Adaptive Watershed Management for Control of Nutrient Loss in the Mackinaw River Watershed

Krista Kirkham and Maria Lemke
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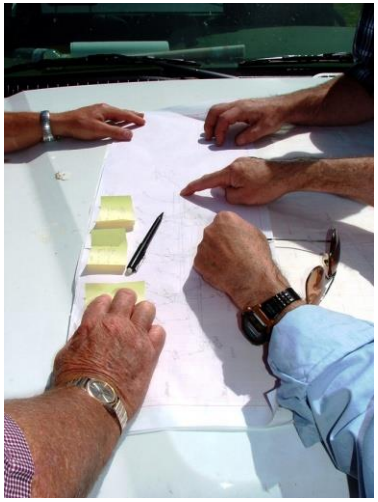
Mackinaw River Program



Innovative Partnerships

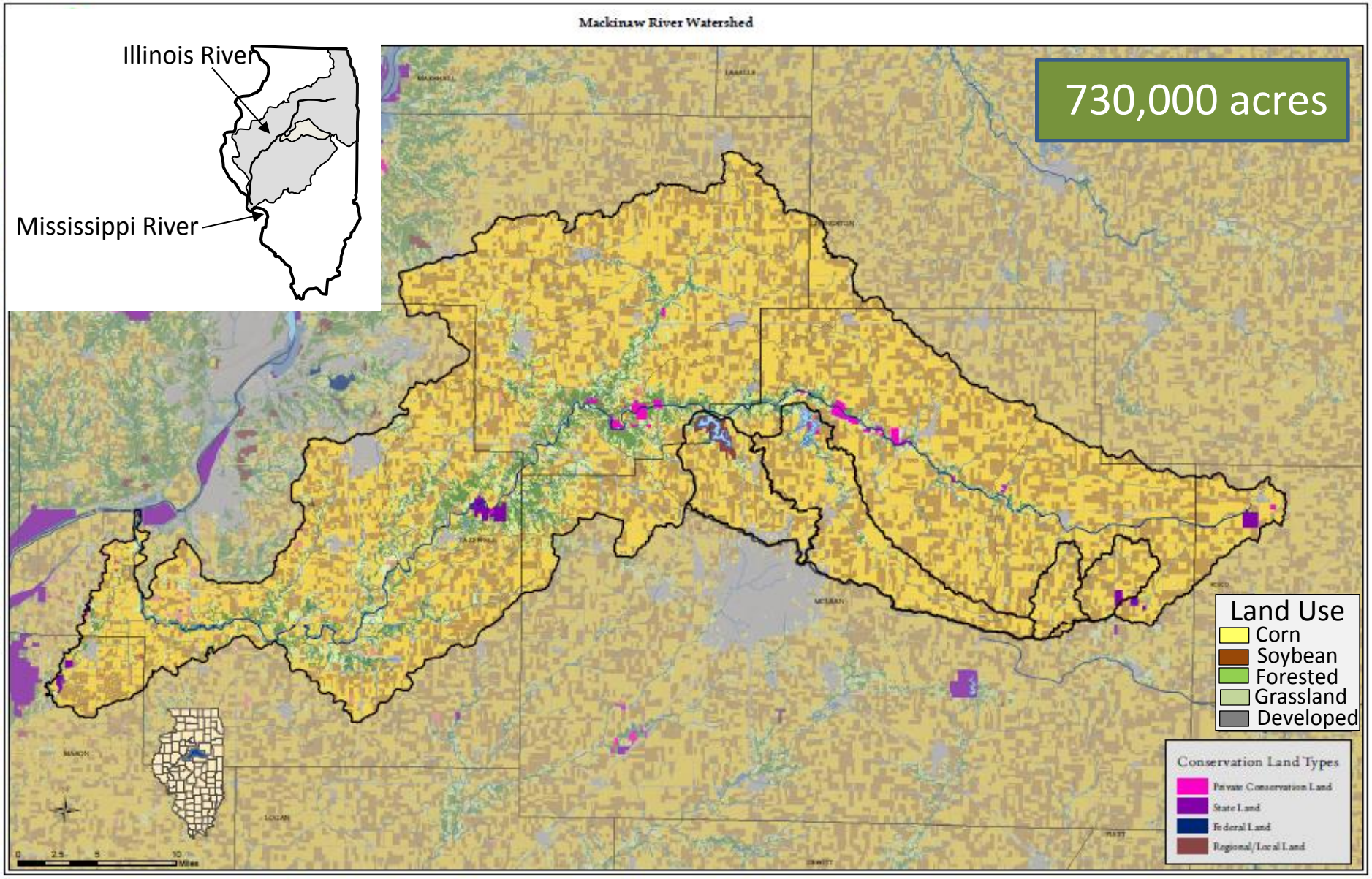
Federal Government (USDA): Natural Resources Conservation Service (NRCS), Farm Service Agency (FSA)

State Government and Universities: McLean County Soil and Water Conservation District (SWCD), University of Illinois Urbana-Champaign, Illinois State University, Ball State University

Not-for Profit: The Nature Conservancy, Environmental Defense Fund

Local: City of Bloomington and landowners/farmers

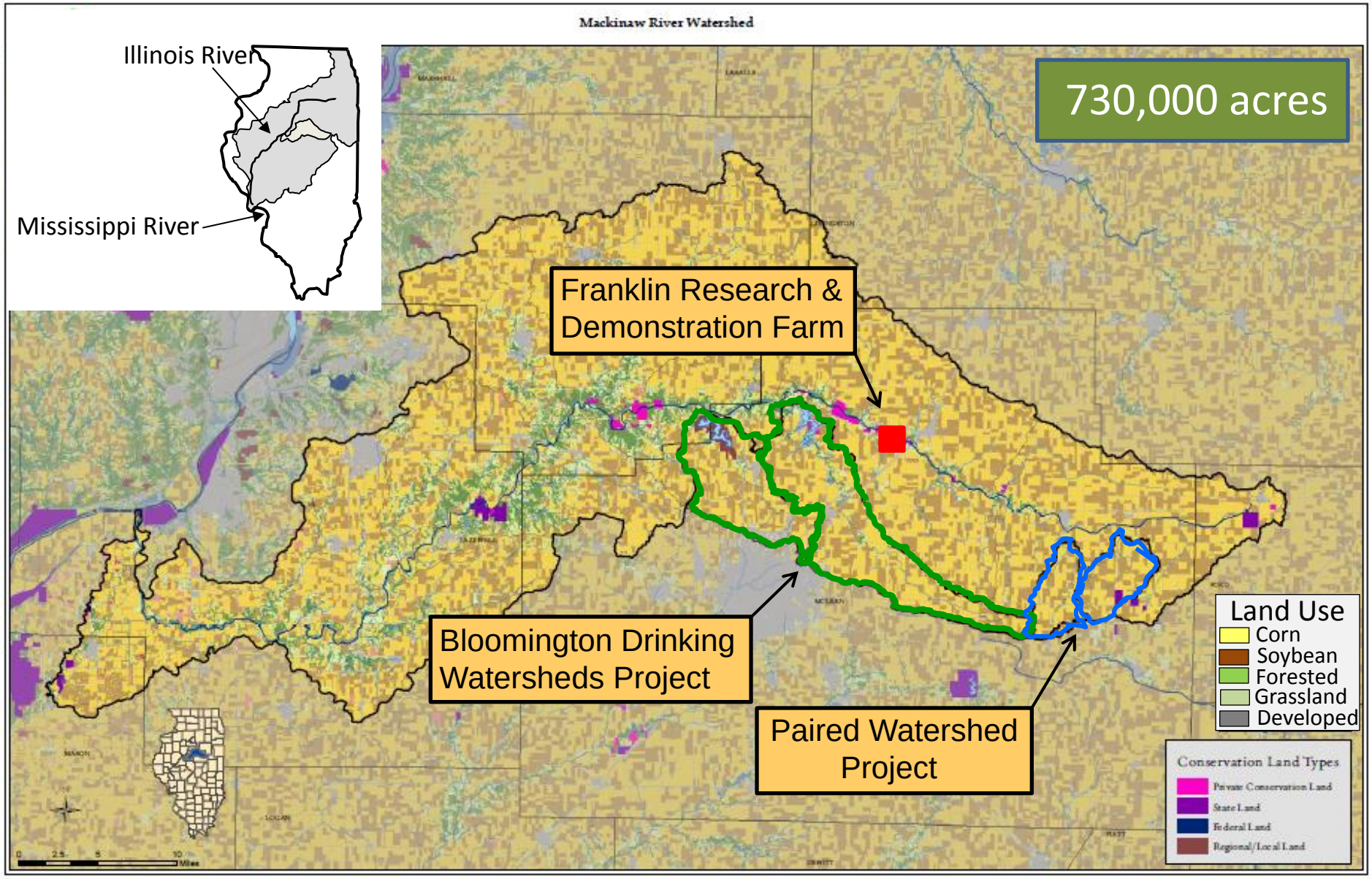
Mackinaw River Watershed Land Use



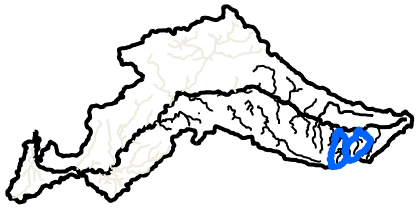
Drainage tile systems:

