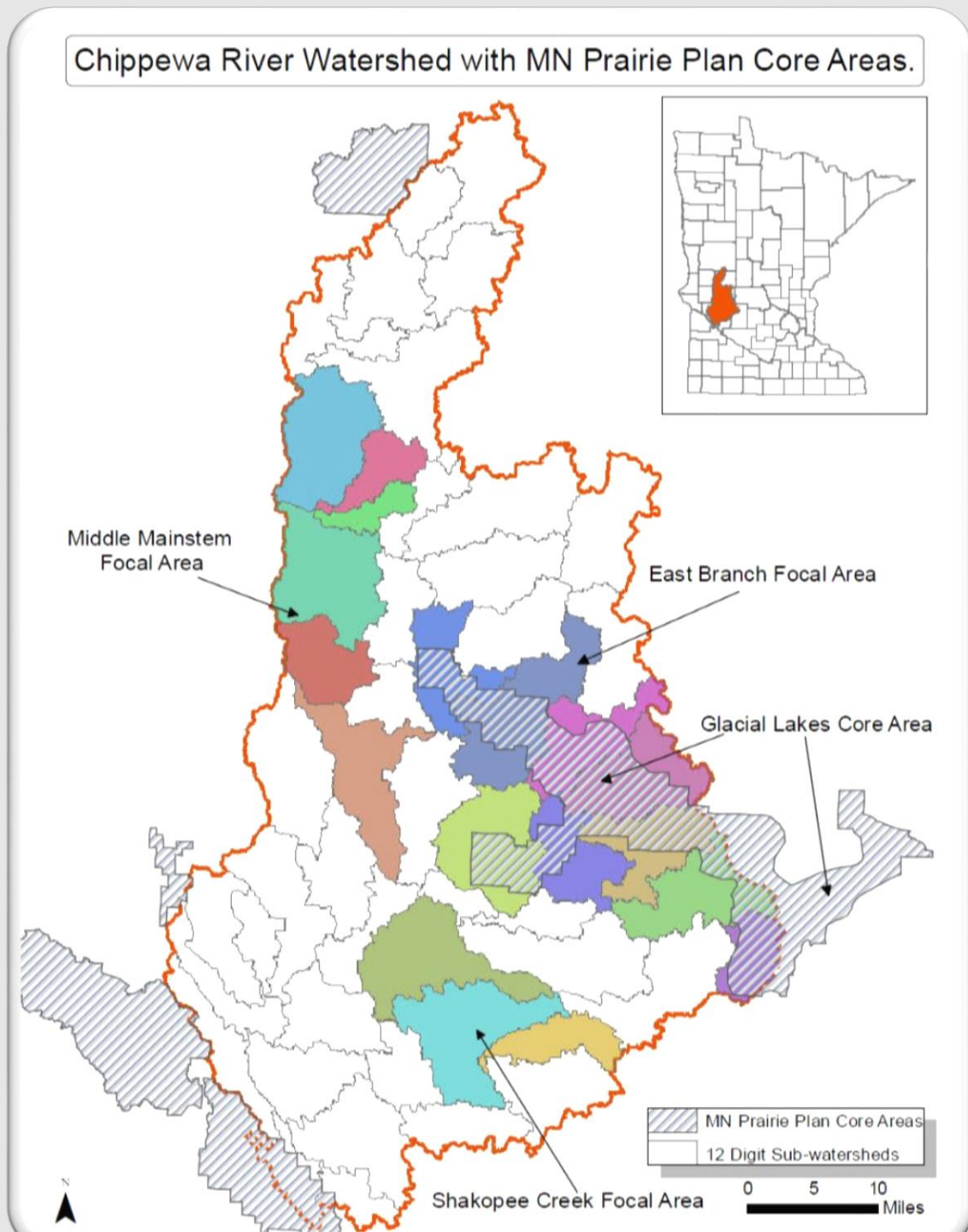
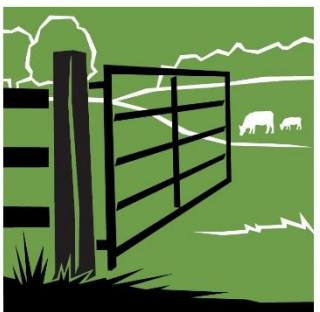


Increasing Continuous Living Cover by 10% to meet Water Quality Standards Land Stewardship Project and Chippewa River Watershed Project.

Mapping Tools for Targeting and Farmer and Landowner Engagement.



Chippewa 10% Project Partners



LAND
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CHIPPEWA RIVER
WATERSHED PROJECT

CONNECTING PEOPLE
THROUGH THEIR RIVER



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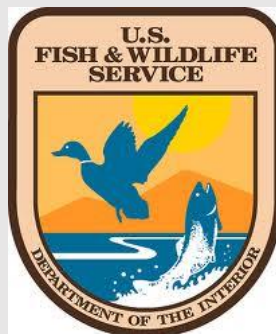


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NFWF

1- Larger
Watershed
(HUC 8)

2- Smaller
Watershed
(HUC 12)

3- Field Scale

GIS Tools Developed
for:

A) Targeting

B) Engagement

Targeting Criteria for Chippewa Watershed (HUC 8)

Corn or Soybean Rotations that were further targeted and given a suggested change of practice(scenarios).

-Poor lands for row crops that are in corn or soybean:

- (C4) Poorer Soils LCC 4-8 --**longer rotations**
- (C3) Moderate soils LCC 3 and slopes > 6%--**prairie strips on 10% of pixel area**
- (C2) C3 and C4 on more than 40 acres—**Managed Rotational Grazing**
- (C1) Proximity to Waters —**filter/buffers**

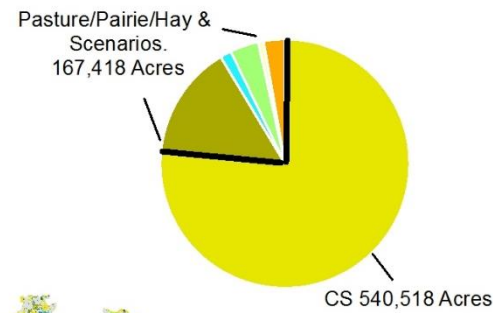
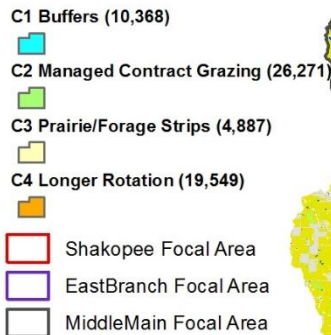
-Good lands for row crops that are in corn or soybean:

- (D) Good Soils LCC 1-2, 3 and slopes <6% --**cover crops**

Land Cover (Acres)



Scenarios (Acres)



CS = Corn and soybean rotation.

