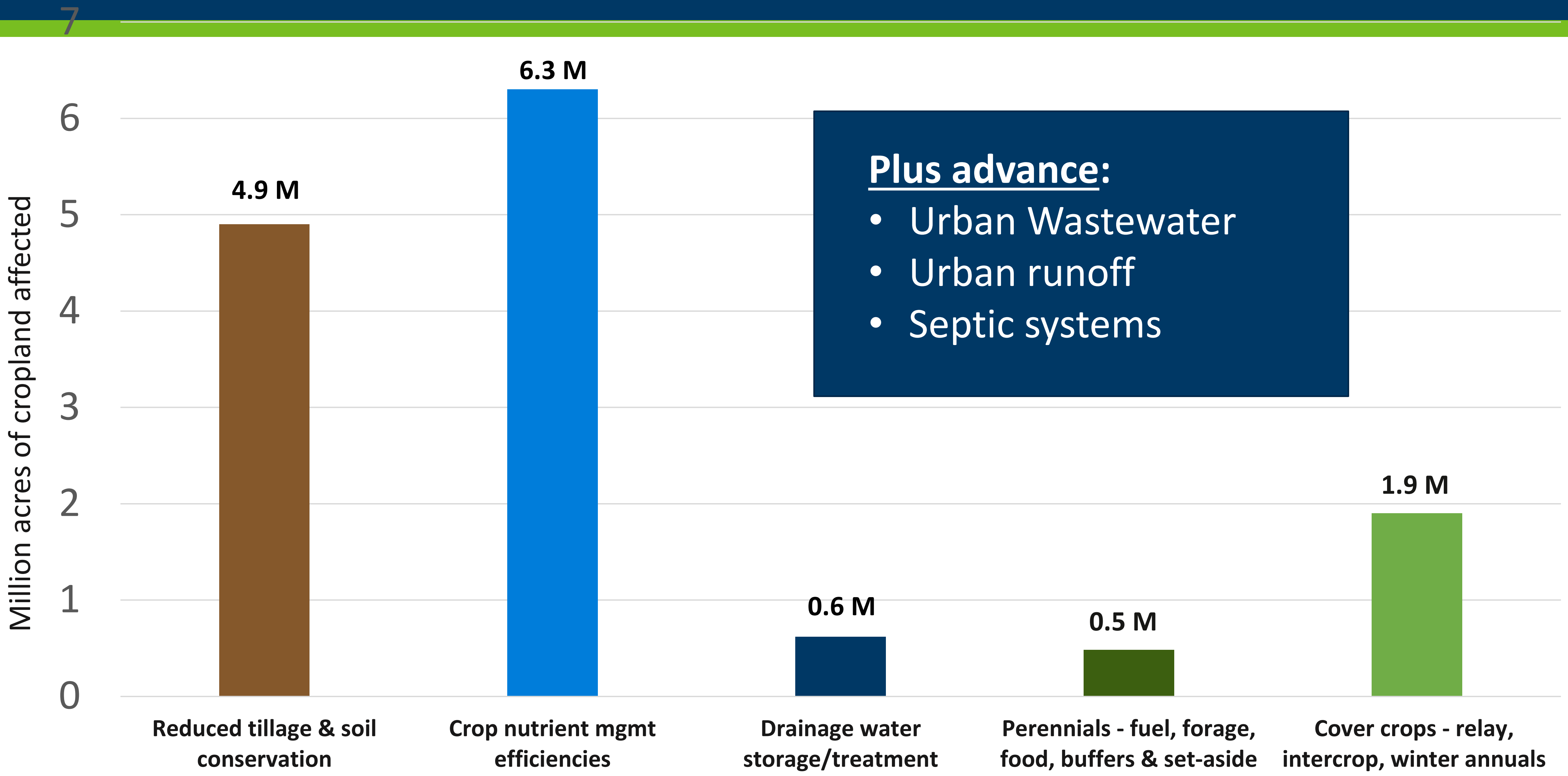
How many new BMP acres needed to achieve 2025 milestones? (statewide scenario for both N & P)



Plus advance:
- Urban Wastewater
- Urban runoff
- Septic systems

Concluding remarks

- We've made a lot of progress over the decades (especially with phosphorus) but we still have a long ways to go.
- We are working hard to avoid leaving a pollution legacy that our children and grandchildren will have to address.
- Nutrients are statewide problem and it requires all citizens and business sectors to be involved with solutions.
  - Ag/urban partnerships are increasing – let's continue working together

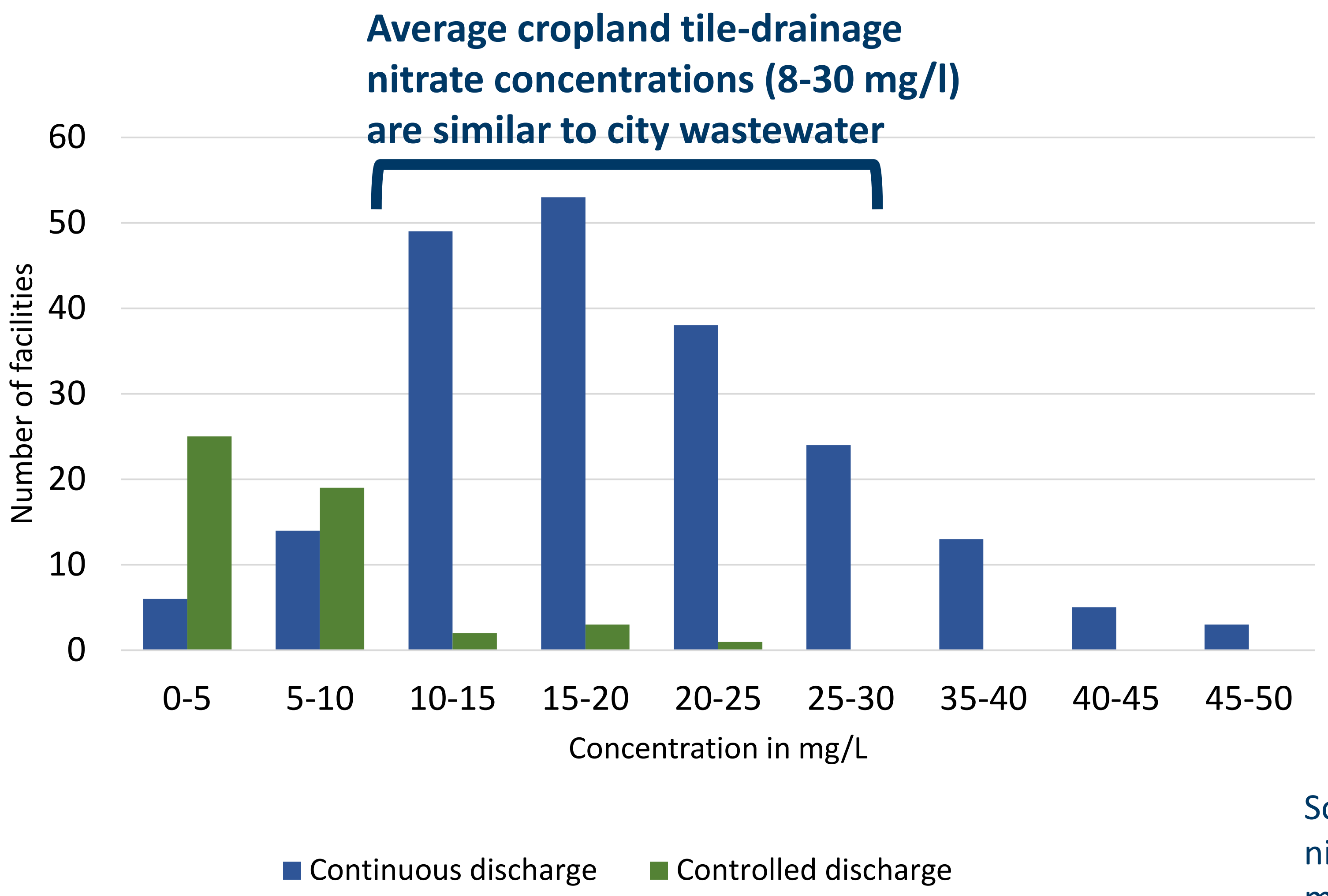
Questions?

MINNESOTA POLLUTION CONTROL AGENCY

CLEAN WATER LAND & LEGACY AMENDMENT

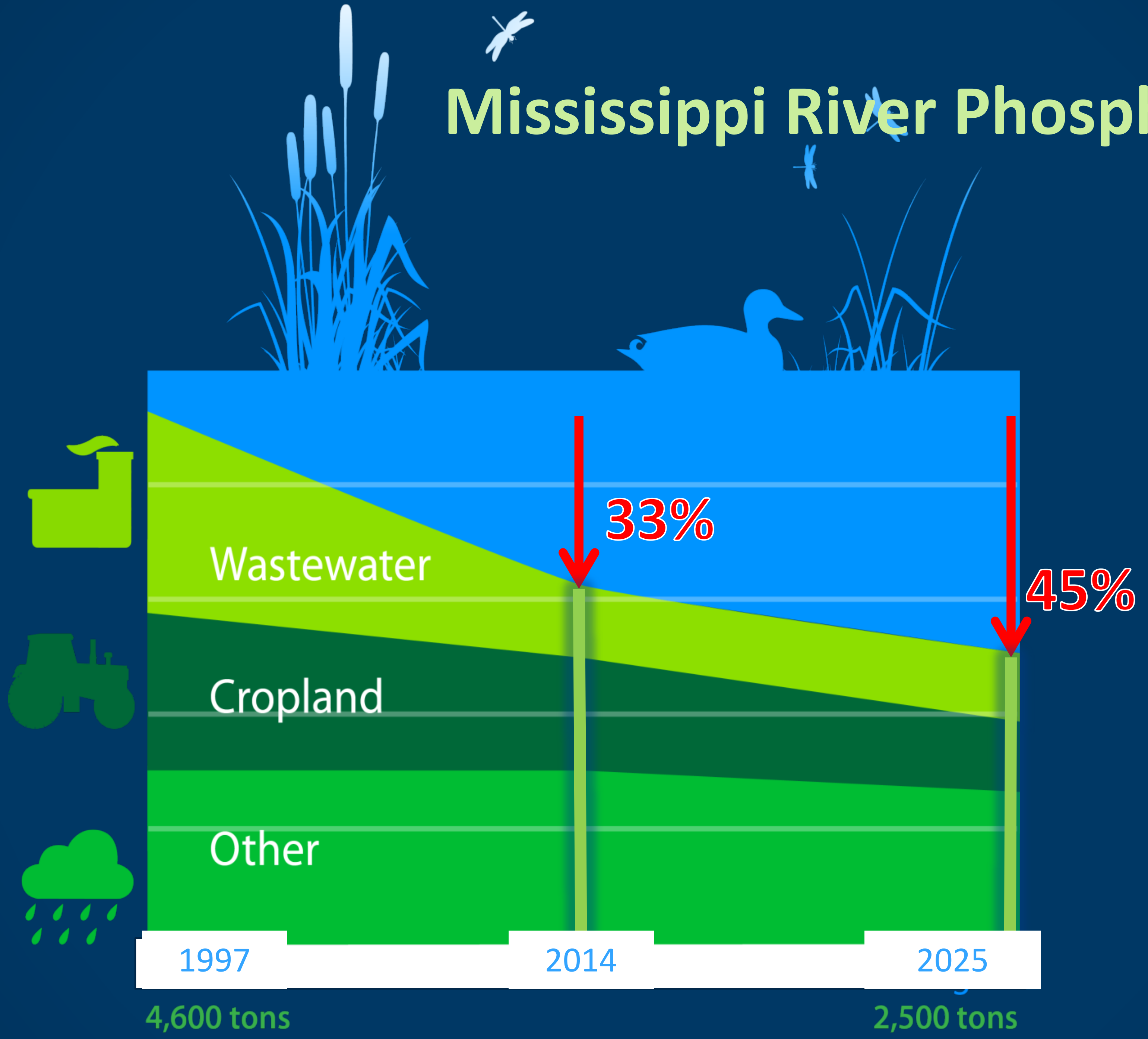
- Note: We could add the next few slides about Minnesota’s nutrient reduction strategy, but for the sake of time, we probably should just leave them out of this talk and defer to Glenn’s talk.

Wastewater nitrogen – typically 10-25 mg/l

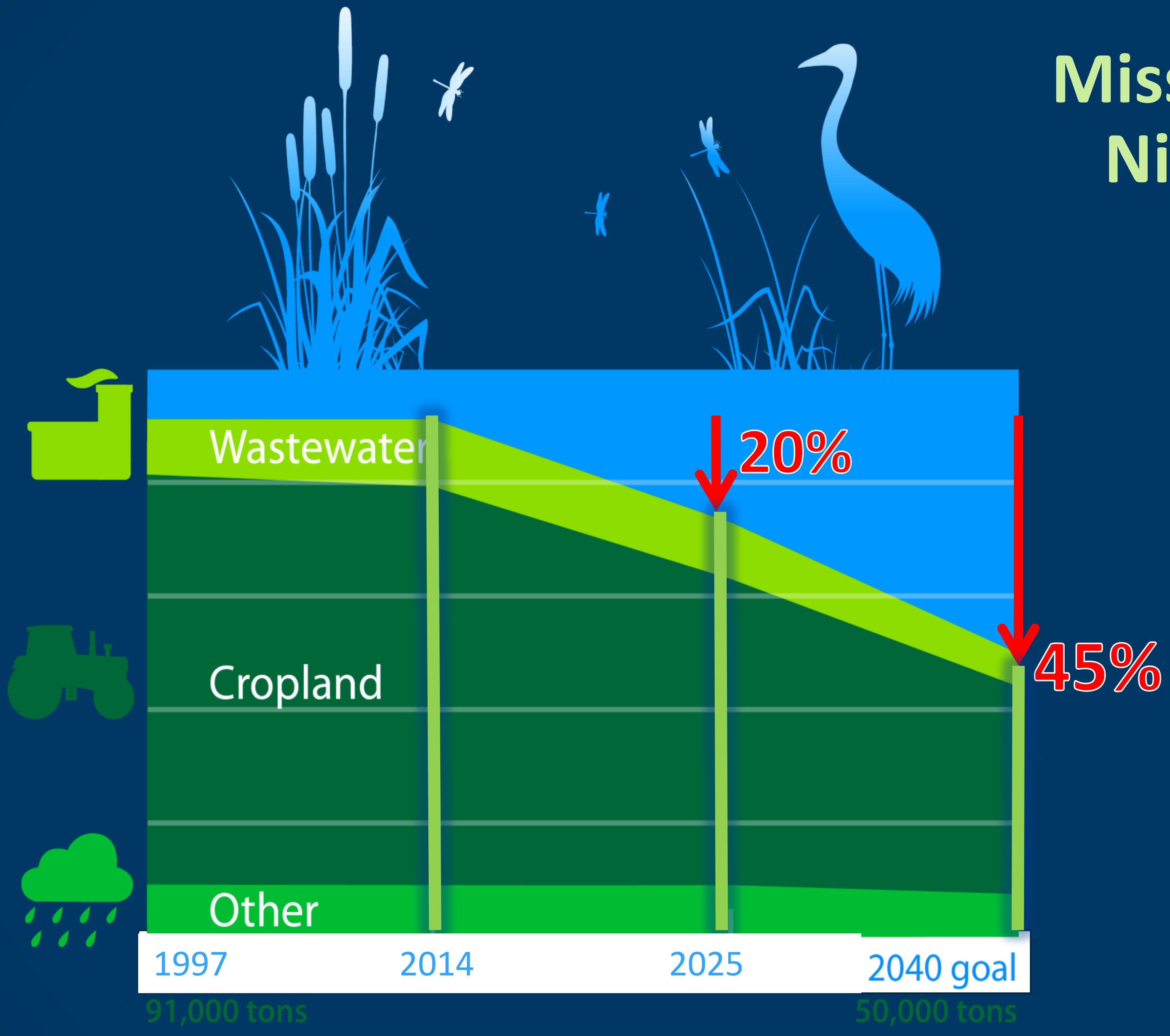


Source of tile-drainage nitrate range (MDA monitoring of Discovery Farms & other sites)

