The Indian Creek Watershed: Assessment and Opportunities

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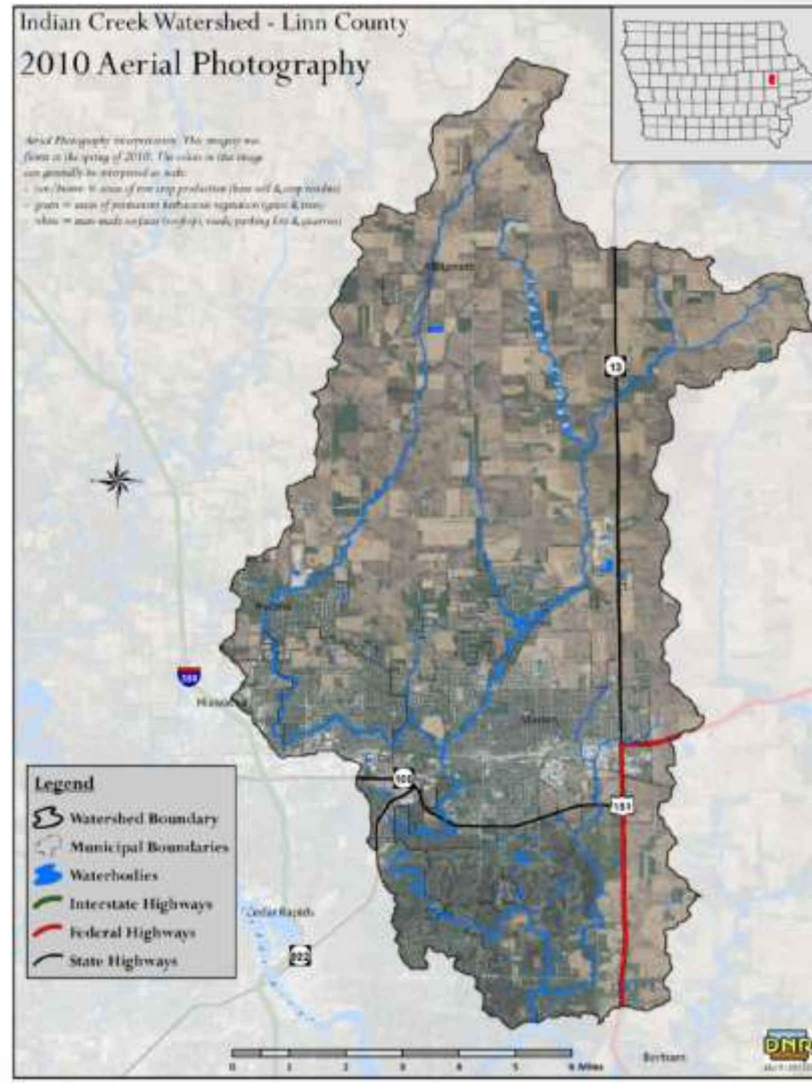
Iowa's Living Landscapes: Challenges and Opportunities

May 2, 2017

Indian Creek

- Coe Water Quality Lab
- Indian Creek Assessment
  - Long term study
  - Intensive study during 2013-14
  - Focused on N, P, sediments, bacteria
- Opportunities
  - Agriculture
  - Urban



Coe Water Quality Lab

- Began with volunteer water monitoring combined with good instrumentation (2000)
- Collaboration with city of Cedar Rapids, IDNR, IGS, WMAs, watershed groups, university researchers
  - Particular thanks to city of CR, IDNR, and ICWMA
- Funding from NSF, DOE, foundations for instrumentation
- Training for >60 undergraduates