C1= Corn and soybean converted to perennials in riparian zones.
C2= Corn and soybean converted to perennials on LCC 3 >= 6% slope and LCC 4-8 greater than 40 acres.
C3= Corn and soybean converted to perennials on LCC 3 >= 6% slope and less than 40 acres.
C4= Corn and soybean converted to perennials on LCC 4-8 with less than 40 acres.
Baseline generated from 2010-2013 USDA Cropland data layers.



The Chippewa 10% Project acknowledge funding from:
MN Environment and Natural Resources Trust Fund
Appropriation M.L., 2010 Chp. 362, Sec. 2, Subd 3i
National Fish and Wildlife Foundation Conservation Partners
National Institute of Food and Agriculture,
U.S. Department of Agriculture,
under Agreement No. 2010-65615-20630.
The Walton Family Foundation
Any opinions, findings, conclusions, or recommendations
expressed in this publication are those of the
author(s) and do not necessarily reflect the view of any funder.

0 5 10 Miles



Data Sources for HUC-8

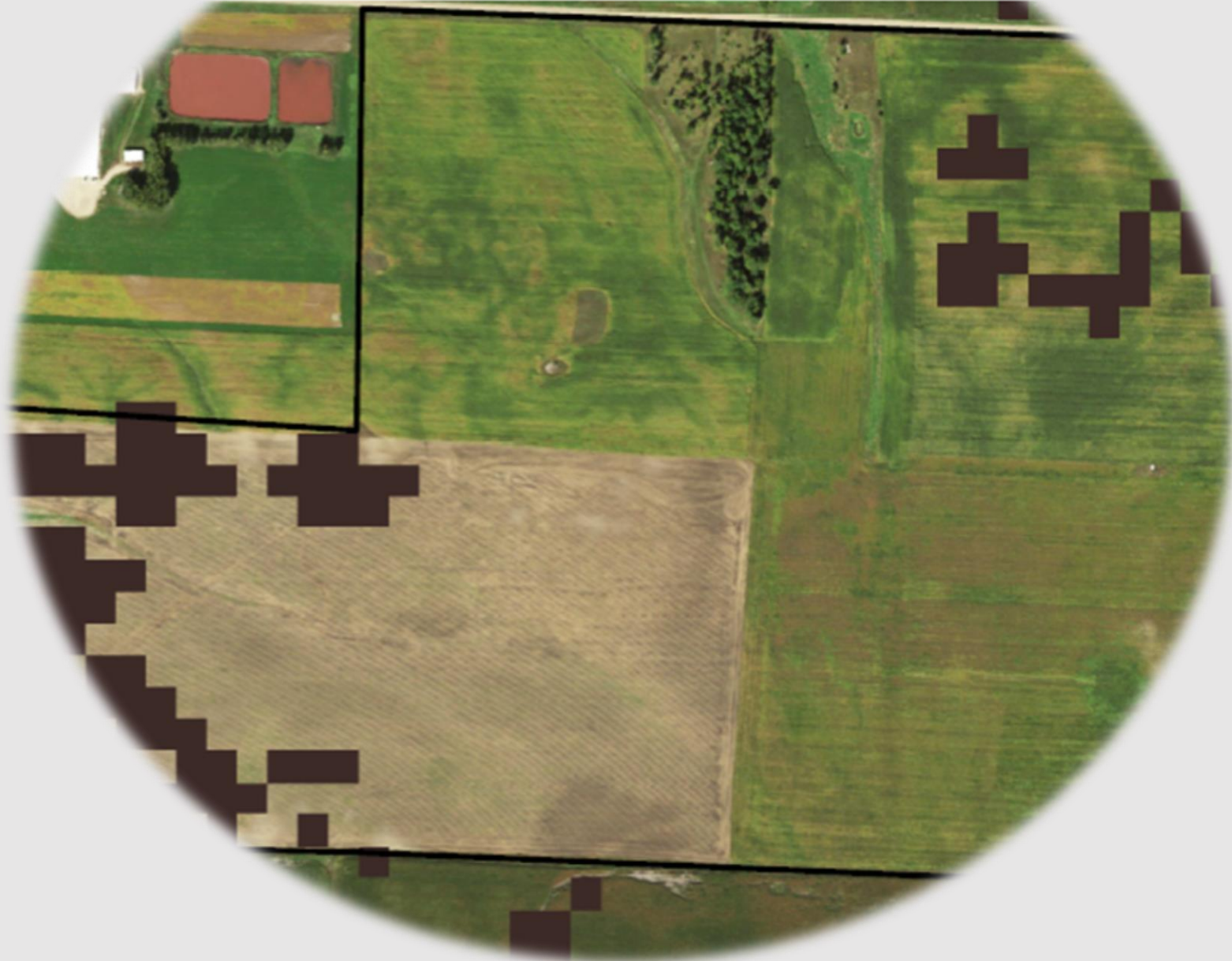
Targeting:

- USDA SSURGO Soils.
- USDA NASS cropland data layer.
- USGS elevation DEM.
- USGS for waters/watershed data.

Aspects of this targeting:

- Easy and quick to get outputs
- 30 meter resolution

(To the right is the land that meets targeting opportunity definition of higher LLCs and/or steeper slopes are displayed in black on ortho images.)



