Working Lands Watershed Restoration Program

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BOARD OF WATER AND SOIL RESOURCES

2016 Legislation*

- "…development of a detailed plan to implement a working lands watershed restoration program to incentivize the establishment and maintenance of perennial crops…"
- Interim report by October 15, 2017 and final report by February 1, 2018
- 11 specific elements

* (Laws 2016, c. 189, s. 4); 103F.519

History: Working Lands Watershed Restoration Program

- Funding for program plan and feasibility study included in 2016 supplemental budget
- Program intent: provide water quality benefits through helping agricultural producers:
  - maintain productive use of land,
  - while supplying biomass feedstocks to produce materials or energy with a lower carbon footprint.

History: Working Lands Watershed Restoration Program

- Program is complementary to the Bioeconomy Production Incentive (2015)
- Commercial financing program for advanced biofuels, biobased chemicals and biomass thermal energy projects
- Responsible biomass sourcing provision to ensure sustainable harvest of crop residues

Why Perennials and Living Cover?

- Changes in agricultural practices
- Changes in precipitation timing and intensity
- Impaired waters
- Economic pressure to increase row crop production
- The limits of “voluntary” and “regulatory” methods

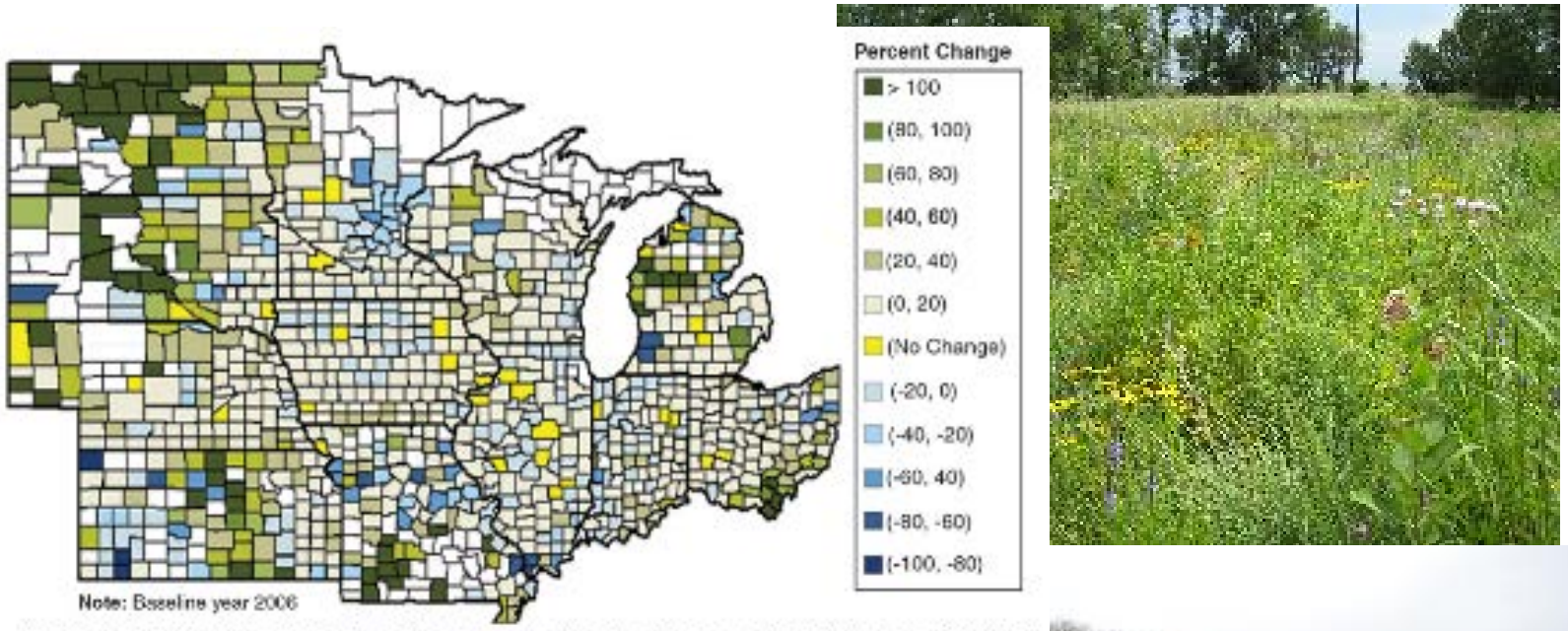


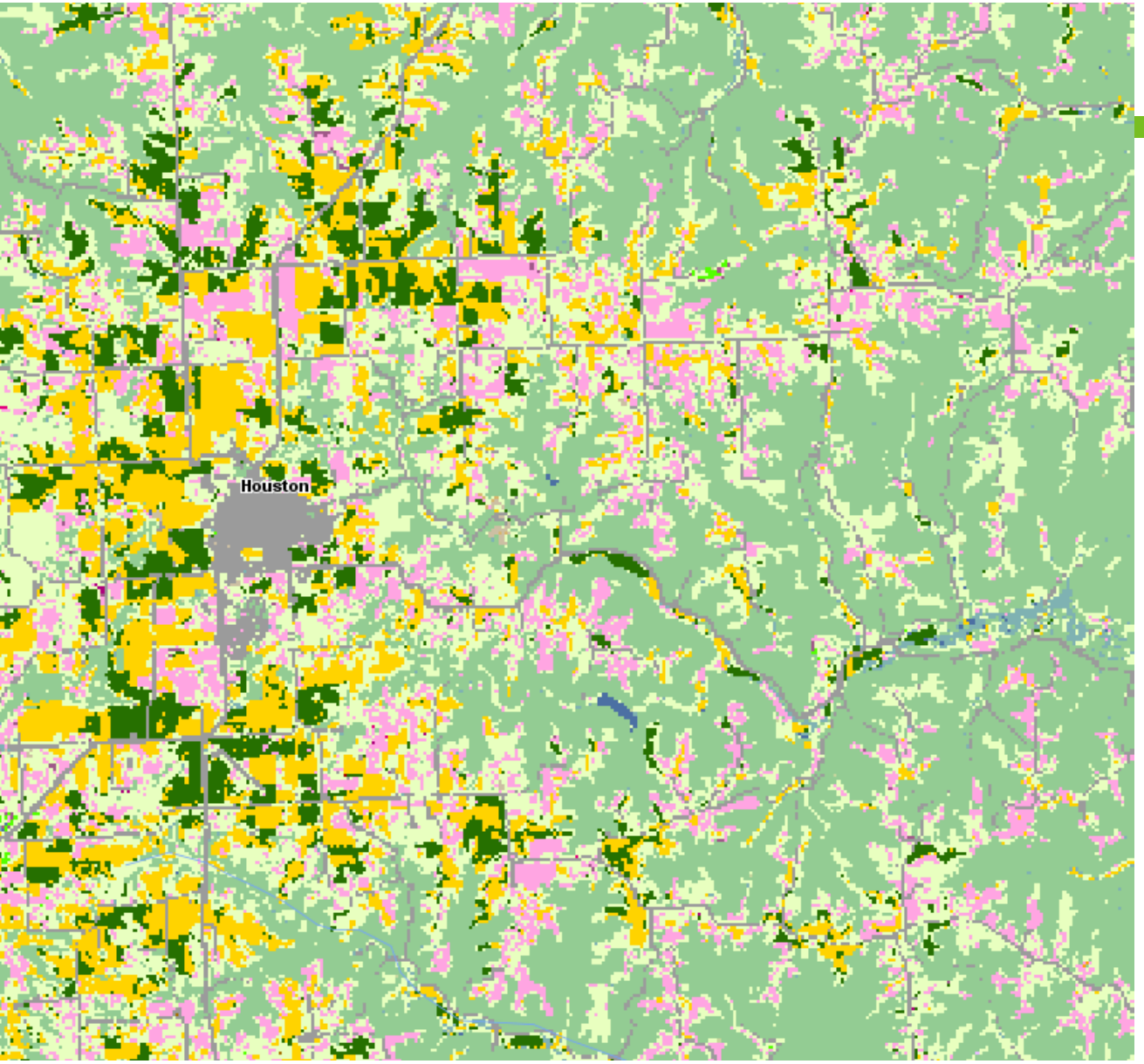
Figure 1. Corn and soybean acreage percentage changes in 2014 (Nass Survey)

Grasslands conversion may increase water pollution in SE Minnesota

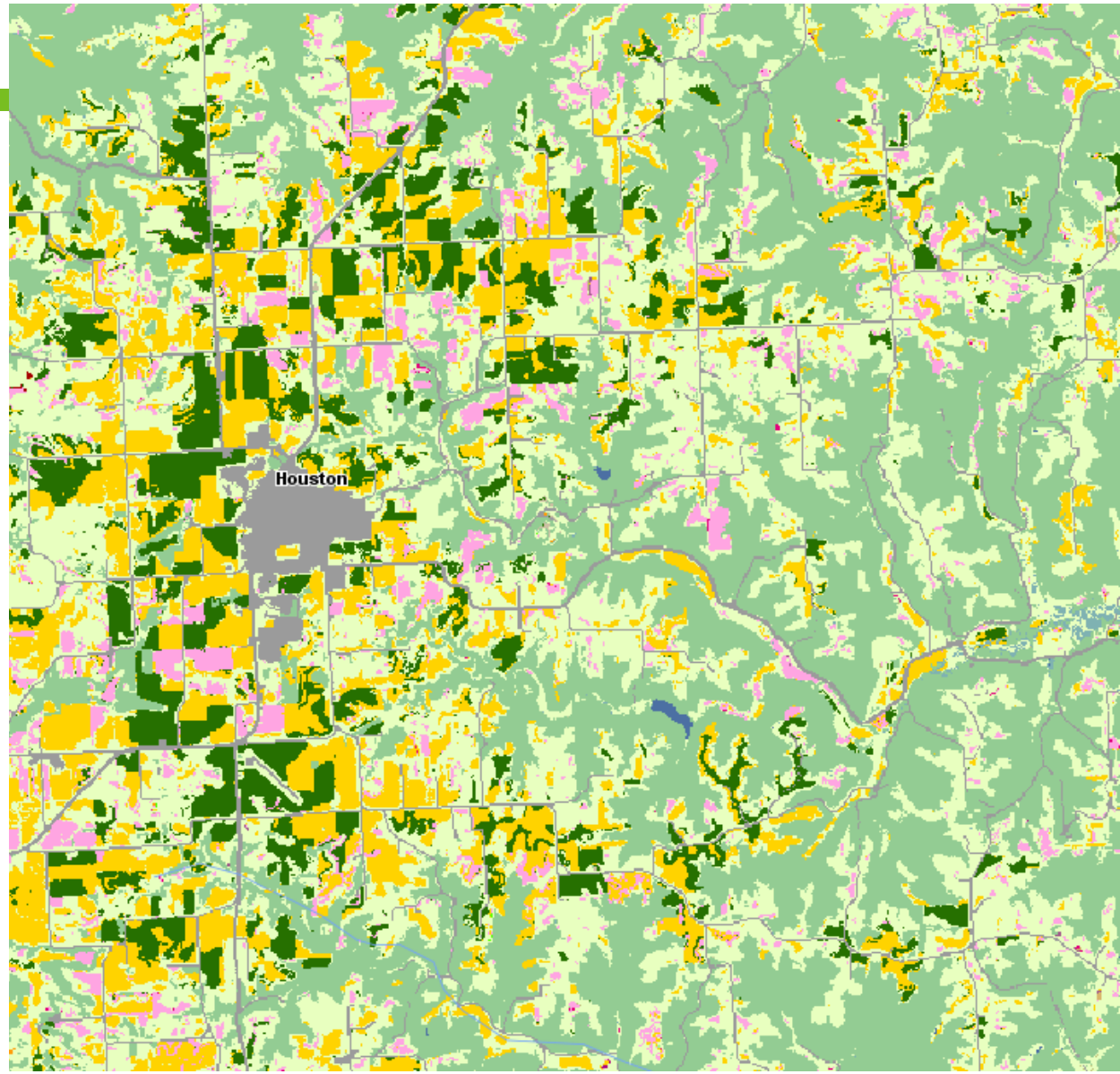
A study predicts that growth in Minnesota cropland will jeopardize drinking water.

By Tom Meersman Star Tribune | JULY 18, 2014 — 9:02PM

Less alfalfa, more corn, soybeans, pasture



Caledonia area – 2006



2016

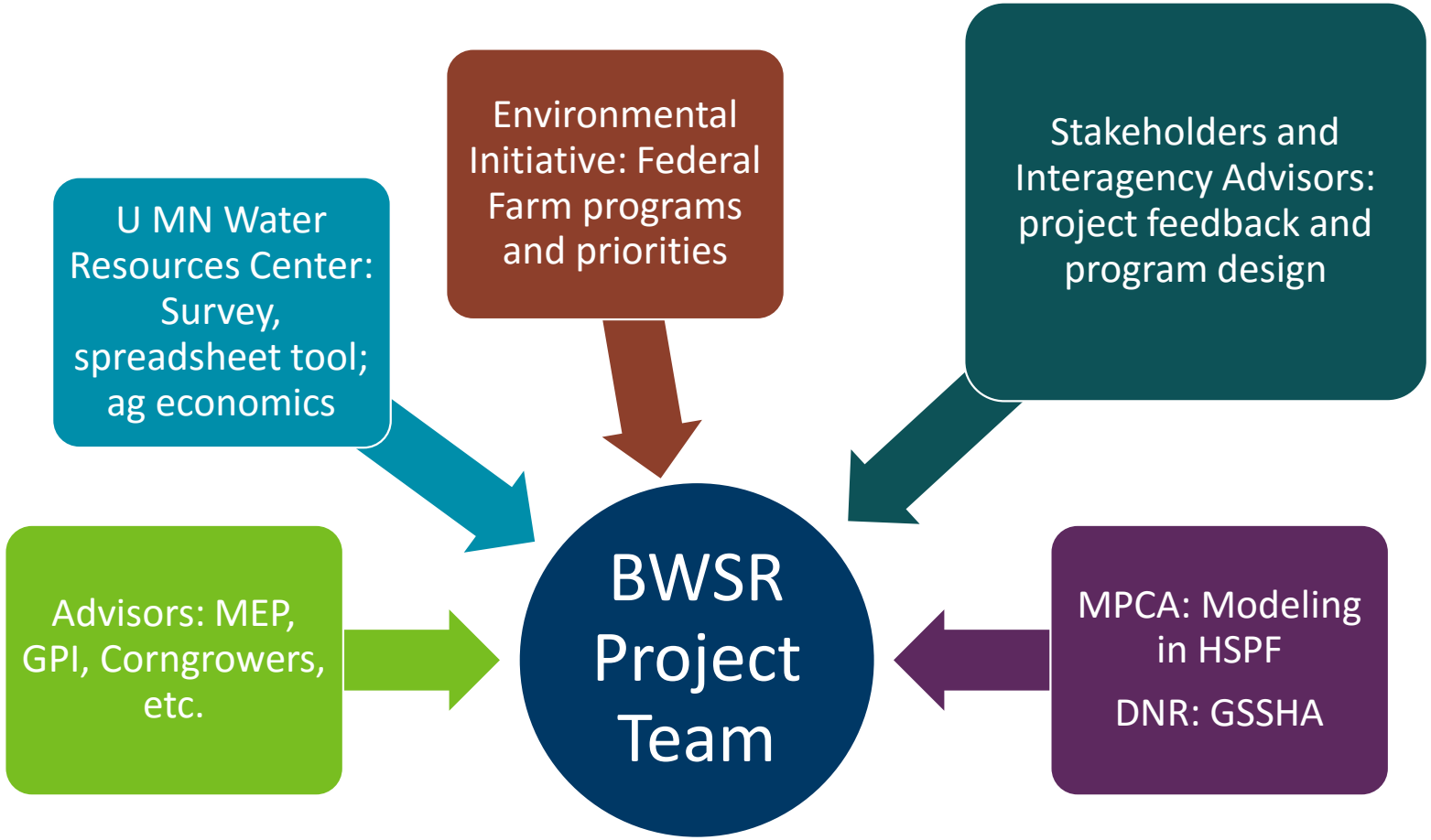
Elements of the plan:

1. A process for selecting pilot watersheds
2. An assessment of the amount of eligible agricultural land
3. An assessment of landowner interest
4. An assessment of contract terms, including possible variable payment rates
5. An assessment of the opportunity to leverage federal funds
6. An assessment of how to best integrate program with existing conservation requirements and benefit wildlife production