Indian Creek

- Studied since 2002
- Carried out chemical and physical assessment for ICWMA in 2013
    - Longer sampling period, more frequent sampling, more sampling sites
- Mix of rural and urban landuse
    - From 1992 to 2013, went from 63% to 52% row crop; 16% to 29% urban/developed
- Focus on nutrients, sediment, and *E. coli*
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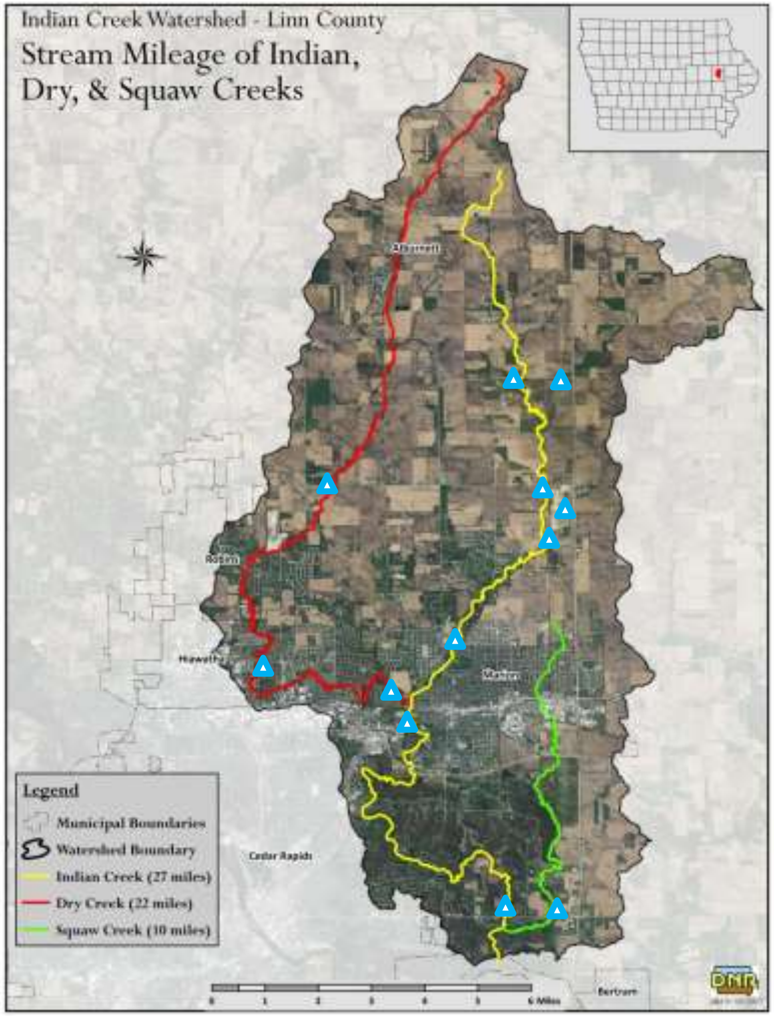
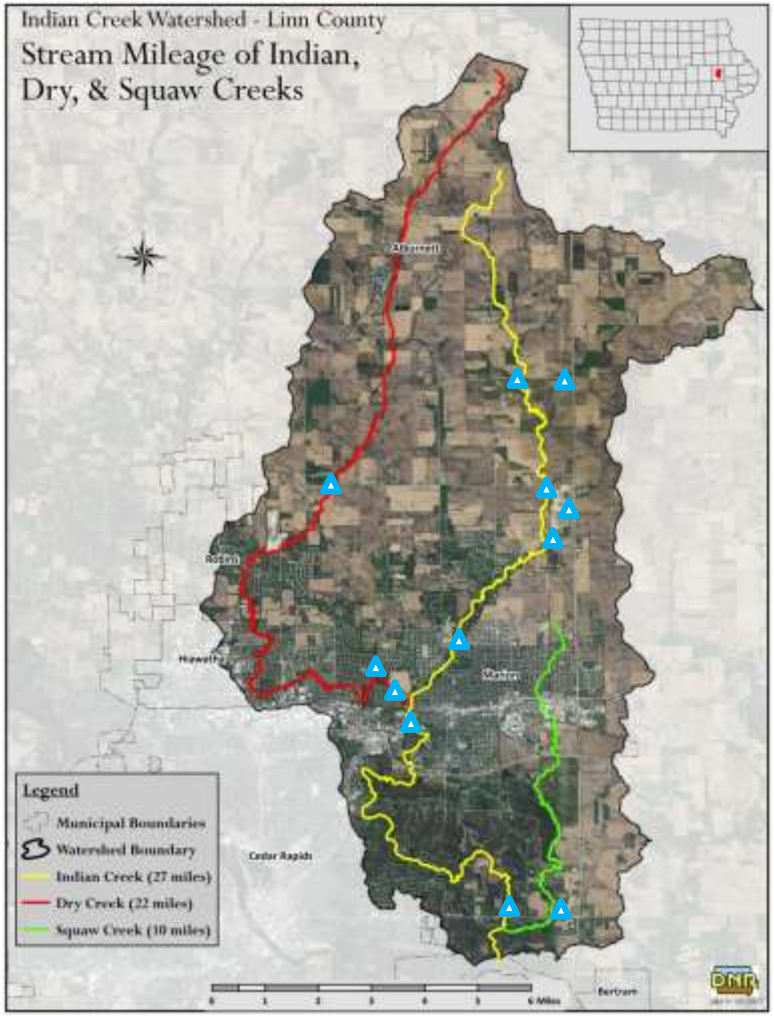


Land use

- Rural vs. urban

Site	Row crop	Grasslands	Forest	Artificial
ICLM	70.1%	20.0%	2.1%	5.1%
Dry Creek	78.4%	12.5%	1.8%	3.3%
IC Thomas	64.0%	19.0%	3.9%	9.8%
ICS (MV Rd.)	55.5%	19.1%	10.1%	11.8%