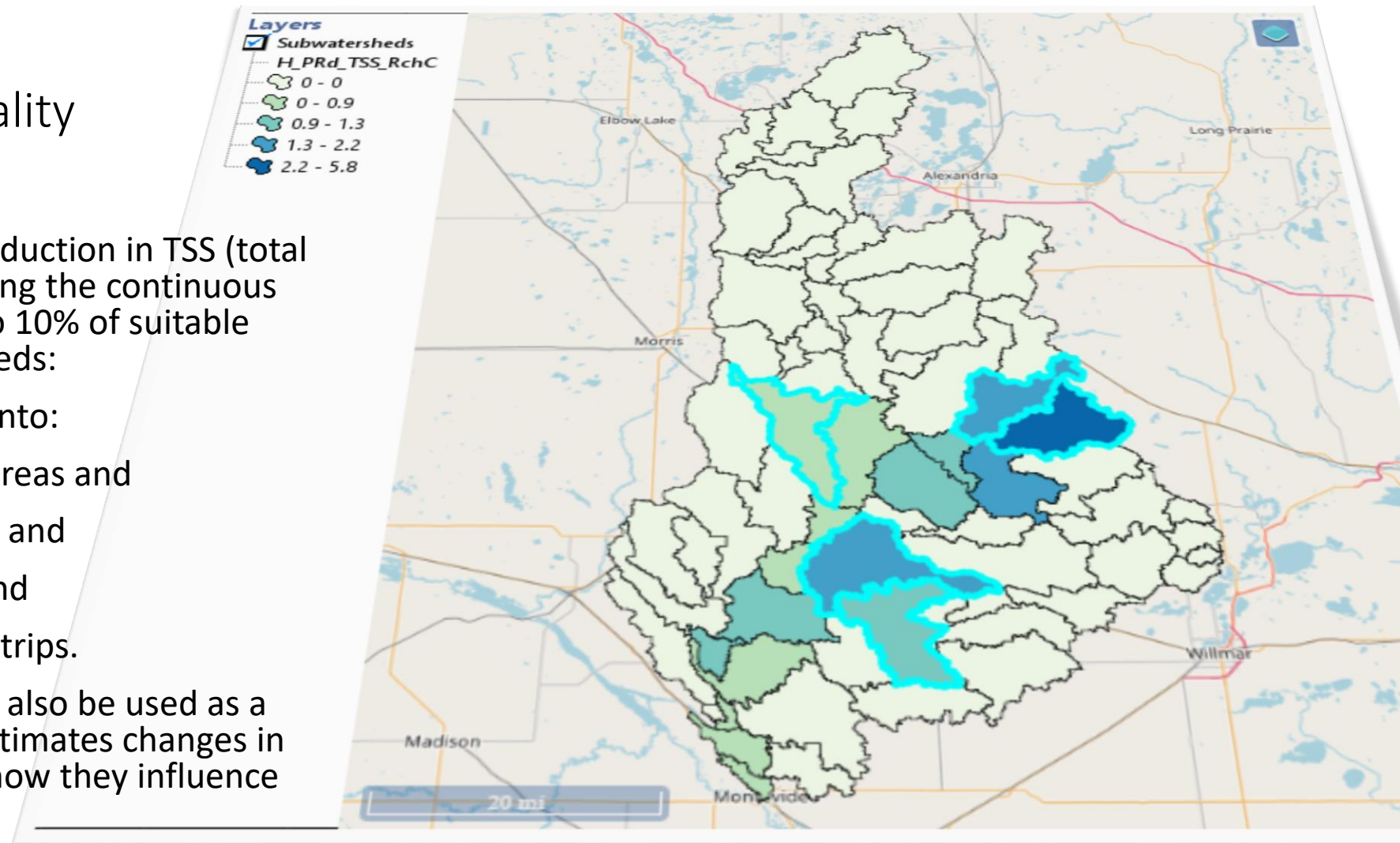
Scenario Application Manager(SAM)—HSPF is Software for Running Scenarios of Land use Changes and Water Quality Impacts

Map of to the right displays % reduction in TSS (total suspended solids) by incorporating the continuous living cover practices below onto 10% of suitable lands in the highlighted watersheds:

Corn and soybean were shifted into:

- Prairie strips on 10% of pixel areas and
- Longer conservation rotations and
- Managed rotational grazing and
- 16 or 50 foot Riparian buffer strips.

This tool is for targeting, but can also be used as a farmer engagement tool. This estimates changes in selected stream pollutants and how they influence the health of the watershed.



Targeting in Smaller Watersheds with ACPF-Agricultural Conservation Planning framework (HUC-12)*

Some types of BMPs ACPF targets :

- Riparian and saturated buffers
- Contour Buffers
- Grassed Waterways
- High Runoff potential fields
- Vulnerable lands (under development)

Aspects:

- Multiple-year rotations
- LiDAR based
- Design placement as well as targeting
- Processing flow of DEM (hydro – conditioned for full use) is required

* If multiple BMPs are located in a field, LSP proposes an option with more continuous living cover. This was tested, but but not used for engagement.