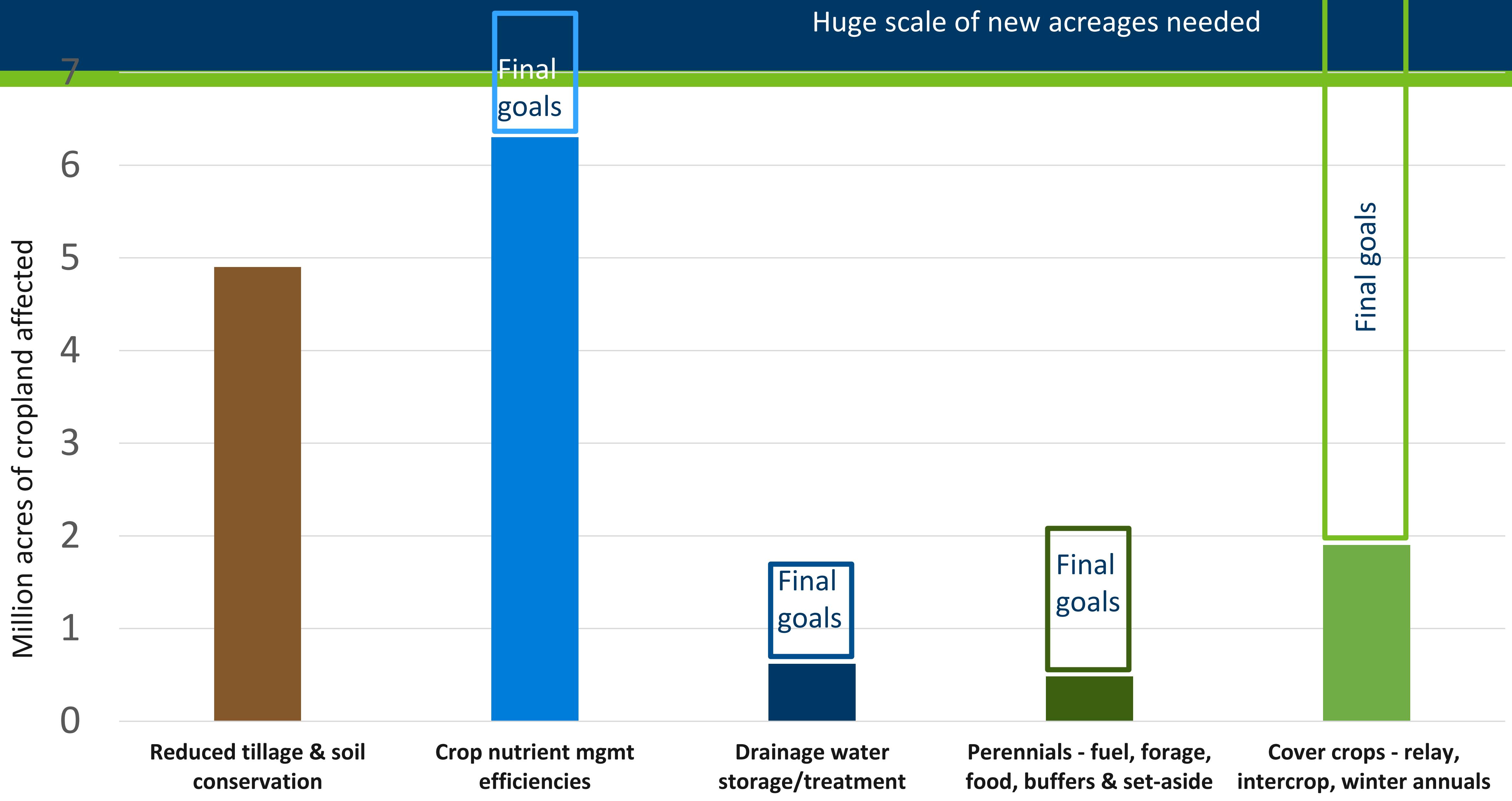
Mississippi River Phosphorus Goals



Mississippi River Nitrogen Goals



New BMP acreages for milestones & final goals



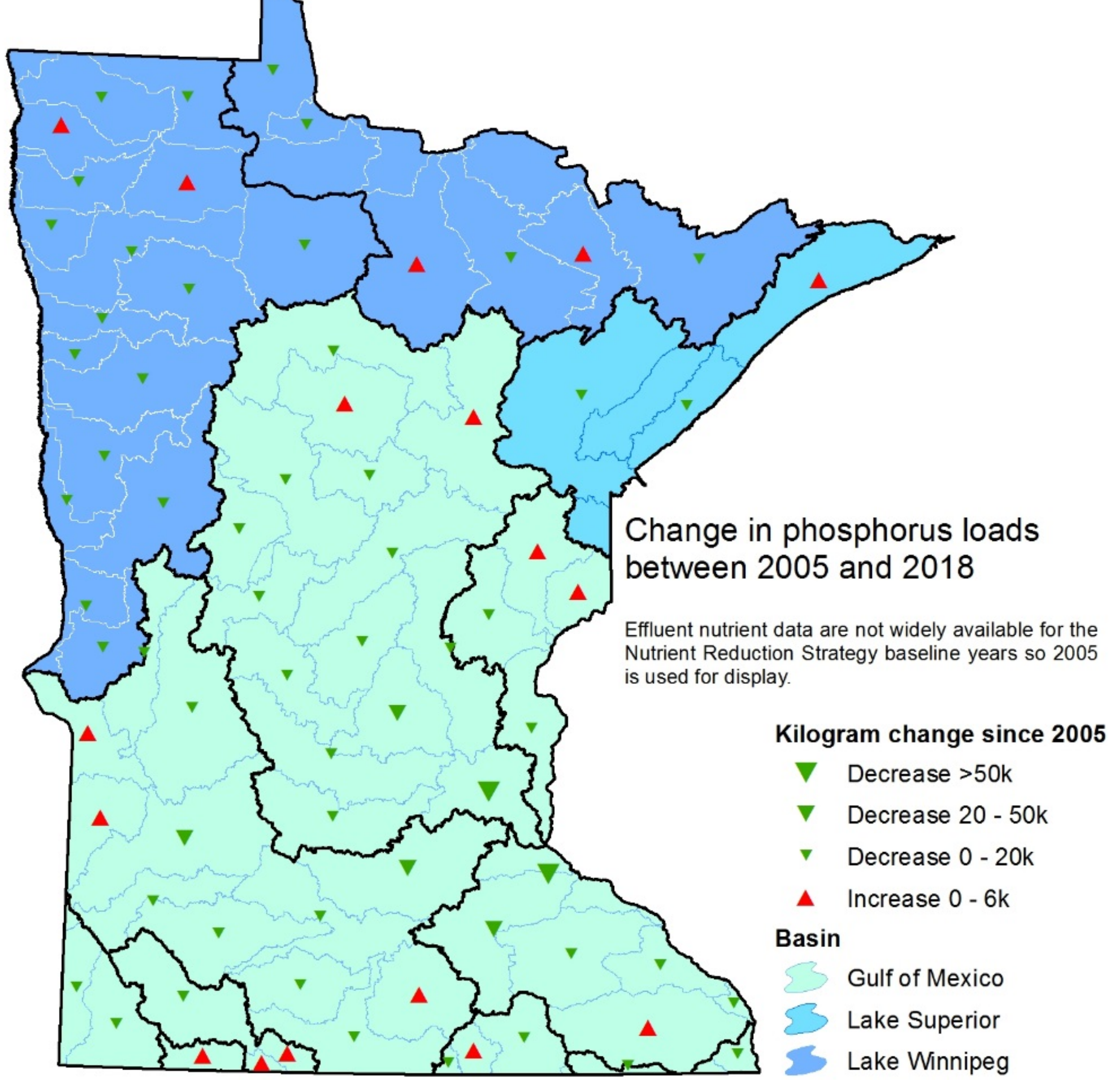
Milestones 10-20% Final goals 45-50%

Major basin	2014 to 2025 (Milestones)	"final" goals
1. Mississippi River	**12%** for P (of pre-2000 baseline loads) **20%** for N	**45%** & meet MN lake & river standards
2. Red River & Lake Winnipeg	**10%** for P **13%** for N	**50%**
3. Lake Superior	No net increase from 1970's	
Statewide Groundwater/ Source Water	Meet 1989 Groundwater Protection Act Goals	

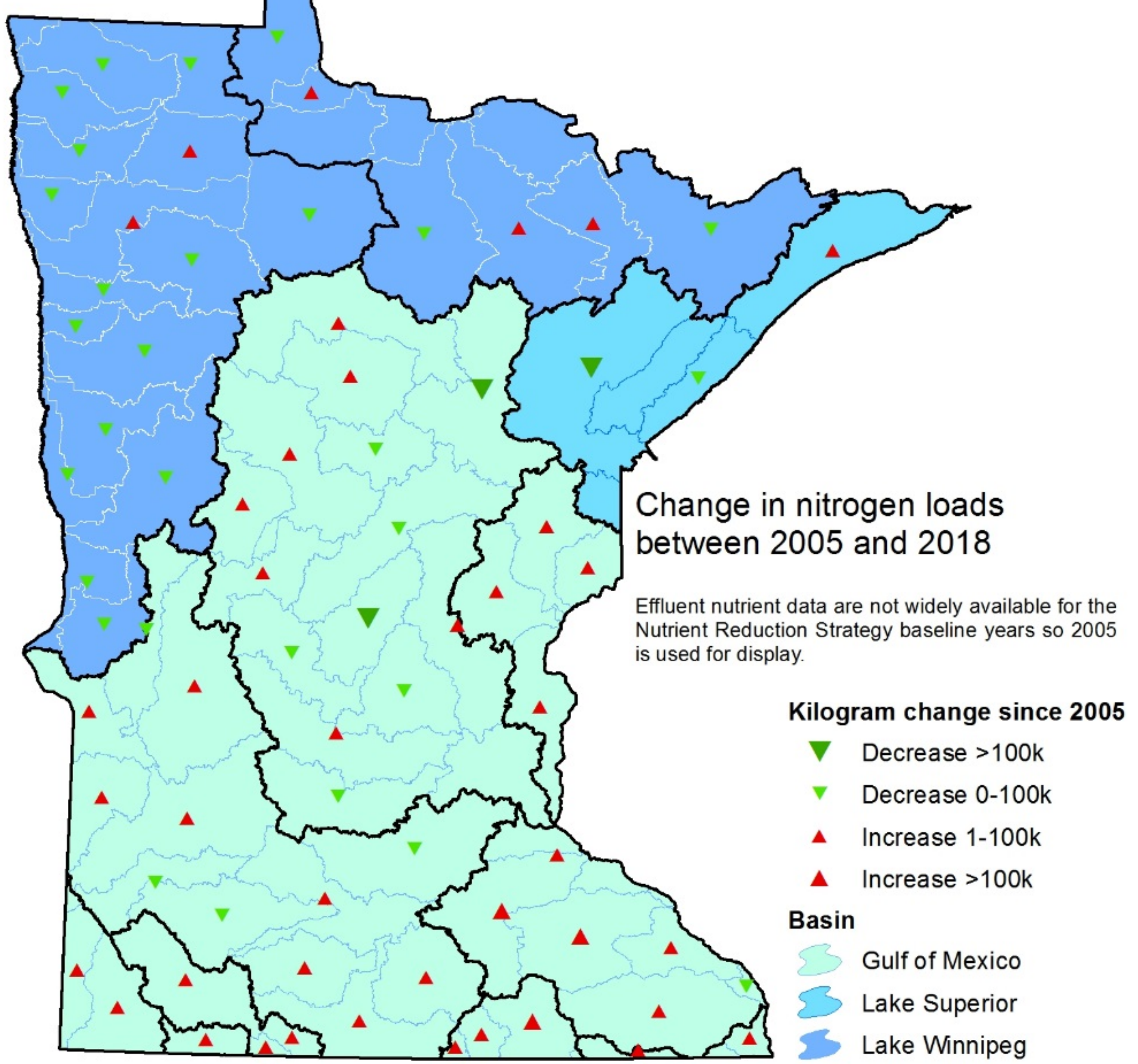
Minnesota’s nutrient reduction strategy to address both urban and agricultural sources

- Brief overview of the strategies for both urban and agricultural sources
- Brief mention of watershed WRAPS and 1W1P efforts to reduce urban and ag sources

- Question and A



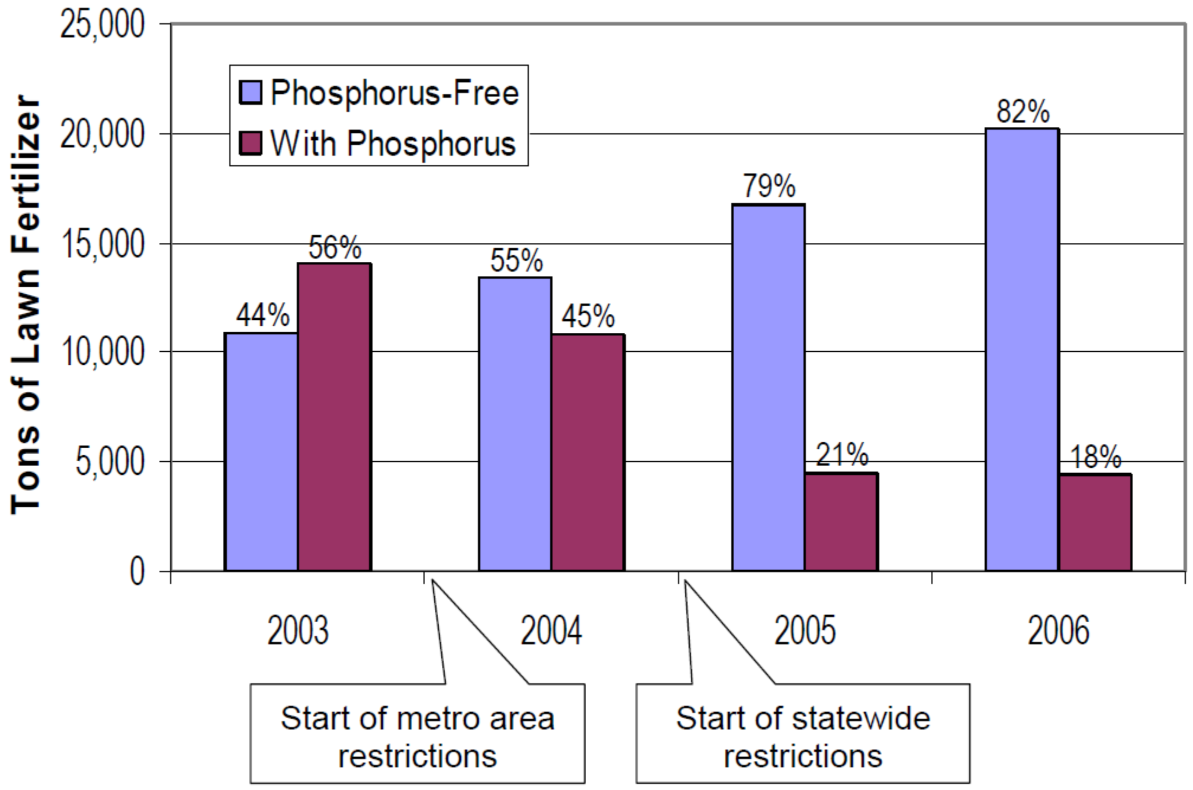
Phosphorus	Percent reduction goal	Baseline (MT)	Target (MT)	Current level (MT)	Progress towards goal
Gulf of Mexico	45%	1,739	783	493	100% met
Lake Winnipeg	10%	58	52	44	100% met
Lake Superior	No net increase			38	-