4.7 million hectares of subsurface drainage in Illinois (12 million acres)

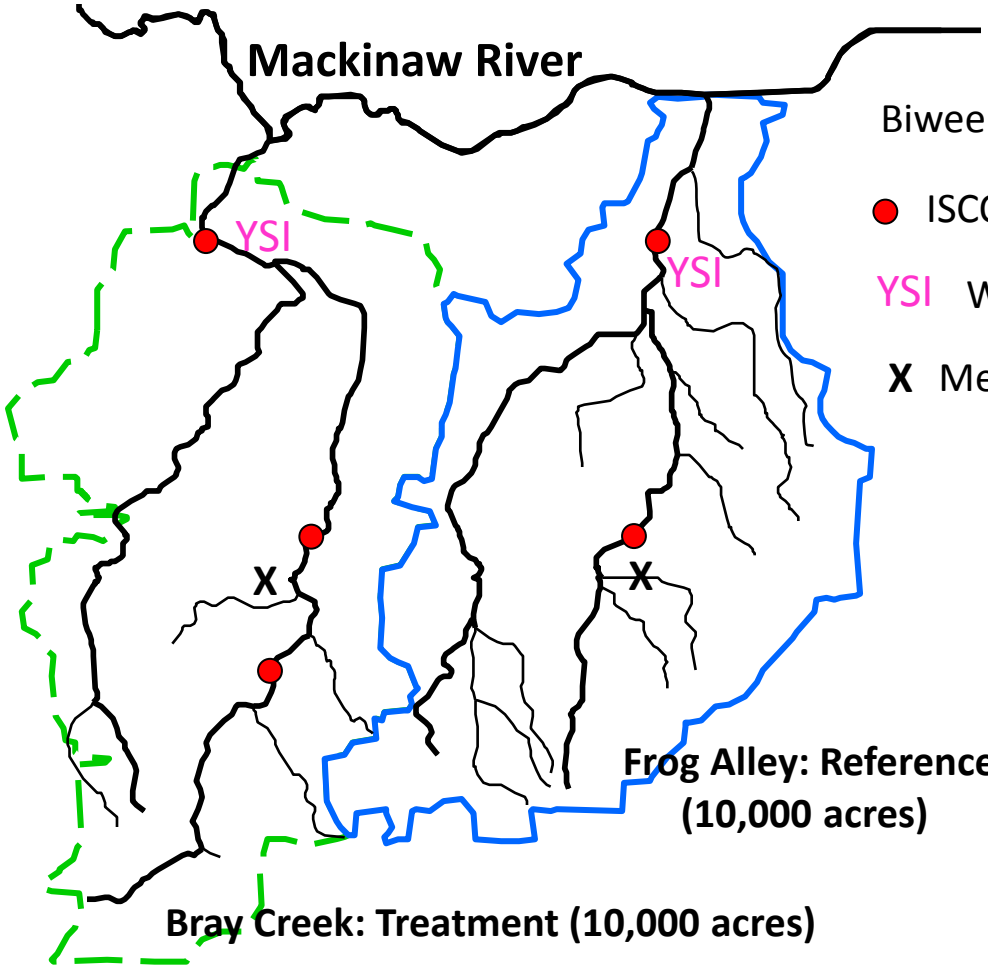
Mackinaw River Watershed Land Use



Paired Watershed Project (15 years)



Question: How well do traditional conservation practices work to improve water quality, hydrology, and biodiversity at the watershed scale?

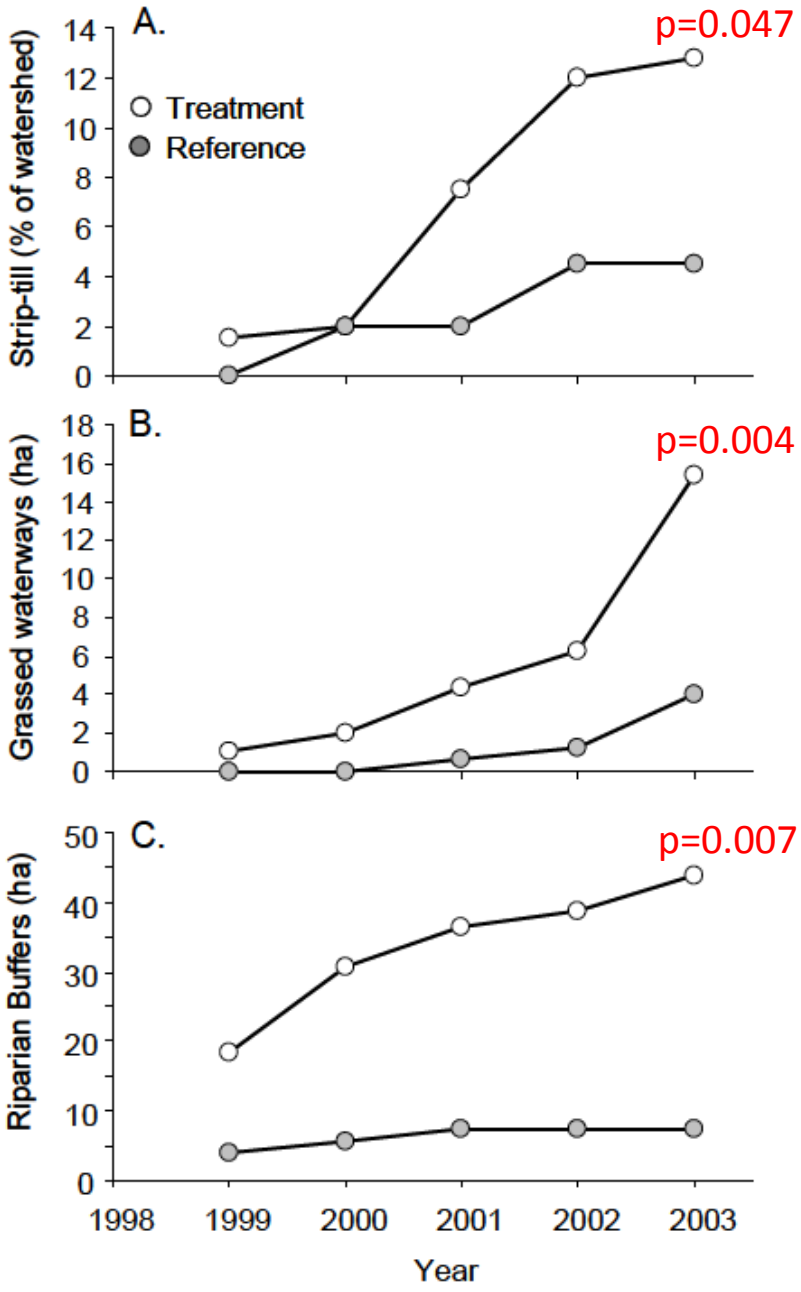


Biweekly grab samples: NH_4^+, NO_3^-, SRP, TP, TSS

ISCO Water Samplers (Storm events, stage height)

YSI Water temperature, turbidity, pH, conductivity, DO

X Met Stations: Air temperature, rain, soil moisture



Lemke et al., 2011 JEQ 40:1215-1228

Paired Watershed Project Results: 1999-2006

- Outreach works
- No nutrient/suspended sediment reduction
- No impact on hydrology or biota