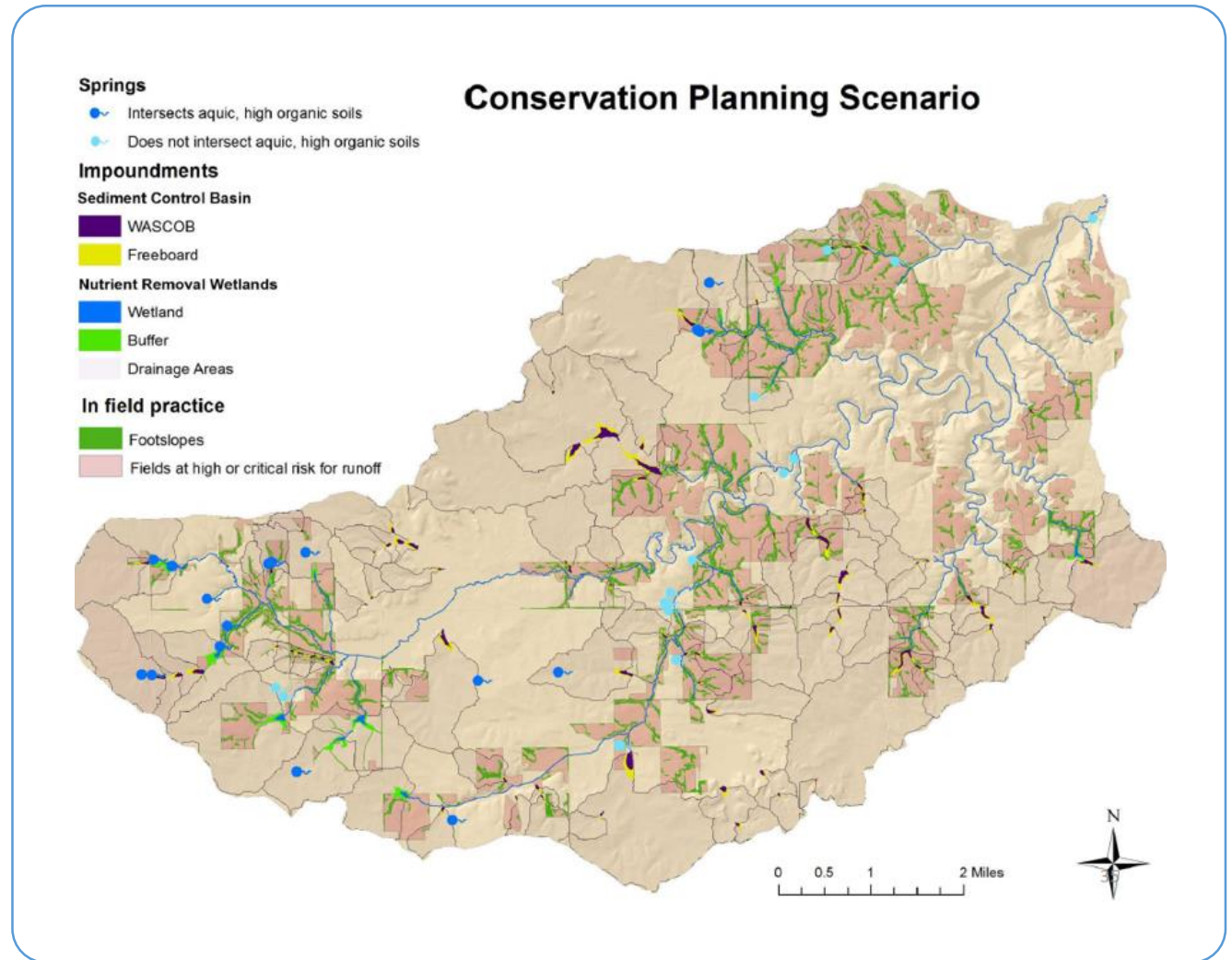
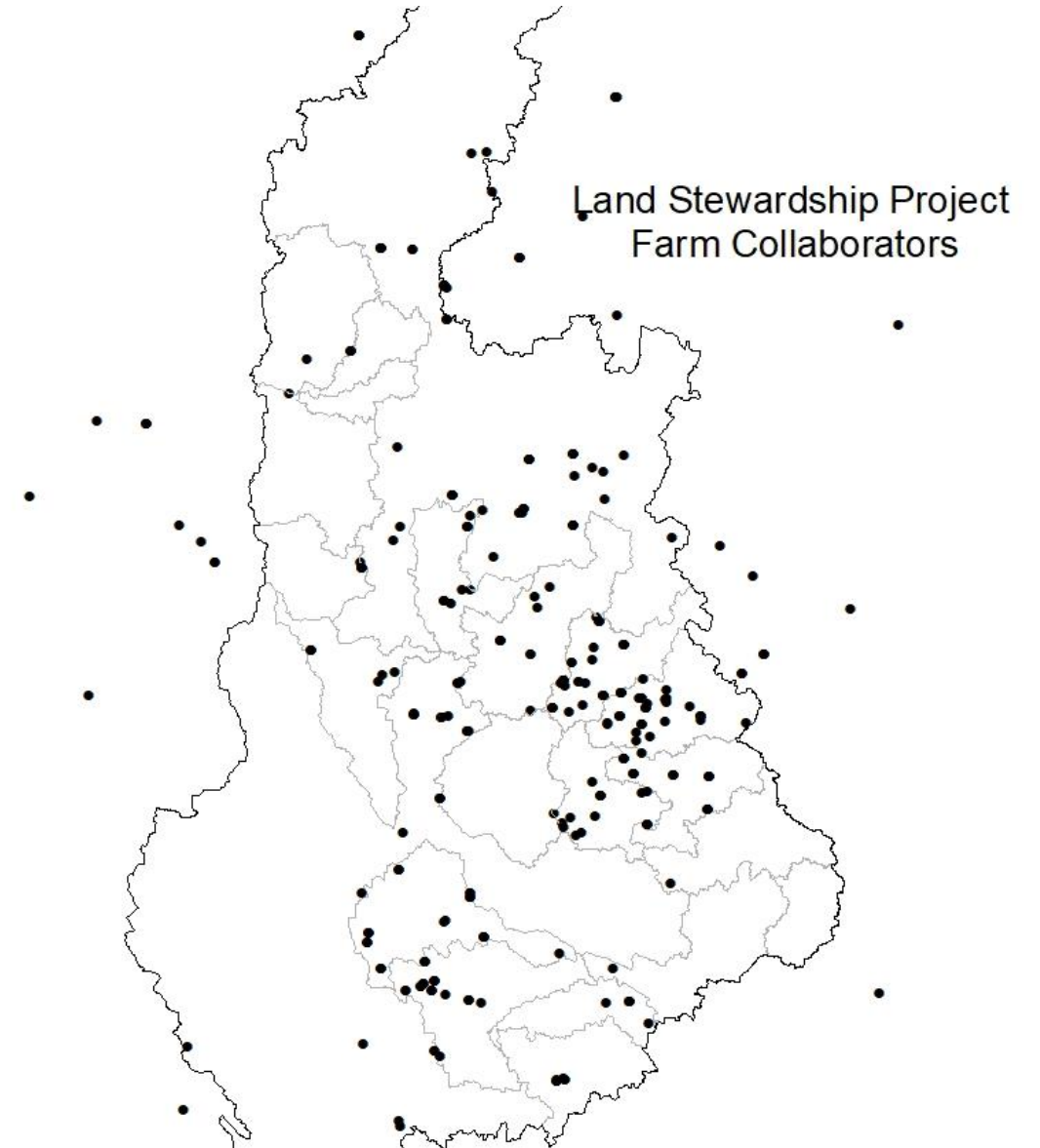
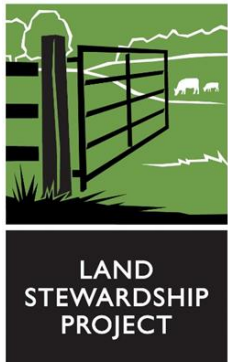


Image from Iowa Agricultural Research Service.

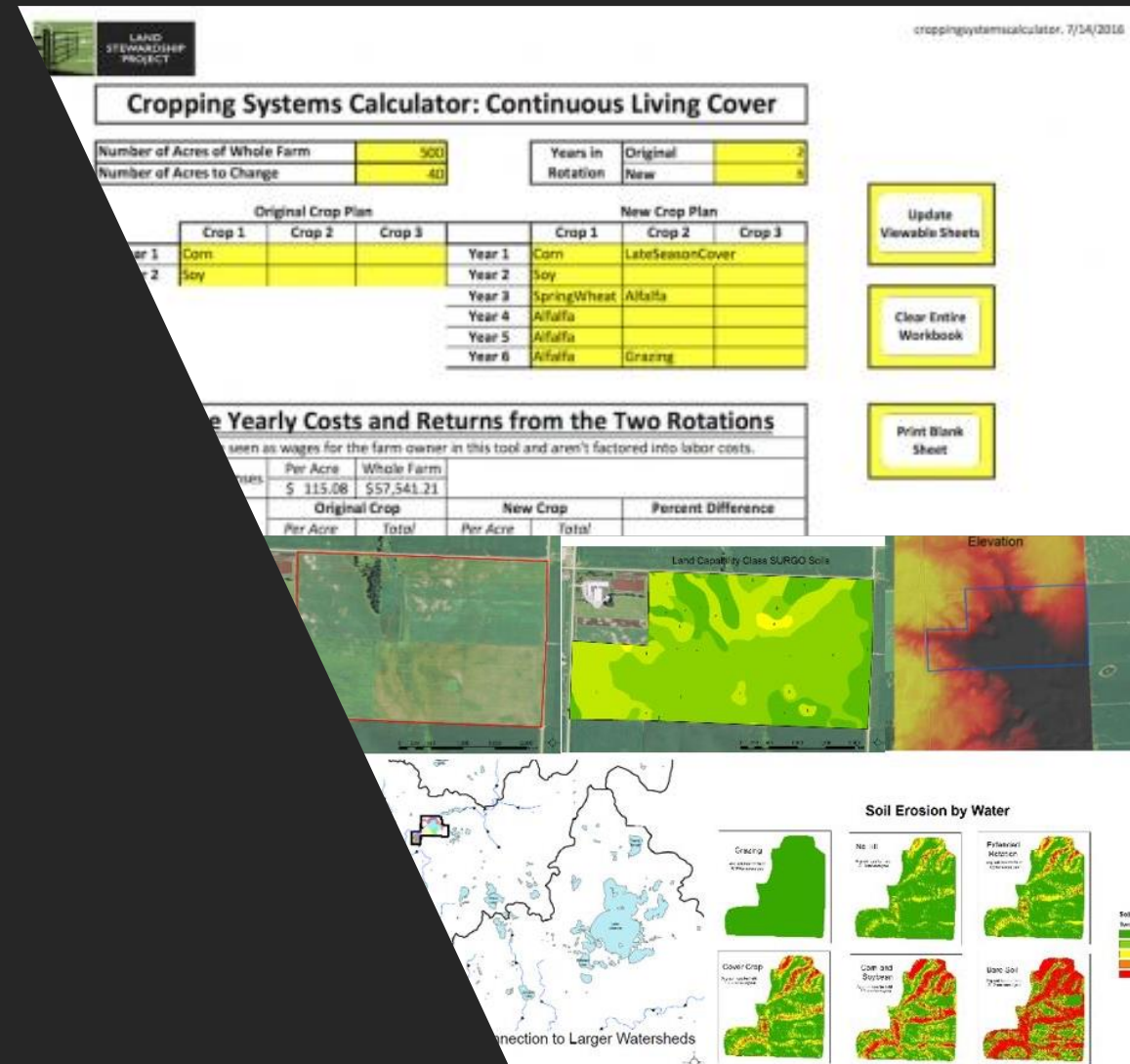
Farmer Collaborators of Land Stewardship Project