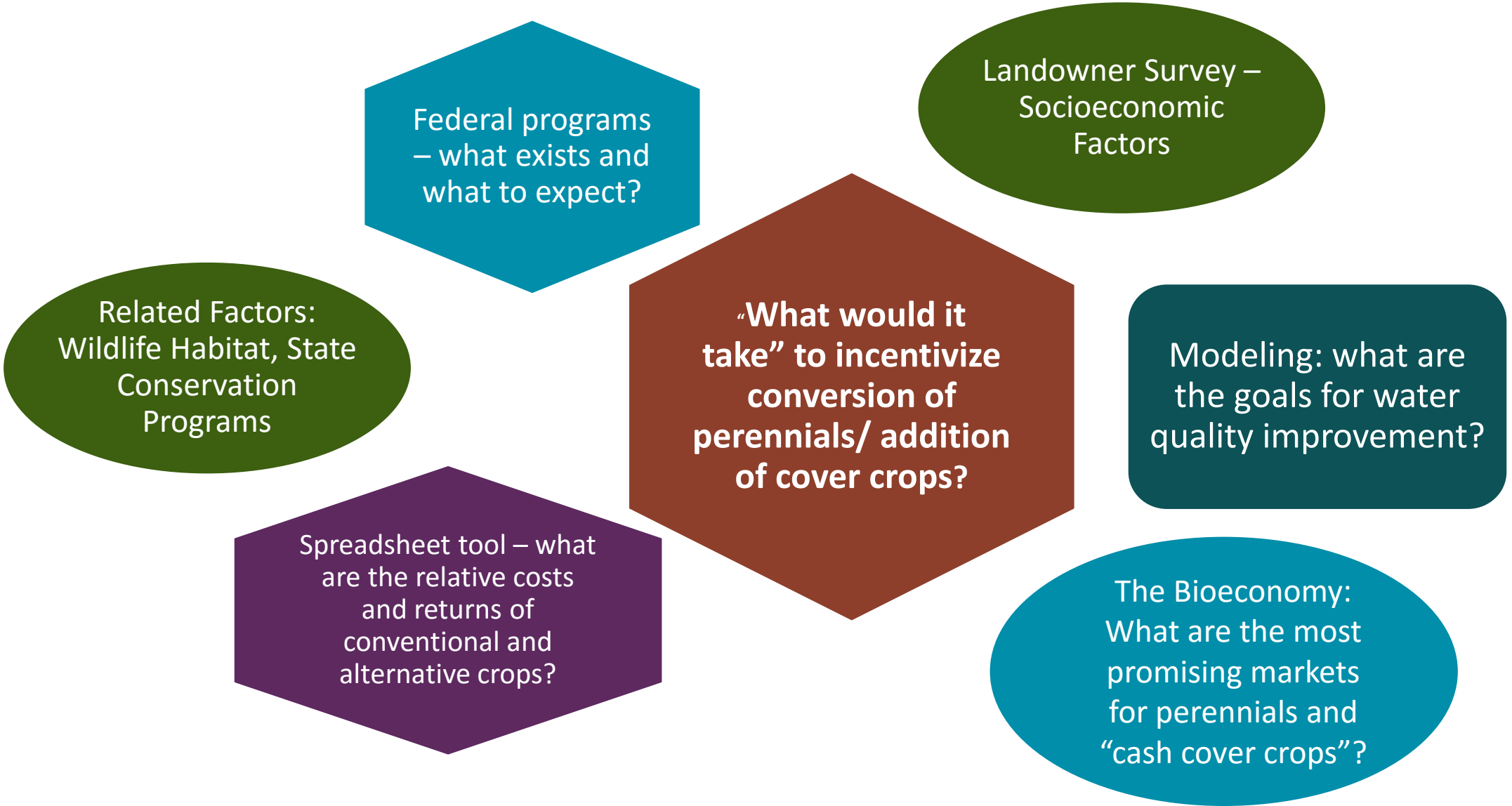
Elements of the plan:

7. An assessment of complementary state programs
8. An estimate of expected water quality improvements
9. An assessment of viability and water quality benefits of cover crops
10. A timeline for implementation, coordinating with proposed biomass processing facilities
11. A projection of funding sources needed for implementation

Project Organization:

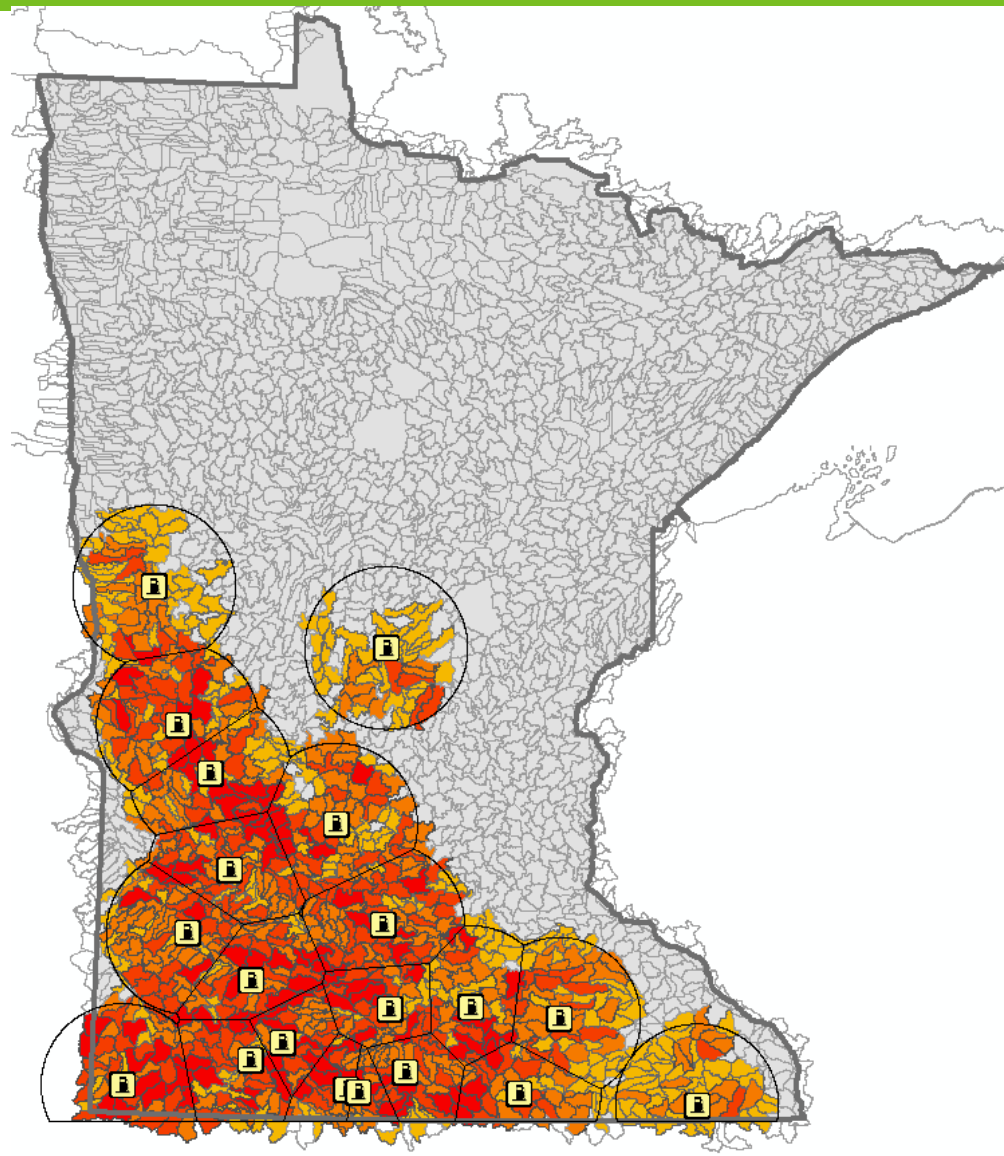


Project Elements



What have we learned so far?

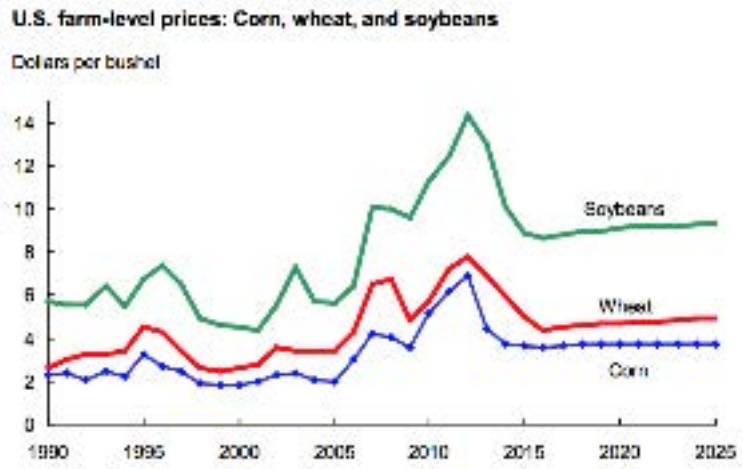
- Cellulosic biofuels in Minnesota and Upper Midwest:
  - Not yet competitive with conventional fuels
  - One remaining pilot plant in Iowa limited to corn stover feedstock
  - “Bolt-on” scenario not likely to be feasible in short term

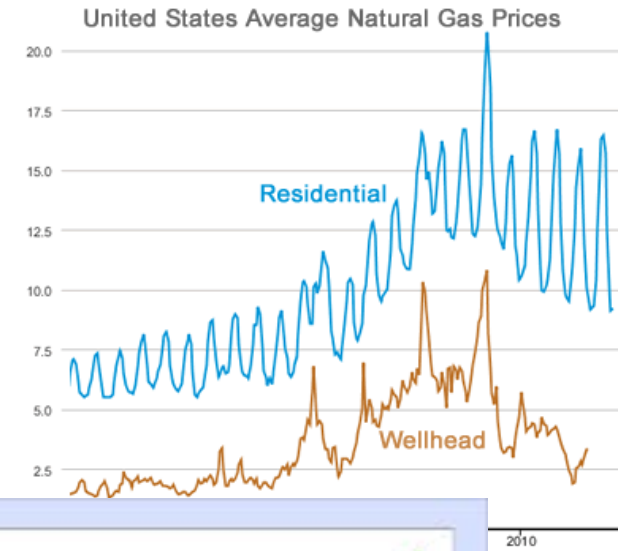


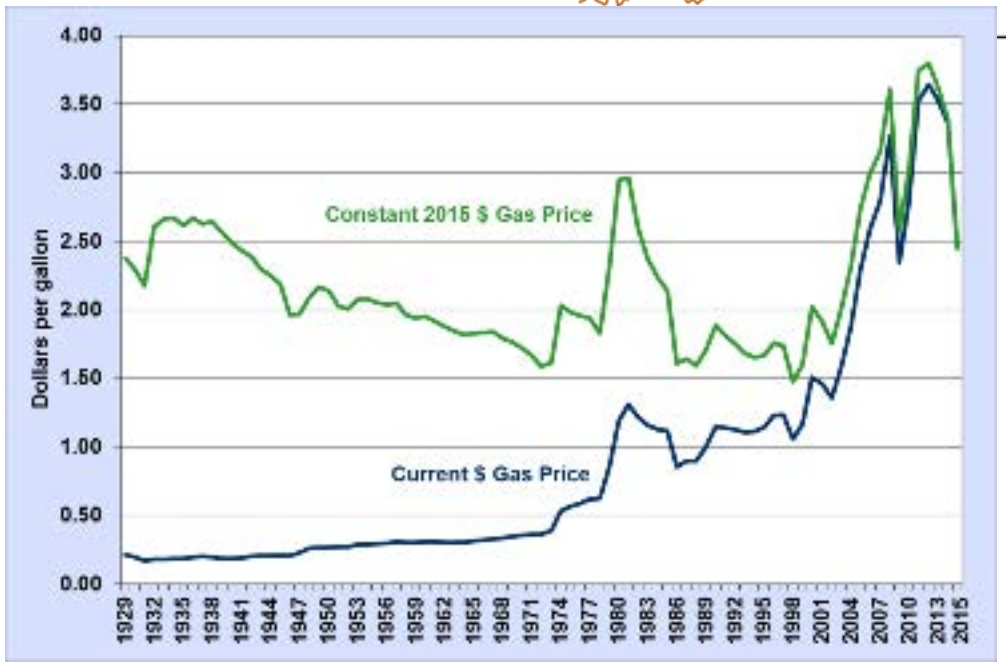
Watersheds with highest concentration of corn production near ethanol plants (from GPI)

What have we learned so far?

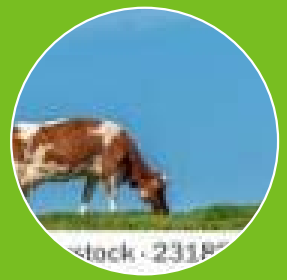
- "Proposed biomass processing facilities" and the state of the bioeconomy:
  - Biofuels the expected initial focus of legislation
  - High oil prices and federal policy drove interest and investment
  - Followed by economic downturn and collapse of the oil market – lack of investment
  - Increasing uncertainty re federal and state policy







Where to focus across a range of biomass uses?



Grazing

- Beef or dairy
- Managed, rotational, mob, etc.

Animal feed, bedding

Human food products

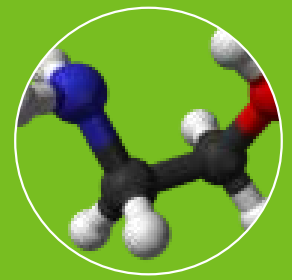
- Processing and transport
- Increasing consumer demand/ new product development

Combustion

- Combustion: heat and/or power

Anaerobic Digestion

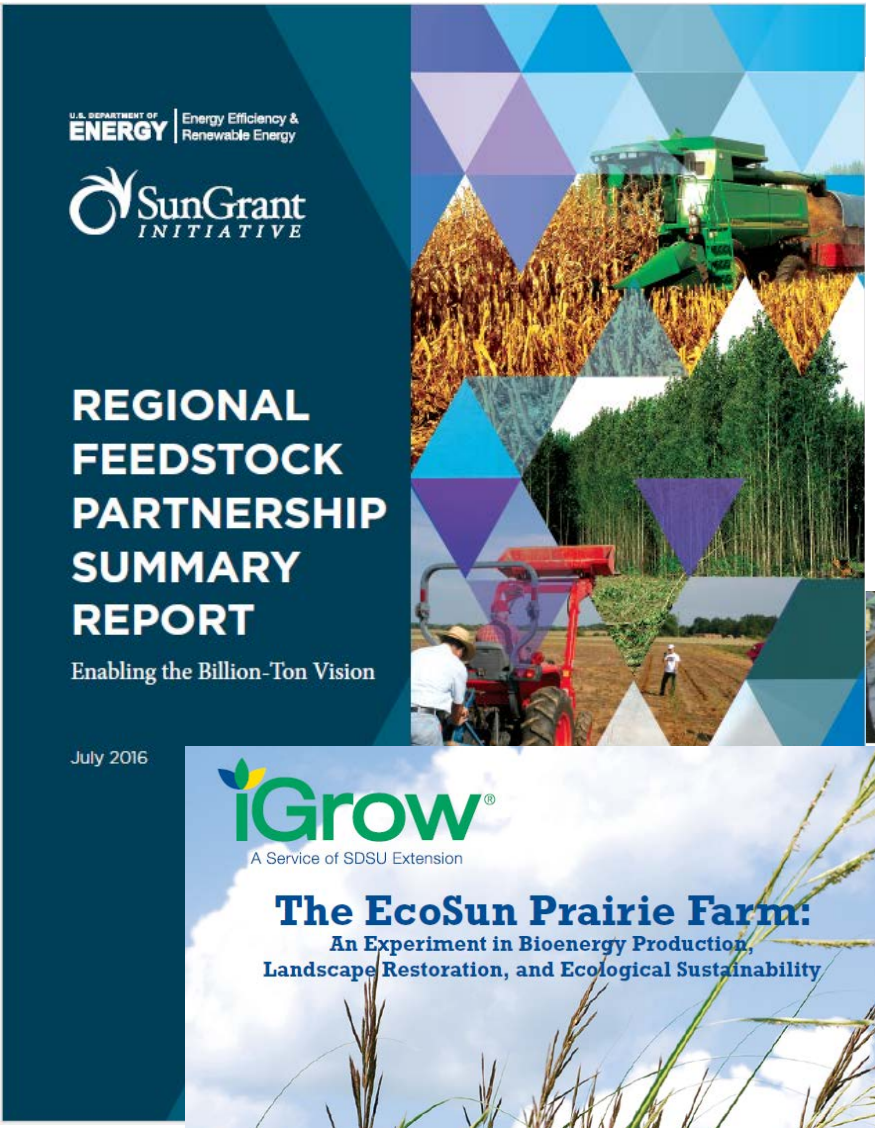
- Methane
- Biogas



Biofuels and Green Chemicals

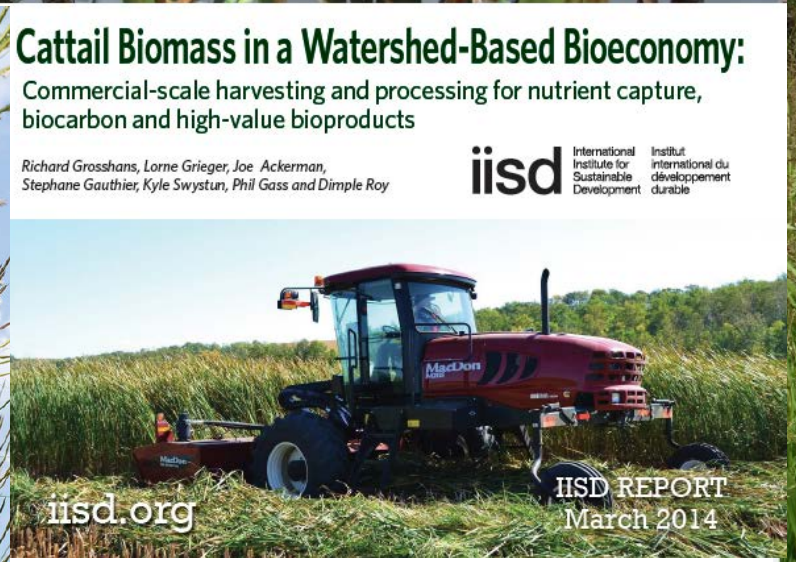
- Ethanol
- Butanol
- Biodiesel
- Bio-jet Fuel

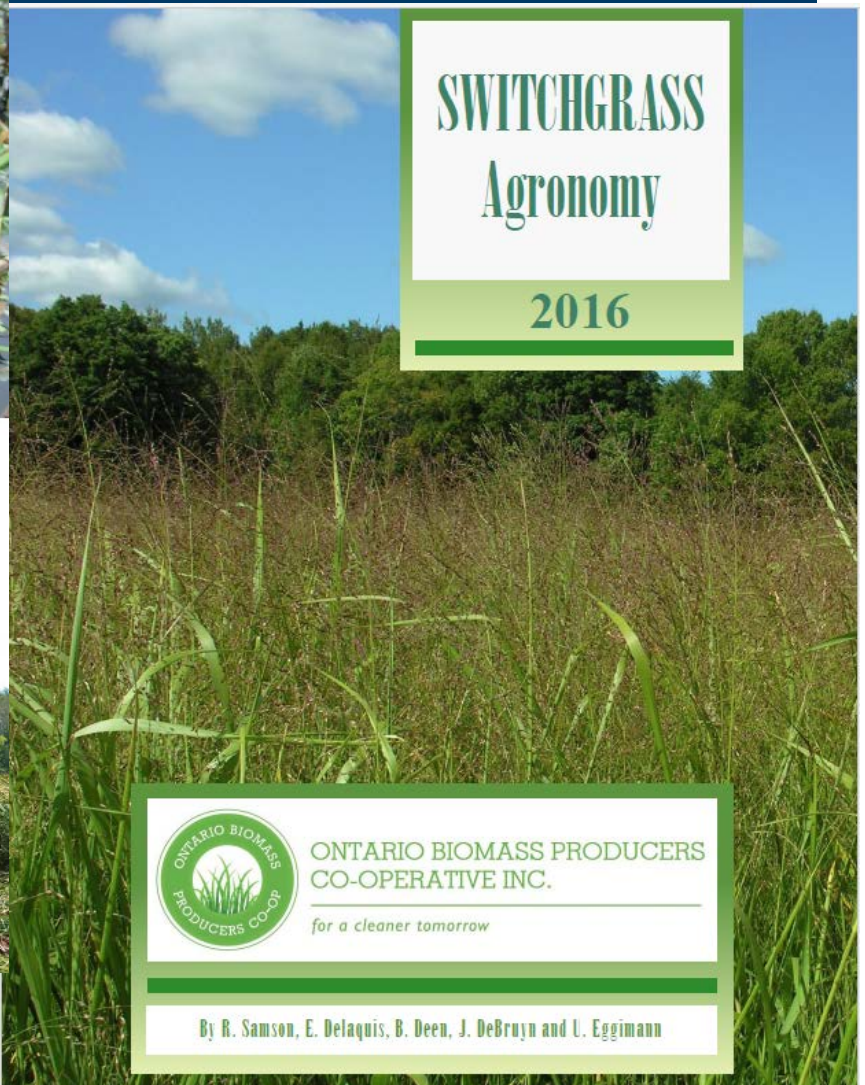
Emerging Crops



Kernza, an intermediate wheatgrass, was planted on three acres of land owned by the City of Chatfield on Tuesday, Sept. 12, 2017, at the intersection of County Road 10 and 155th Avenue Southeast near Chatfield.