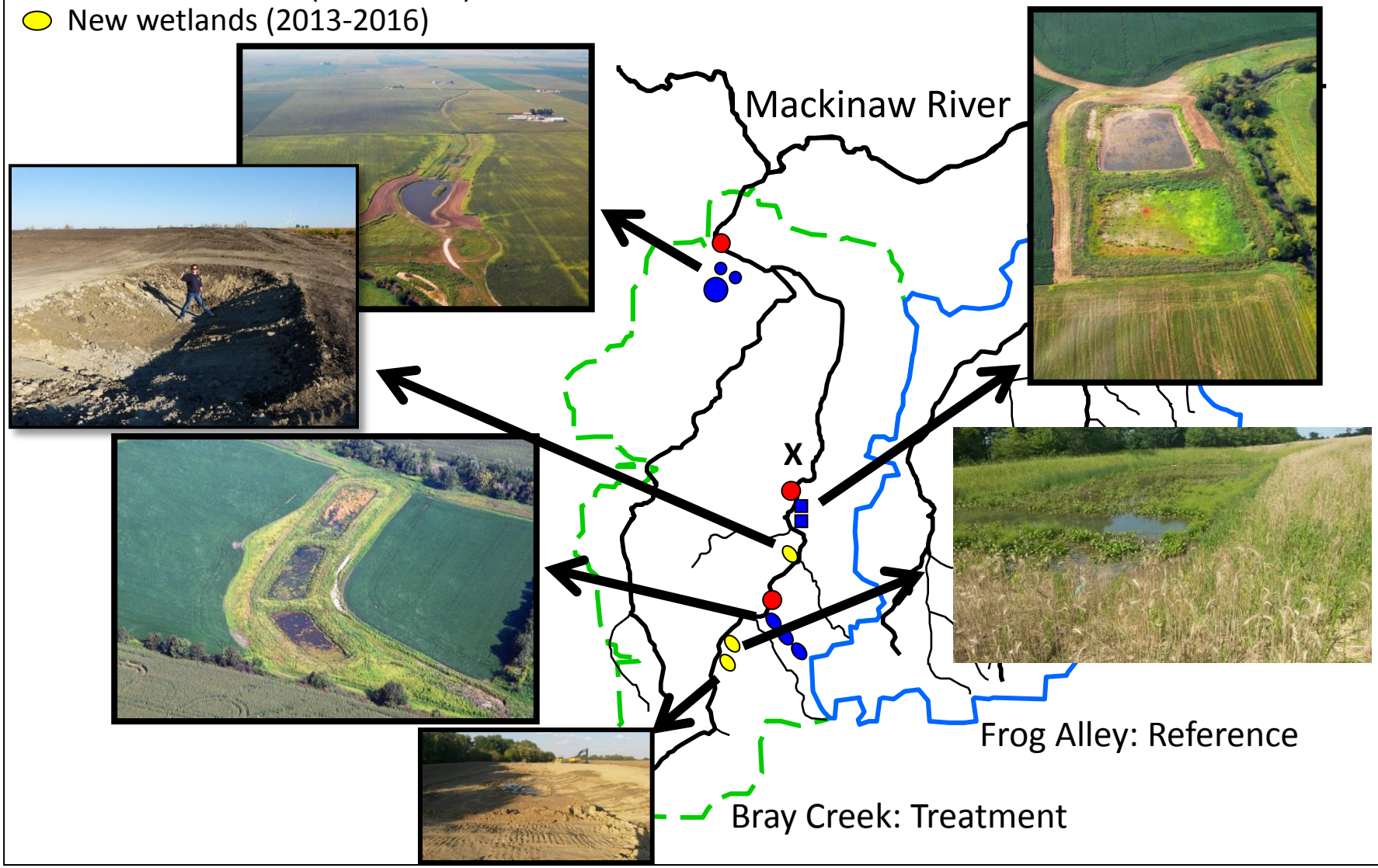
Need to better retain runoff, especially from tile drainage

WETLANDS

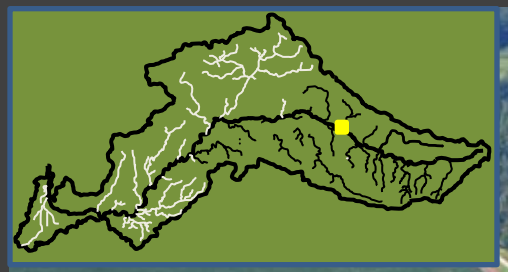
Paired Watershed Project (2006-present)

Quantify watershed-scale effectiveness of constructed wetlands at restoring altered hydrology and reducing nutrient and sediment transport (10,000 acre-scale)

- Current wetlands (2005-2007)
- New wetlands (2013-2016)



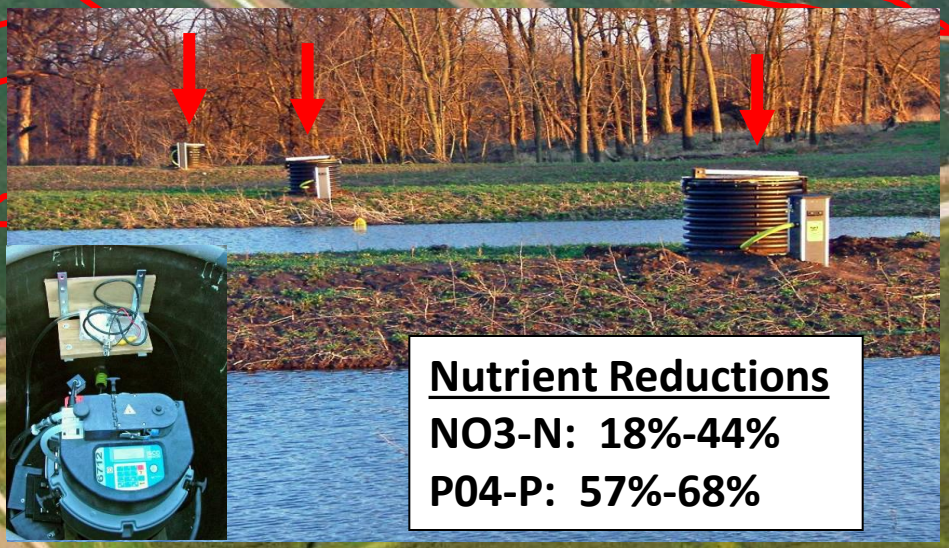
How well does a wetland perform?



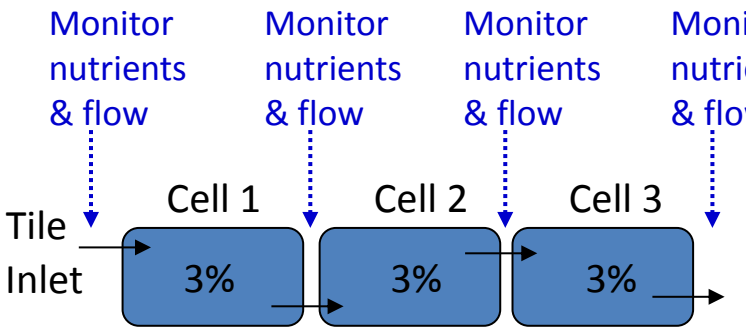
9% 6% 3%

3% 6% 9%

9% 6% 3%



Nutrient Reductions
NO3-N: 18%-44%
P04-P: 57%-68%



What size of wetland is most effective at reducing nutrients in tile runoff?

6%

9%

Next Steps:

1. How do winter cover crops influence nutrient export from tile-drained farmland?
2. Effectiveness of bundled in-field and edge of field practices