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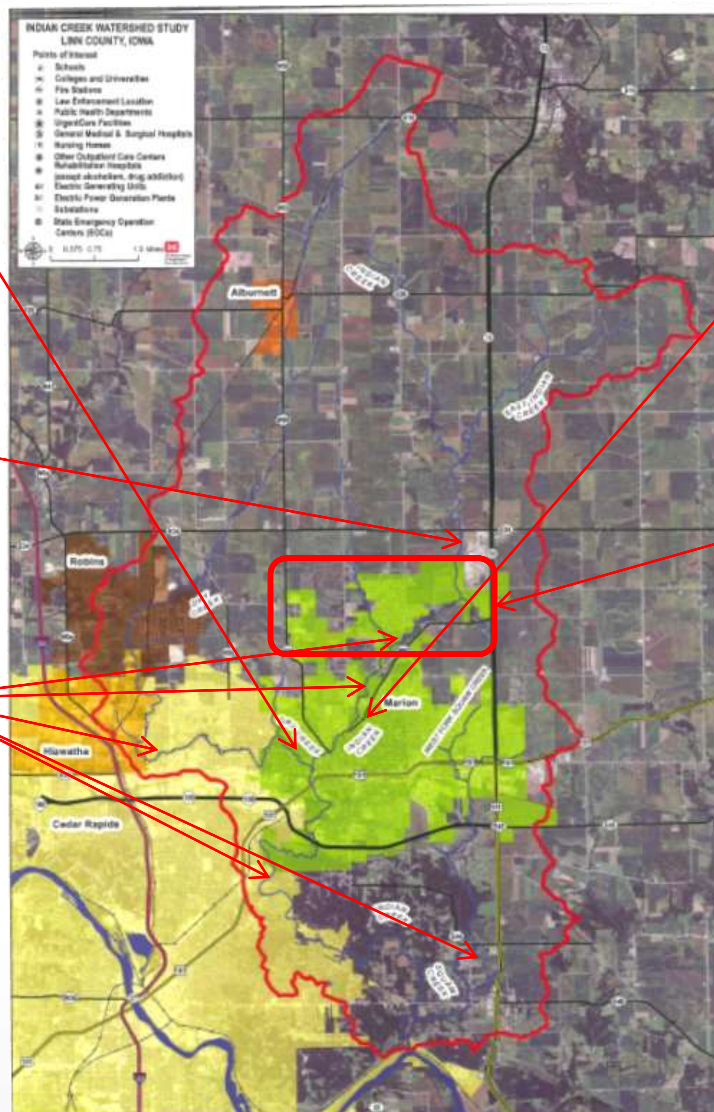
Indian Creek watershed

78.4% row crop on Dry Creek ('02)

Cedar Rapids/Linn County Solid Waste Agency Landfill

5 golf courses in watershed



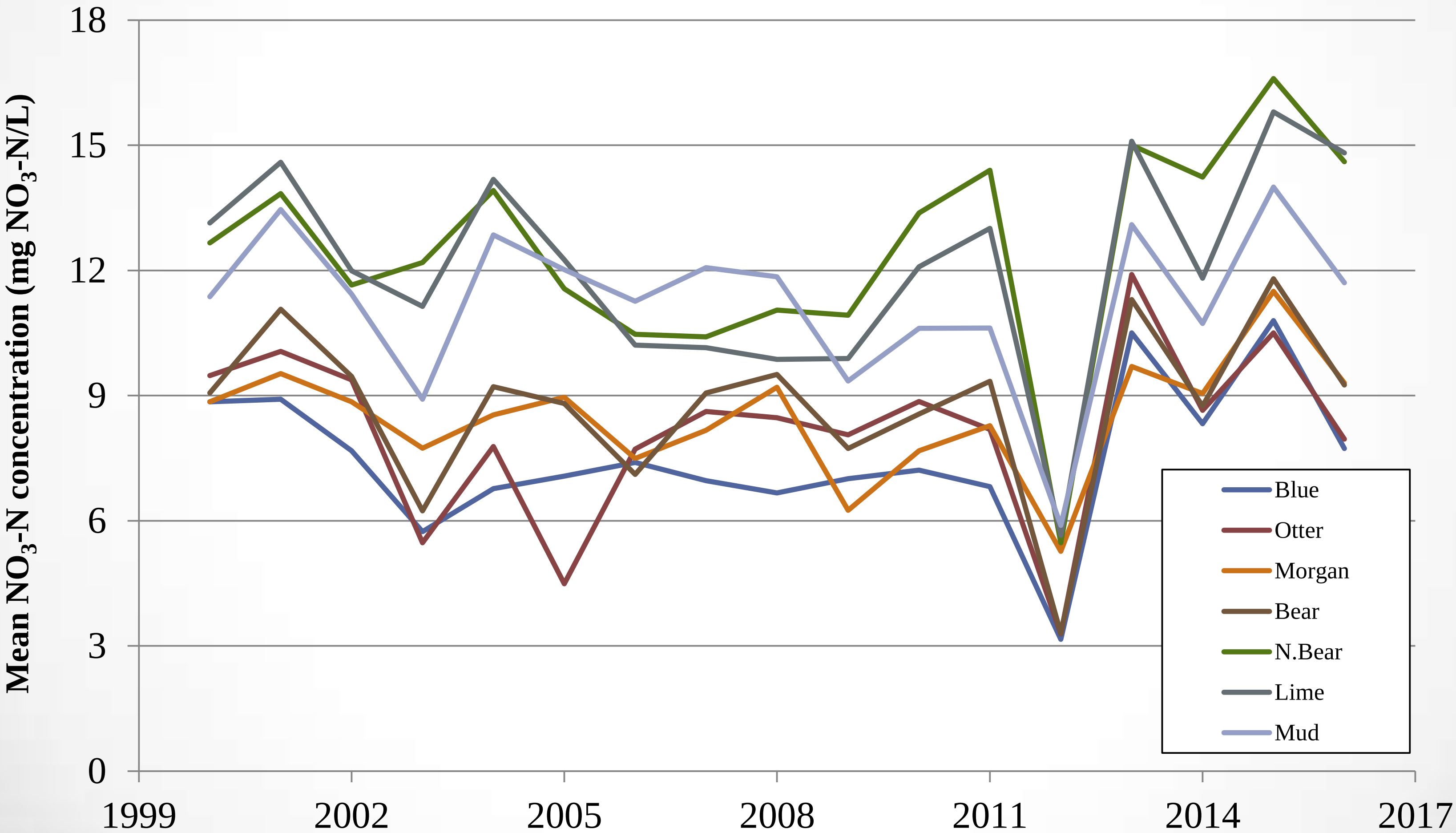
70.1% row crop above Linn-Mar ('02)