To the right is a map of farmer collaborators who participated in monitoring or practice changes. Note the correspondence with focal area HUC 12s.



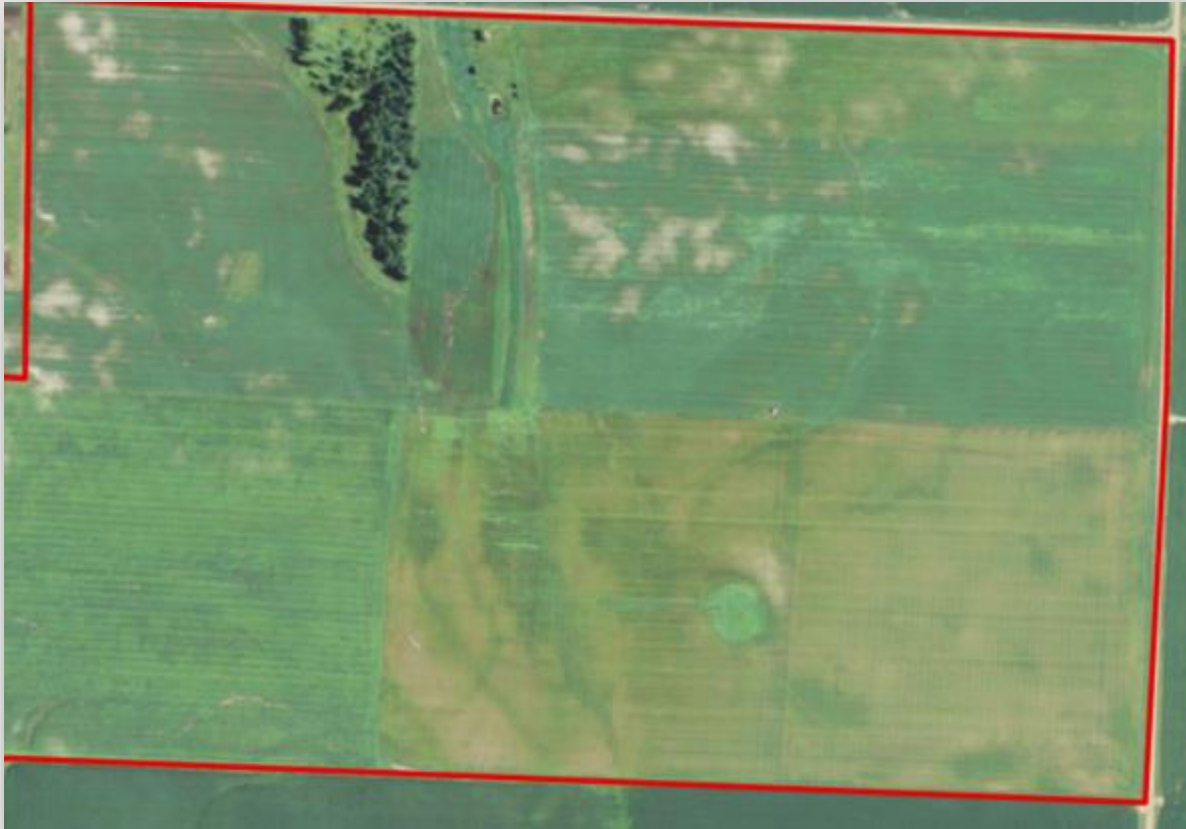
Engagement Maps/Tools LSP has used with farmers:

- High resolution imagery(current or historical date), Soils, 3D Elevation, Stream Power Index (SPI) maps.
- RUSLE and MUSLE (single storm) soil erosion maps.
- Cropping system calculator for applying economics (addition of soil erosion in development.)



High Resolution Current and Historical Imagery

Data source NAIP imagery or historical imagery in Minnesota available from the University of Minnesota
<https://www.lib.umn.edu/apps/mhapo/> and <http://www.mngeo.state.mn.us/chouse/airphoto/fsa.html#naip>