Application Methods

Modified Hiboy

No-till drill

Aerial

Seed Type/Rate

Oats and Radish

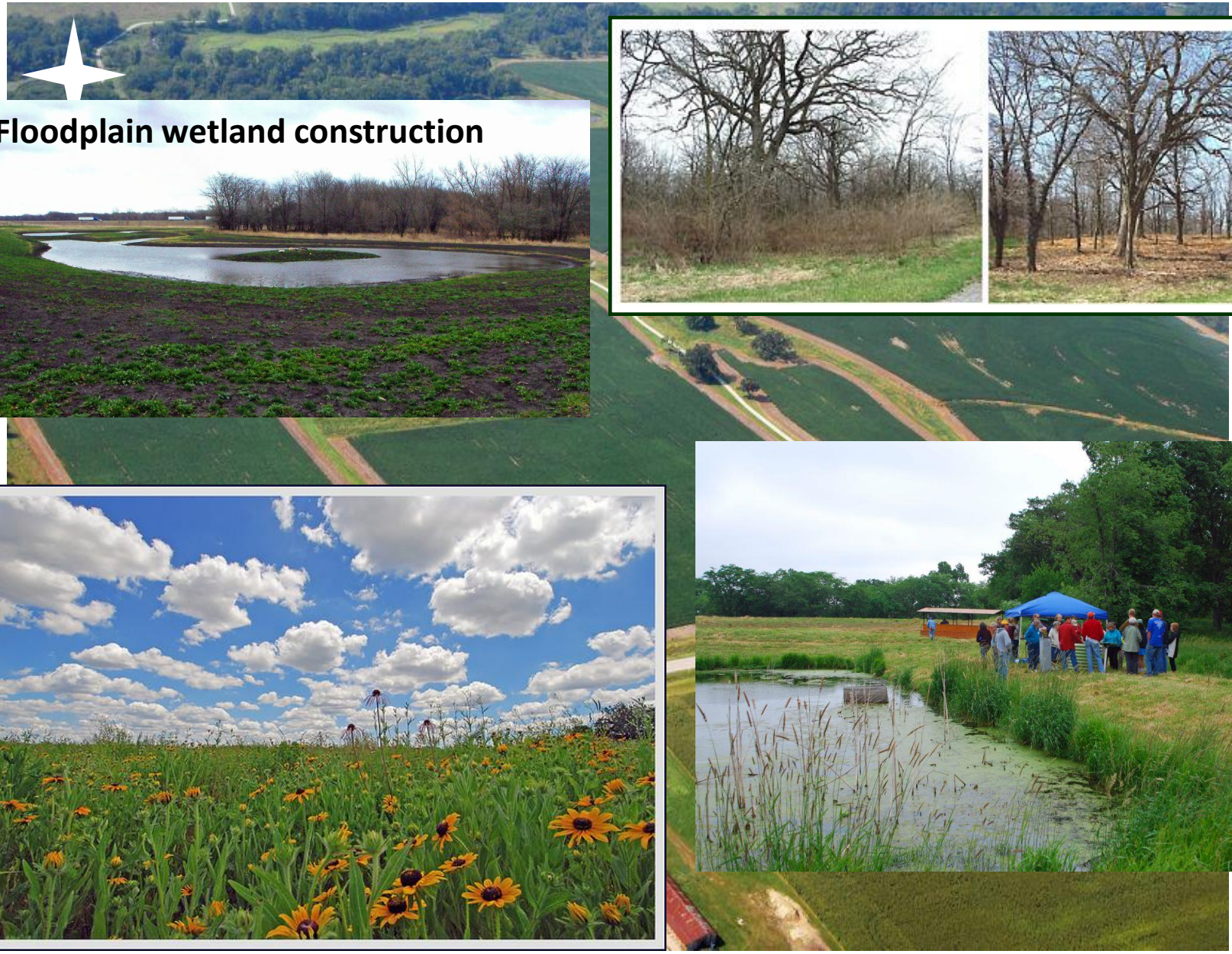
Cereal rye

Tillage Radish

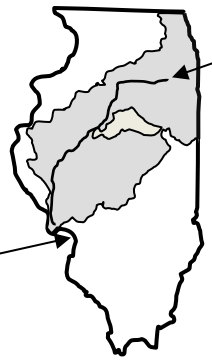
Annual Ryegrass

Demonstrate many conservation practices on a working farm

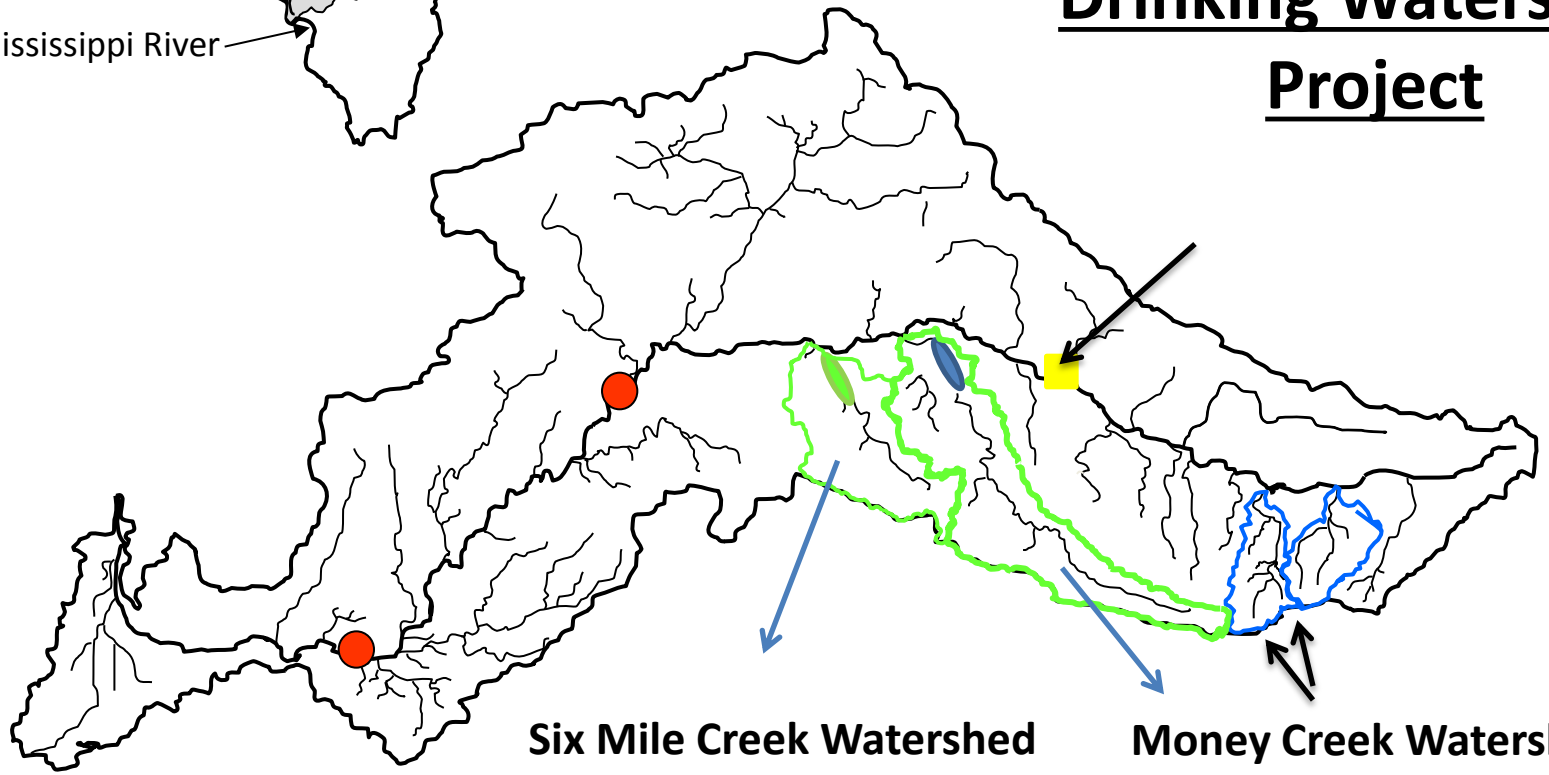
Demonstrate many conservation practices on a working farm



Mackinaw River Project Sites



Drinking Watershed Project

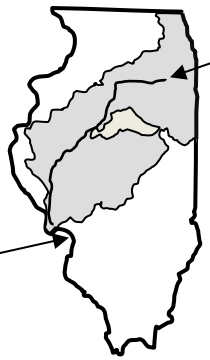


Six Mile Creek Watershed
- **25,730 acres**
- **Evergreen Lake**

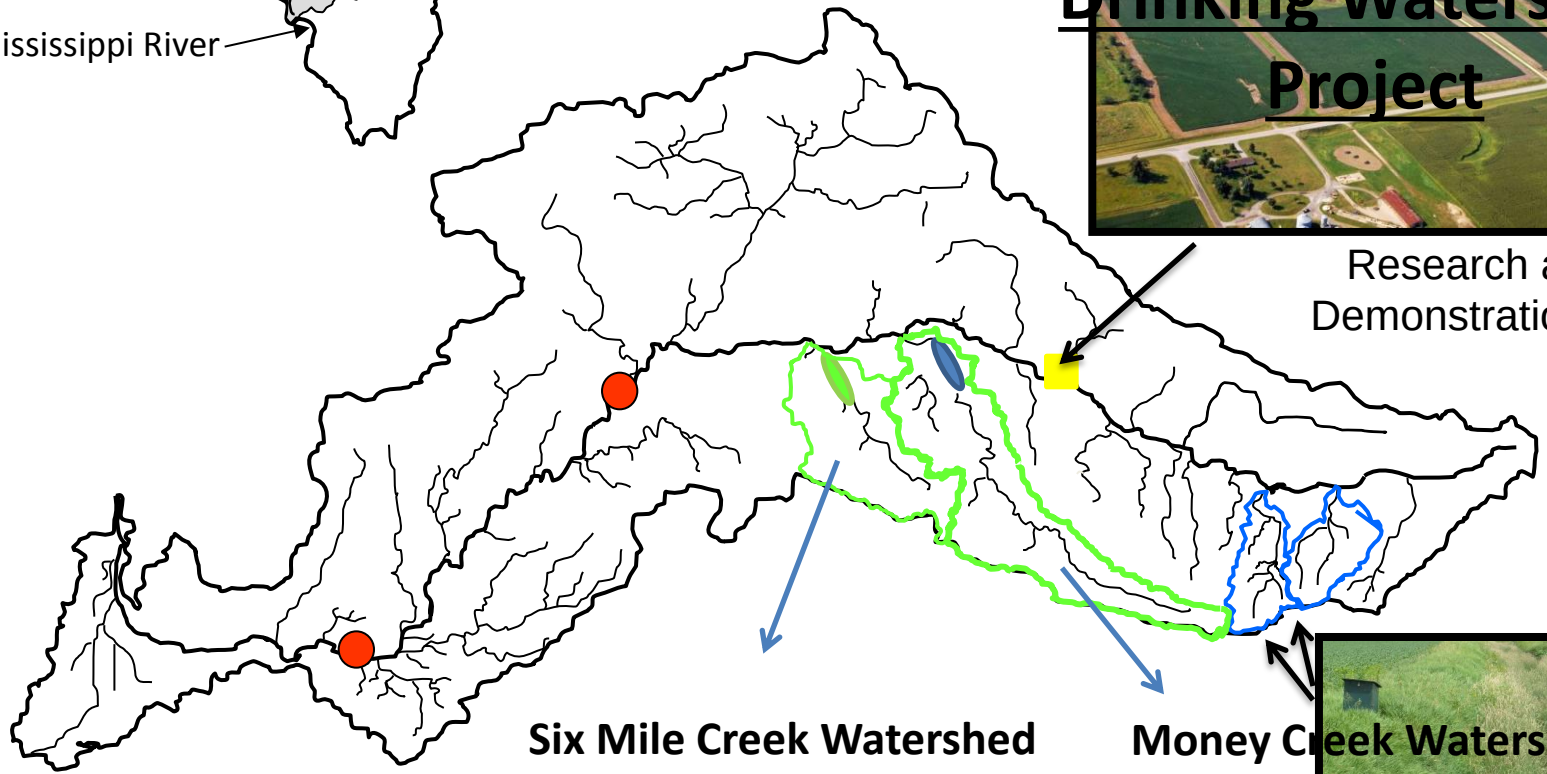
Money Creek Watershed
- **43,100 acres**
- **Lake Bloomington**