Rapid suburban development

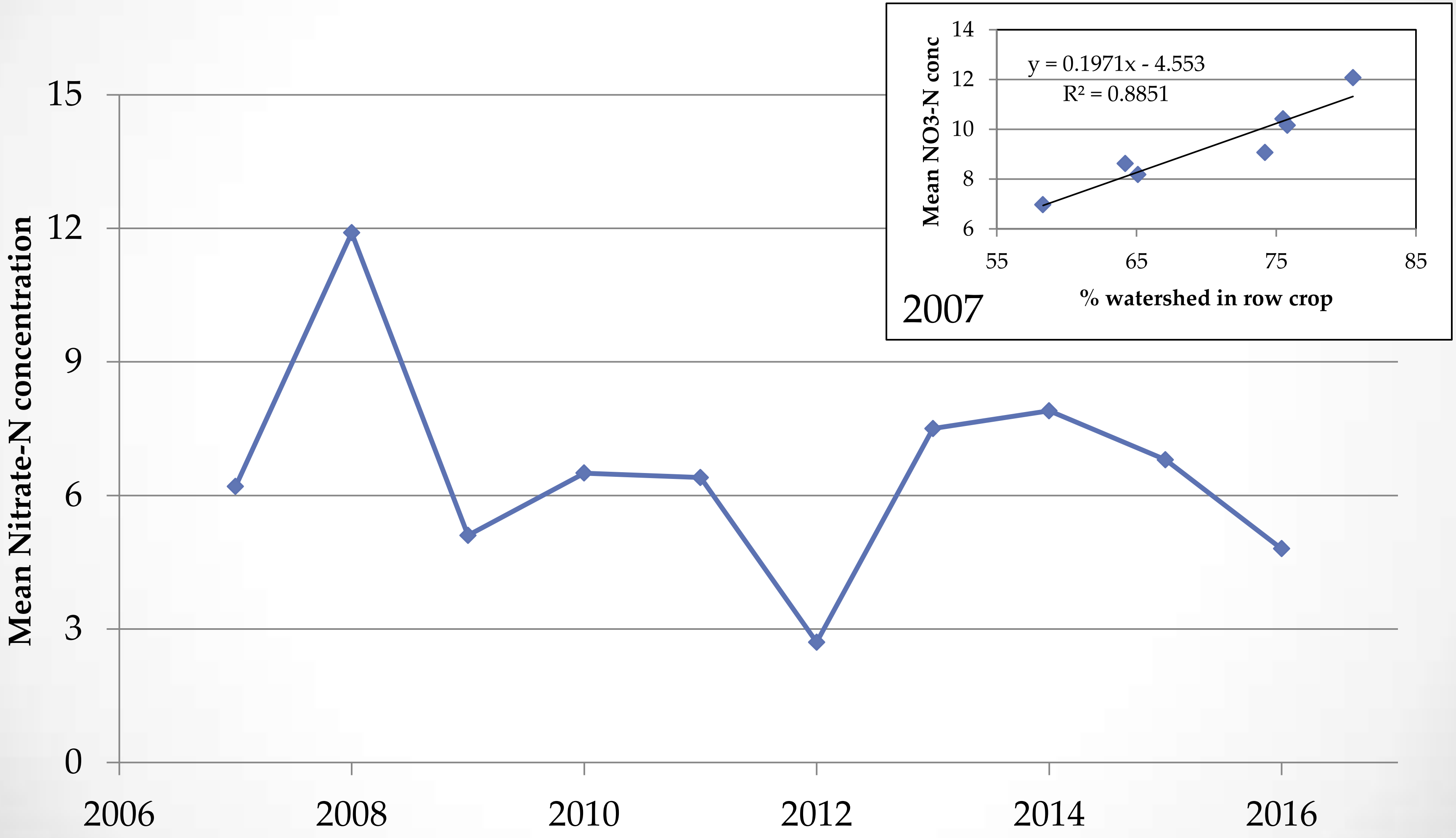
Nitrate – how much is too much?