Nitrogen	Percent reduction goal	Baseline (MT)	Target (MT)	Current level (MT)	Progress towards goal
Gulf of Mexico	20%	9,600	7,680	12,460	38% needed
Lake Winnipeg	13%	300	261	935	72% needed
Lake Superior	No net increase			1,122	-

- Extra slides

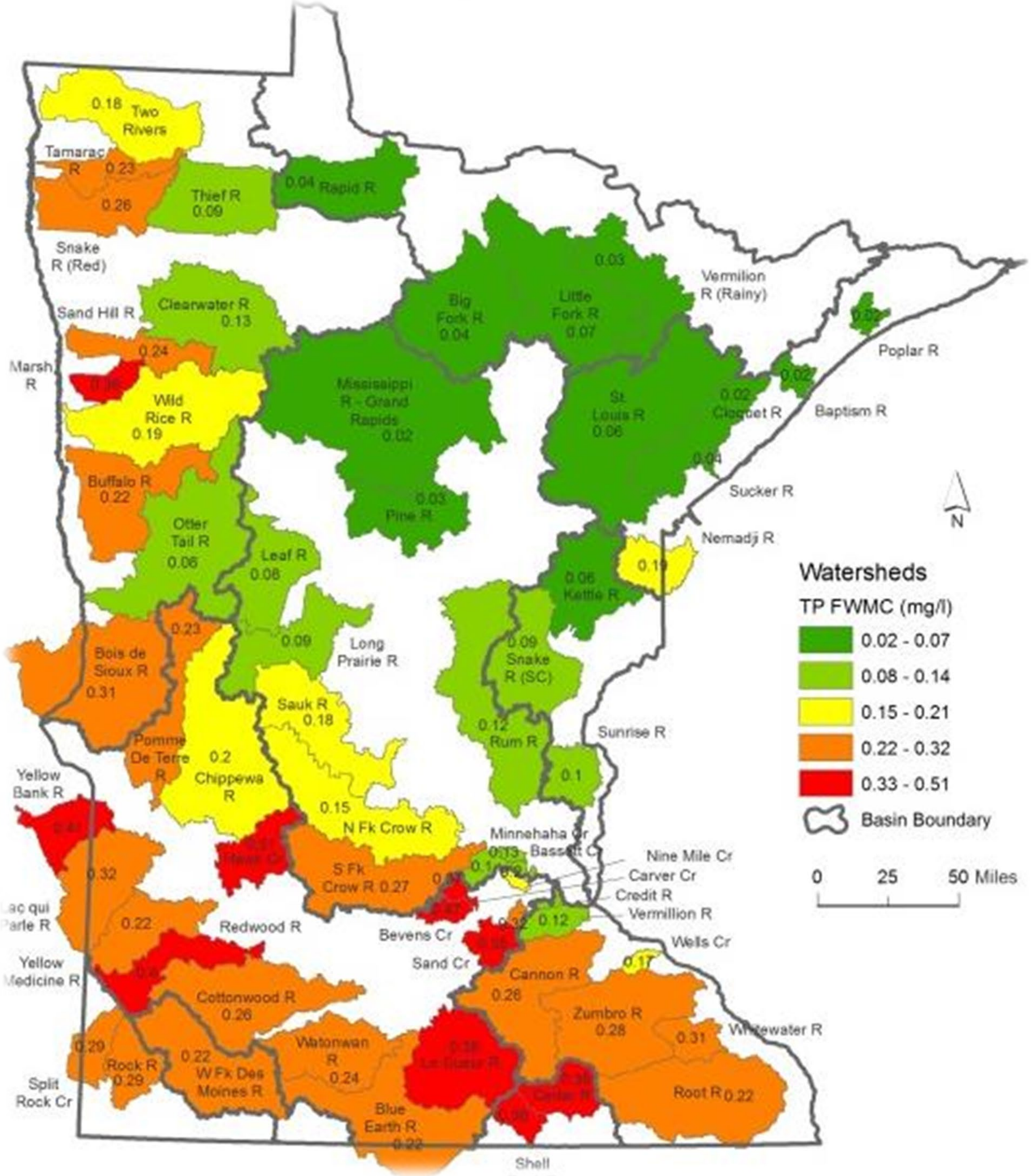
Phosphorus and phosphorus-free lawn fertilizer used[2] statewide



FWMC

flow-weighted mean concentration

T. Phosphorus



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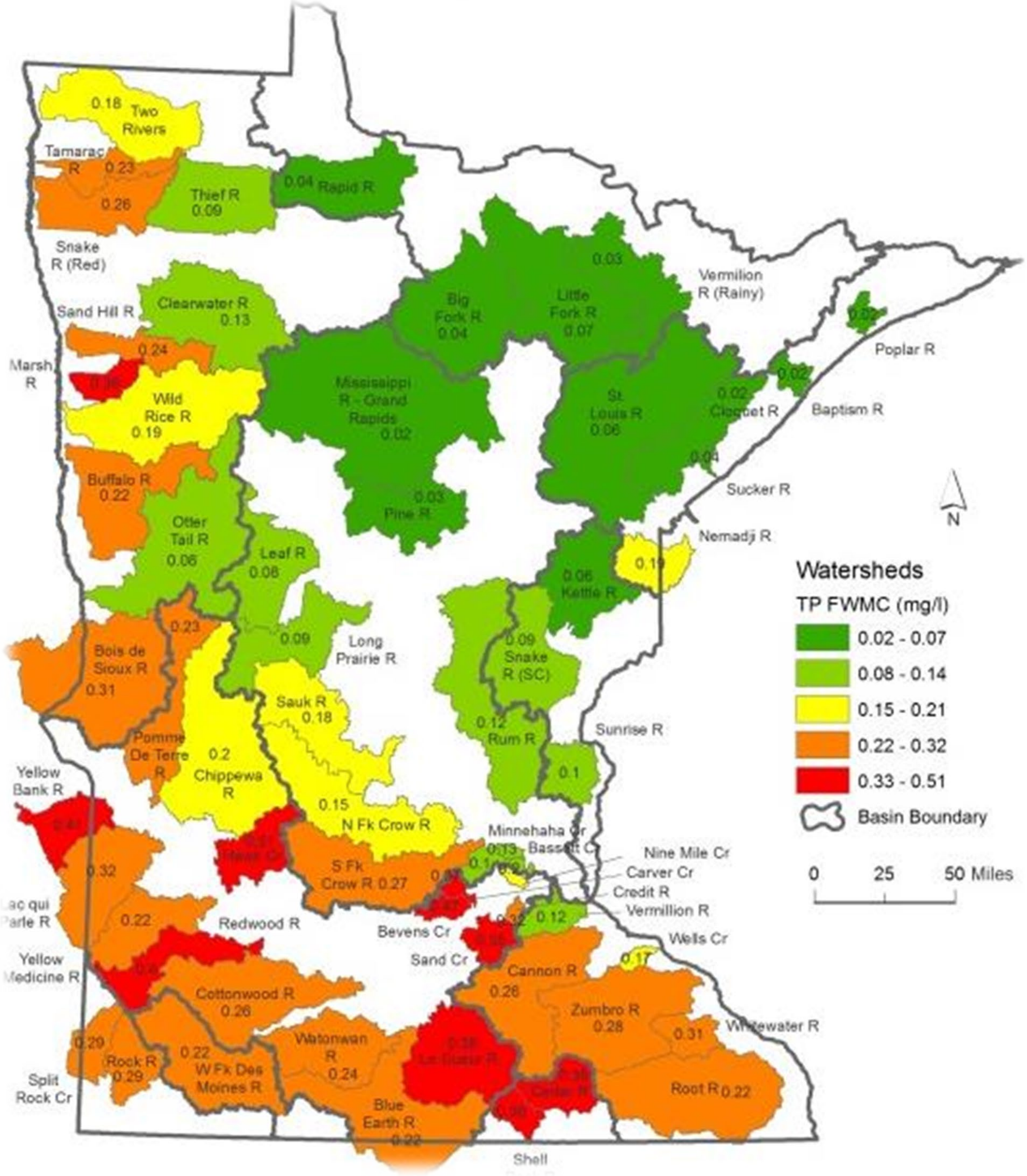
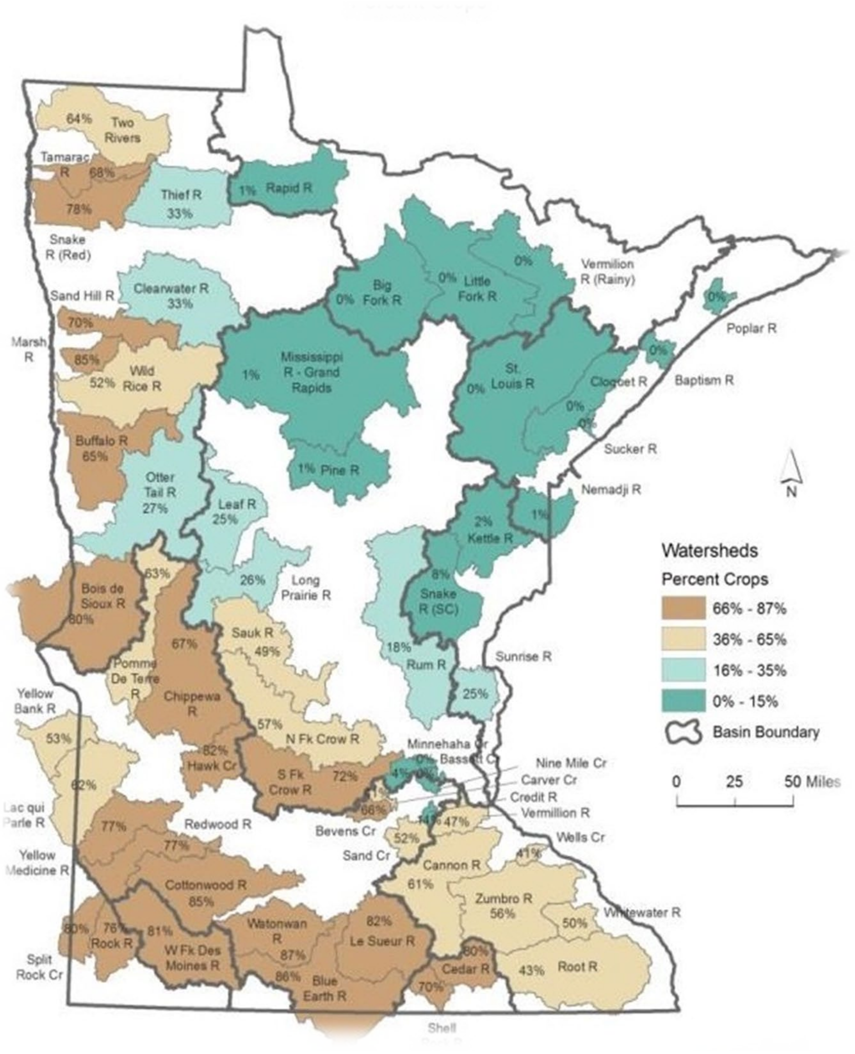
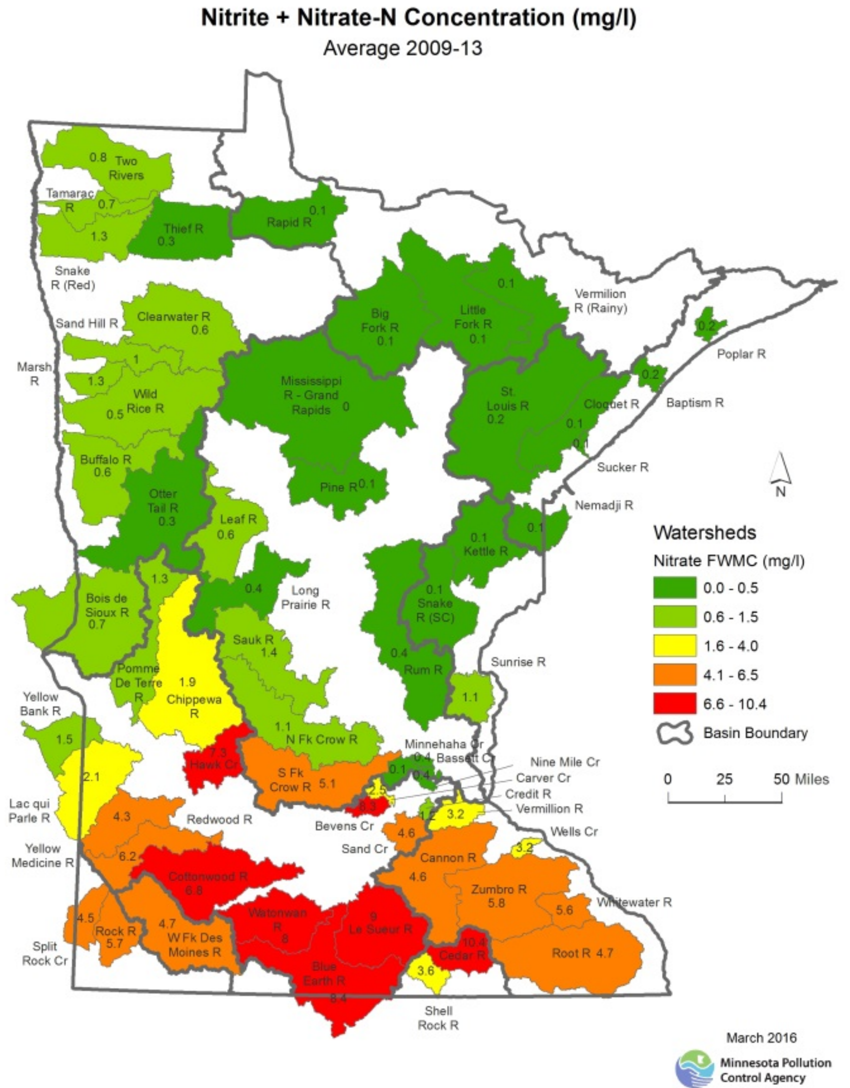
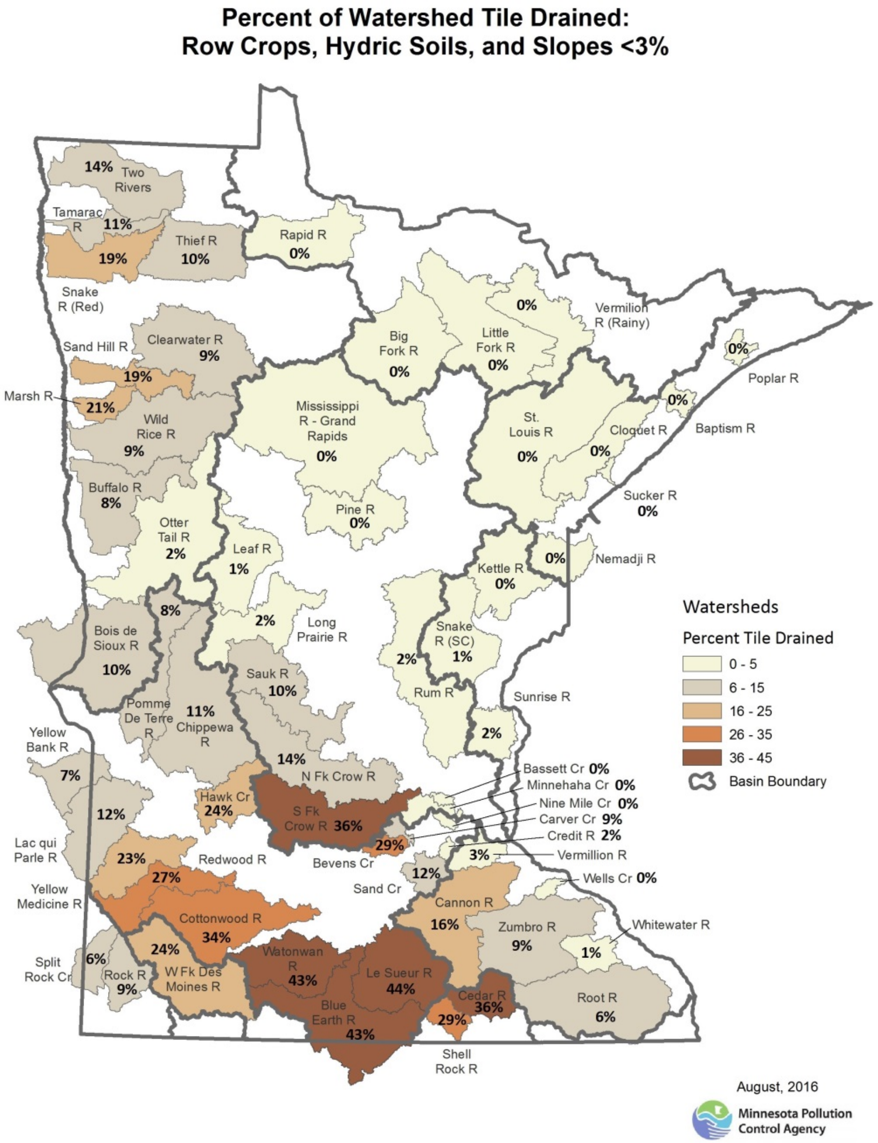