Lake Evergreen
Lake Bloomington
USGS gaging stations

Mackinaw River Project Sites



Research and Demonstration Farm



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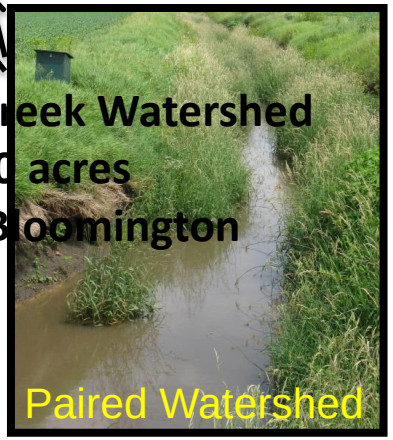
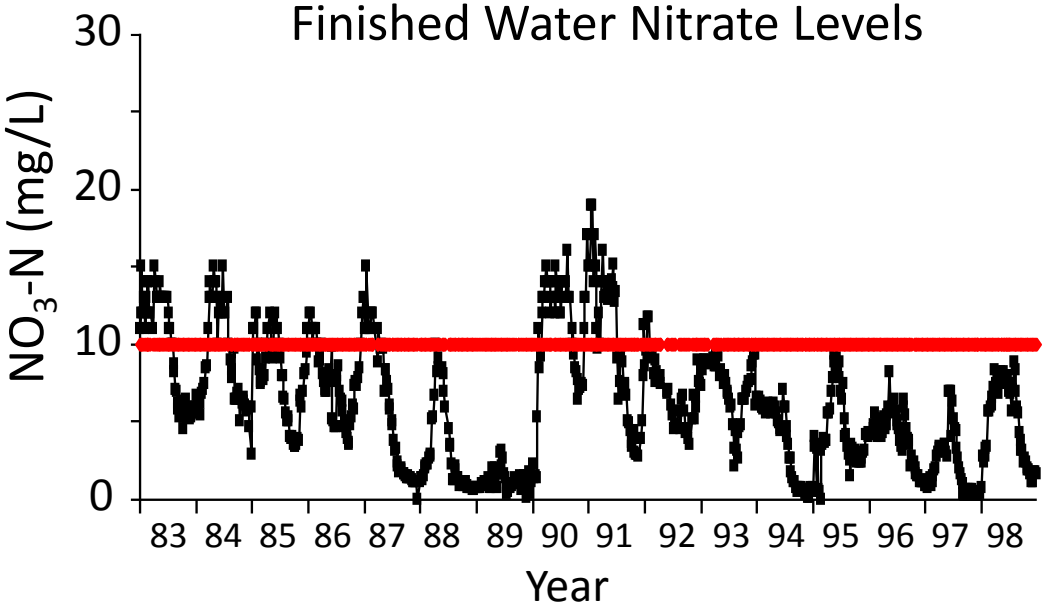
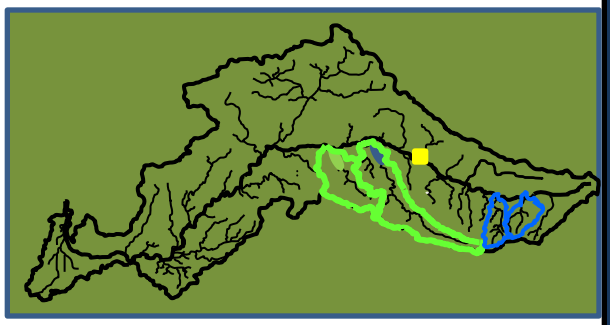
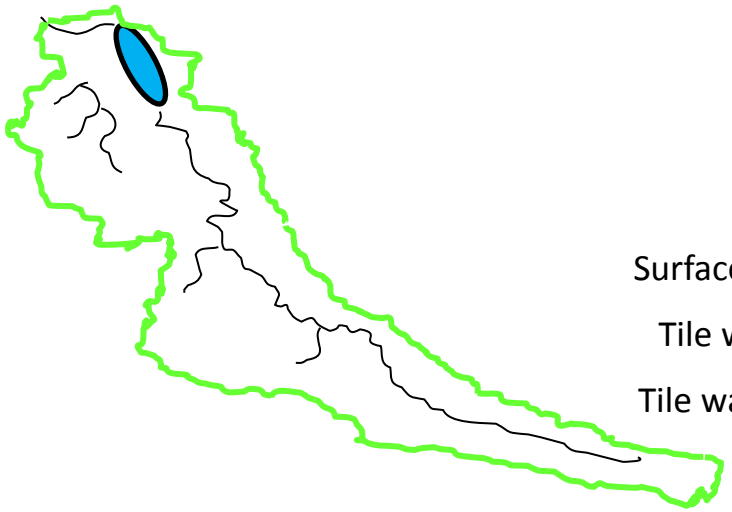


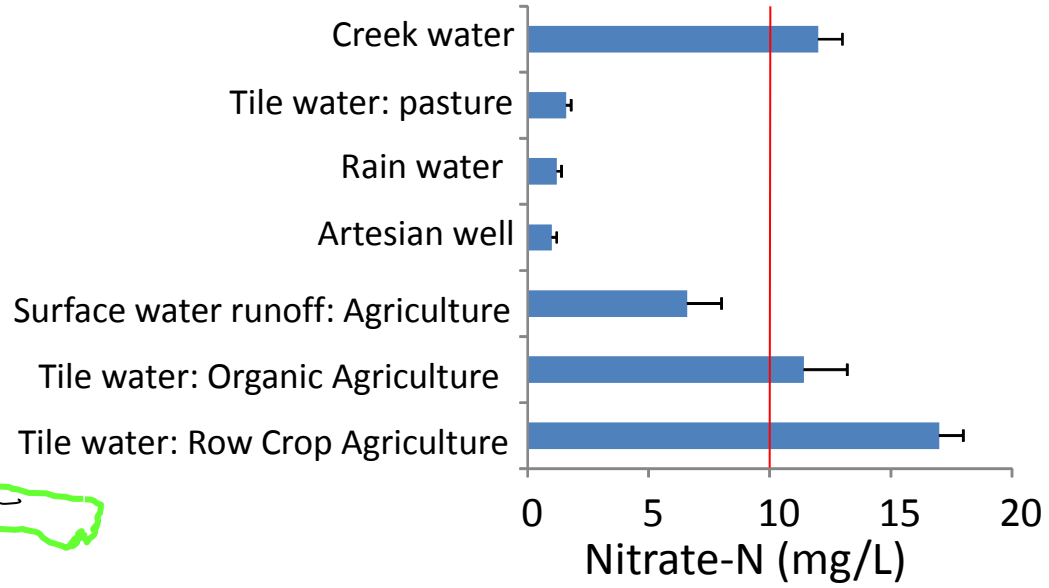
Lake Evergreen
Lake Bloomington
USGS gaging stations