- Drinking water standard: 10 mg NO_3^-- N/liter
- Standard for aquatic life?
  - What levels result in negative impacts on aquatic community?
    - Usually looking at excessive algal growth
  - EPA (2000): For ecoregion 47 (Western Corn Belt Plains), TN is given at 2.615 mg/L, with NO_2 + NO_3 at 1.965 mg/L
  - Minnesota (draft 2014 nitrate): < 4.9 mg/L "good"; >4.9 mg/L "poor"

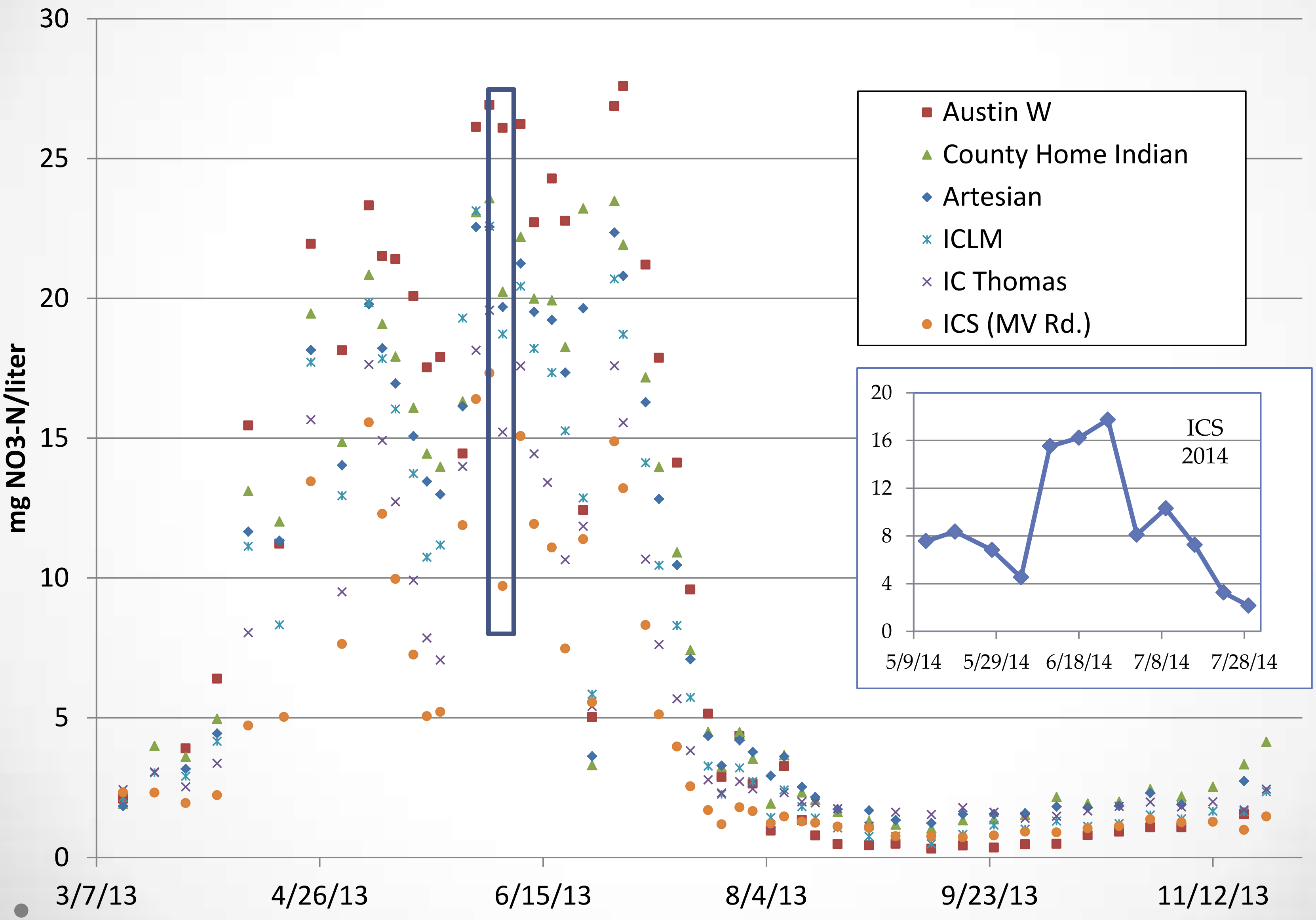
Nitrate trends



Nitrate trends – Indian Creek