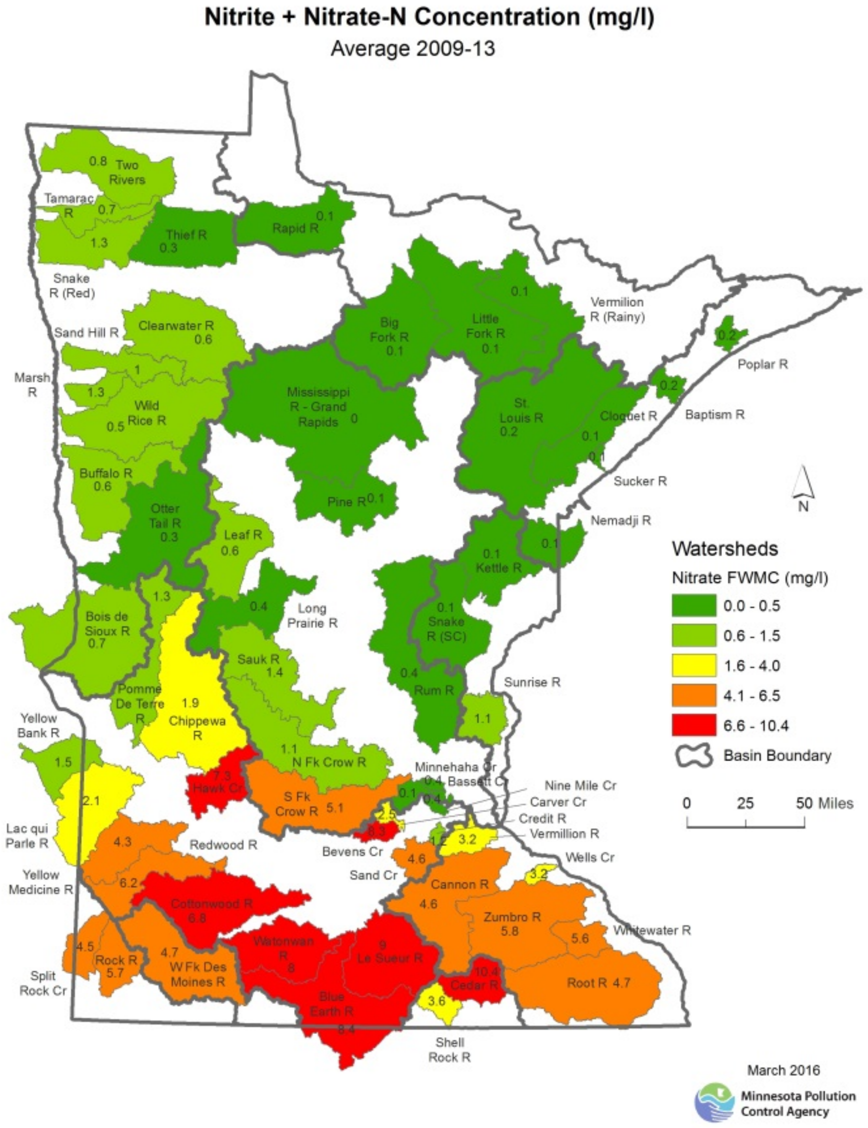
Percent of watersheds in cropland





High nitrate water in highly tiled watersheds





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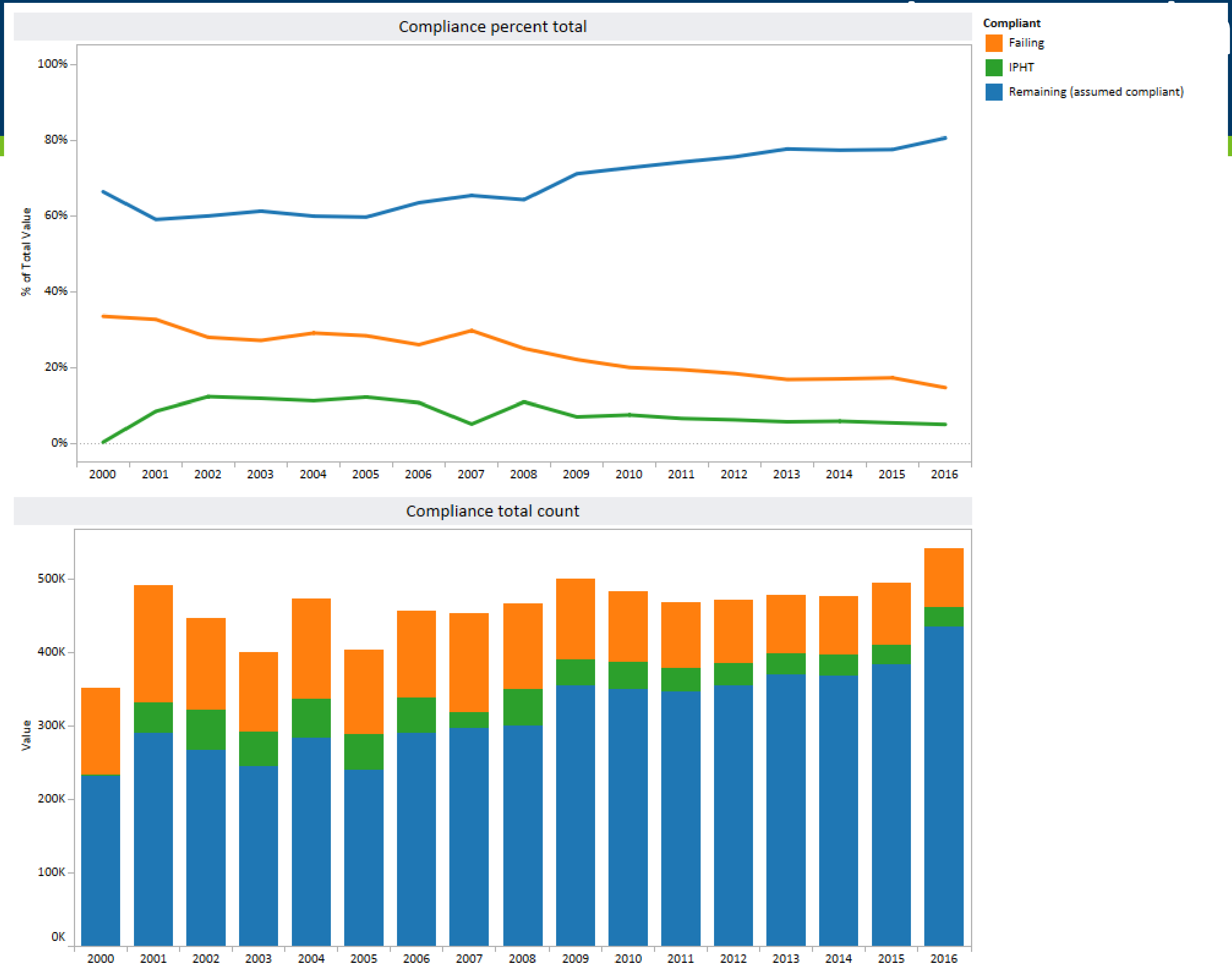
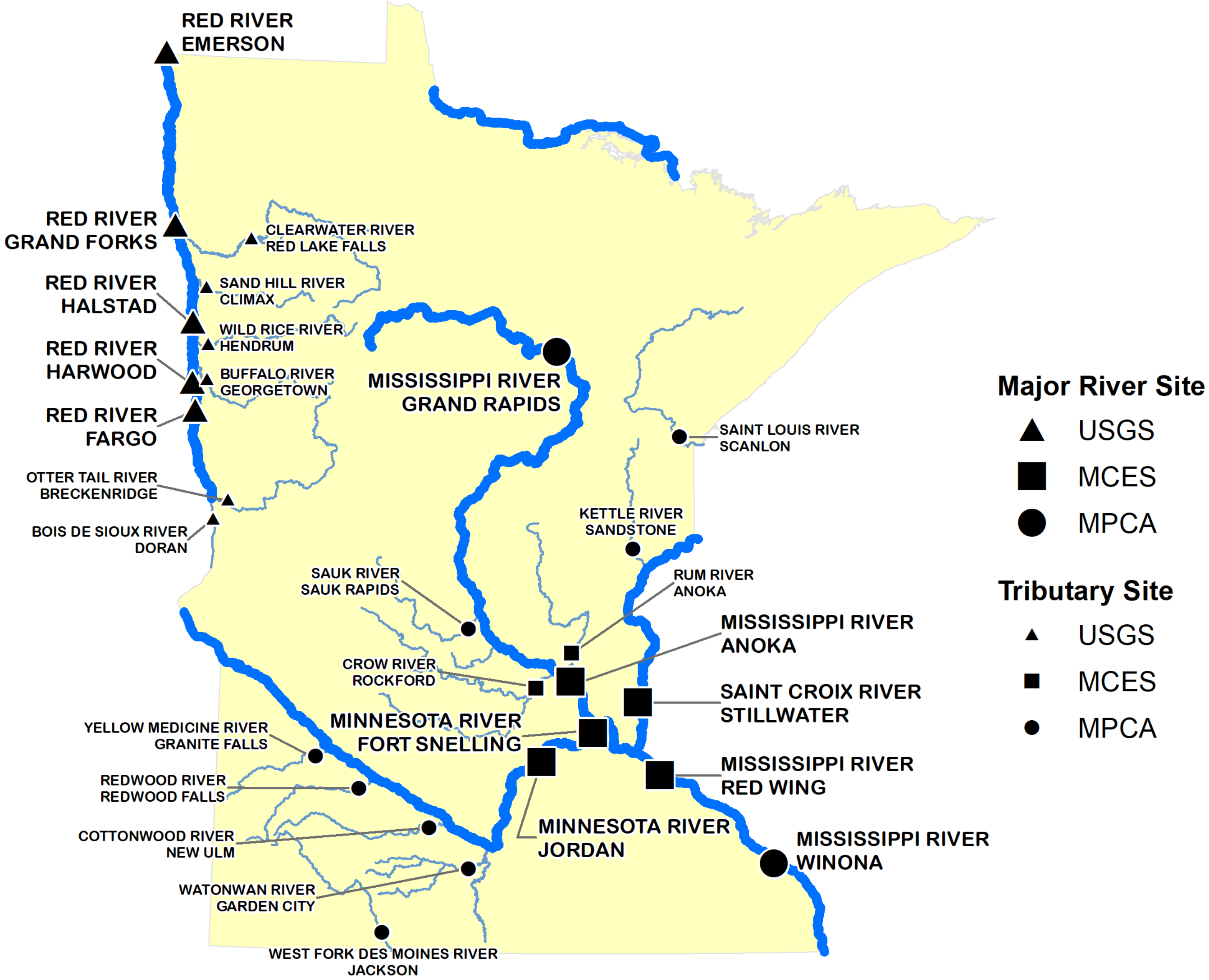

Compliance percent total
Compliant
Failing
IPHT
Remaining (assumed compliant)
% of Total Value
100%
80%
60%
40%
20%
0%
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
Compliance total count
Value
500K
400K
300K
200K
100K
0K
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016

20-year phosphorus trends - showing improvements



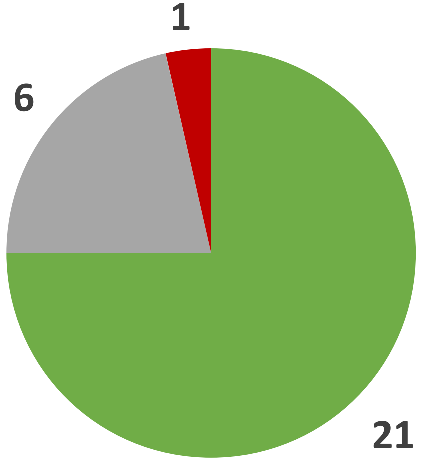
Phosphorus concentrations (flow-corrected)