EPA Drinking Water Standard

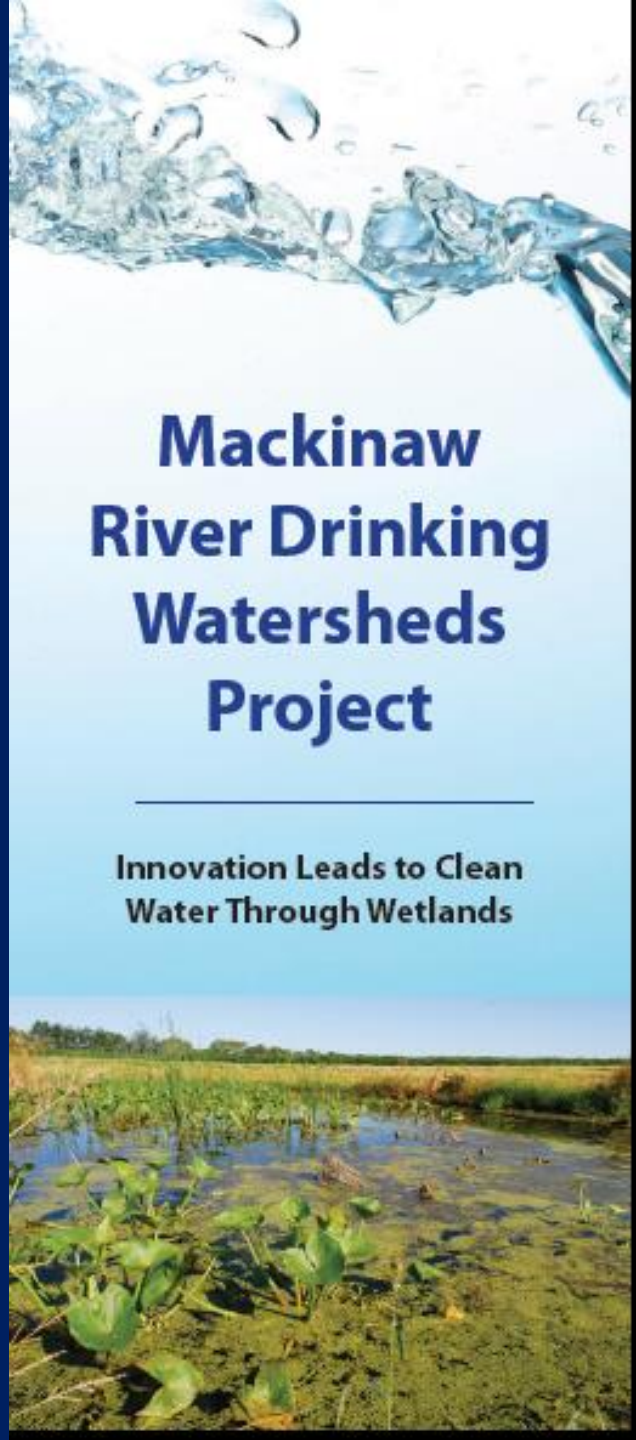




Smiciklas et al., 2008

Long-term goals:

- To reduce nitrate loading to Lake Bloomington, the source of water for 80,000 people and Bloomington and Normal, IL.
- To construct tile-drainage treatment wetlands and nutrient management practices at scale throughout the Lake Bloomington watershed.
- A proof of concept study that proposes a more sustainable approach to agricultural runoff than solely an engineering solution.



Conservation Practices

Conservation Reserve Program (CRP):

Farmable Wetlands Program (CP39)

- 50% cost-share
- 40% practice incentive payment
- $100/acre signing incentive payment
- CRP annual soil rental payments + 20%

Farmer Network

- Nitrogen field trials on corn (rate and timing)
- Corn stalk and soil nitrogen testing
- Aerial imagery to determine nitrogen uptake
- Nitrogen management plan

USDA-NRCS Conservation Innovation Grant : 2012-2016

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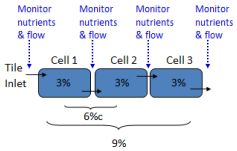
Farmer Network

- Results: Farmers are not over applying nitrogen
- Next step: Increase spring application of nitrogen
  - Agricultural Advisory Group (AAG)
  - IEPA 319 proposal and IL Nutrient Research and Education Council (NREC)

USDA-NRCS Conservation Innovation Grant : 2012-2016



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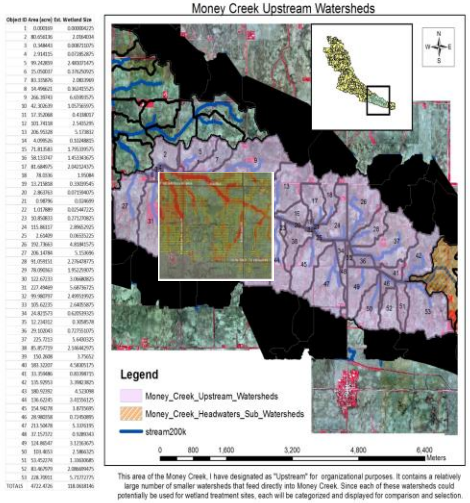

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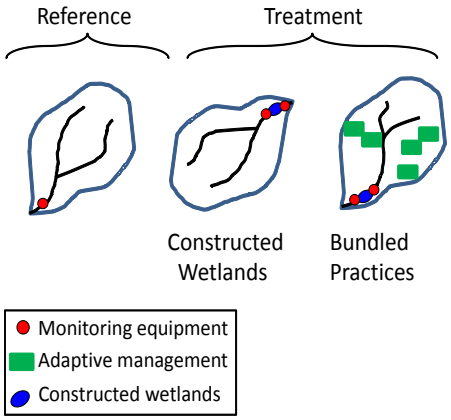
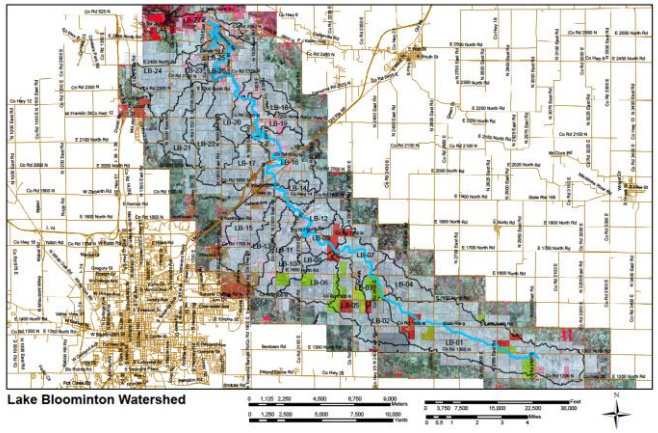