Nitrate – main stem of Indian Creek



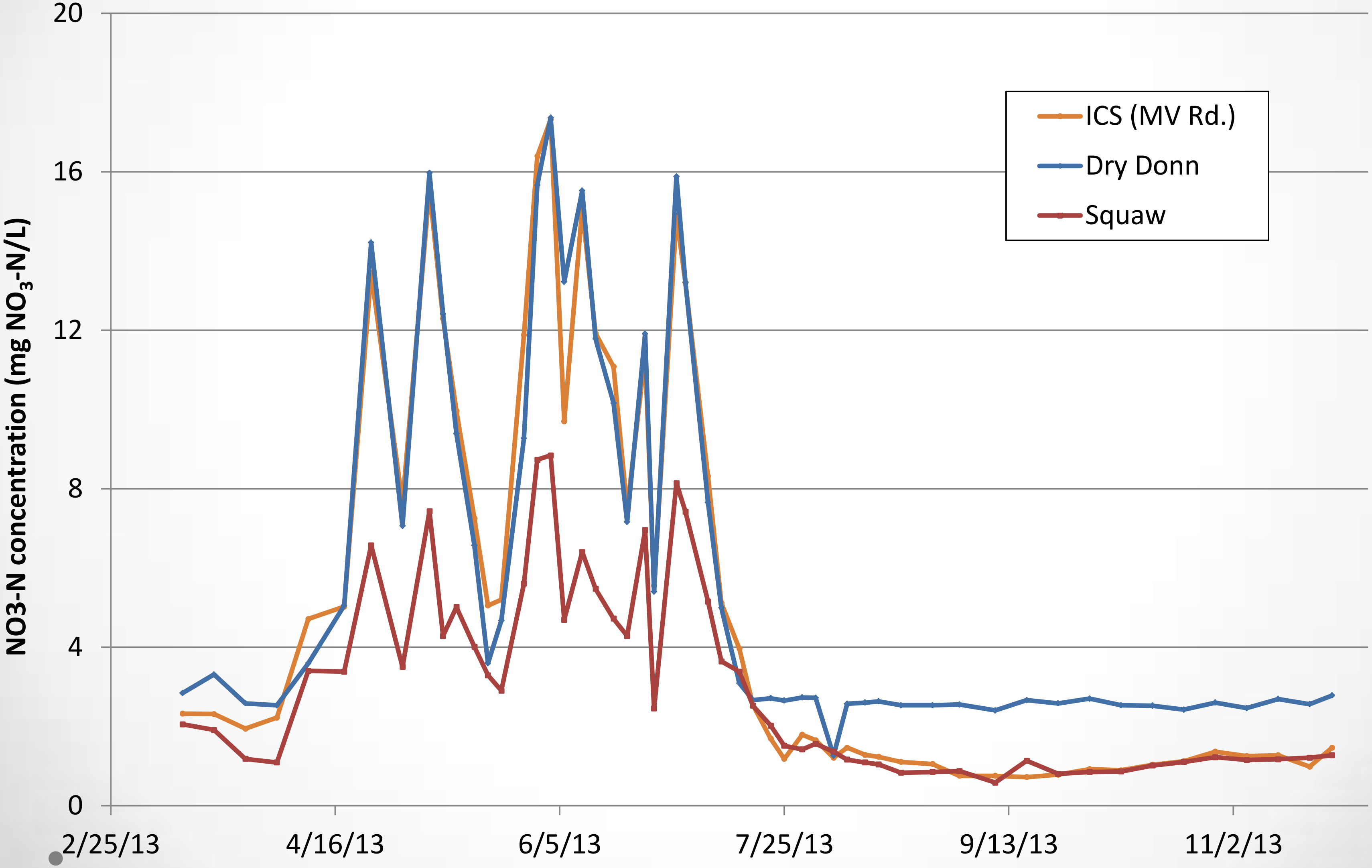
Indian Creek nitrate over time

	2004	2005	2006	2007	2008	2009
ICLM	8.6	4.6	12.0	10.5	12.0	7.4
IC Thomas	6.7	4.0	9.7	8.2	8.4	5.9
Dry Donn	2.6	3.2	5.4	5.3	6.5	NA
ICS	5.8	2.5	7.6	6.2	7.7	4.9

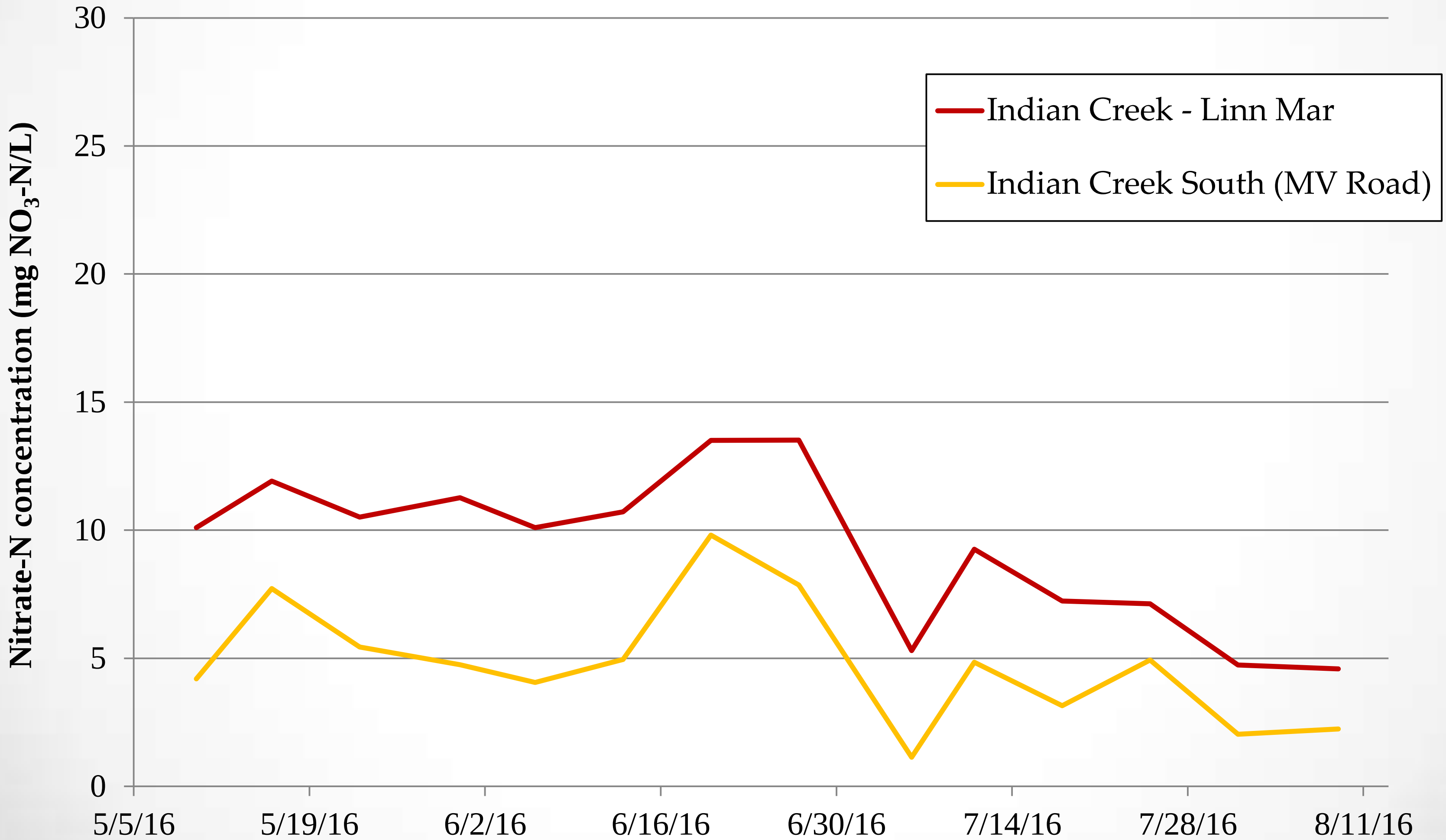
	2010	2011	2012	2013	2014	2015	2016
ICLM	9.0	9.3	3.9	12.0	12.9	10.6	9.3
IC Thomas	7.3	7.0	3.5	9.6	10.3	8.3	6.9
Dry Donn	5.8	5.9	2.9	7.9	7.6	7.9	4.6
ICS	6.0	5.9	2.7	7.8	8.4	6.8	4.8