Soils

Land Capability Classes (LCC)*

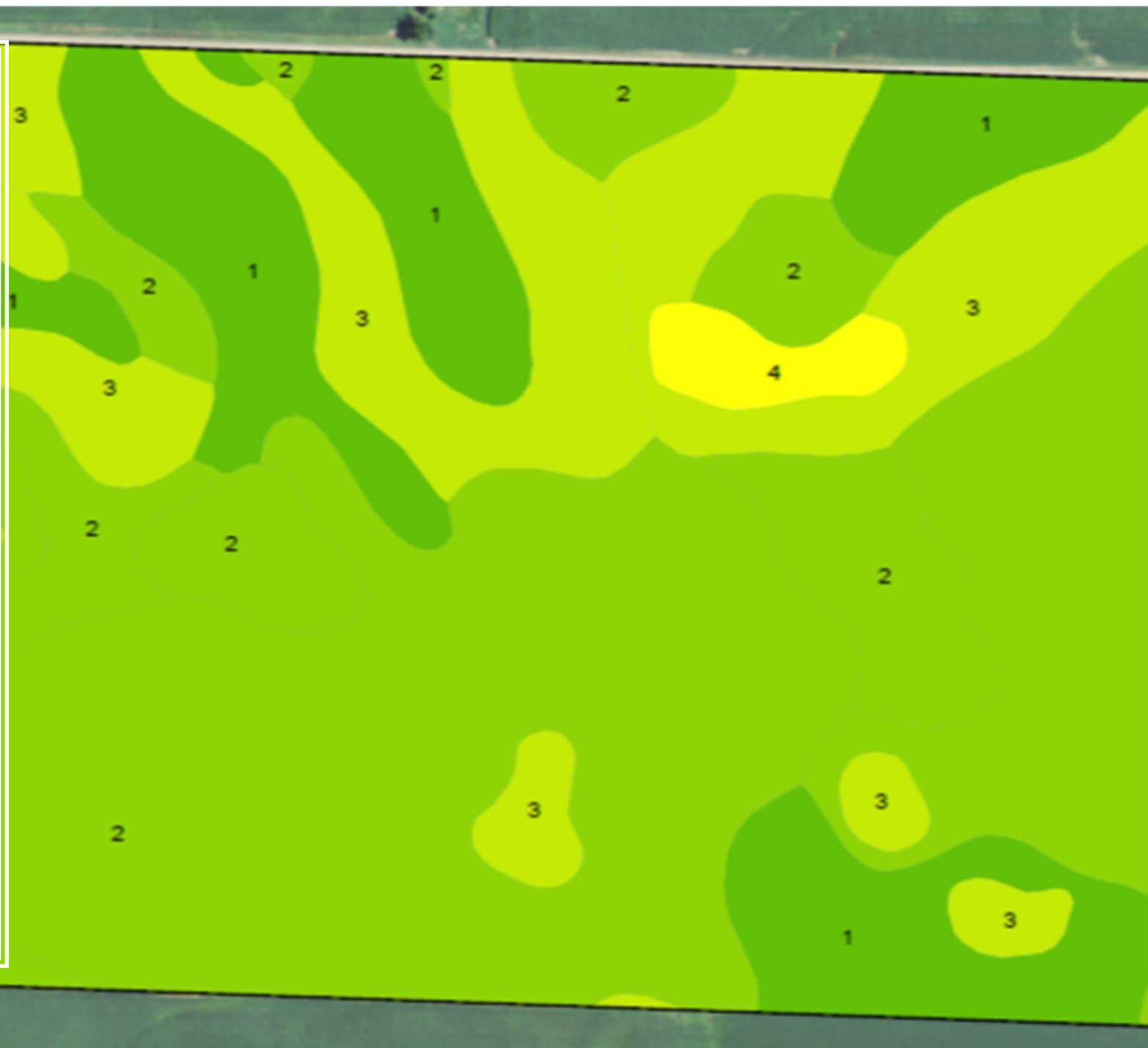
LCC1 being good cropland to

LCC8 being not suitable.

From SSURGO soils database:

<https://arcg.is/GOSrT>

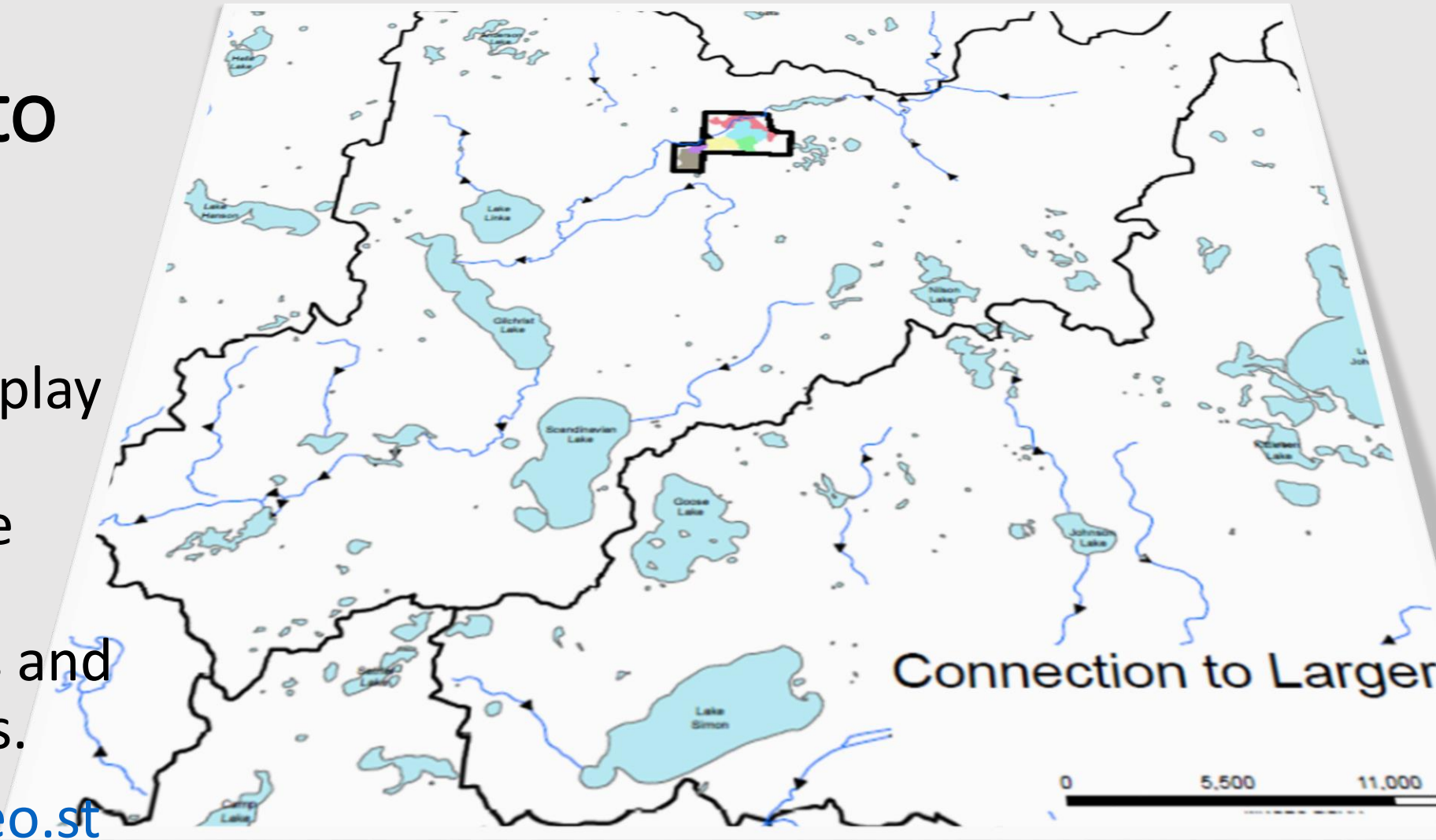
* LCCs were used to group soil types by combined economic and conservation considerations.