Andrew Link / alink@postbulletin.com





Which crops? Which end uses?

- Perennials grasses: Switchgrass and Miscanthus – biofuel, livestock bedding, soil conditioning, etc.
- Kernza wheat – forage, food products, biofuel
- Alfalfa – hay, mixed forages, other livestock feed, etc.
- Oil seeds – Camelina and Pennycress – oils, bio-jet fuel, bioproducts, livestock feed, etc.
- Mixed forage crops for grazing, feed – grass-fed beef, organic dairy, cow-calf operations, etc.
- Mixed cover crops for soil health

Switchgrass

- Grown for animal bedding and dairy cattle feed in Eastern Ontario
- Widely grown in Eastern TN for biofuel
- Pennsylvania-based association of warm season grass producers – in-field processing of poultry bedding

What Makes a Good Dairy Bedding?

- Comfortable surface for cows to lay down on.
- Absorbs fluids to keep the stall dry and cows clean.
- Absorbs nutrients, ammonia and other odours.
- Non-slippery and cushions the cow's feet.
- Non-abrasive to cow's knees and hock joints.
- Contains low numbers of environmental mastitis causing organisms in raw state.
- Readily available at reasonable costs.
- Easily stored, applied and removed.
- Low dust.
- Environmentally friendly when spread on land

(adapted from Milk2020)

Miscanthus

- Grown in Illinois for poultry bedding
- Part of University of Iowa's power plant goal of 40% renewables by 2020
  - Feedstocks: wood chips, prairie grasses
- Some test plots in MN in 2008

New Eastern Iowa Airport miscanthus crop will fuel University of Iowa power plant

Kernza - Intermediate Wheatgrass

- Both a forage and a food crop
- Marketing and supply-chain development accelerating
- Supply is still intentionally limited
- Yields decline after 2-3 years
- Continuing breeding work to improve yields, seed size
- Strongest interest in vulnerable wellhead protection areas (DWSMAs)

Greenspace: Chatfield tests new cover crop that protects groundwater

Ryan Faircloth, rfaircloth@postbulletin.com Sep 19, 2017 Updated Sep 19, 2017 (0)

Kernza, an intermediate wheatgrass, was planted on three acres of land owned by the City of Chatfield on Tuesday, Sept. 12, 2017, at the intersection of County Road 10 and 155th Avenue Southeast near Chatfield.

Andrew Link / alink@postbulletin.com

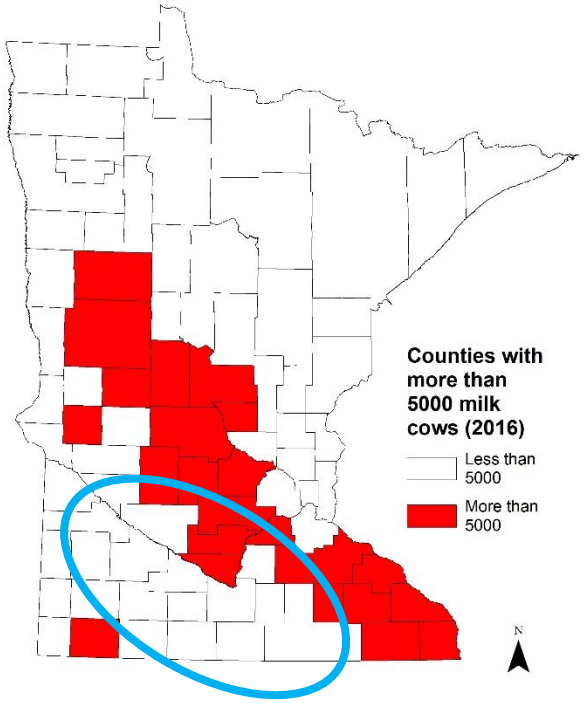
habitat surrounding its crop lands.

Alfalfa / Other Hay Crops

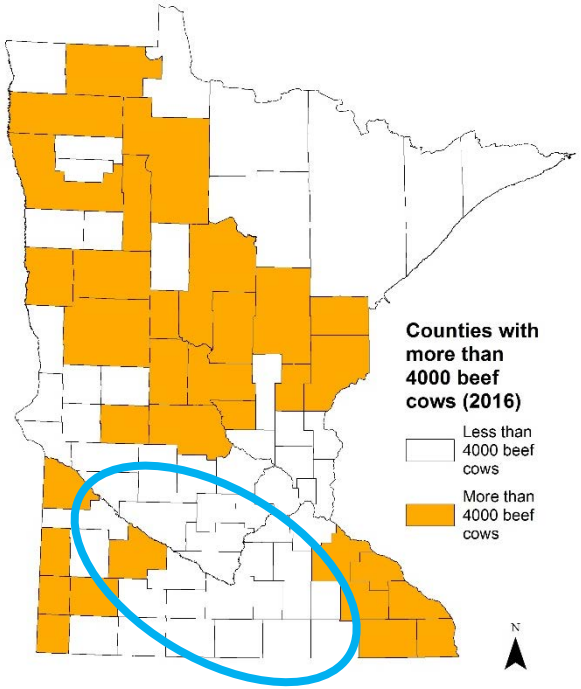
- Alfalfa is cornerstone of dairy farm forage ration
- Can perform better mixed with perennial grasses or companion crops
- “Hay” by definition also includes grass mixtures and other legumes such as clover, crop residue such as cornstalks.
- Grown where cattle are still found on the landscape
- Subject to weather-related fluctuations

Supply is Localized to the Demand

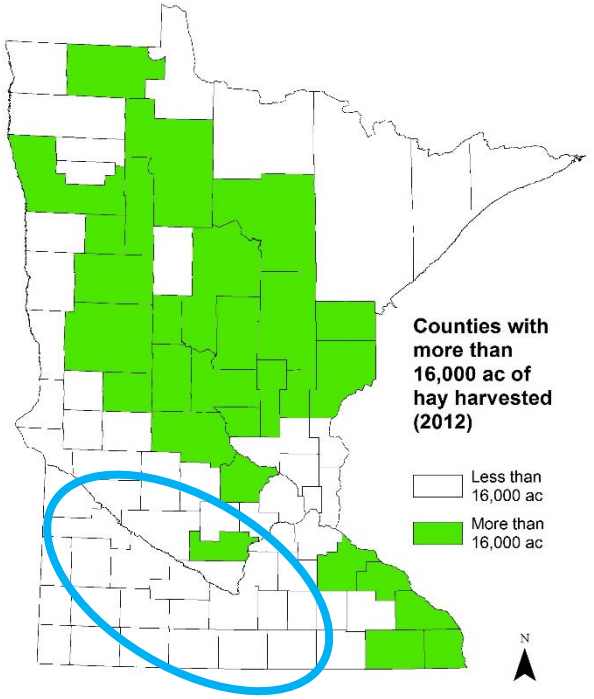
Milk Cows



Beef Cows



Hay Production



USDA-NASS

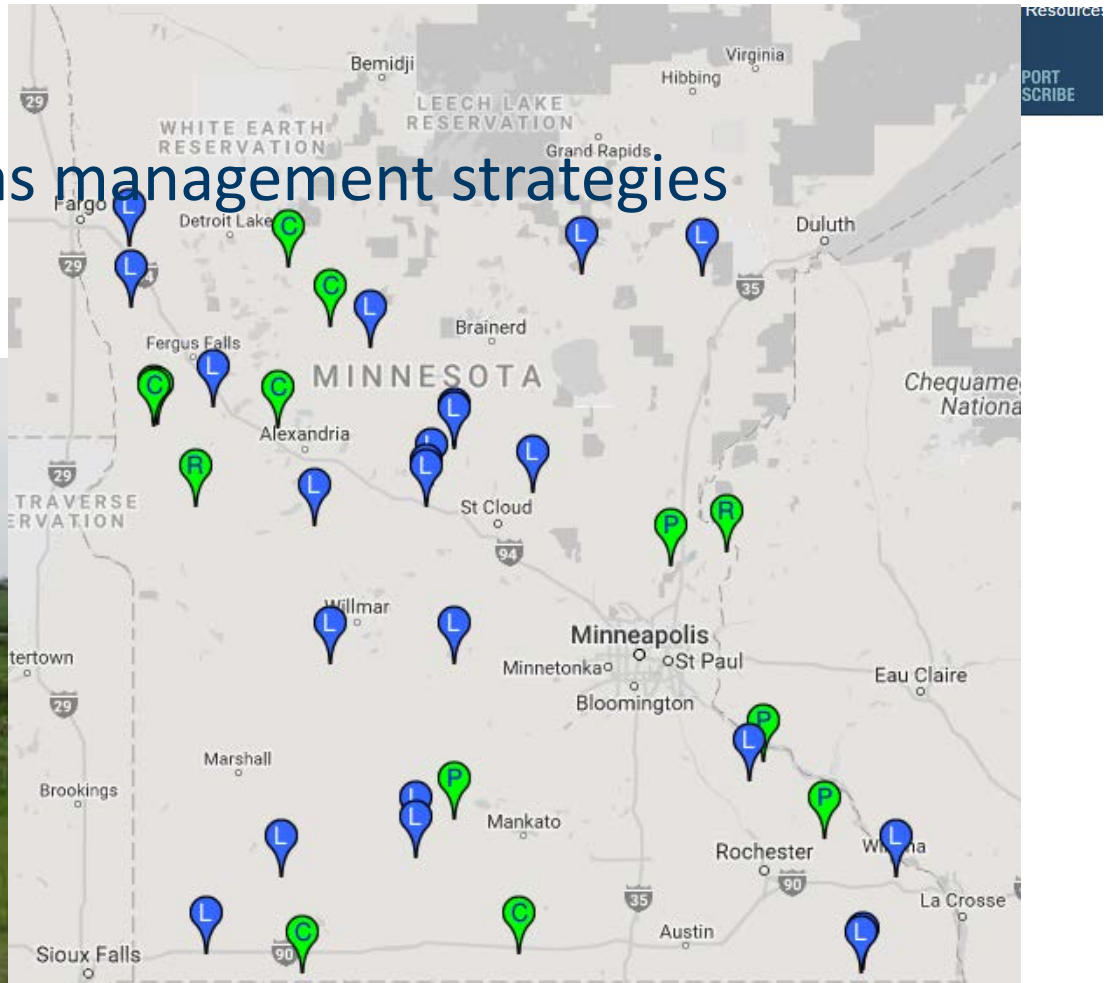
Jared Goplen, UM Extension –
Economics of Hay Production in MN

Cover crops (mixes)

- Build soil organic matter
- Add nitrogen to the soil
- Break up soil compaction
- Reduce soil erosion
- Create wildlife habitat, attract pollinators
- Annual or perennial – brassicas, cereals, rye, fescue, etc.
- Interseeding is improving viability – but establishment is still weather-dependent

Managed/Controlled Grazing

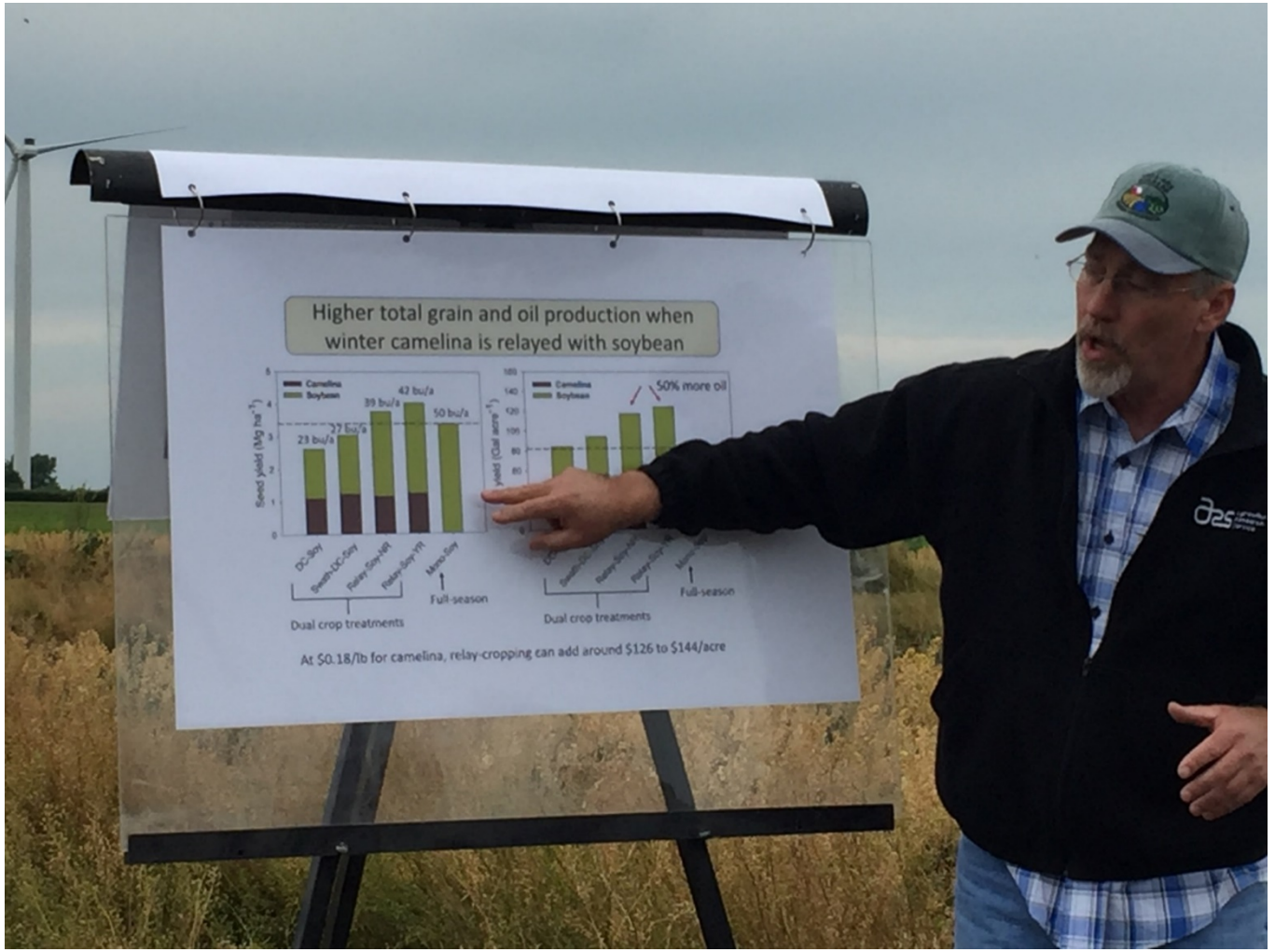
- A natural disturbance agent in North American grasslands – and beneficial for wildlife
- Minnesota Prairie Plan – grazing and fire as management strategies
- Increasing consumer interest
- MDA Cropland Grazing Exchange