28 sites

21 – decreasing 15-55%

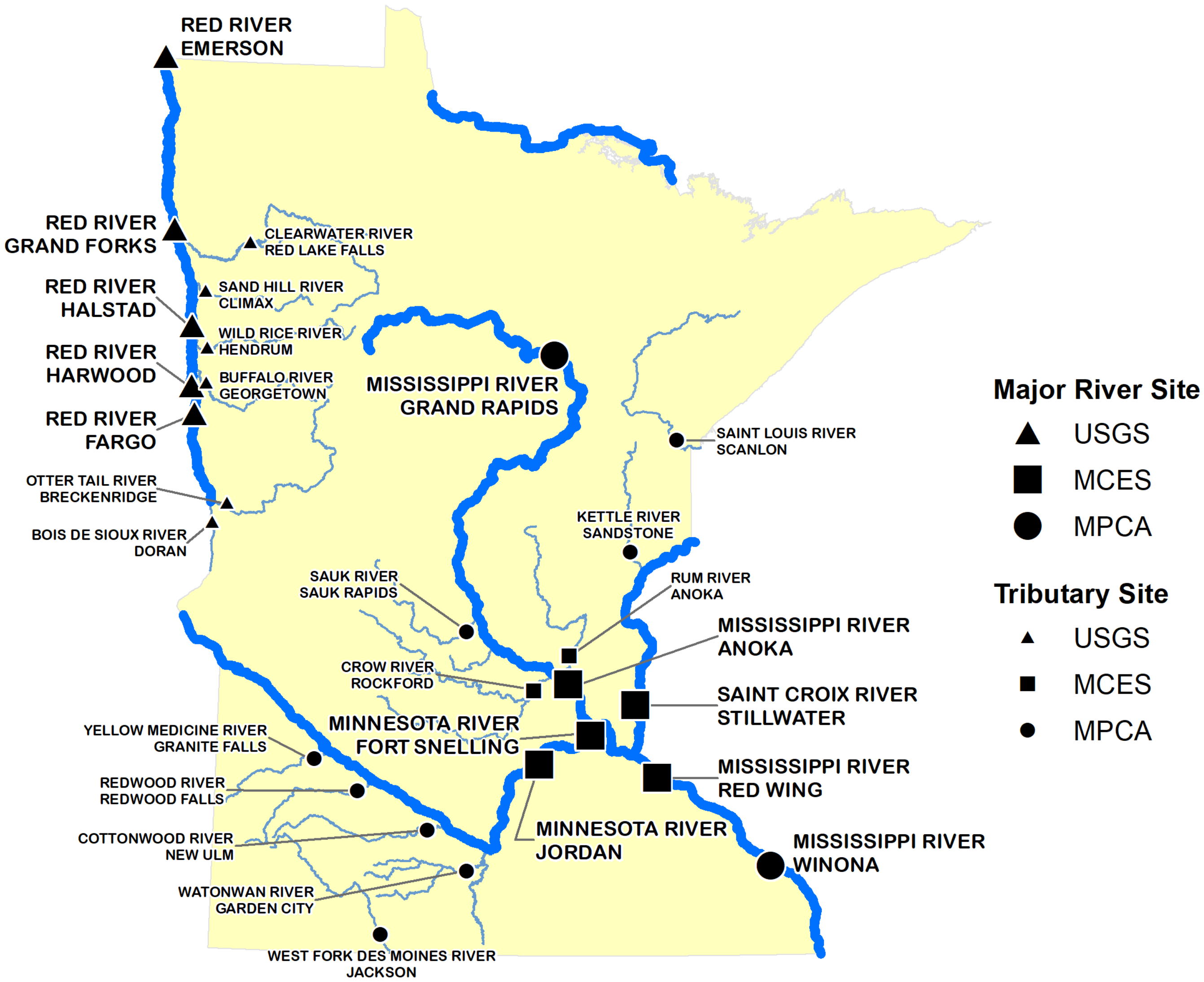
6 - no significant trend

1 - increase



DRAFT

20-year nitrate trends do not show many improvements



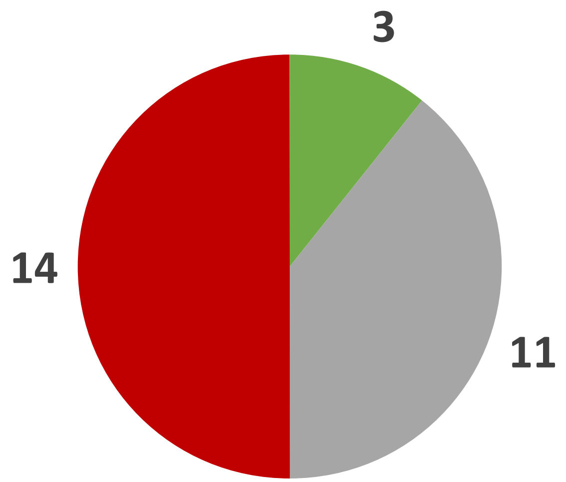
Nitrate concentrations (flow-corrected)

28 sites

3 – decreasing

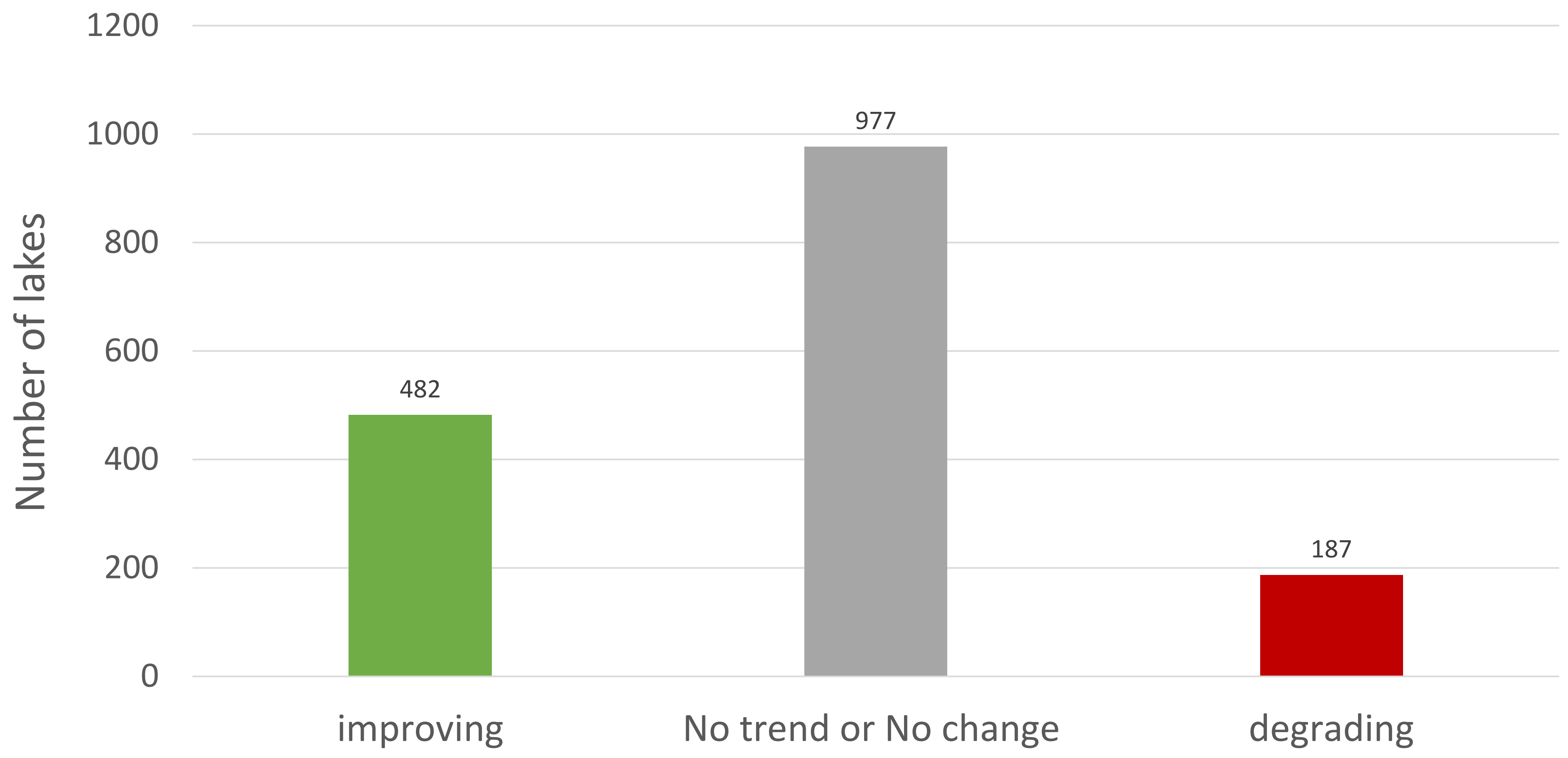
11 - no significant trend

14 - increasing



DRAFT

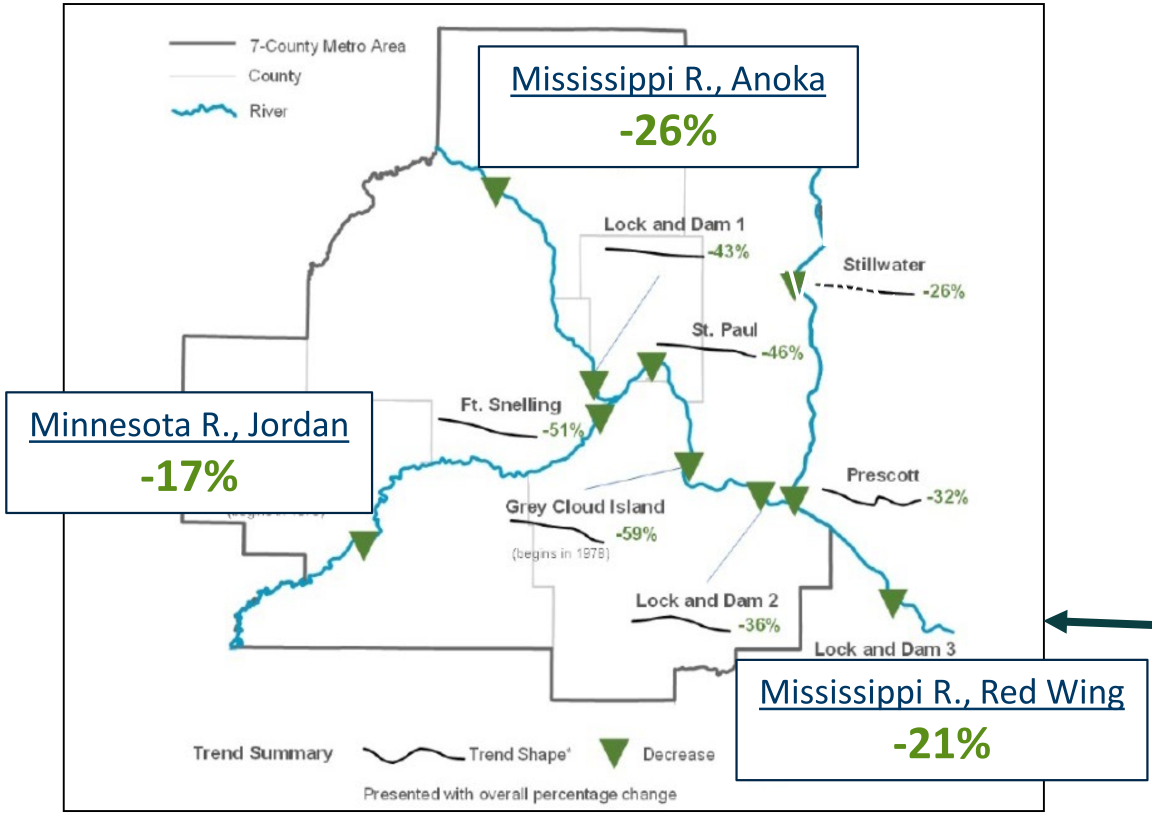
Lake Clarity Trends



Source: MPCA 2019

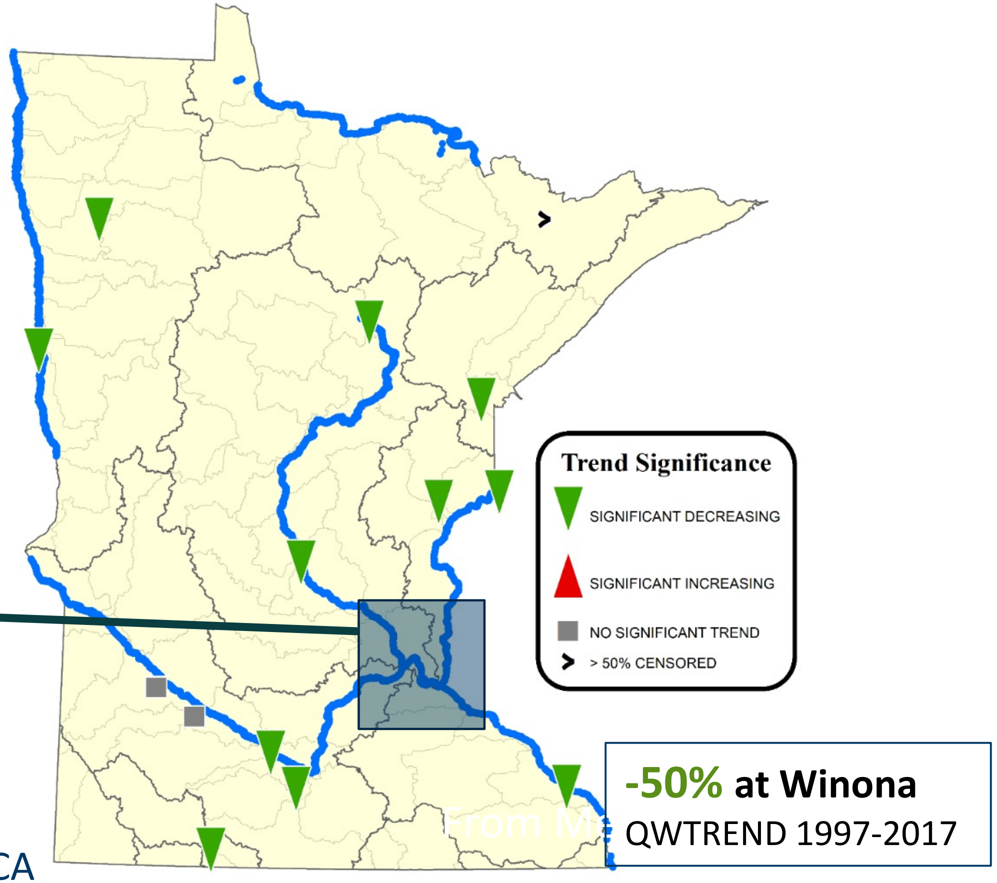
Phosphorus in Rivers (20 years - corrected for flow variability)