Connection to Watersheds

Simple map to display farm fields relationship to the landscape. Helps show connections and where flow moves.

http://www.mngeo.state.mn.us/chouse/water_watersheds.html



A 3D elevation map (hillshade) derived from LiDAR data. The map uses a color gradient where yellow and orange represent higher elevations and red and dark grey represent lower elevations. A blue rectangular outline is drawn on the map, highlighting a specific area of interest. The word "Elevation" is printed in black text in the upper left portion of the map.

Elevation

Engagement Maps based on LiDAR

- 3D Elevation/Hillshade(left)
- Stream Power Index
- Within Field Erosion Mapping (RUSLE and MUSLE)

3-meter LiDAR data can be found at:

<http://arcgis.dnr.state.mn.us/maps/mntopo/>



Stream Power Index (SPI)

This map shows areas within fields with high potential for overland surface flow and where ephemeral gullies could potentially form.

The SPI is function of slope and flow accumulation. LSP mapped the higher SPI values—those greater than the 85th percentile—that DNR found correspond with gully formation.

Equation used in ESRI GIS software for calculation of SPI:

$$\text{SPI} = \text{LN}([(\text{FlowAcc_Dem}] + 0.001) * (([\text{Slope_Dem}] / 100) + 0.001))$$

Where is soil erosion
by water occurring
on a farm field?

How much soil is
being lost from
those areas?



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These tools can help farmers/resource staff compare between different cover and management options.

GIS LiDAR based tools built from RUSLE and MUSLE erosion models



Two ArcGIS python script tools for mapping soil erosion by water for a farm field.

RUSLE

Inputs:

The screenshot shows the RUSLE tool window with the following inputs and outputs:

- Input DEM: 3-meter DEM (LiDAR)
- Input R: (empty)
- Input K: K factor- soil
- Input C: C factor- cover/management practices
- Input P: P factor- conservation practices
- Input P: R factor- rainfall Factor
- Out RUSLE: (empty)

Buttons at the bottom: OK, Cancel, Environments..., Show Help >>

MUSLE

Inputs:

The screenshot shows the MUSLE tool window with the following inputs and outputs:

- input DEM: 3-meter DEM (LiDAR)
- Input Q: (empty)
- Input qp: K factor- soil
- Input K: (empty)
- Input C: C factor- cover/management practices
- Input P: (empty)
- Output MUSLE: P factor- conservation practices

Buttons at the bottom: OK, Cancel, Environments..., Show Help >>

Soil Erosion by Water

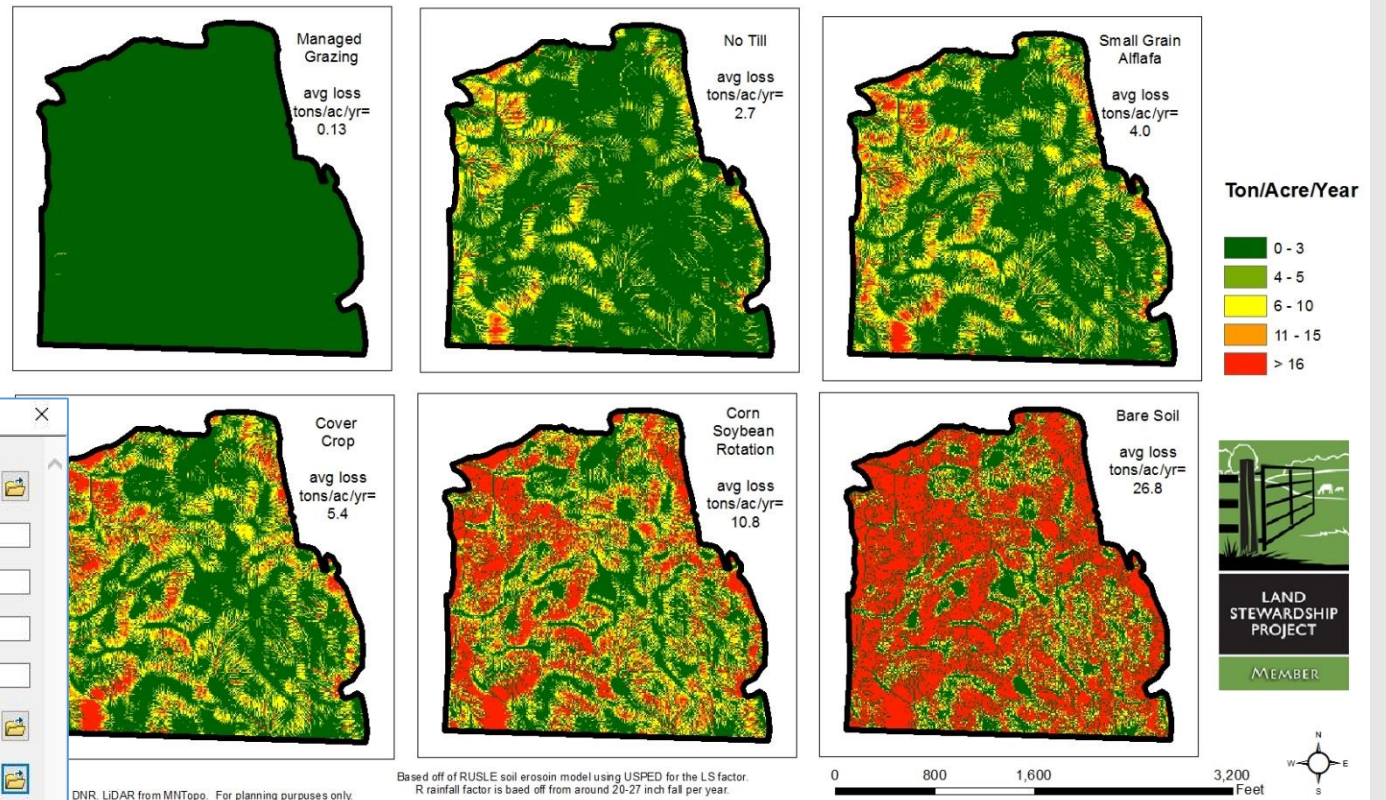
(RUSLE)

Below are example maps of running different scenarios with the RUSLE tool.
This field averaged slope 6%, averaged rainfall 21-25in/yr.