Managed grazing with cover crops and paddocks

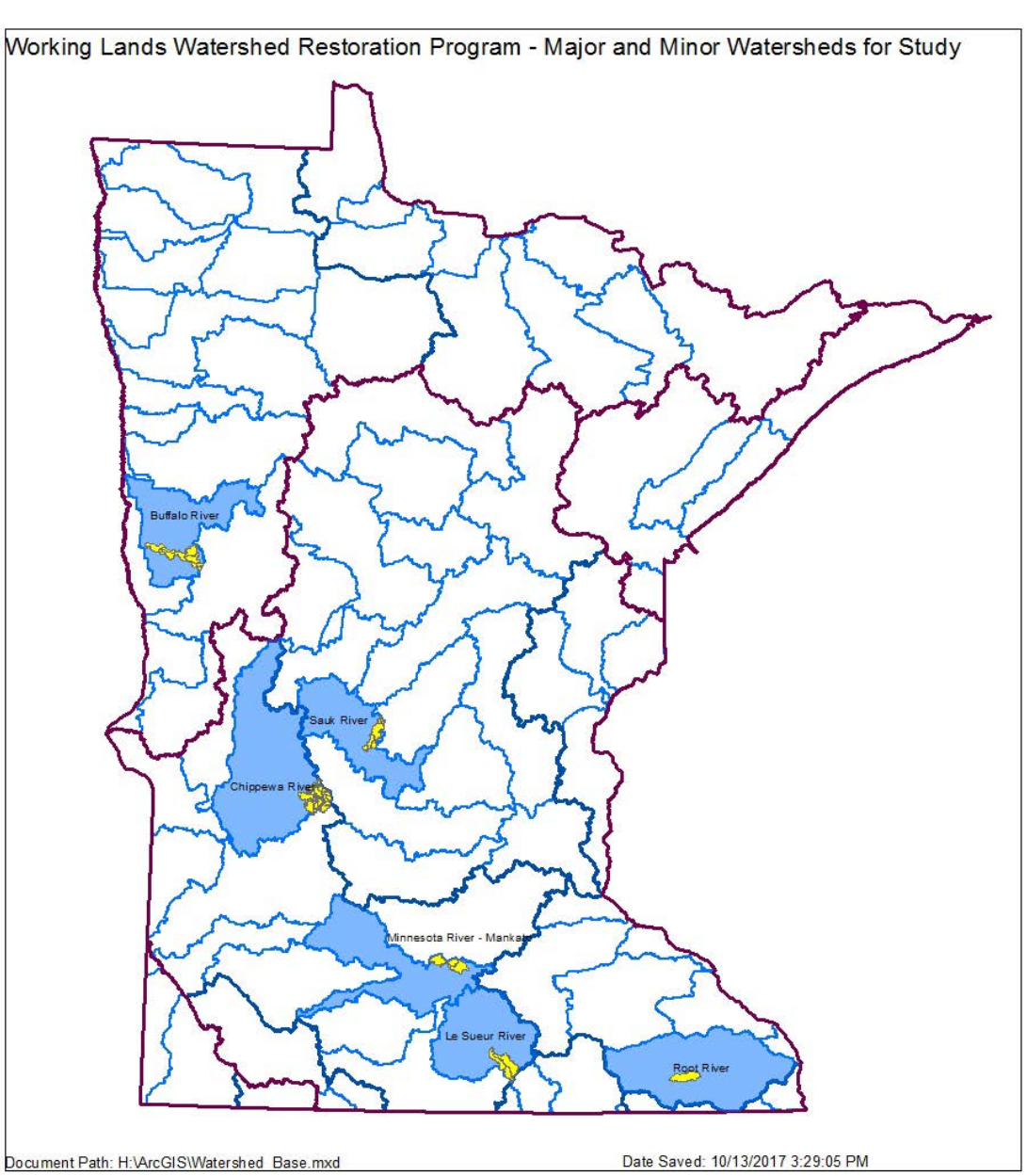
Stoney Creek Farm case study

Oilseeds – camelina and pennycress – as relay crop with soybeans

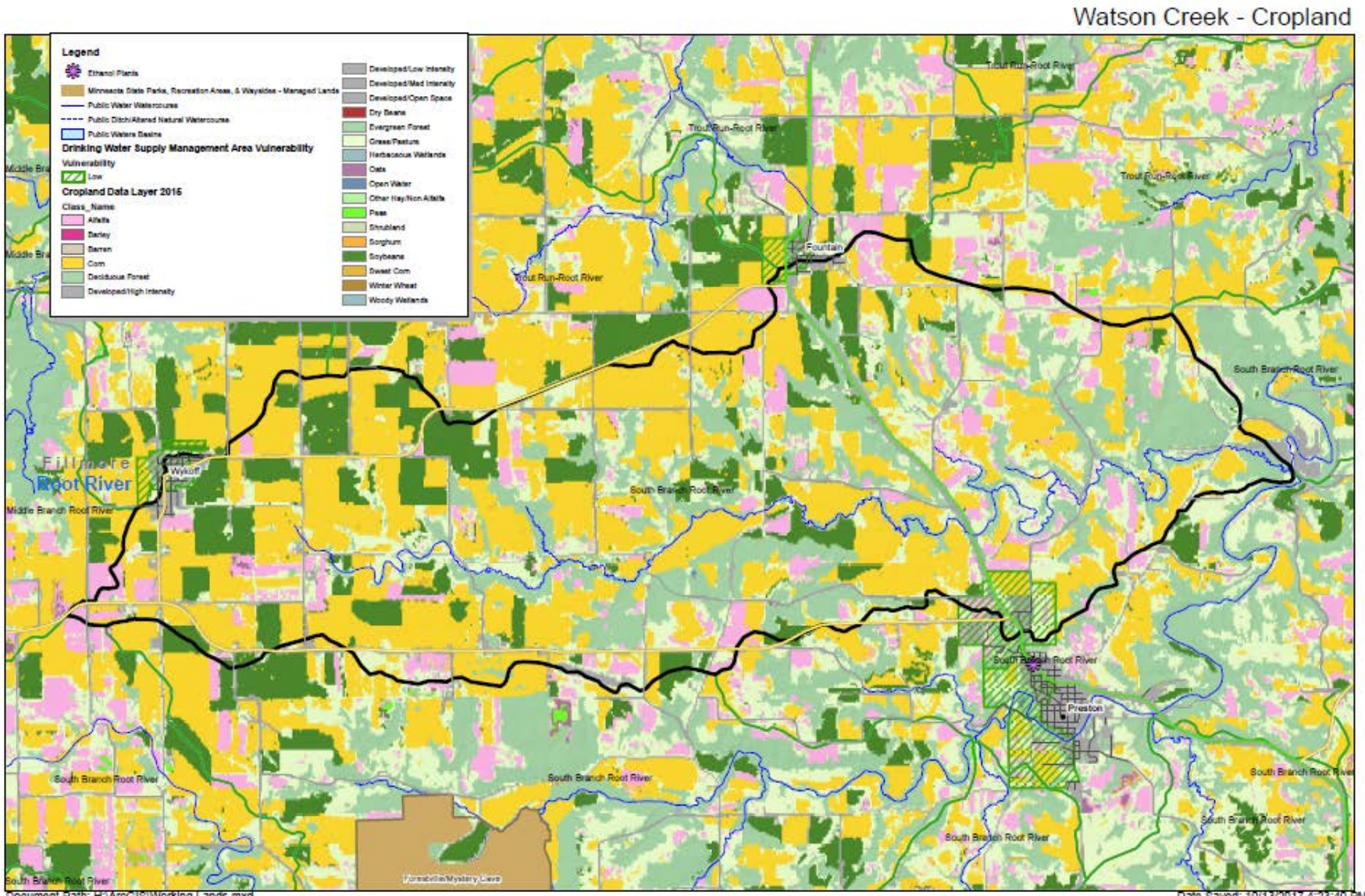


Selecting pilot watersheds

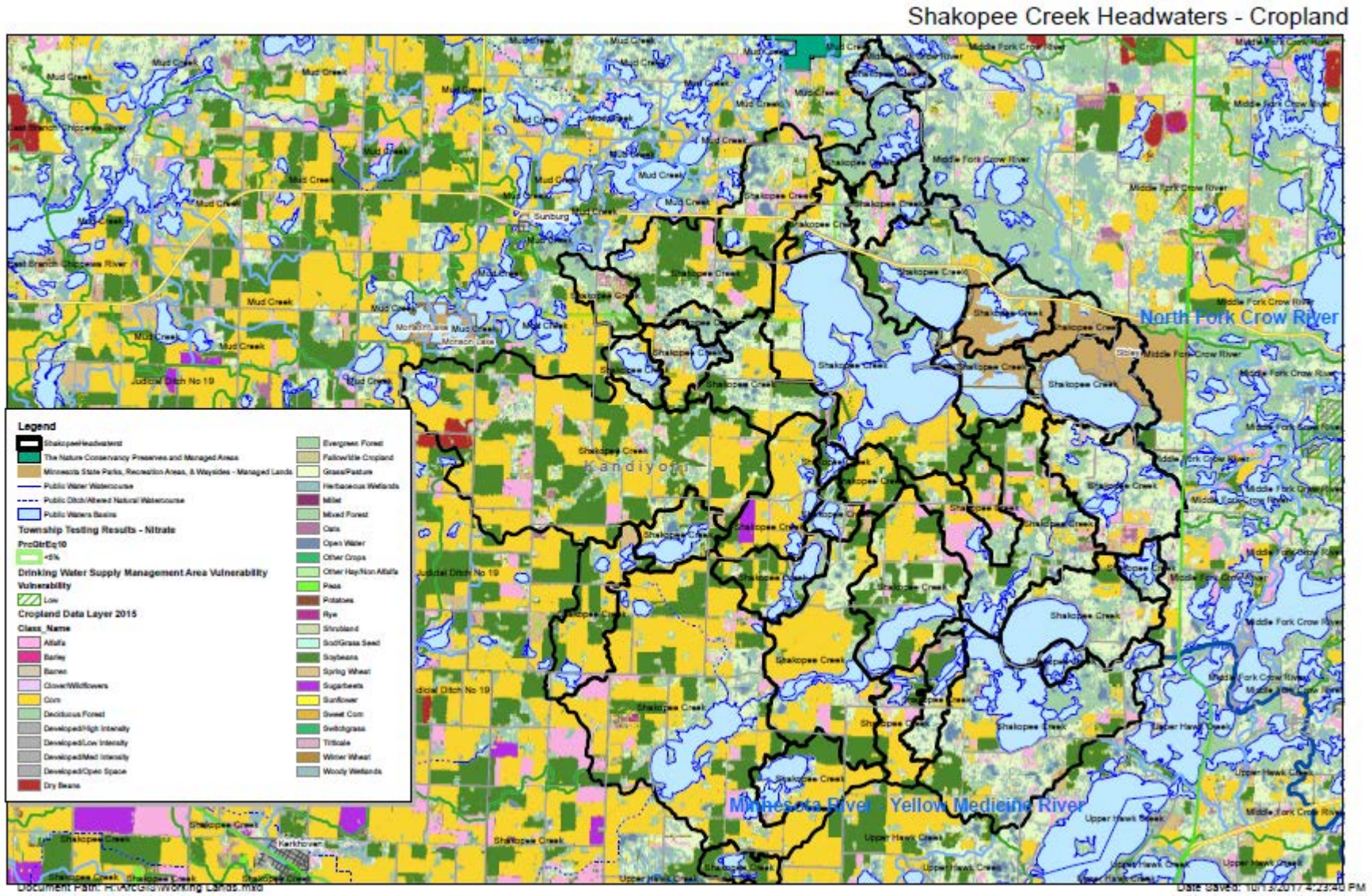
- Criteria
  - Scale, size, landscape character
  - Geographic distribution
  - Proximity to refiners, processors, potential end-users
  - Planning efforts, prior engagement
  - Level of interest, social capacity, local leadership
  - Economics of crop production and conservation
  - Water quality benefits



Root River – Watson Creek



Chippewa River – Upper Shakopee Creek



Economic / socioeconomic analysis – UMN Water Resources Center

- What is the likely value of alternative crops?
- What are the environmental benefits?
- What kind of contracts might incentivize farmers to grow alternative crops? What kind of contract terms?
- Relation to existing federal programs (i.e., crop insurance)
- How will social values and local capacity influence participation?

ID#_____

A Study of Farming Practices in Minnesota

Center for Changing Landscapes

UNIVERSITY OF MINNESOTA

Driven to Discover℠

Before you begin:

We are conducting this survey to better understand farmer perspectives on soil and water conservation, and farming practices as they relate to perennial and cover crops. This survey is voluntary and confidential. It should take about 20 minutes to complete this questionnaire. Please answer the questions as completely as possible.

Do you use your land for agricultural production?

[ ] Yes (please complete the survey) [ ] No (please discontinue and return the survey)

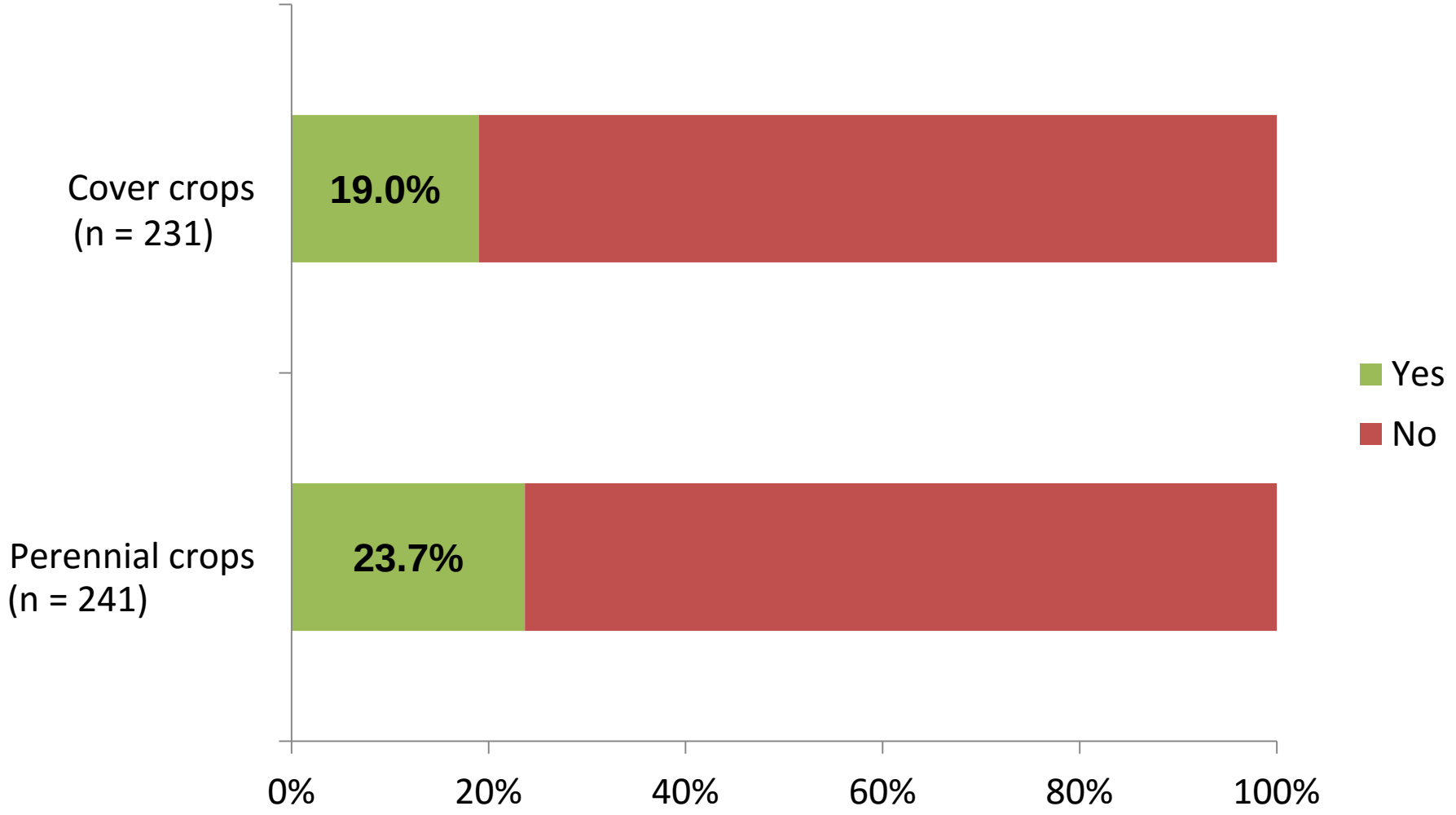
Once you've completed the survey:

Please fold it in thirds and mail it back in the enclosed self-addressed stamped envelope.

Thank you for your help!