1999 – 2018 Trends (QWTREND)



Source: Metropolitan Council

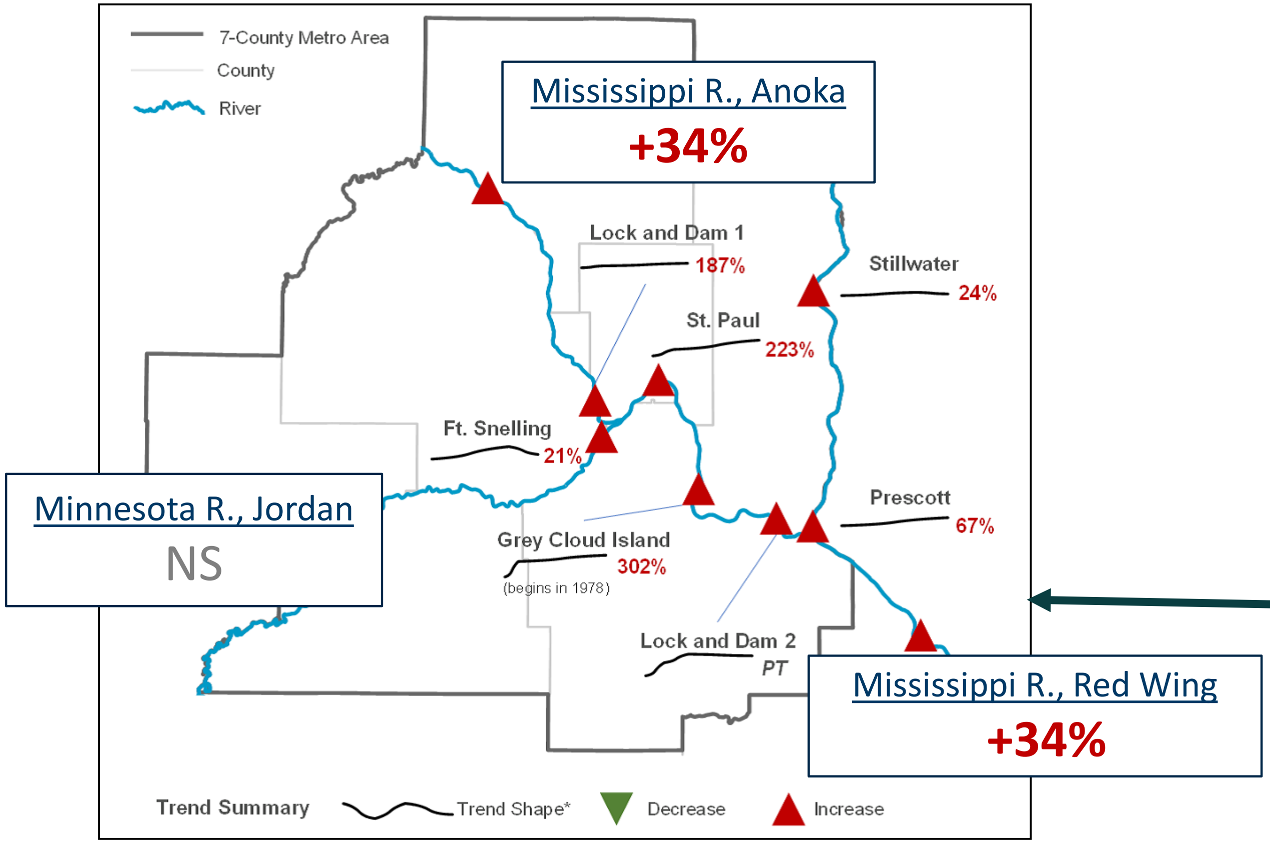
Resampled Seasonal Kendall Results
90% Significance Flow Corrected
Total Phosphorus
1998-2017



Source: MPCA

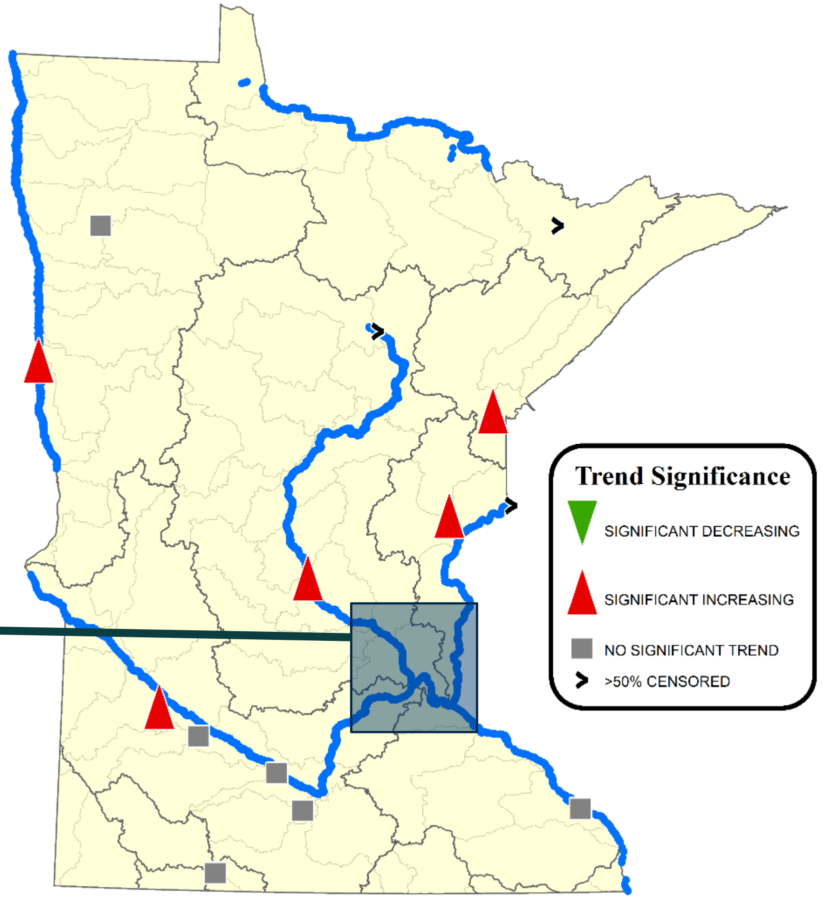
Nitrate in rivers (20 year - adjusted for flow variability)

1999 – 2018 Trends (QWTREND)

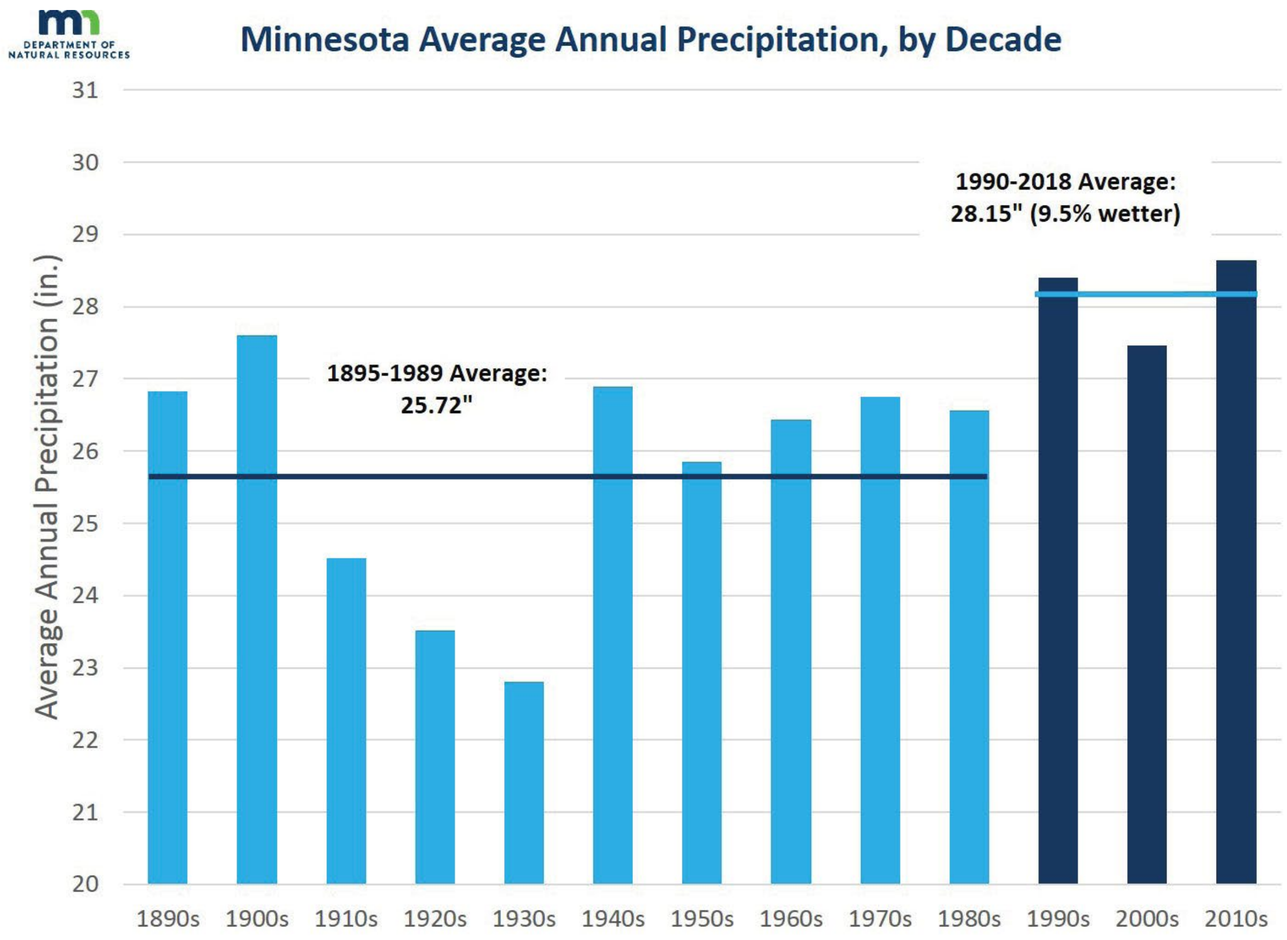


Source: Metropolitan Council

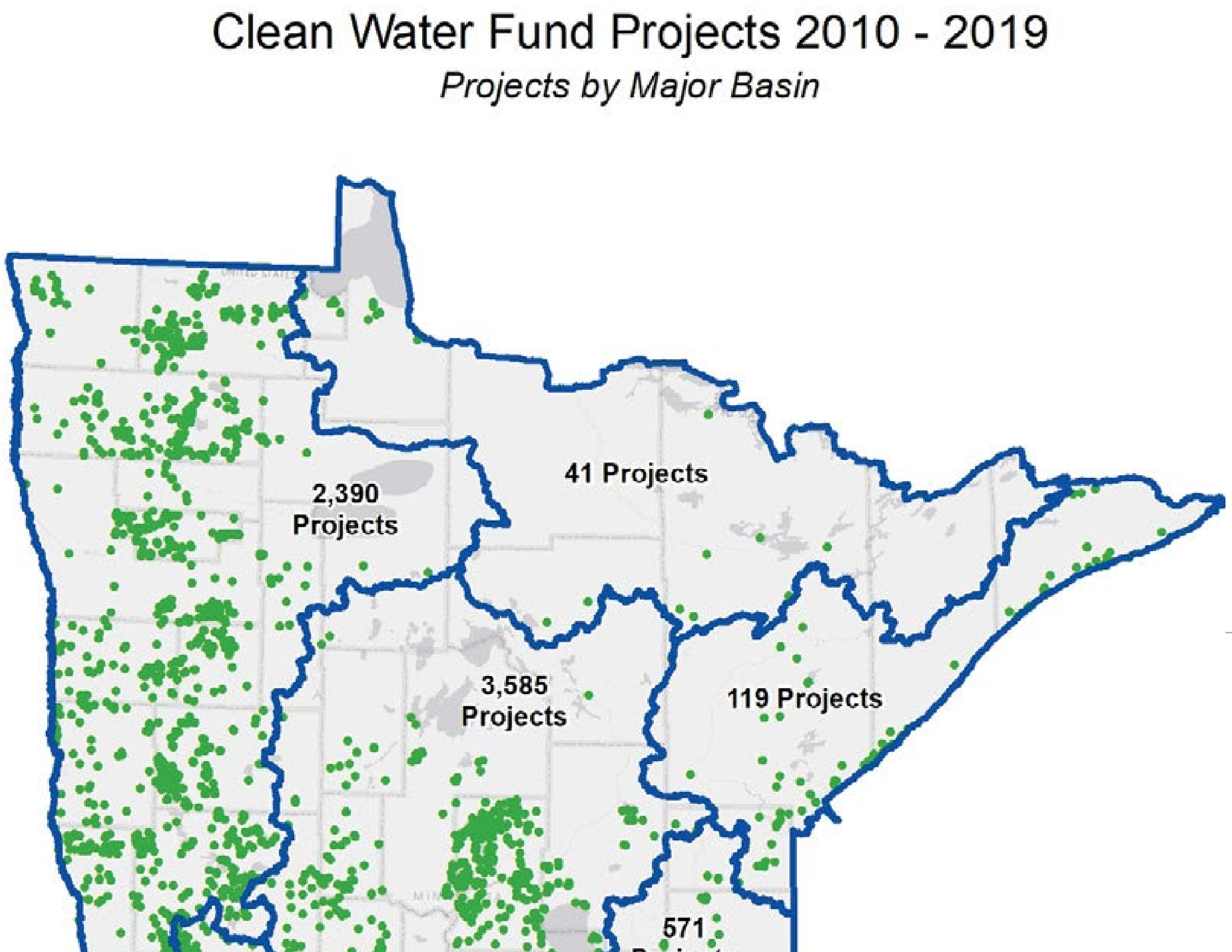
Resampled Seasonal Kendall Results
90% Significance Flow Corrected
Nitrate + Nitrite
1998-2017