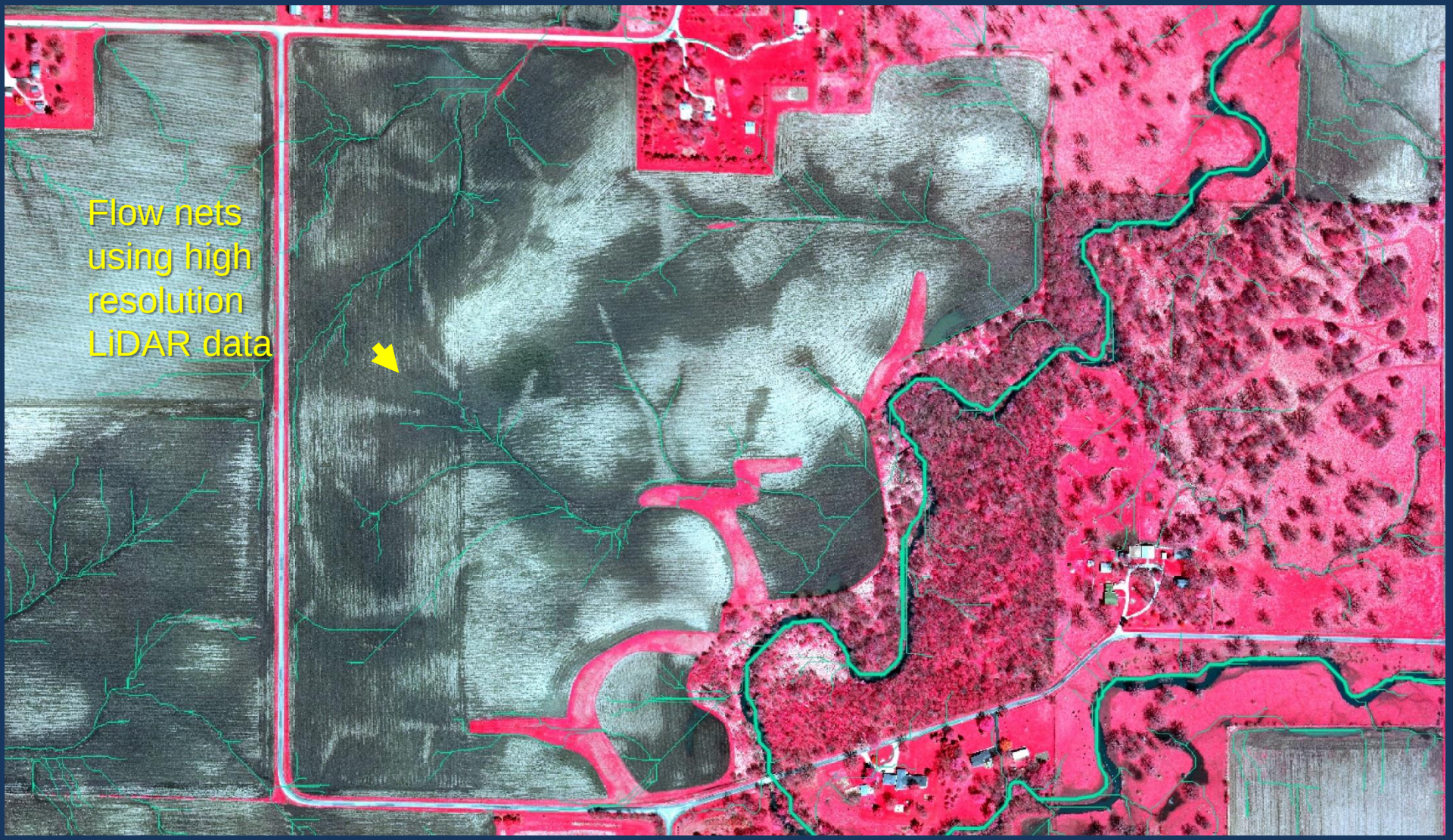
x 3 +



How many wetland acres are needed? (i.e., how much tile is in the watershed?)

What kind of watershed reductions can be expected?

How many wetland acres are possible?


Flow nets
using high
resolution
LiDAR data

Miran Day
(Cal Poly)

Dr. David Kovacic
(University of Illinois)

Watershed Mapping: i.e., Where are the tiles?

Miran Day
(Cal Poly)

Dr. David Kovacic
(University of Illinois)

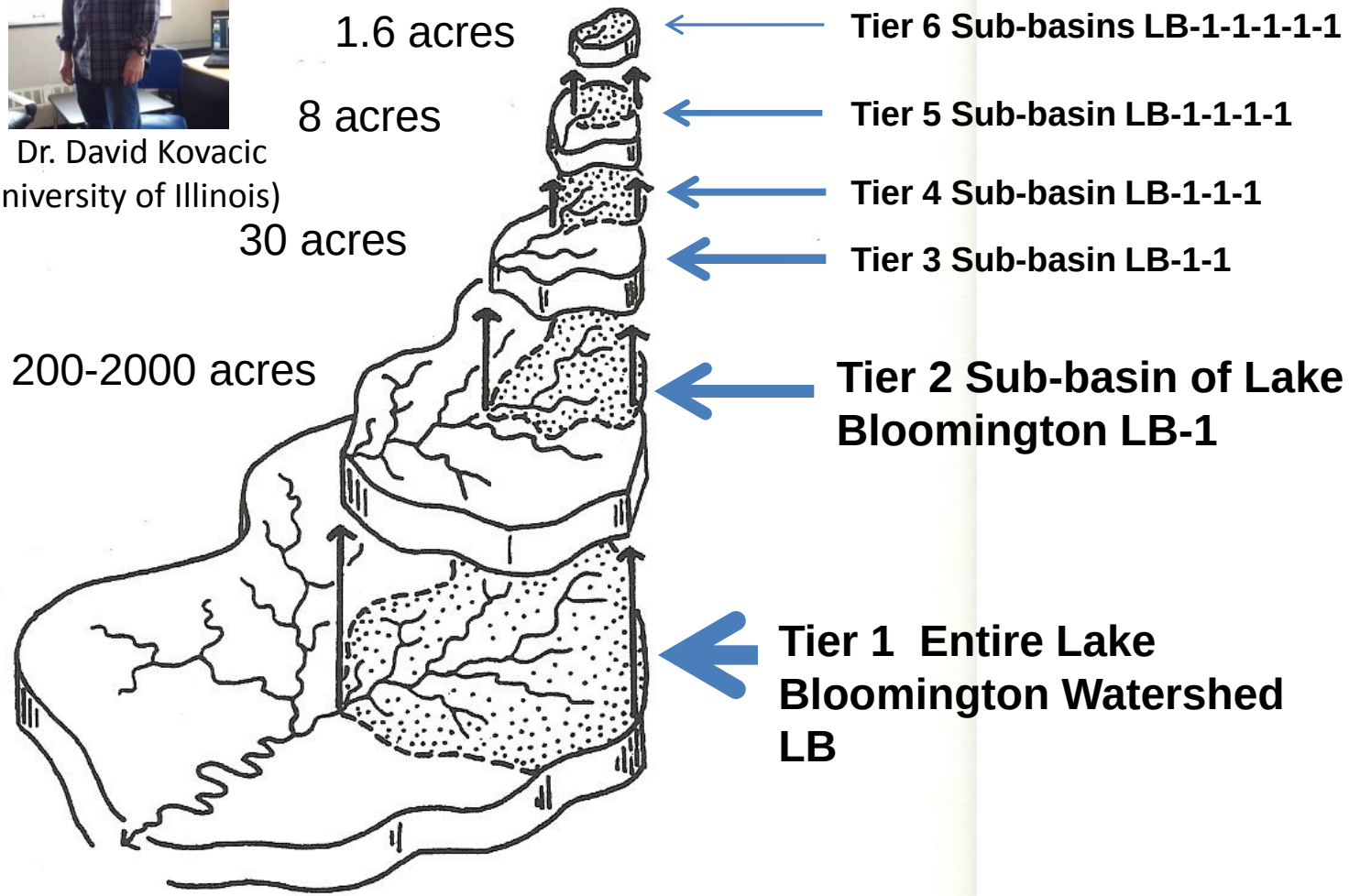
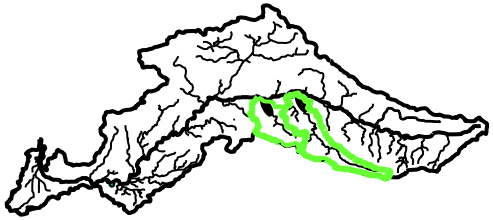
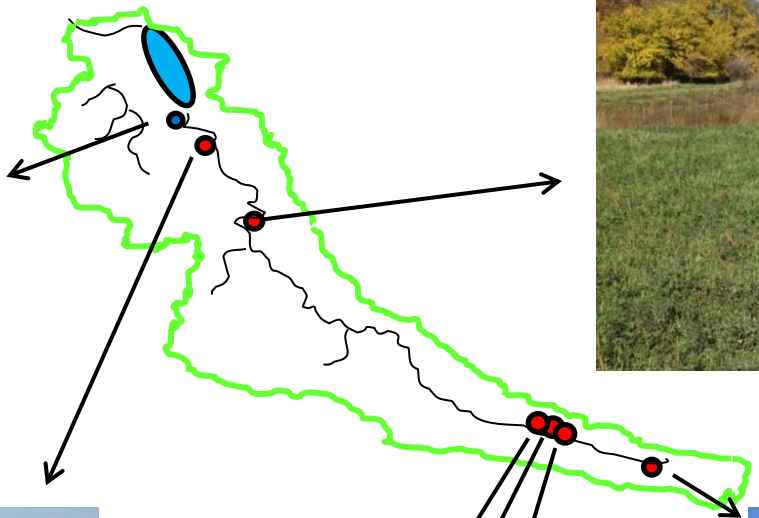


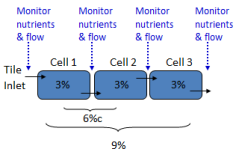
Fig. 9.2 Illustration of the nested hierarchy of lower-order basins within a large drainage basin.

Money Creek watershed

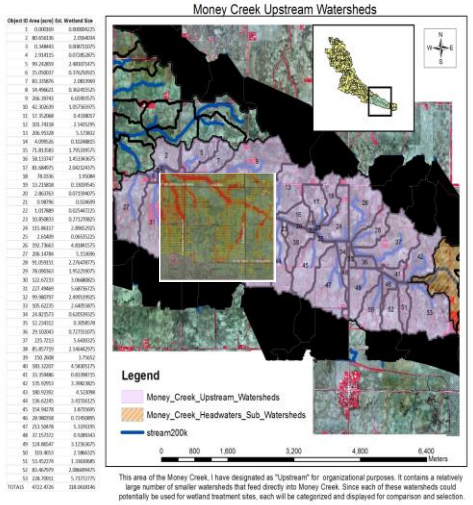




USDA-NRCS Conservation Innovation Grant : 2012-2015



How well does a wetland perform?