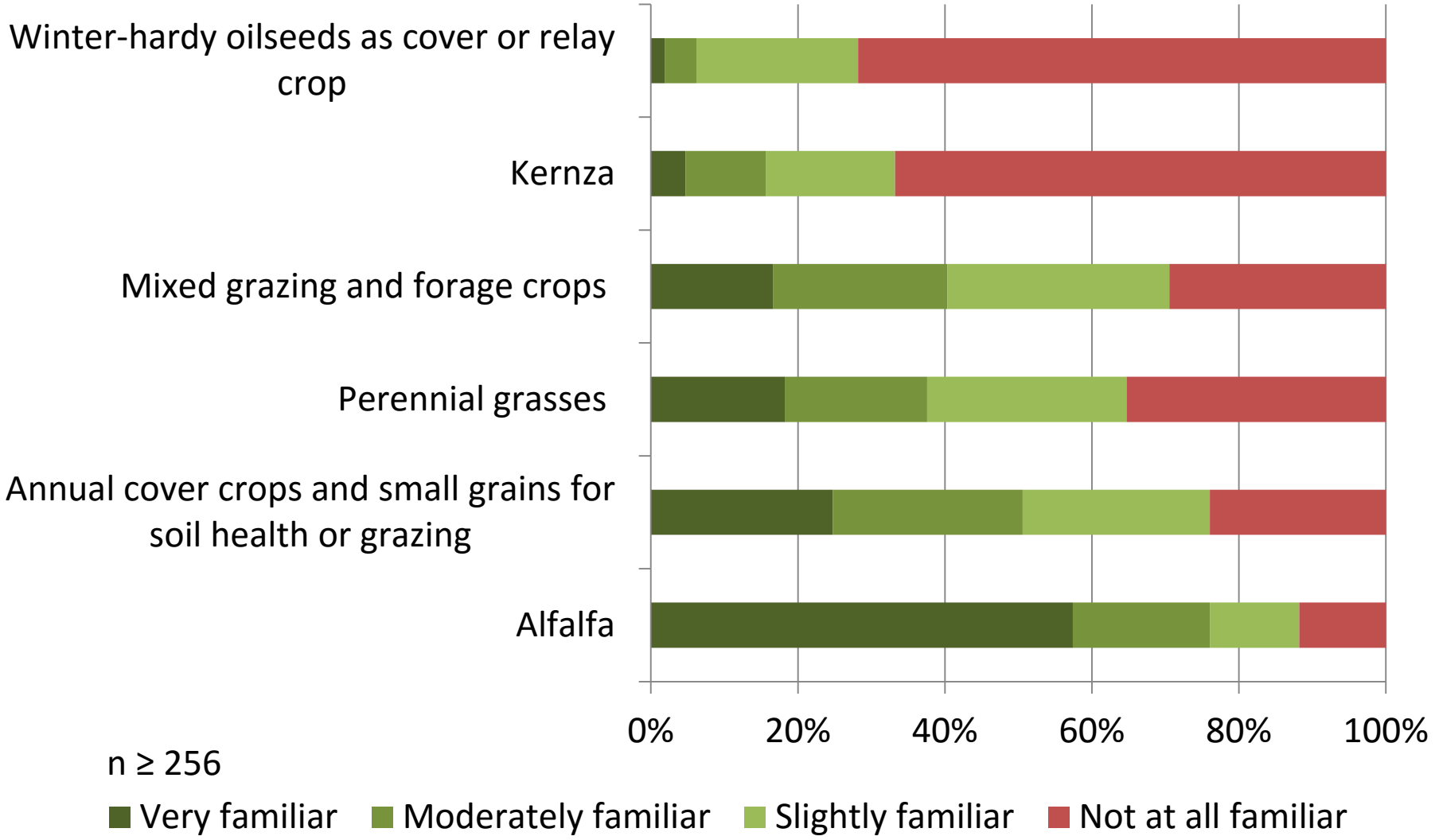
- Self-administered mail survey
- Farmers
- Random sample of 500 farmers in each watershed (n = 3000)
- 3-wave mailing

Conversion to cover/perennial crops

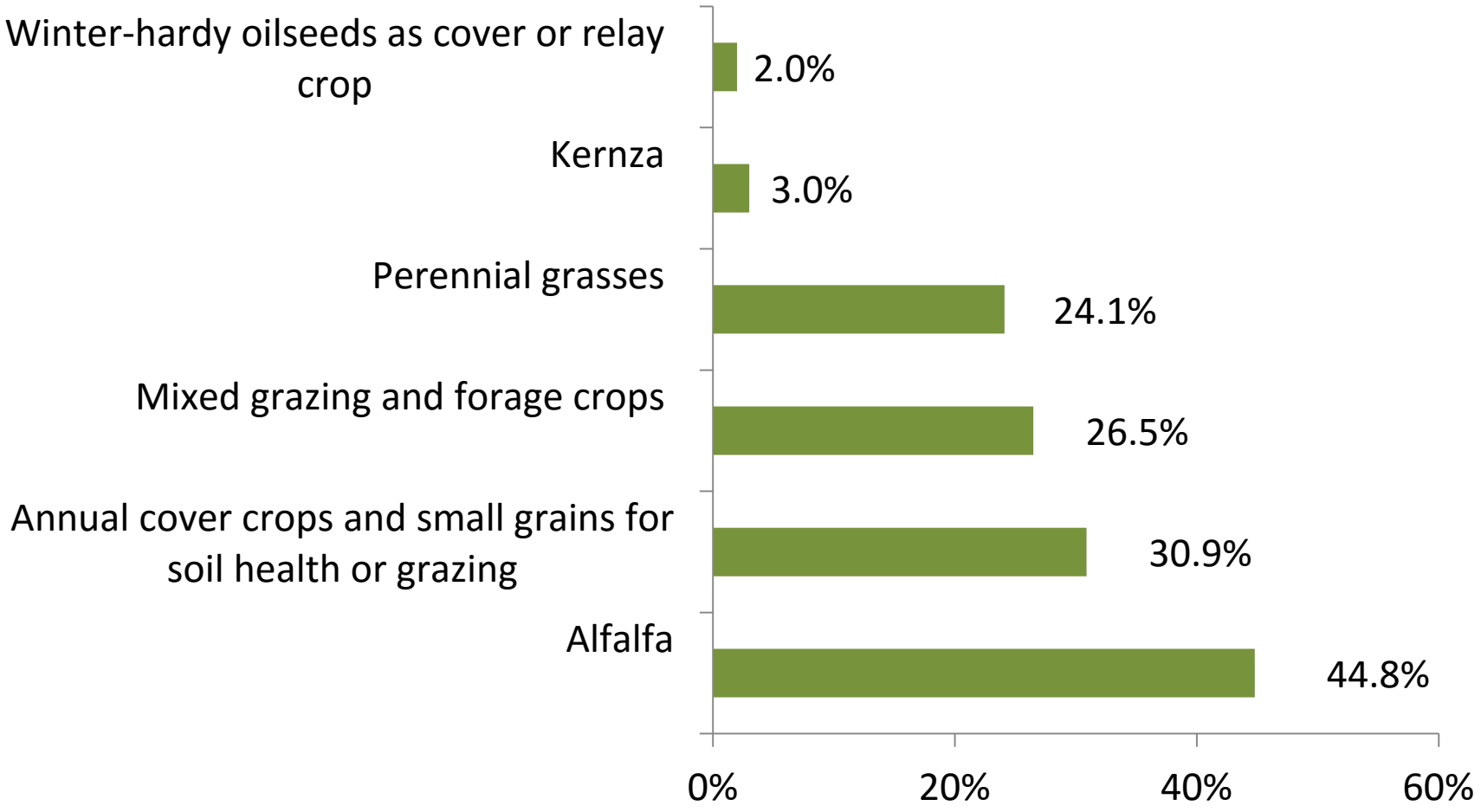


Percent of respondents who have converted any portion of their farm from single annual row crops to perennial crops or added cover crops in the past 10 years

Familiarity with perennial/cover crops

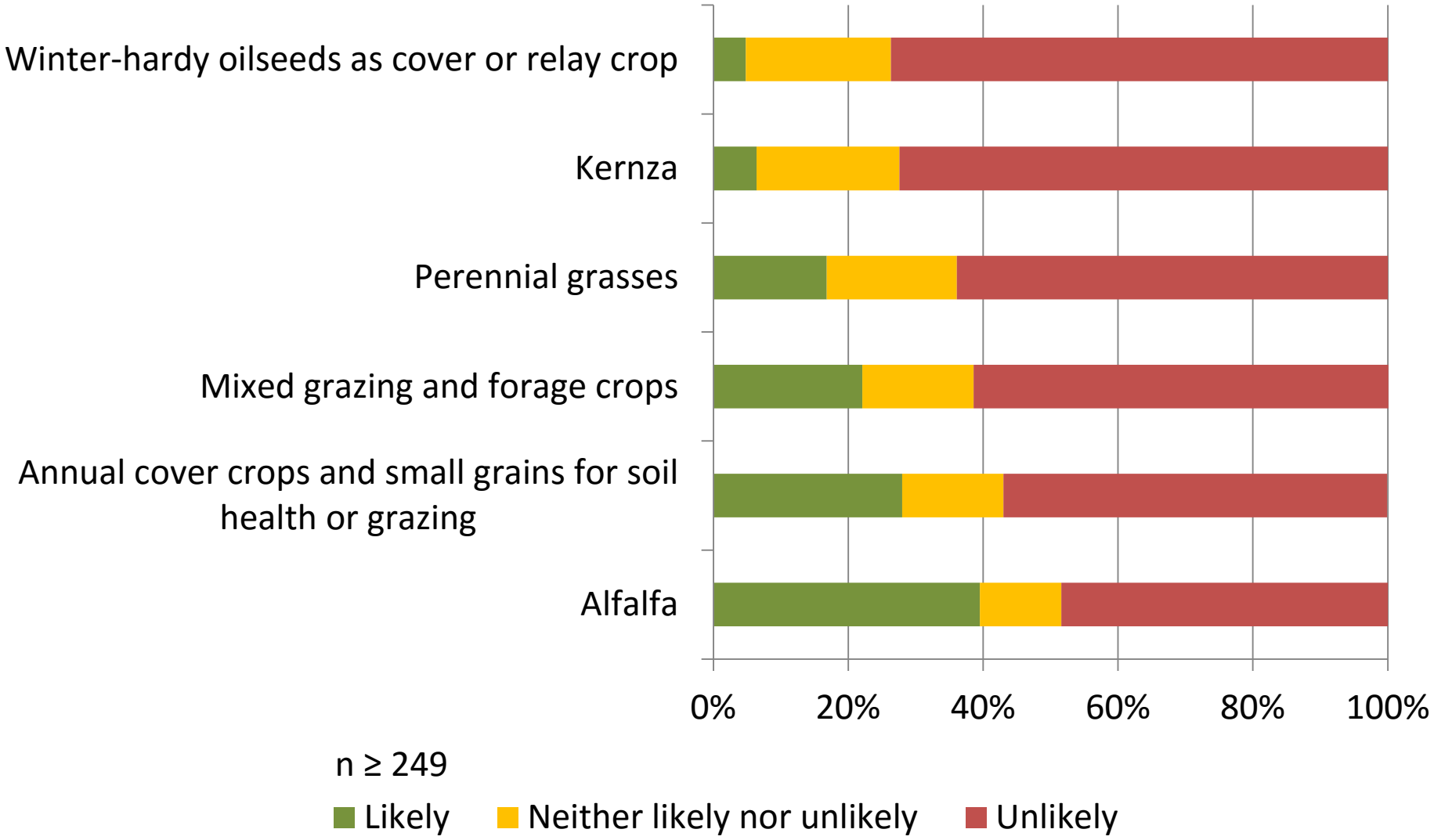


Use of perennial/cover crops

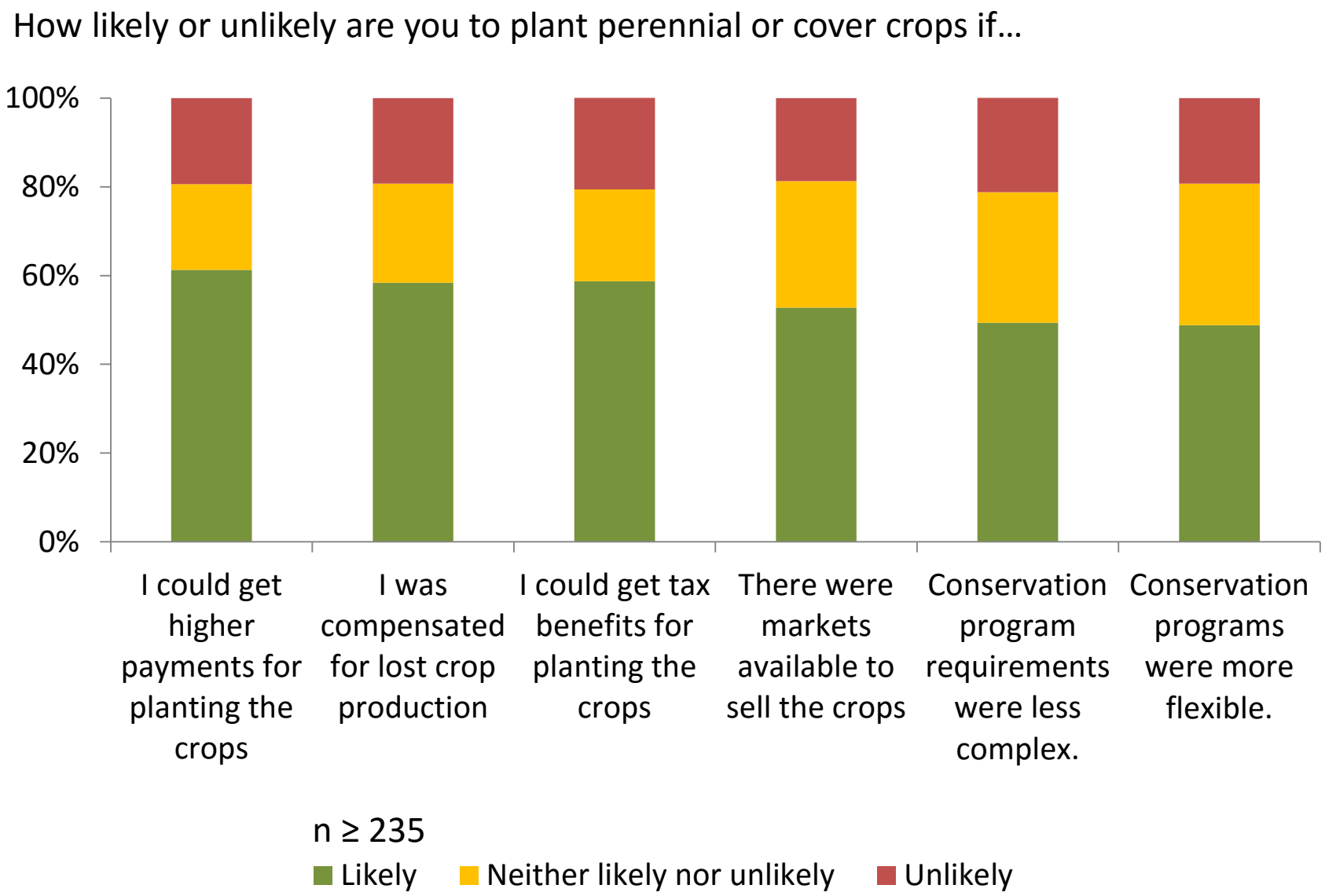


Percent of respondents who have planted perennial or cover crops on their farm in the past 10 years (n ≥ 197)

Likelihood of adoption

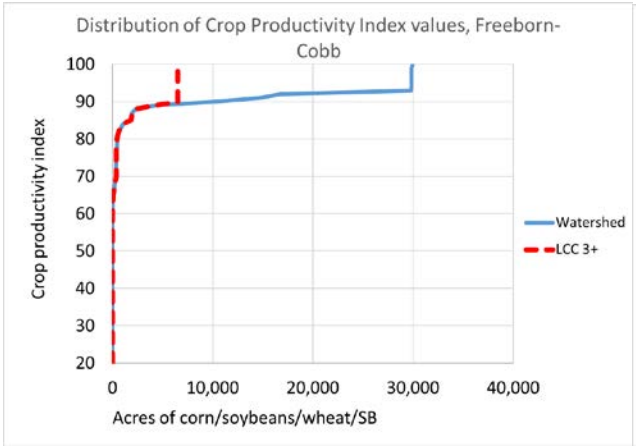


Factors influencing adoption

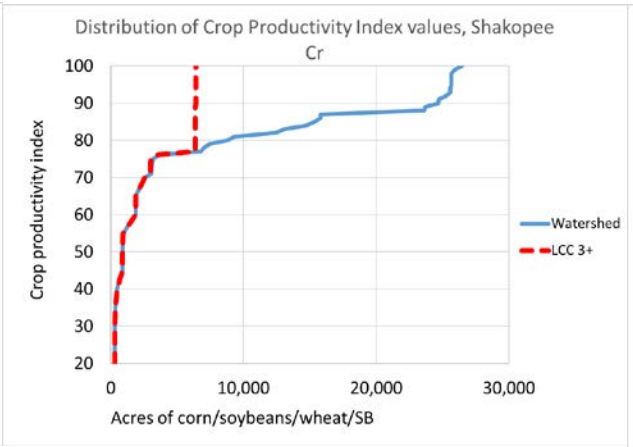


Spreadsheet Decision Tool

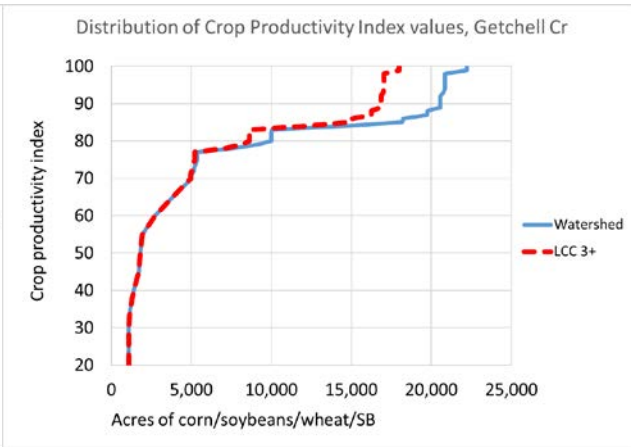
- Compares crop yields and returns of major annual crops to perennial crops and addition of cover crops within the six watersheds
- Compares results from conversion of marginal cropland and all cropland
- Marginal soils: based on Land Capability Class – “3” with slopes and 4 – 8
- Cost of conversion varies by Crop Productivity Index
- 14 conversion scenarios, including crops and livestock