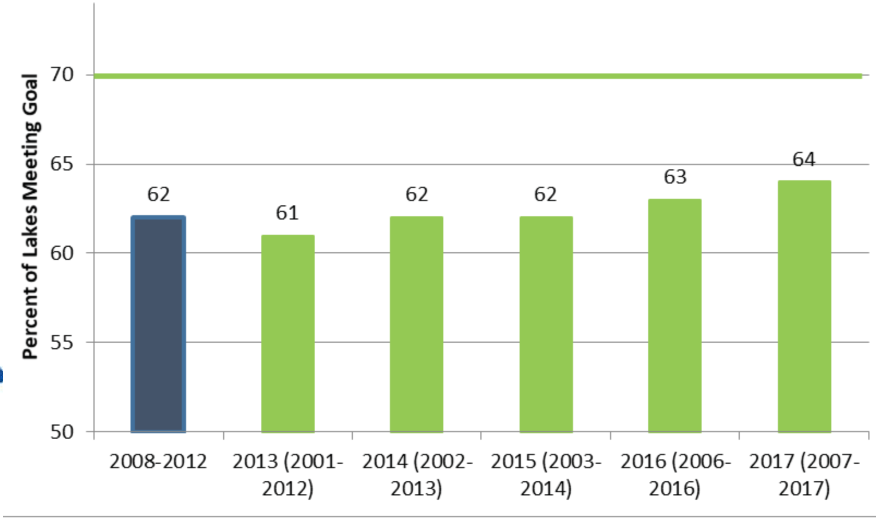


MPCA

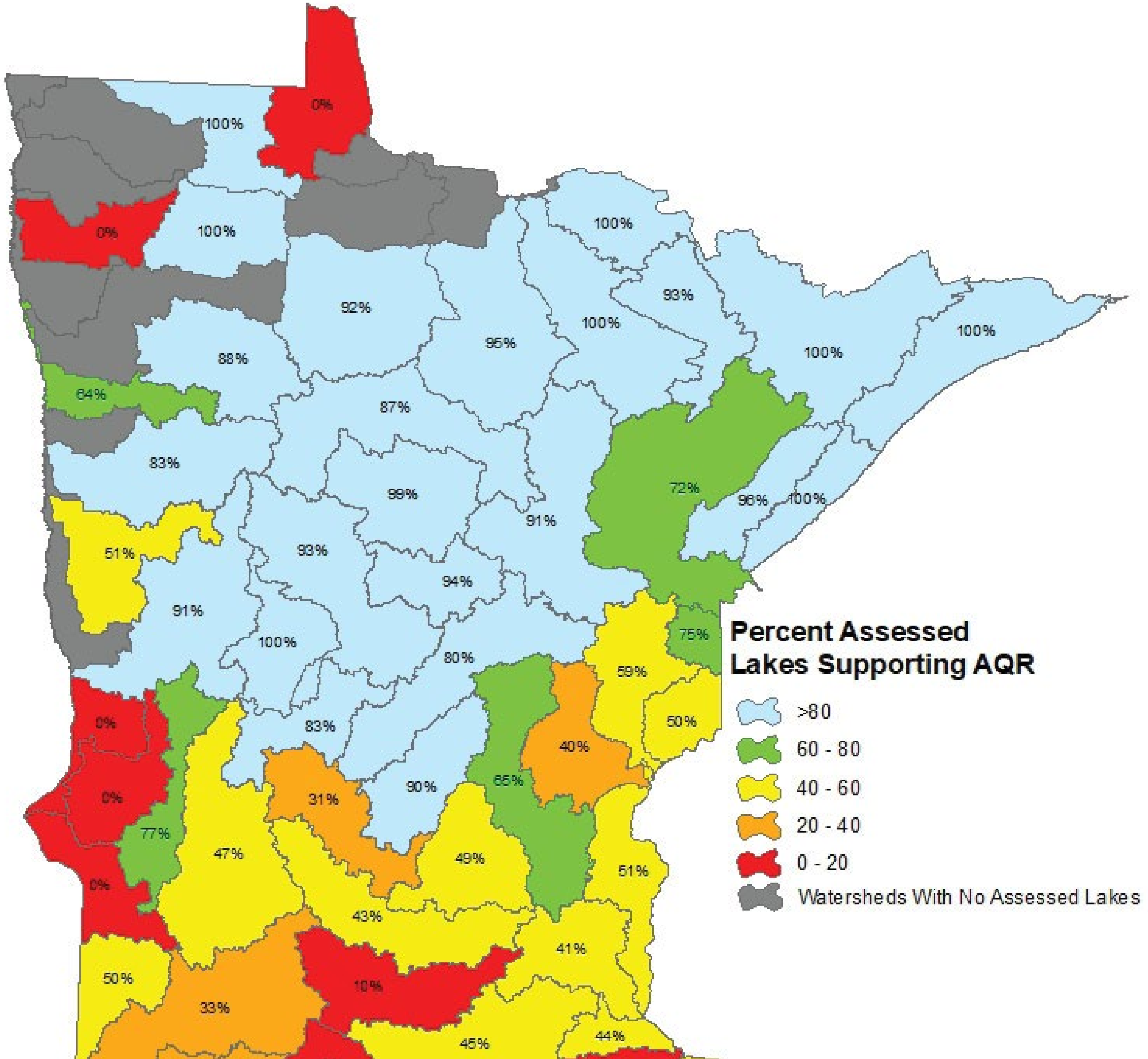


DEPARTMENT OF NATURAL RESOURCES
Minnesota Average Annual Precipitation, by Decade
Average Annual Precipitation (in.)
31
30
29
28
27
26
25
24
23
22
21
20
1895-1989 Average: 25.72"
1990-2018 Average: 28.15" (9.5% wetter)
1890s
1900s
1910s
1920s
1930s
1940s
1950s
1960s
1970s
1980s
1990s
2000s
2010s

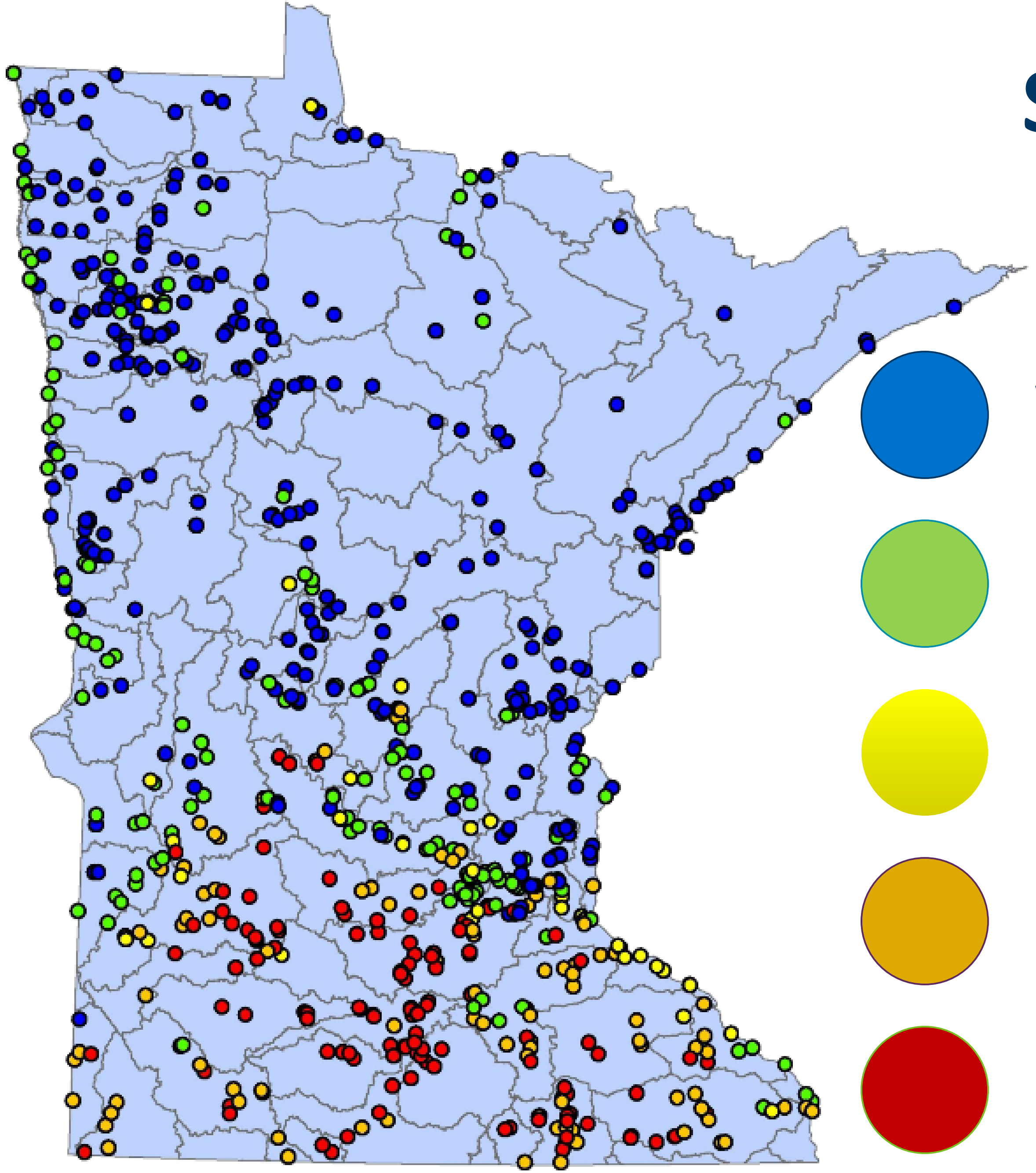

Clean Water Fund Projects 2010 - 2019
Projects by Major Basin
2,390
Projects
41 Projects
3,585
Projects
119 Projects
571


Percent of Lakes Meeting Goal
70
65
60
55
50
62
61
62
62
63
64
2008-2012
2013 (2001-2012)
2014 (2002-2013)
2015 (2003-2014)
2016 (2006-2016)
2017 (2007-2017)

Lake Assessments (Aquatic Recreation Use - AQR)
Eutrophication - Phosphorus, Chlorophyll, and Secchi Transparency



Stream nitrate monitoring



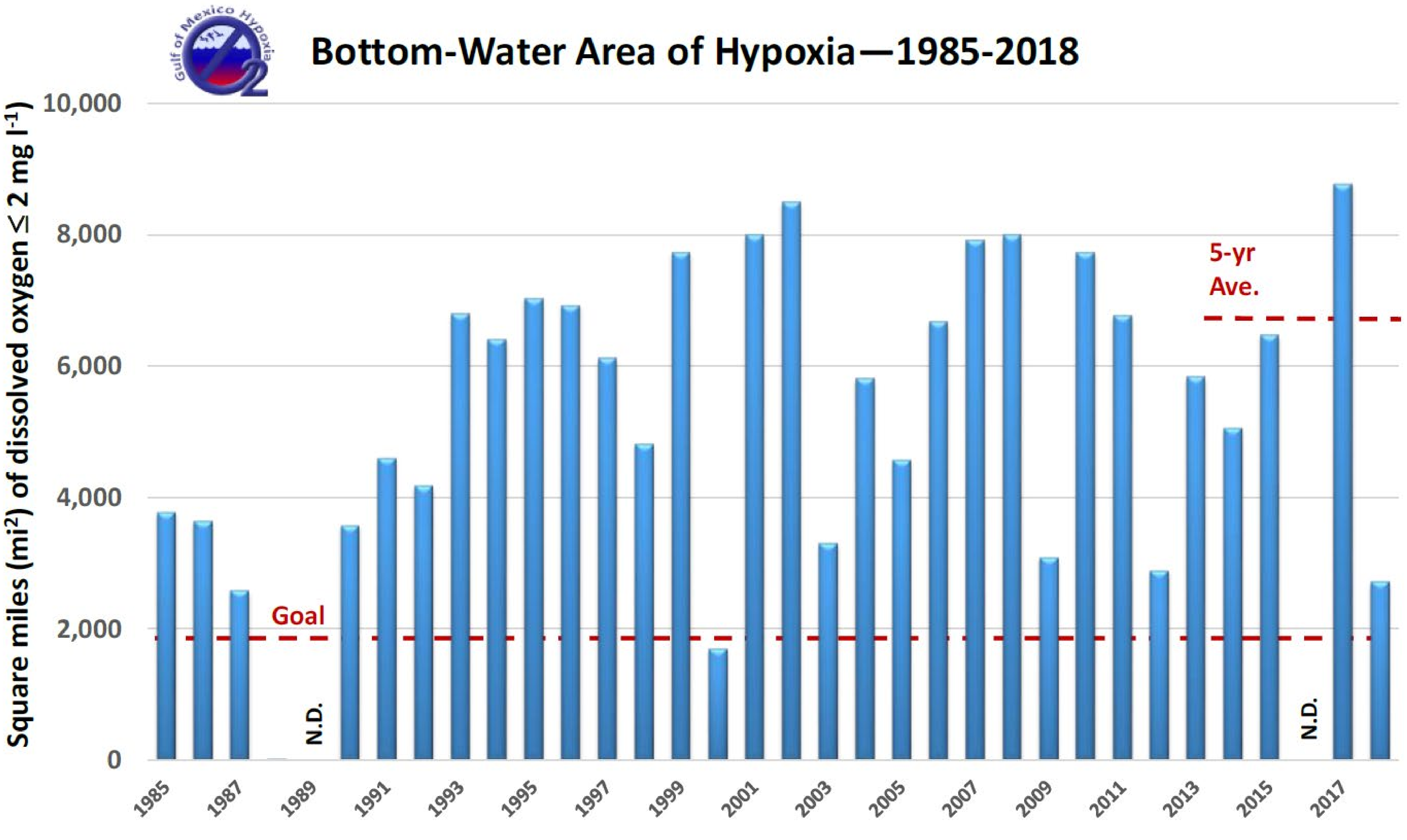
Very low: <1 mg/L

Low

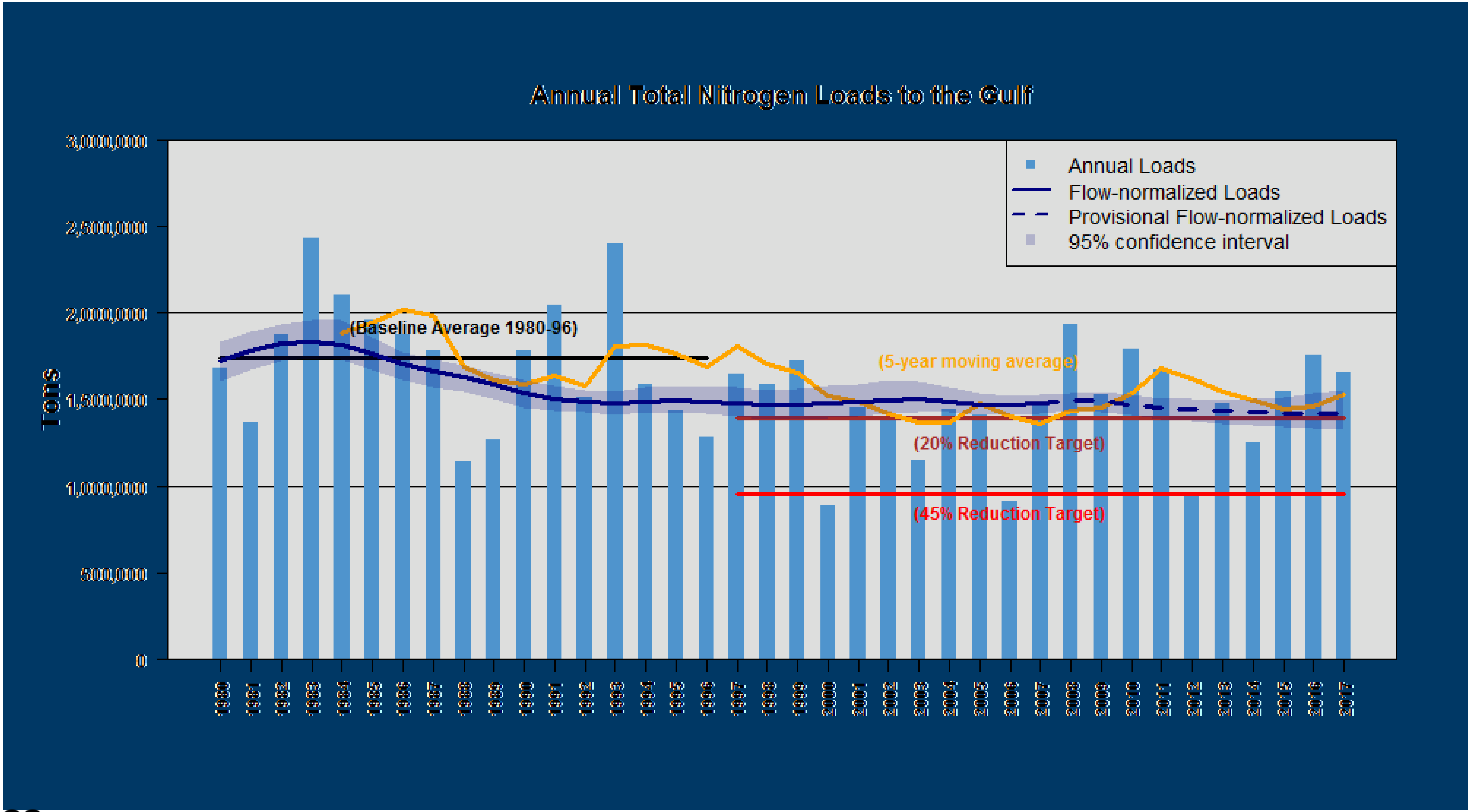
Medium: 3-5 mg/l

High

Exceeds 10 mg/l



Gulf of Mexico Hypoxia
Bottom-Water Area of Hypoxia—1985-2018
Square miles (mi²) of dissolved oxygen ≤ 2 mg l⁻¹)
10,000
8,000
6,000
4,000
2,000
0
Goal
5-yr
Ave.
N.D.
N.D.
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017