Soil Erosion by Water-RUSLE

- Input DEM
- Input Value R Factor
- Input Value K Factor
- Input Value C Factor
- Input Value P factor conservation
- Output: Average Soil Loss for Field
- Output: Within Field Soil Erosion Losses

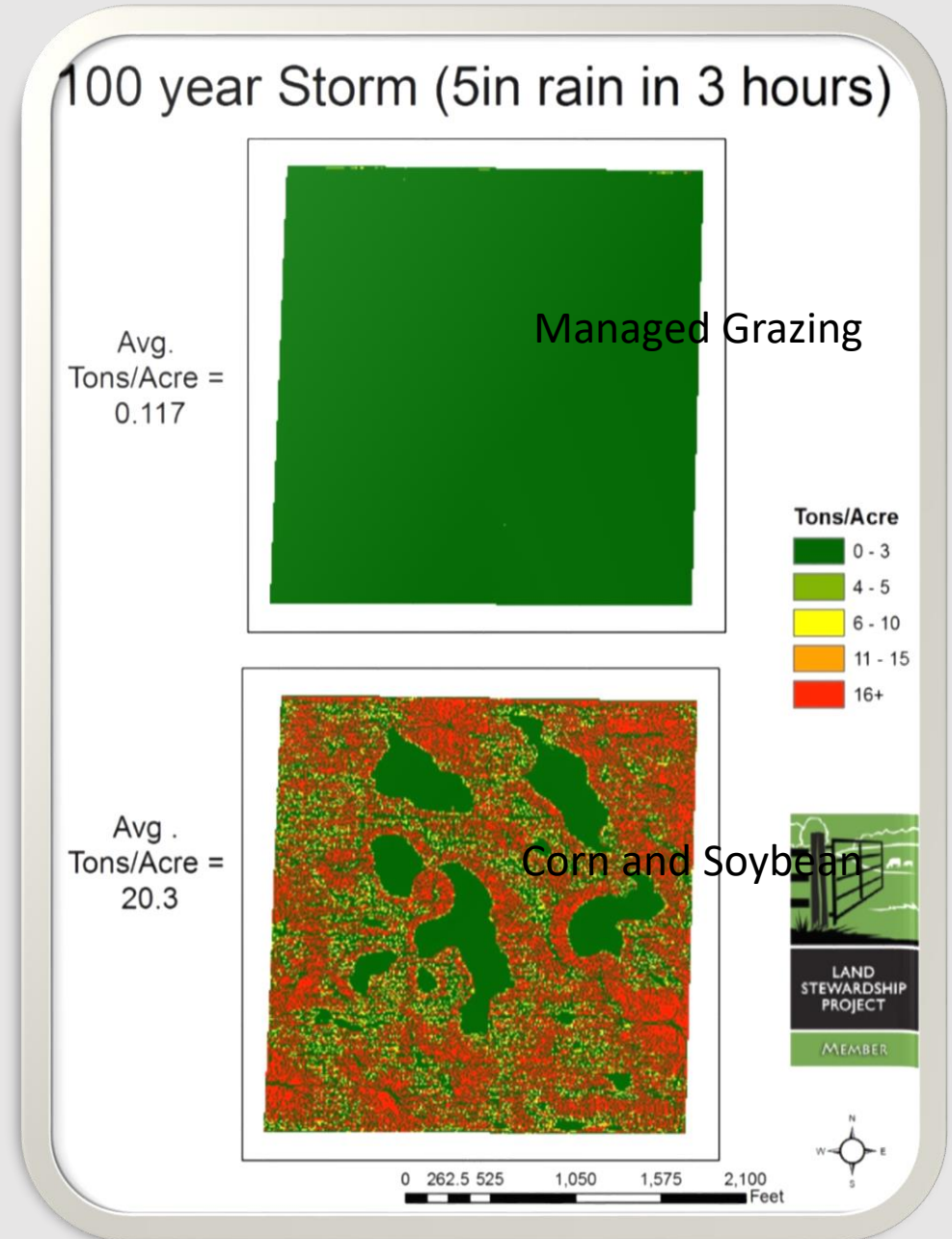
Potential Soil Erosion by Water



Single Storm Event (MUSLE)

To the right is an example map of single-storm rain event comparing managed rotational grazing to a corn/soybean rotation with spring tillage.

This 150 acre field has an average slope of 1.5% and it is based on a 100 year storm from Benson MN area.




Usage **Settings**

tion tools are different from RUSLE2 tools in that they are:

Also Available: Cropping System Calculator to Evaluate the Economics (Addition of Soil Erosion)

<http://landstewardshipproject.org/stewardshipfood/chippewa10croppingsystemscalculator>

croppingsystemscalculator. 7/14/2016

Cropping Systems Calculator: Continuous Living Cover

Number of Acres of Whole Farm	500	Years in Original	2
Number of Acres to Change	40	Years in New	6

Original Crop Plan

	Crop 1	Crop 2	Crop 3
Year 1	Corn		
Year 2	Soy		

New Crop Plan

	Crop 1	Crop 2	Crop 3
Year 1	Corn	LateSeasonCover	
Year 2	Soy		
Year 3	SpringWheat	Alfalfa	
Year 4	Alfalfa		
Year 5	Alfalfa		
Year 6	Alfalfa	Grazing	

Update Viewable Sheets

Clear Entire Workbook

Print Blank Sheet

Average Yearly Costs and Returns from the Two Rotations

Returns are seen as wages for the farm owner in this tool and aren't factored into labor costs.

	Per Acre	Whole Farm			
Total Overhead Expenses	\$ 115.08	\$57,541.21			
	Original Crop		New Crop		Percent Difference
	Per Acre	Total ¹	Per Acre	Total ¹	
Total Crop Expenses	\$410.14	\$16,405.40	\$491.35	\$19,654.15	20%
Total Crop Income	\$482.13	\$19,285.07	\$810.66	\$32,426.28	68%
Other Income	\$77.49	\$3,099.71	\$31.95	\$1,277.98	-59%
Returns to Management	\$34.40	\$1,376.08	\$236.17	\$9,446.82	587%

¹Percent difference shows the percent increase in the new crop when compared to the old crop

Future Needs: Web Tool for Conservation Planning

Such a tool could combine some concepts from the previous slides to include:

- Economics of soil erosion as part of estimating the costs of production.
- Web maps for soil erosion modeling into Cropping Systems Calculator.
- Additional maps to encourage conservation practices.

Abbreviations:

- LSP- Land Stewardship Project
- LCC- Land Capability Classes
- CLC-Continuous Living Cover
- HSPF-Hydrological Simulation Program--Fortran
- LiDAR-Light Detection and Ranging
- HUC- Hydrologic unit code
- GIS- Geographic information system
- BMP- Best management practices
- TSS-Total suspended solids
- DEM- Digital elevation model
- MIRG- Managed intensive rotational grazing
- USGS- United States Geological Survey
- USDA- United States department of agriculture
- NASS- National agricultural statistics service
- USPED- Unit Stream Power - based Erosion Deposition



The GIS tools were
developed by
Steve Ewest

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George Boody

[gboody@landstewardshipproject.
org](mailto:gboody@landstewardshipproject.org)

(612) 722-6377

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