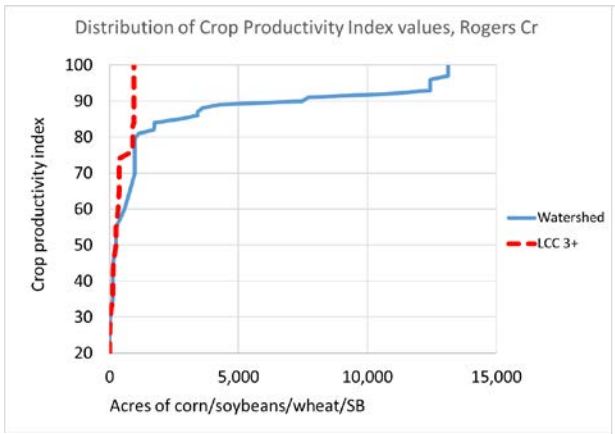
Freeborn



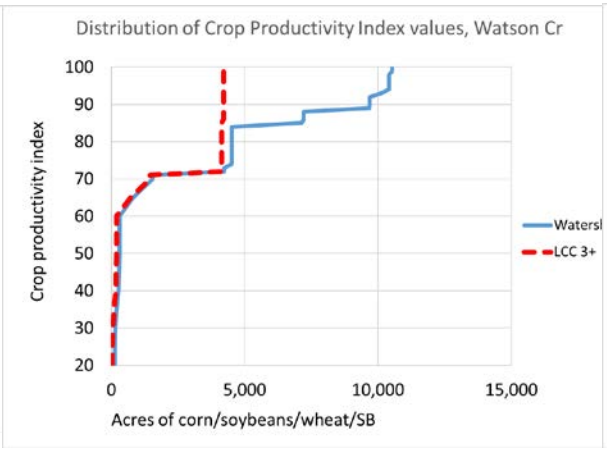
Shakopee



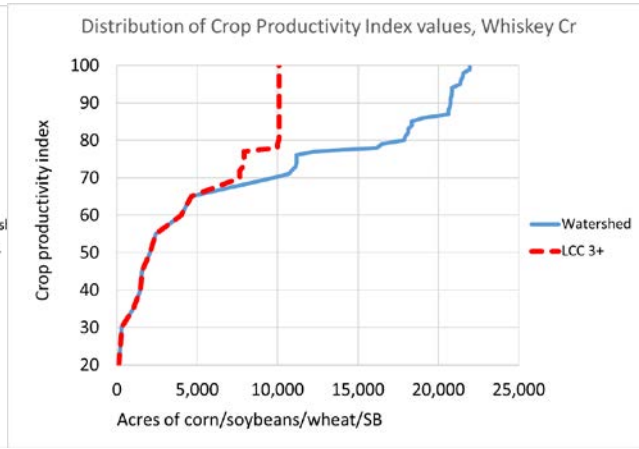
Getchell



Rogers



Watson



Whiskey

		Freeborn Lake-Cobb R	Shakopee Creek	Getchell Cr/Co. Ditch 9	Rogers Creek	Watson Creek	Whiskey Cr, part L & U
	These net returns are based on land in the entire watersheds. (See above for the Land Capability Class 3+ crop acreages))						
Net returns for current annual crops	Corn grain	162	126	130	114	121	48
	Soy- beans	222	142	169	169	204	71
	Wheat						65
	Sugar- beets						-43
	All current annual crops	187	133	147	135	149	51
Net returns for alternative crops	Land retirement	-28	-28	-28	-28	-28	-28
	Switchgrass	75	57	50	66	52	35
	Miscanthus	14	-16	-29	-1	-26	-56
	Kernza	181	149	135	165	138	107
	Covercrop Sm Grain	183	136	148	138	154	59
	Covercrop Corn Soy	149	94	108	97	110	29
	Camelina Corn-Soy	235	170	178	183	192	85
	Camelina Corn-Wht-Soy	207	156	163	162	170	83
	Pennycress	207	156	163	162	170	83
	Grass-fed beef	19	10	7	14	7	0
	Beef cow-calf	49	34	28	41	29	15
	Grazing dairy (organic)	137	106	93	121	96	68
	dairy heifers	28	17	12	22	13	3
	Alfalfa hay for sale	290	230	206	260	211	153
Subsidy required/A	Land retirement	215	161	175	163	177	79
Show negatives?	Switchgrass	113	75	**96**	69	97	16
yes	Miscanthus	173	149	175	137	175	107
	Kernza	6	**-16**	11	-29	10	**-56**
	Covercrop Sm Grain	4	-4	**-1**	-3	-5	-8
	Covercrop Corn Soy	**39**	39	39	39	**39**	22
	Camelina Corn-Soy	-47	**-37**	-32	**-48**	-43	-35
	Camelina Corn-Wht-Soy	-20	-24	-17	-27	-22	-32
	Pennycress	-20	-24	-17	-27	-22	-32
	Grass-fed beef	168	122	140	121	141	**51**
	Beef cow-calf	138	99	119	94	120	35
	Grazing dairy (organic)	50	27	53	14	**53**	-17
	dairy heifers	159	116	135	113	136	48
	Alfalfa hay for sale	**-103**	-98	-59	**-125**	-63	-102

Modeling

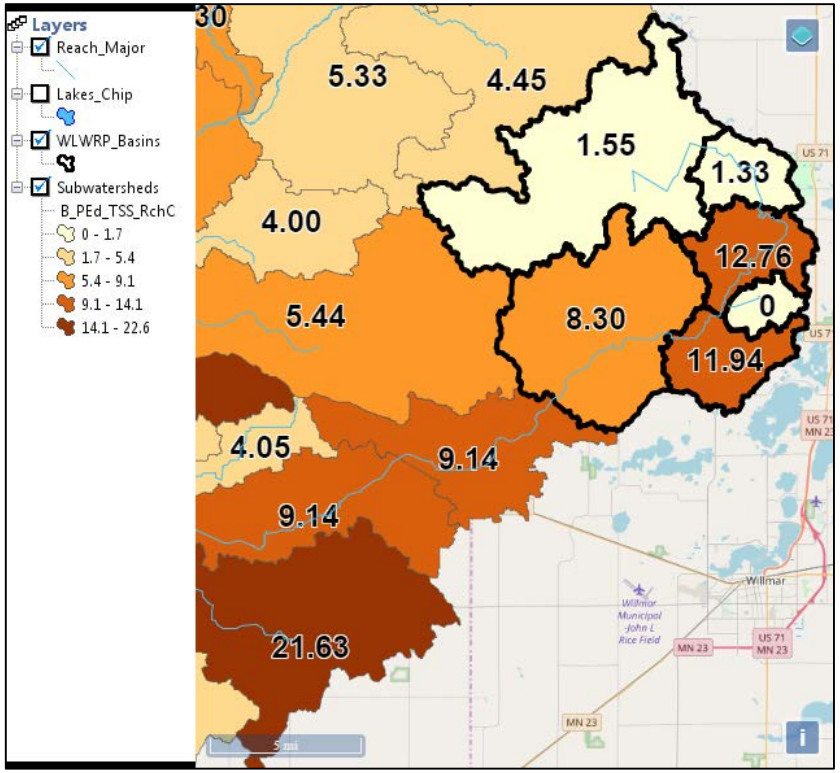
Model and Tool Scales

- Site scale models and tools
  - Gridded Surface Subsurface Hydrologic Analysis (GSSHA) model
  - Agricultural Conservation Planning Framework (ACPF) Tool (Tomer)
  - Prioritize, Target, and Measure Application (PTMApp)
- Watershed models
  - Land to receiving water simulation
  - Some also include groundwater & river hydrology and transport
  - HSPF, Soil+Water Assessment Tool (SWAT)
- Receiving water models
  - (BATHTUB) for lakes
  - Hydrologic Engineering Center (HEC) models for open channels

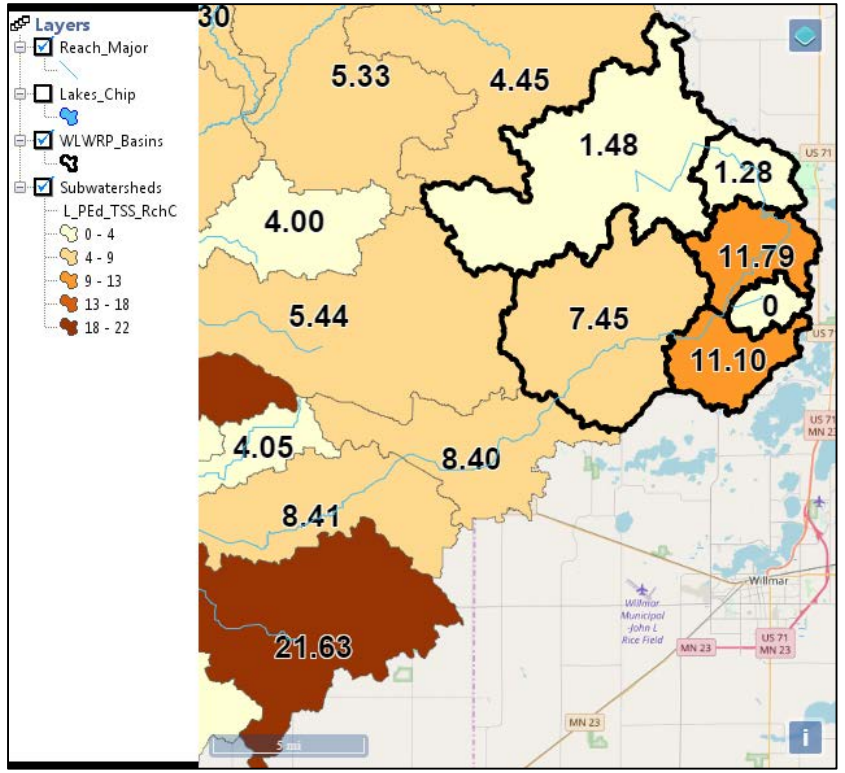
Slide provided by Dr. Jonathan Butcher, Tetratech, Inc.

TSS Standard - % Exceedance

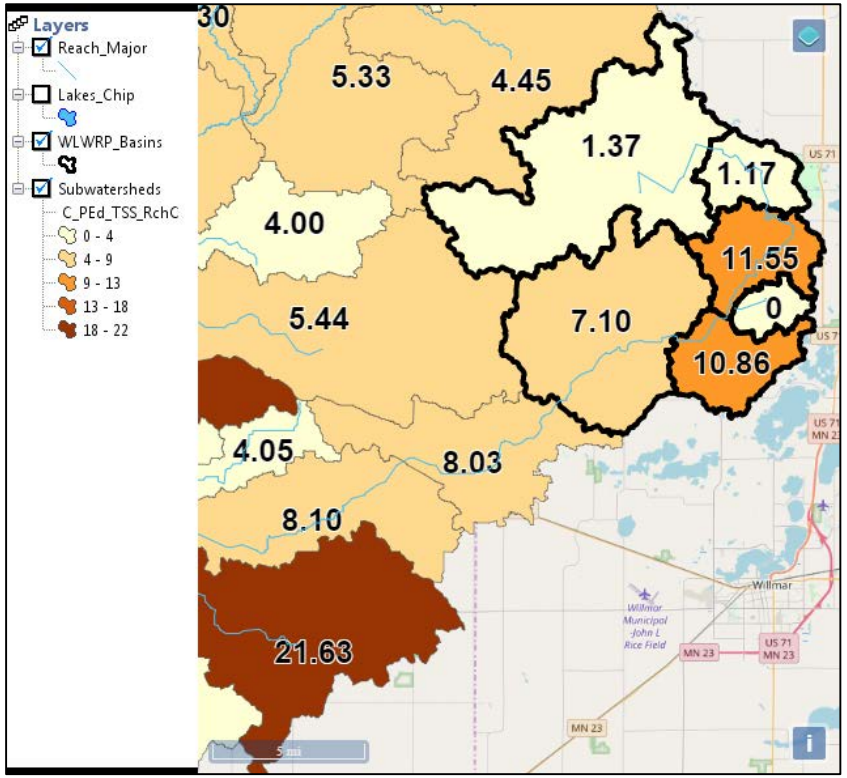
Baseline



LCC3+ To Grassland

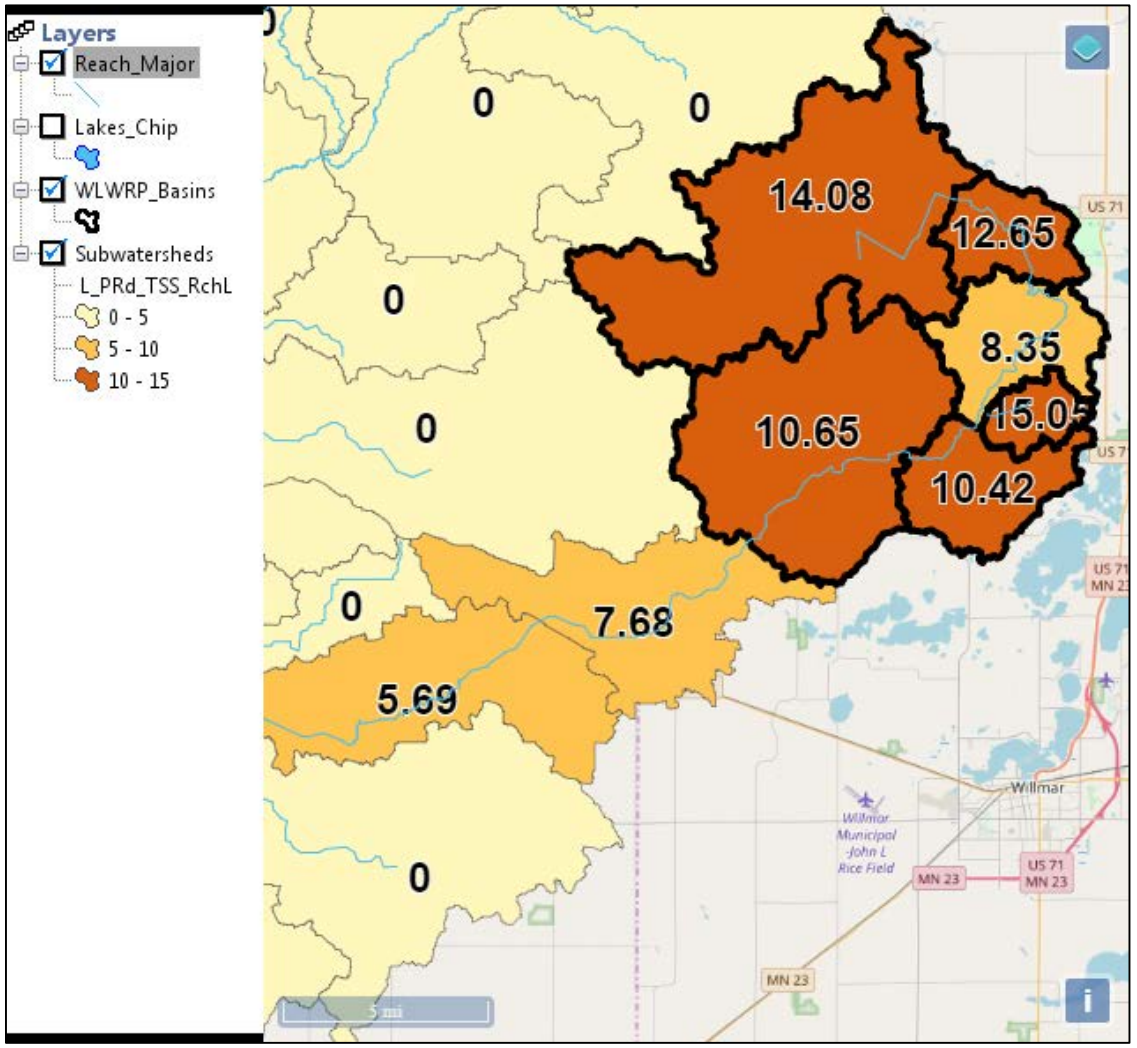


Cover Crop: 50% of row crop acres

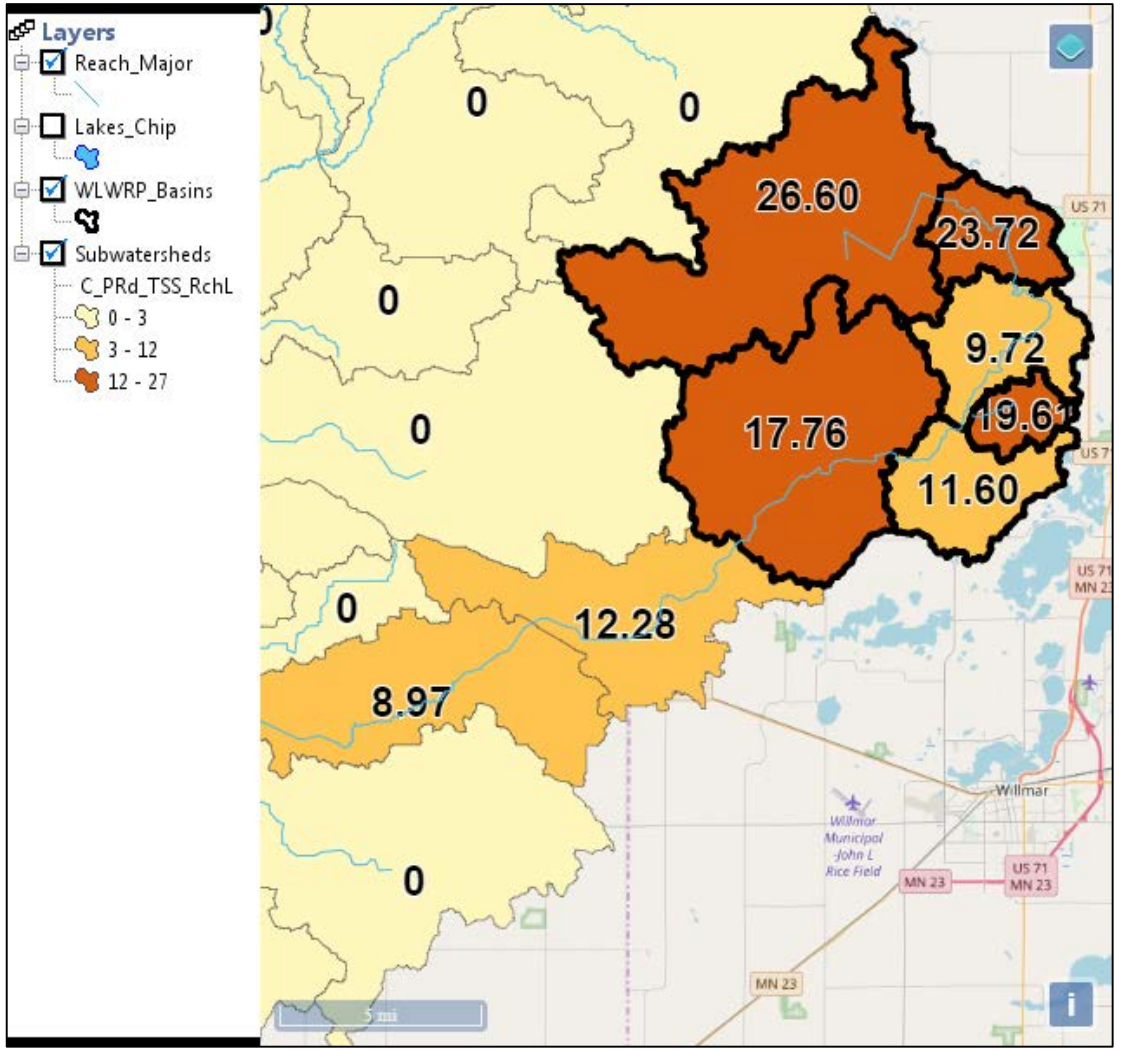


Reduction in TSS Load (%)