Annual Total Nitrogen Loads to the Gulf
Tons
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
Annual Loads
Flow-normalized Loads
Provisional Flow-normalized Loads
95% confidence interval
(Baseline Average 1980-96)
(5-year moving average)
(20% Reduction Target)
(45% Reduction Target)
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017

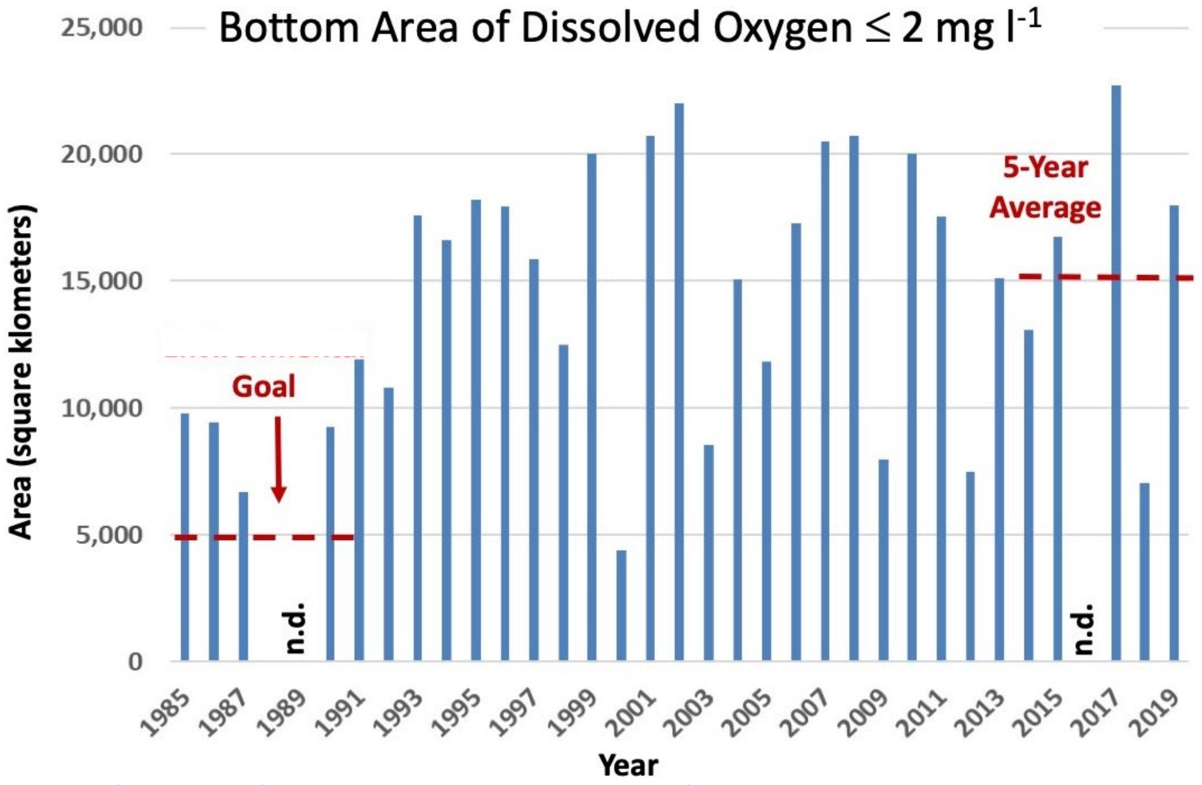
Mississippi River Gulf of Mexico Watershed Nutrient Task Force

Coastal Goal

By 2035, reduce 5-year running average size of the Gulf hypoxic zone to 5,000 km^2

Interim Target

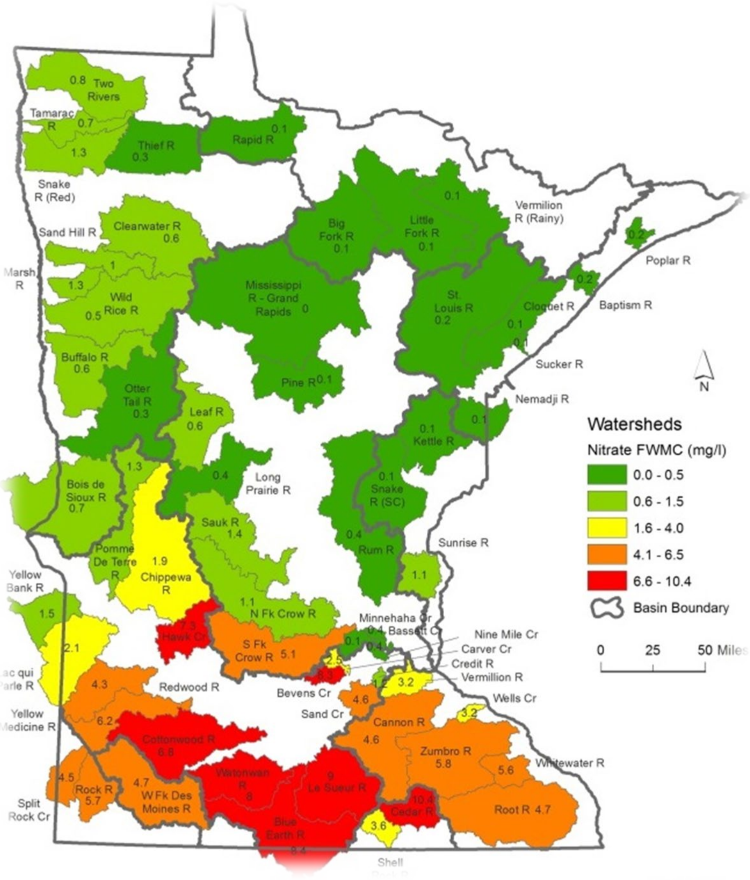
20% reduction of N & P loading from the MARB by 2025



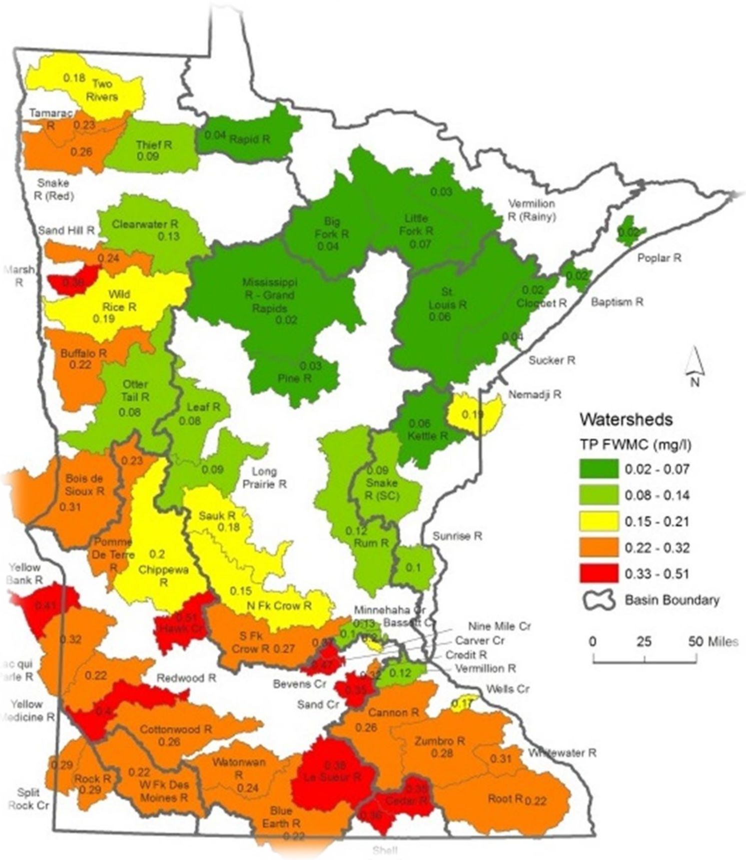
Historic size of hypoxia from 1985 to 2019. No data for 1989 and 2016. 1988 value is 15 sq. mi.

(N. Rabalais, LSU/LUMCON & R. Turner, LSU)

River nutrient concentrations vary greatly across MN

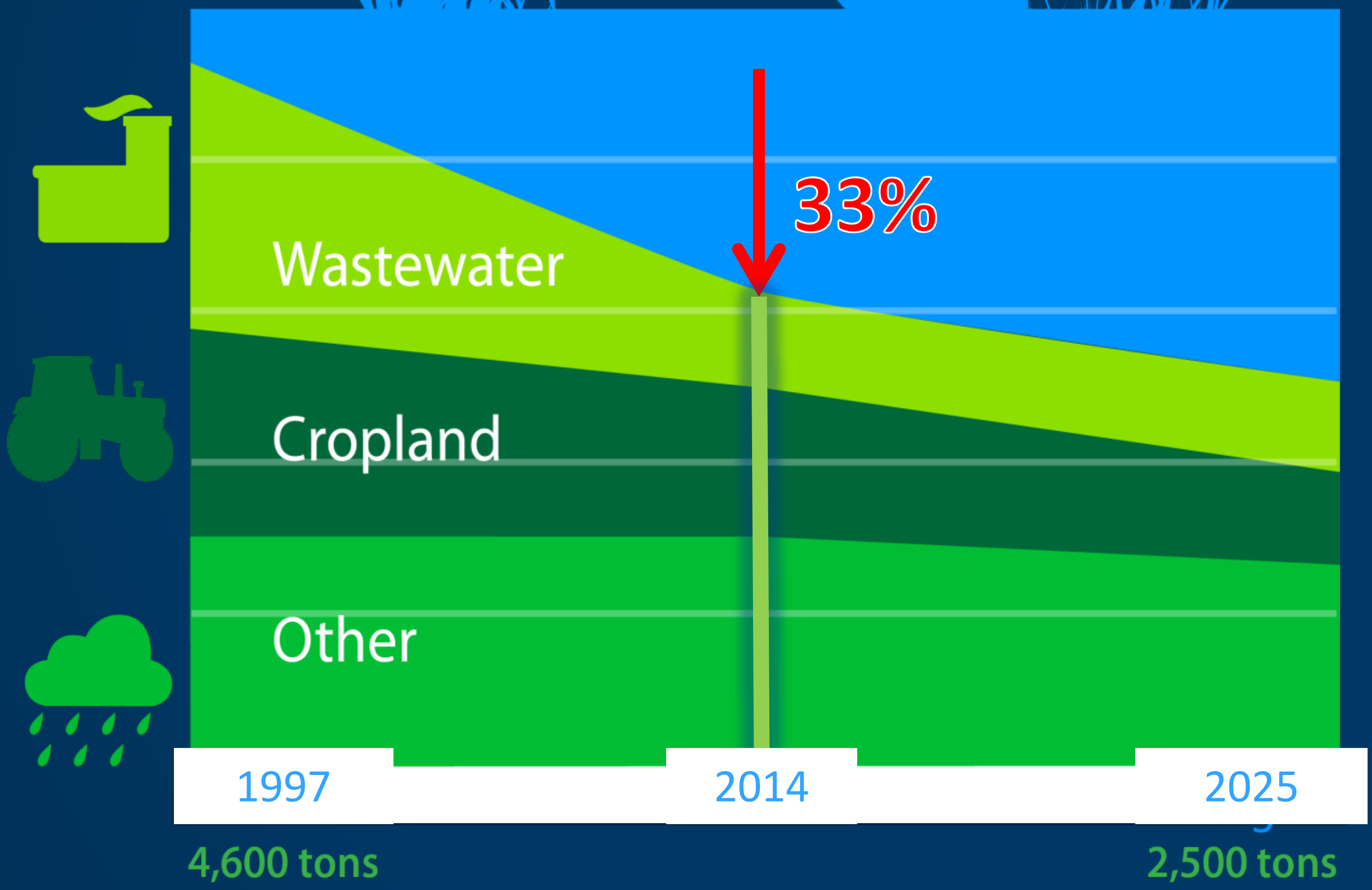


Nitrate

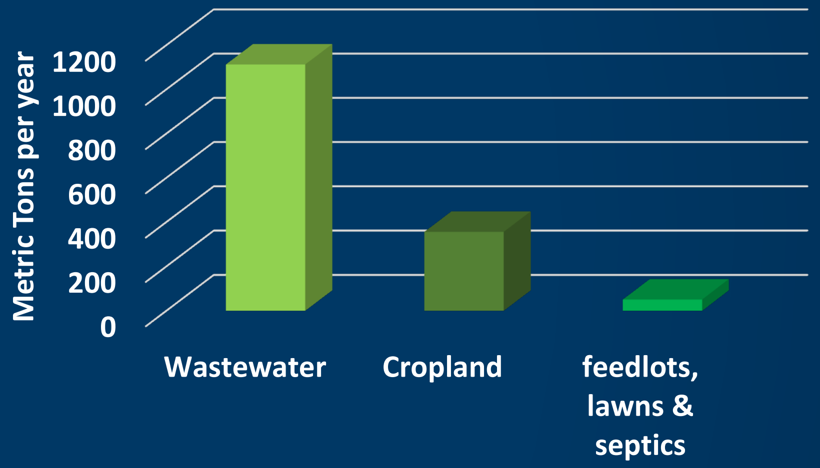


Phosphorus

Mississippi River Phosphorus Goals



Phosphorus reduced into Mississippi River 1997-2013



Note: 48% agric. P reduction to Minnesota River Basin during decades prior to 2006

Based on National Conservation Effects Assessment Project (USDA 2010).