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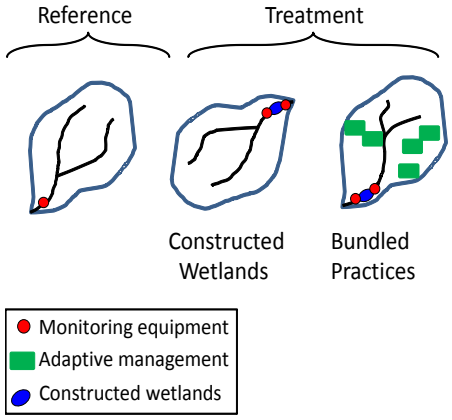
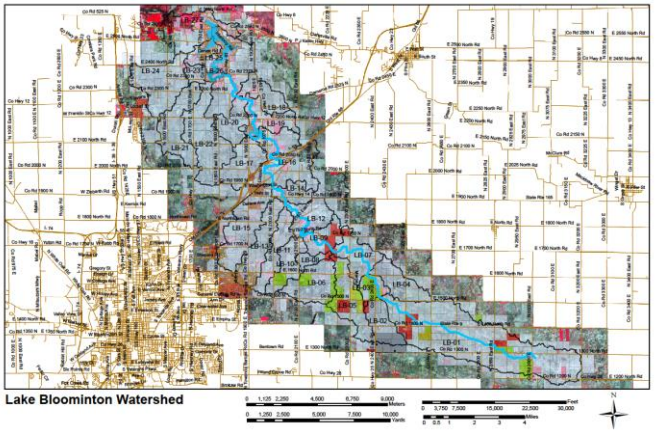


X 3 +



How many wetland acres are needed?

What kind of watershed reductions can be expected

How many wetland acres are possible?

Economic analyses and financial models

+

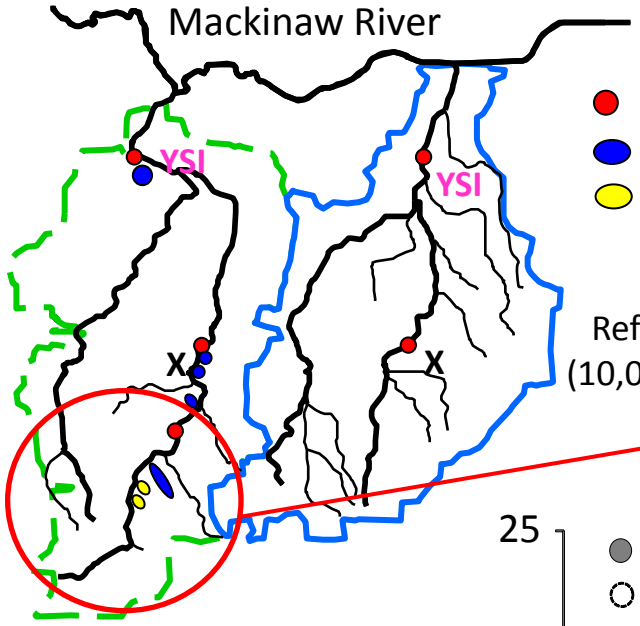
Landowner and funding commitment

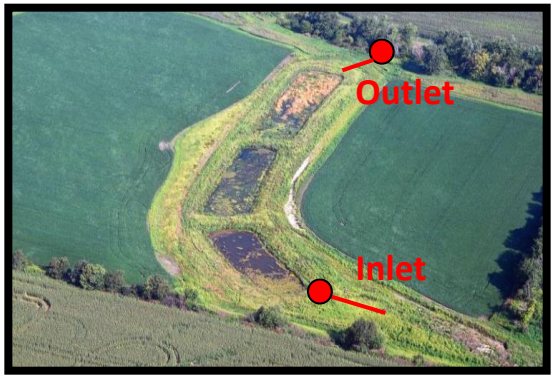
- **Watershed conservation blueprint for the City of Bloomington**
- **Applicability beyond the Mackinaw River for sustainable conservation and agricultural production**

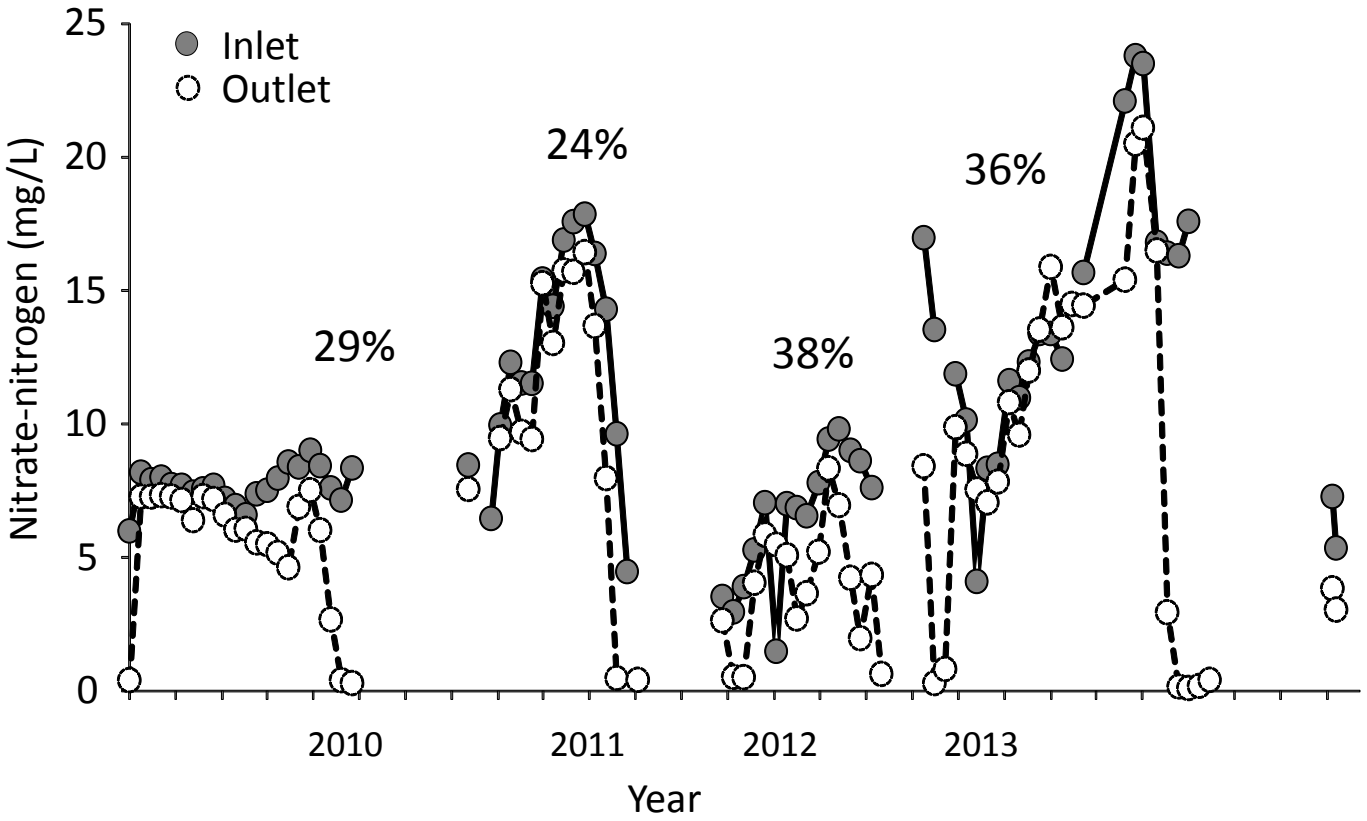
Collaborators, Partners and Funding Sources:

Natural Resources and Conservation Service (NRCS)
Soil and Water Conservation District (SWCD)
University of Illinois at Champaign-Urbana (UIUC)
Environmental Defense Fund (EDF)/Walton Family Foundation
City of Bloomington, Illinois
World Wildlife Foundation
Private landowners and producers
Illinois State University (ISU)
Monsanto
DuPont -Pioneer
Lumpkin Family Foundation
Illinois State Water Survey (ISWS)
AGREM LLC
Illinois Department of Natural Resources (IDNR)
Southern Illinois University (SIU)
Ducks Unlimited (DU)
Illinois Natural History Survey (INHS)
Illinois State Geological Survey (ISGS)
Illinois Environmental Protection Agency (IEPA)
United States Environmental Protection Agency (USEPA)
United States Department of Agriculture (USDA)
Kellogg Foundation; Mackinaw River Partnership

Questions?


Mackinaw River
YSI
YSI
X
X
Long term monitoring
Current wetlands
New wetlands
Reference
(10,000 acres)
Treatment
(10,000 acres)
1000 tile-drained acres


Outlet
Inlet


Inlet
Outlet
Nitrate-nitrogen (mg/L)
25
20
15
10
5
0
29%
24%
38%
36%
2010
2011
2012
2013
Year