LCC3+ To Grassland

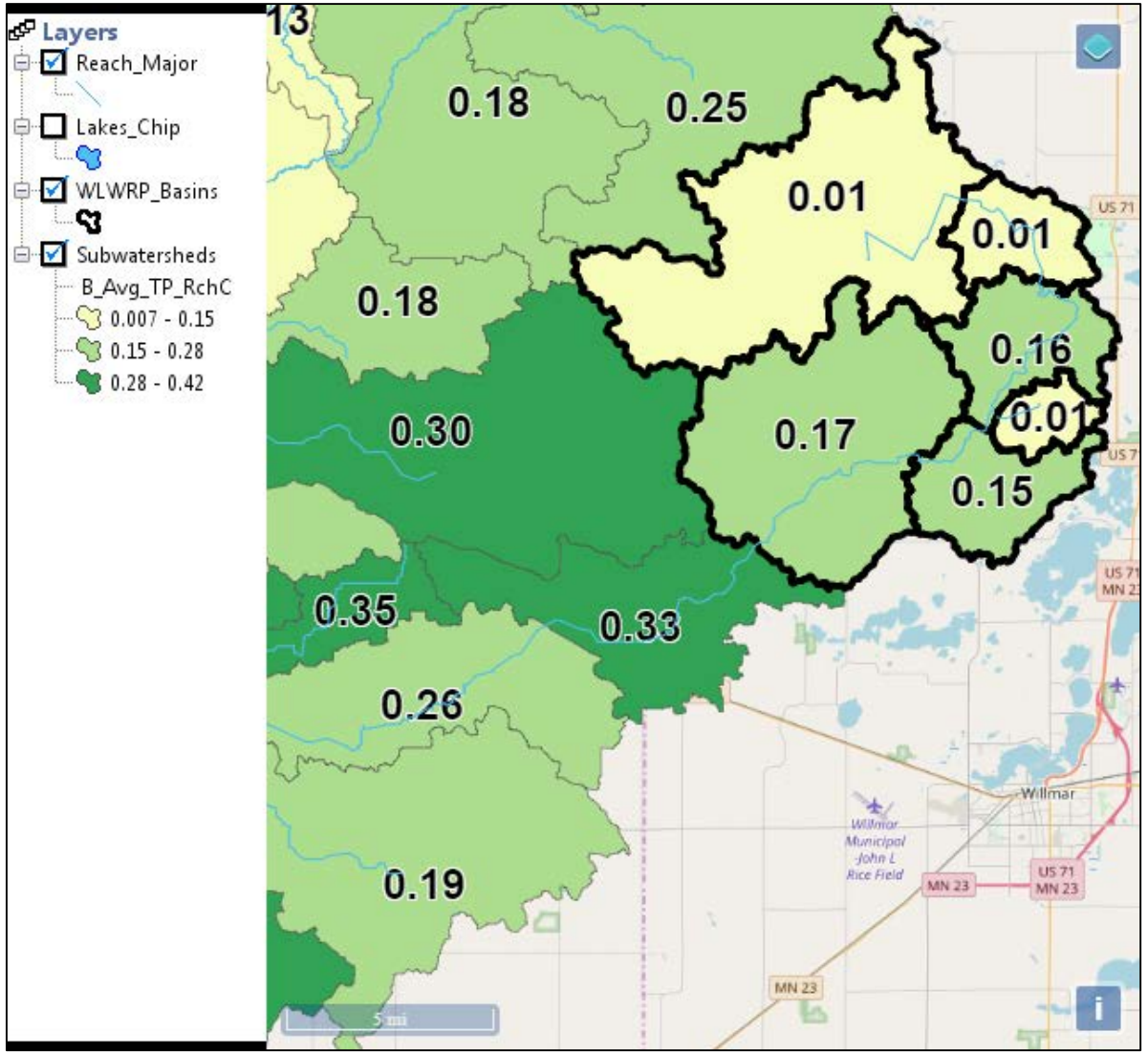


Cover Crop: 50% of all row crop acres – A & B soils

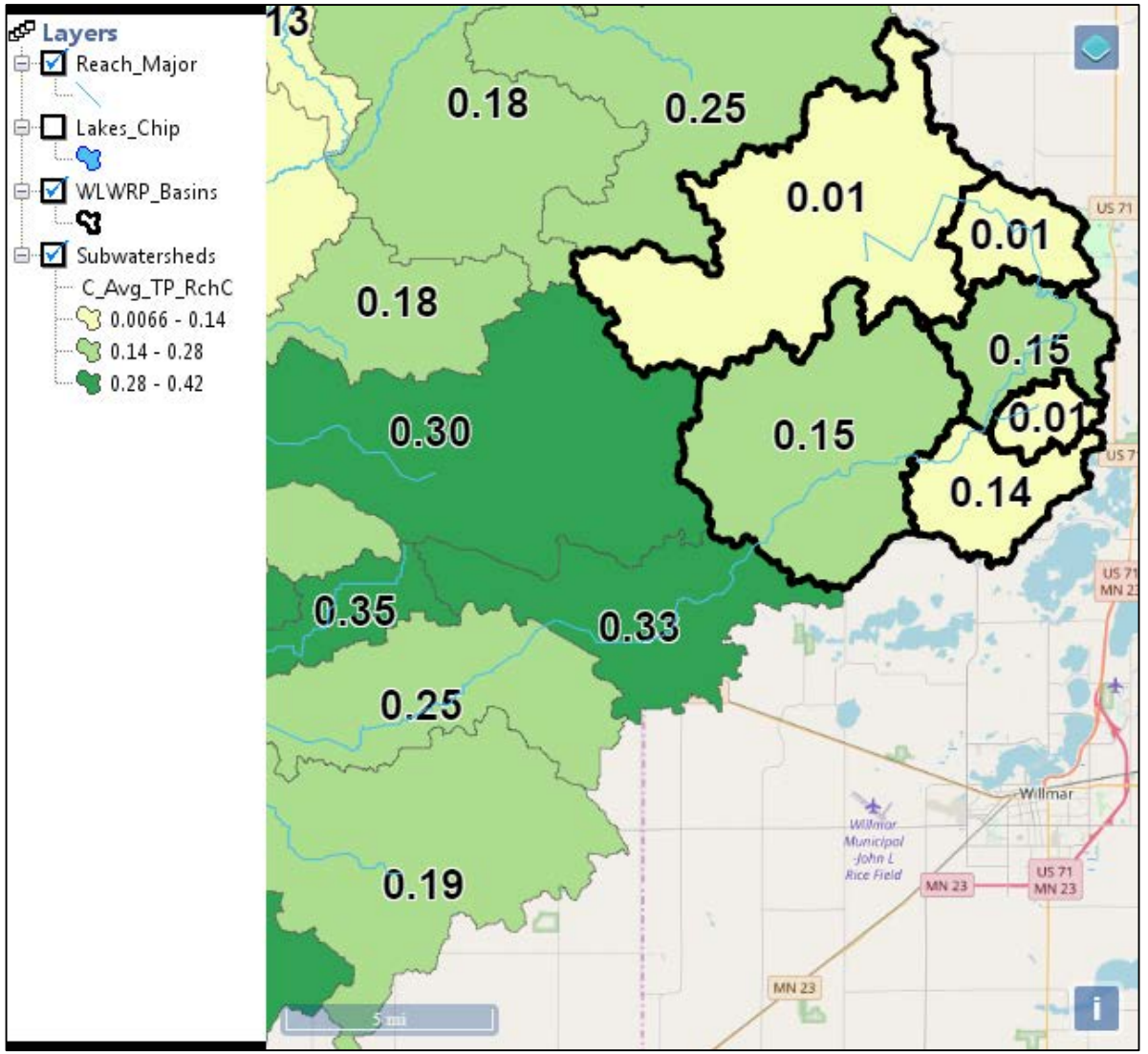


TP Standard – Reach Concentration

Baseline

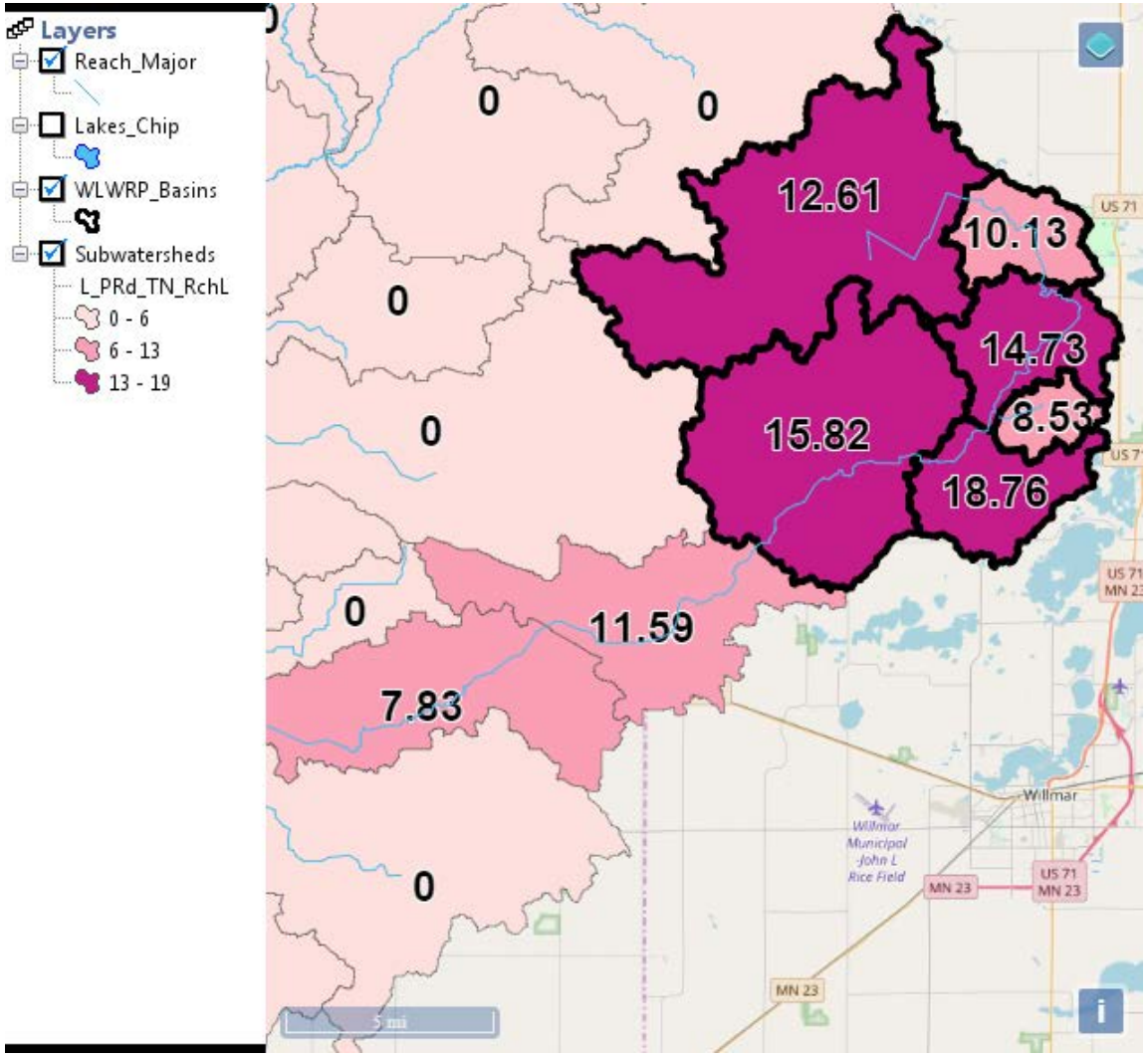


Cover Crop: 50% of row crop acres

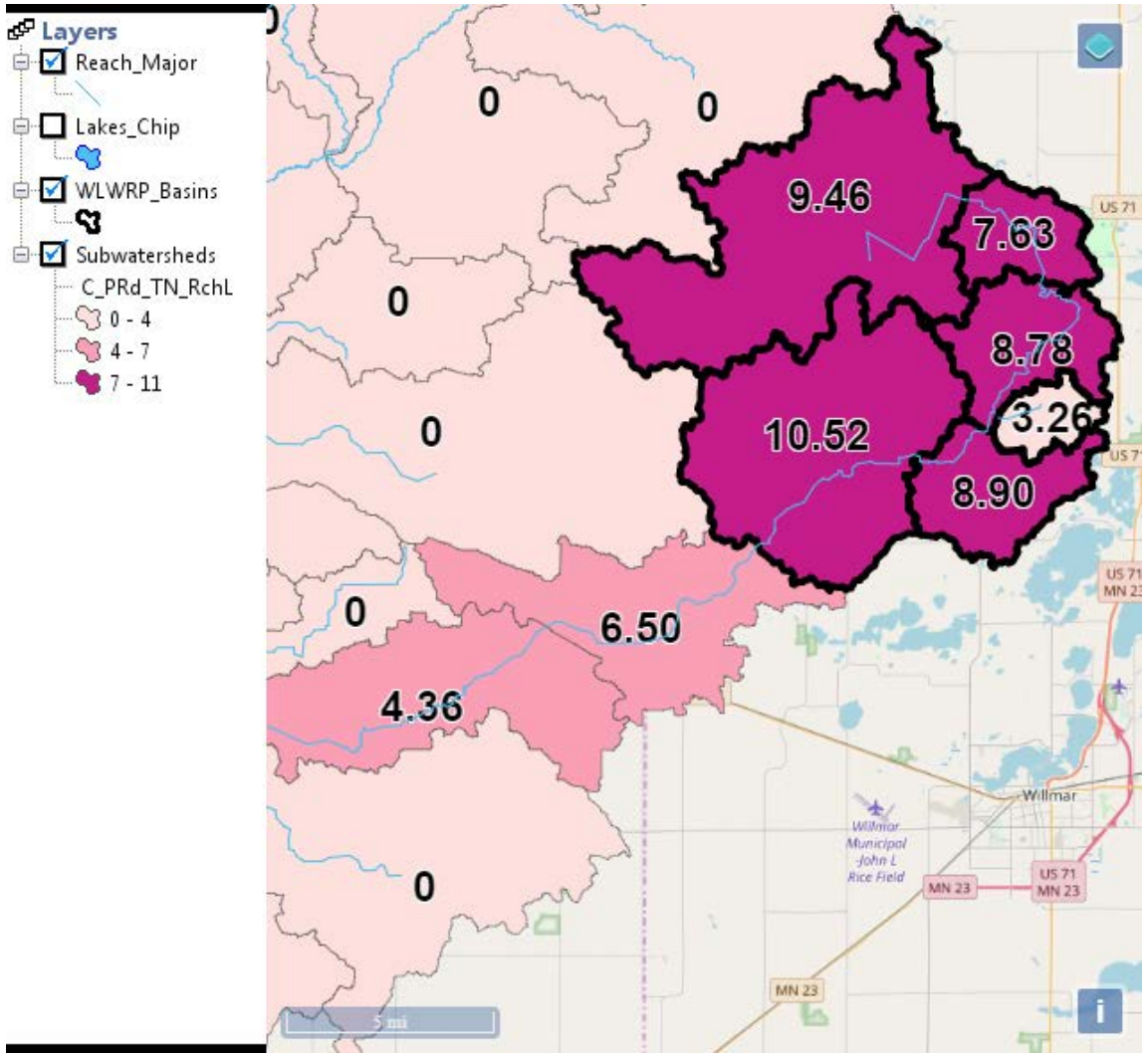


Reduction in Nitrogen Load (%)

LCC3+ To Grassland



Cover Crop: 50% of row crop acres



What would a Working Lands Incentive program look like? Initial concepts

- Different contract terms for
  1. Cover crops
  2. “Cash cover crops”
  3. Perennial crops
- Flexibility on which crops to plant each year
- Risk management
- Watershed or “supplyshed” focus
- Prioritize environmentally-sensitive lands and multiple ecosystem benefits

Next steps

- Interim Report as of October 15
- December 15 Forum: Bioproduct and Bioenergy Market Opportunities for Cover Crops and Perennials
- Federal programs and policies - Farm Bill development
- Complete modeling work
- Develop strategies and elements of a pilot program
- Final report to Legislature: February 1, 2018

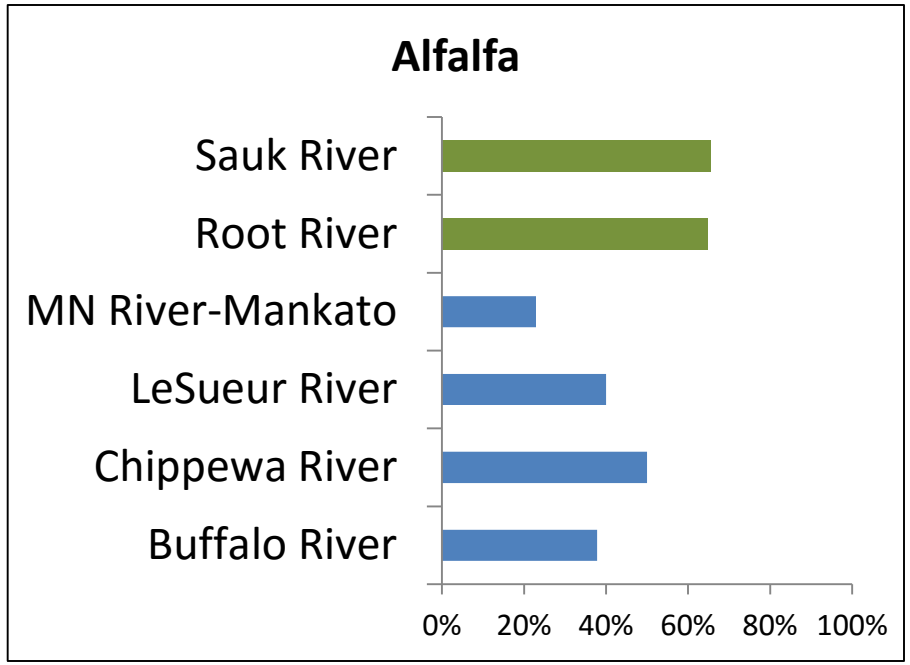
BOARD OF WATER AND SOIL RESOURCES

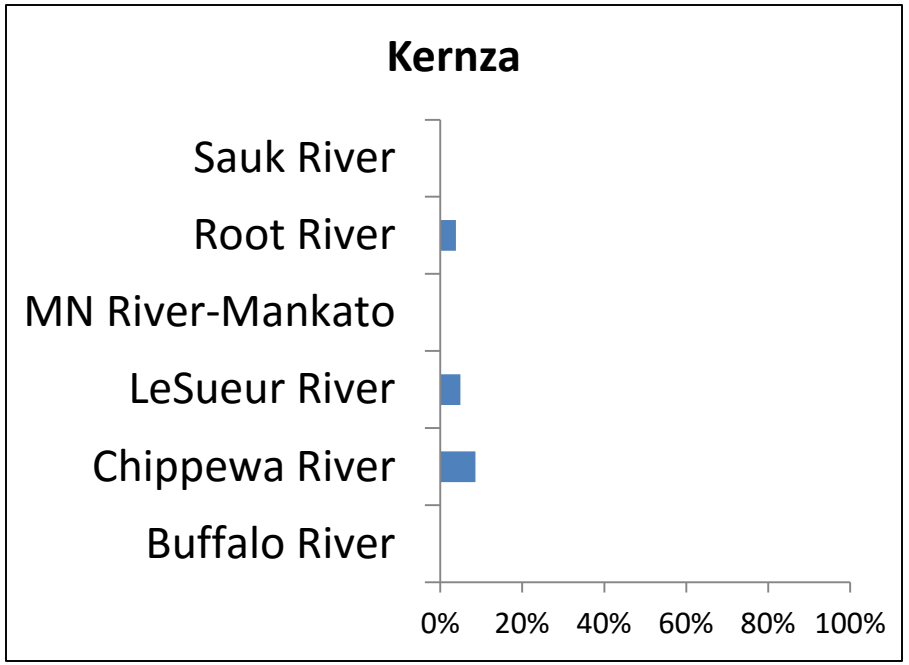
Thank You!

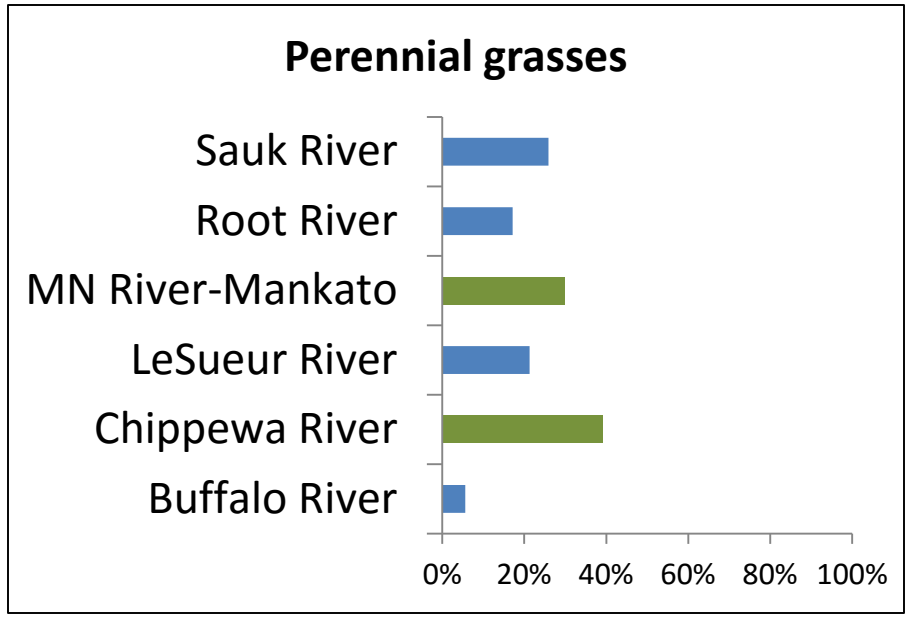
http://www.bwsr.state.mn.us/planning/WLWRP/wlwrp.html

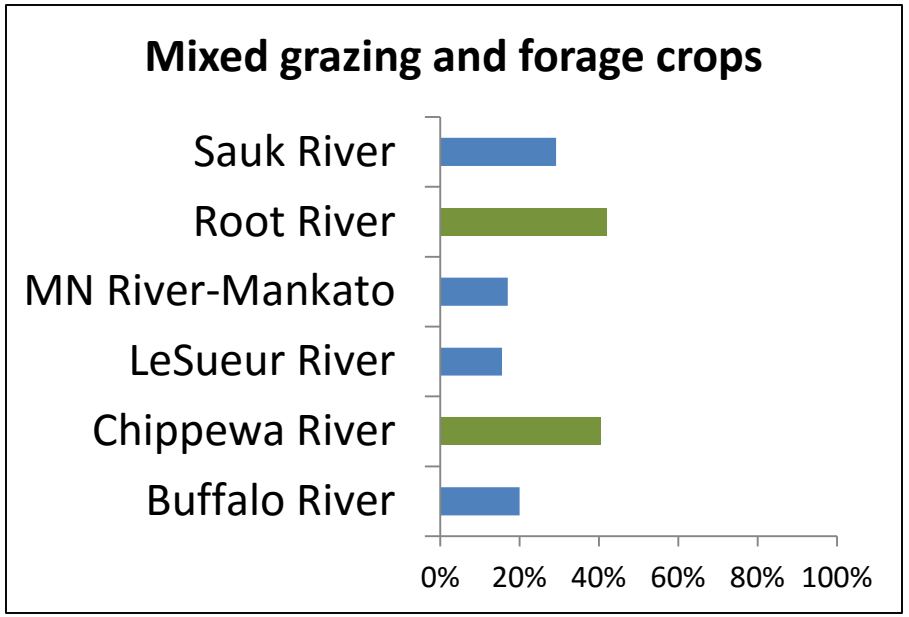
suzanne.rhees@state.mn.us

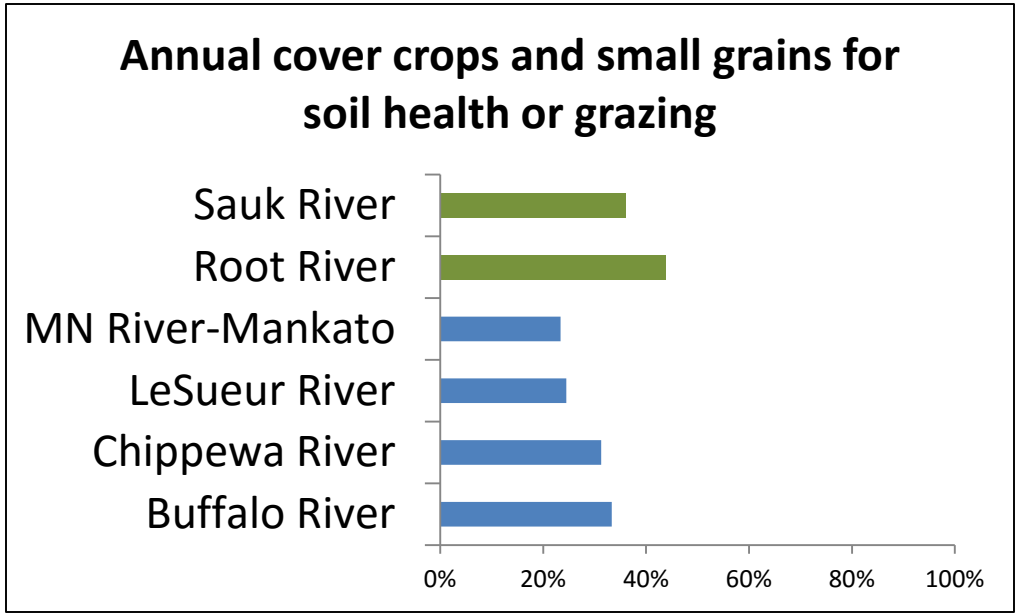
651-296-0768

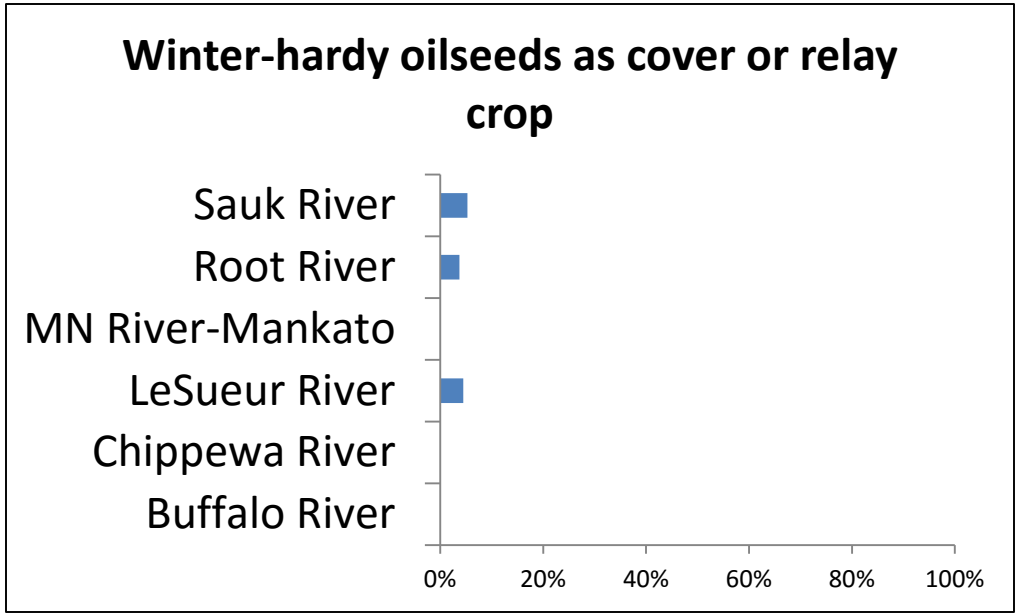

Alfalfa
Sauk River
Root River
MN River-Mankato
LeSueur River
Chippewa River
Buffalo River
0%
20%
40%
60%
80%
100%


Kernza
Sauk River
Root River
MN River-Mankato
LeSueur River
Chippewa River
Buffalo River
0%
20%
40%
60%
80%
100%

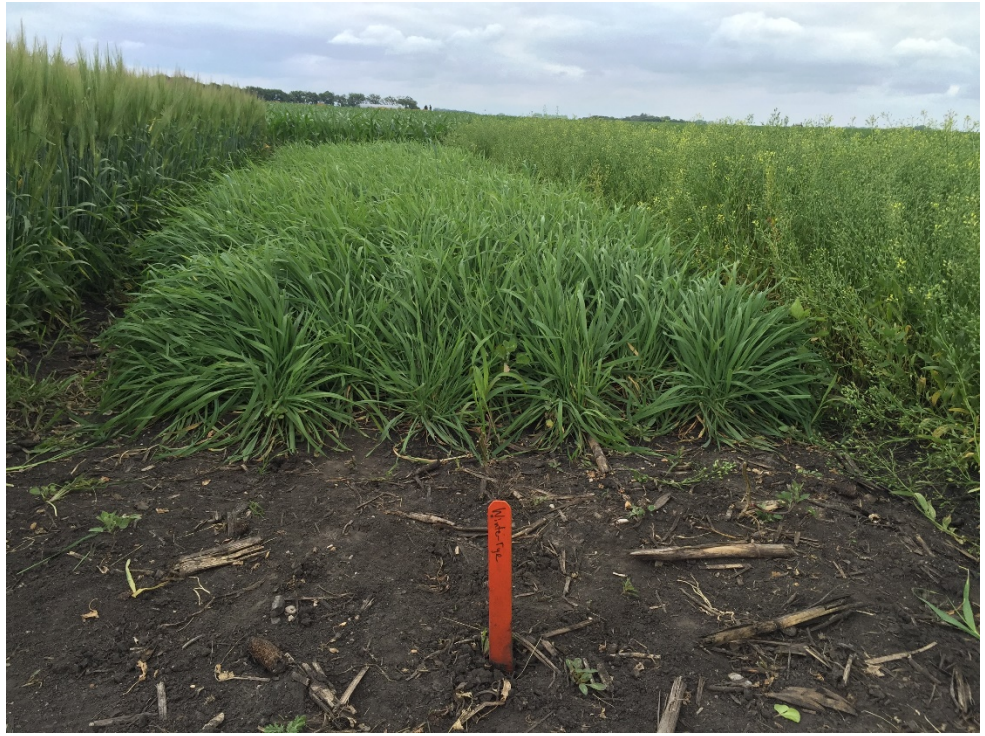

Perennial grasses
Sauk River
Root River
MN River-Mankato
LeSueur River
Chippewa River
Buffalo River
0%
20%
40%
60%
80%
100%


Mixed grazing and forage crops
Sauk River
Root River
MN River-Mankato
LeSueur River
Chippewa River
Buffalo River
0%
20%
40%
60%
80%
100%

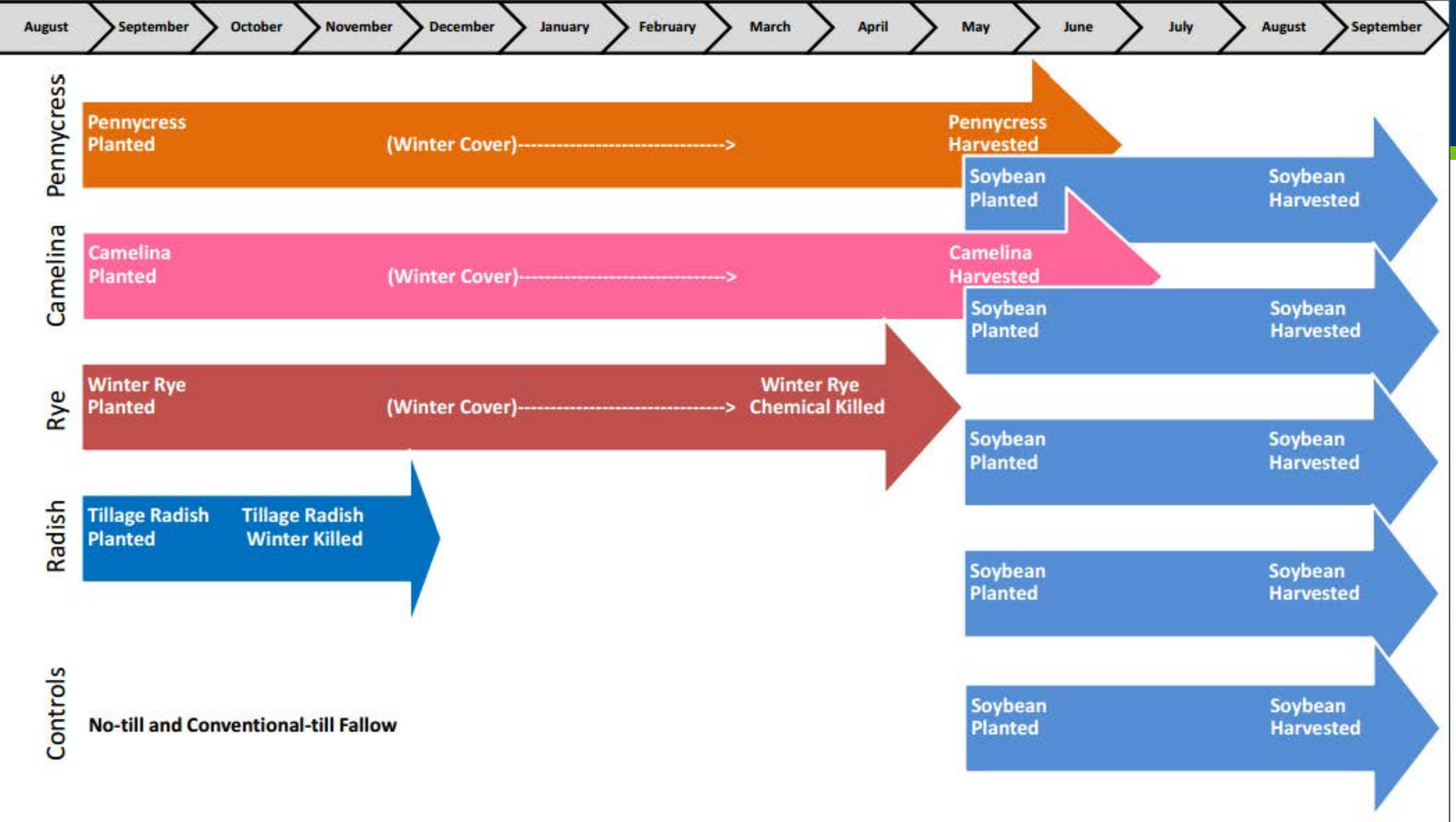

Annual cover crops and small grains for soil health or grazing
Sauk River
Root River
MN River-Mankato
LeSueur River
Chippewa River
Buffalo River
0%
20%
40%
60%
80%
100%


Winter-hardy oilseeds as cover or relay crop
Sauk River
Root River
MN River-Mankato
LeSueur River
Chippewa River
Buffalo River
0%
20%
40%
60%
80%
100%

Winter rye and soybeans, sugar beets



Cover crops


August
September
October
November
December
January
February
March
April
May
June
July
August
September
Pennycress
Pennycress Planted
(Winter Cover)---------->
Pennycress Harvested
Soybean Planted
Soybean Harvested
Camelina
Camelina Planted
(Winter Cover)---------->
Camelina Harvested
Soybean Planted
Soybean Harvested
Rye
Winter Rye Planted
(Winter Cover)---------->
Winter Rye Chemical Killed
Soybean Planted
Soybean Harvested
Radish
Tillage Radish Planted
Tillage Radish Winter Killed
Soybean Planted
Soybean Harvested
Controls
No-till and Conventional-till Fallow
Soybean Planted
Soybean Harvested