May – August averages of NO_3-N (mg/L)

Nitrate by sub-watershed



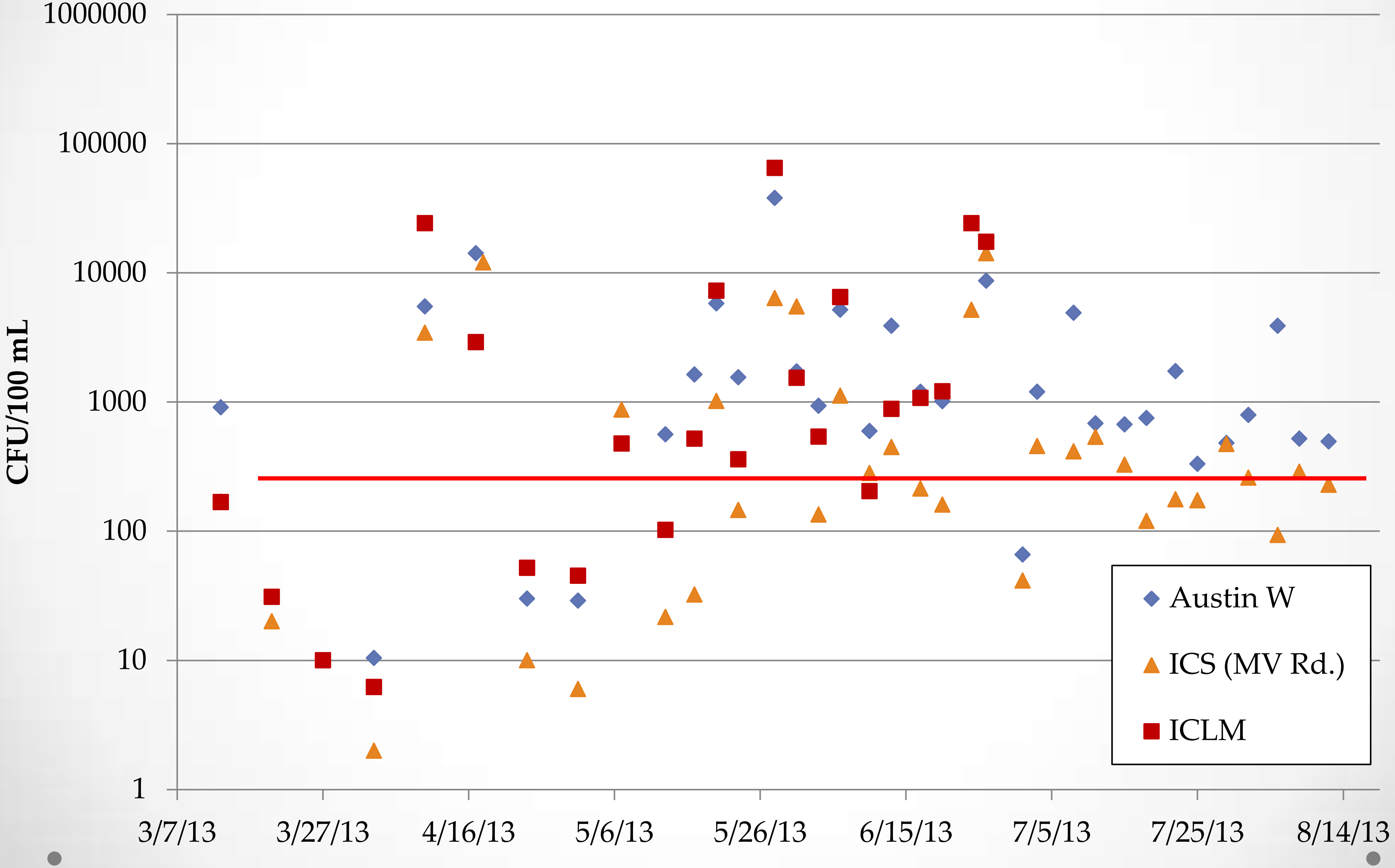
Indian Creek – Nitrate 2016



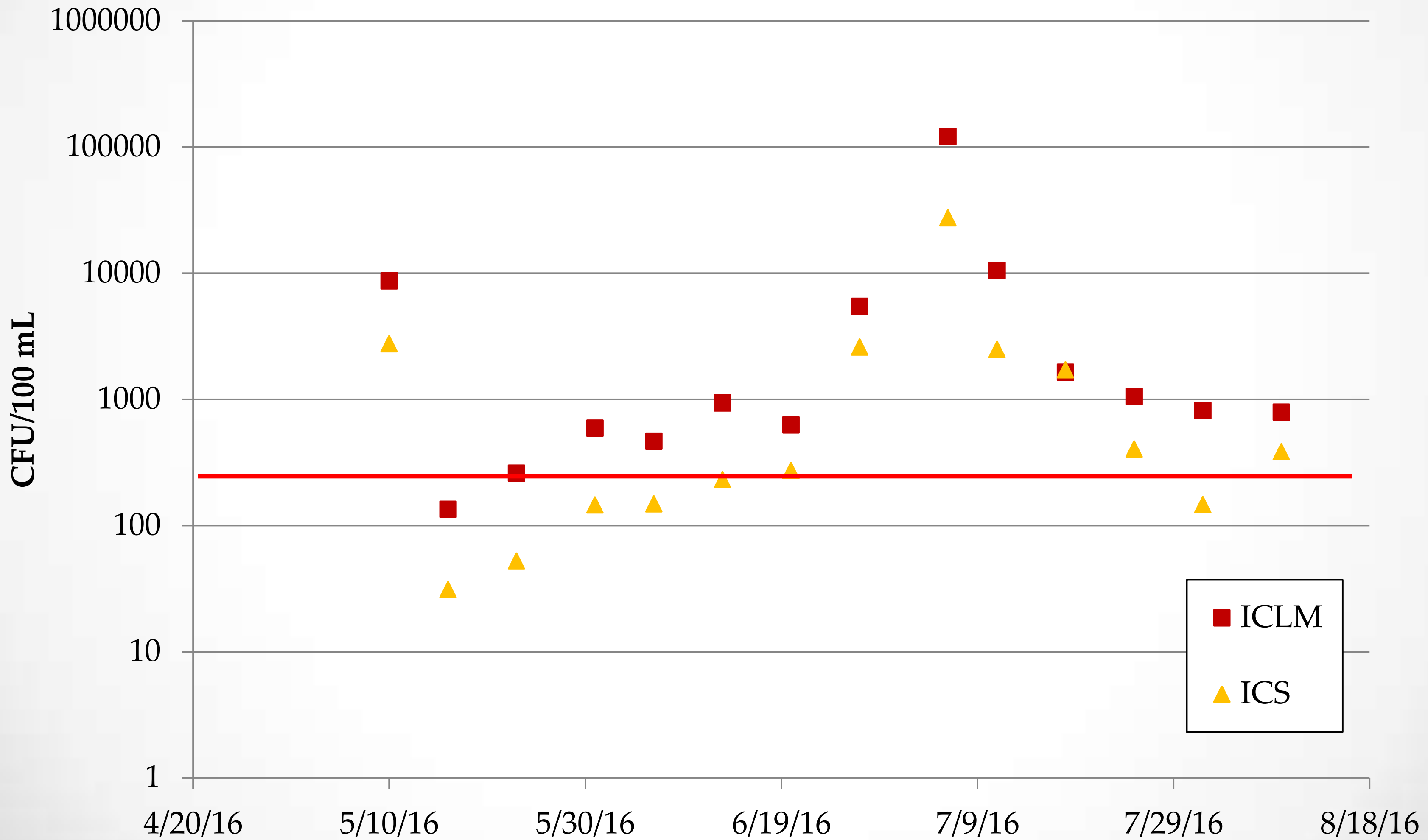
E. coli

- *Escherichia coli* - indicator organism
  - Found in intestinal tract of mammals
  - May not be pathogenic, but indicates the possible presence of organisms which are disease-causing
- Possible sources
  - Wildlife
  - Pet waste
  - Livestock waste
  - Human waste
    - Septic systems
- Standard?
  - For children's recreation – 235 cfu/100 mL

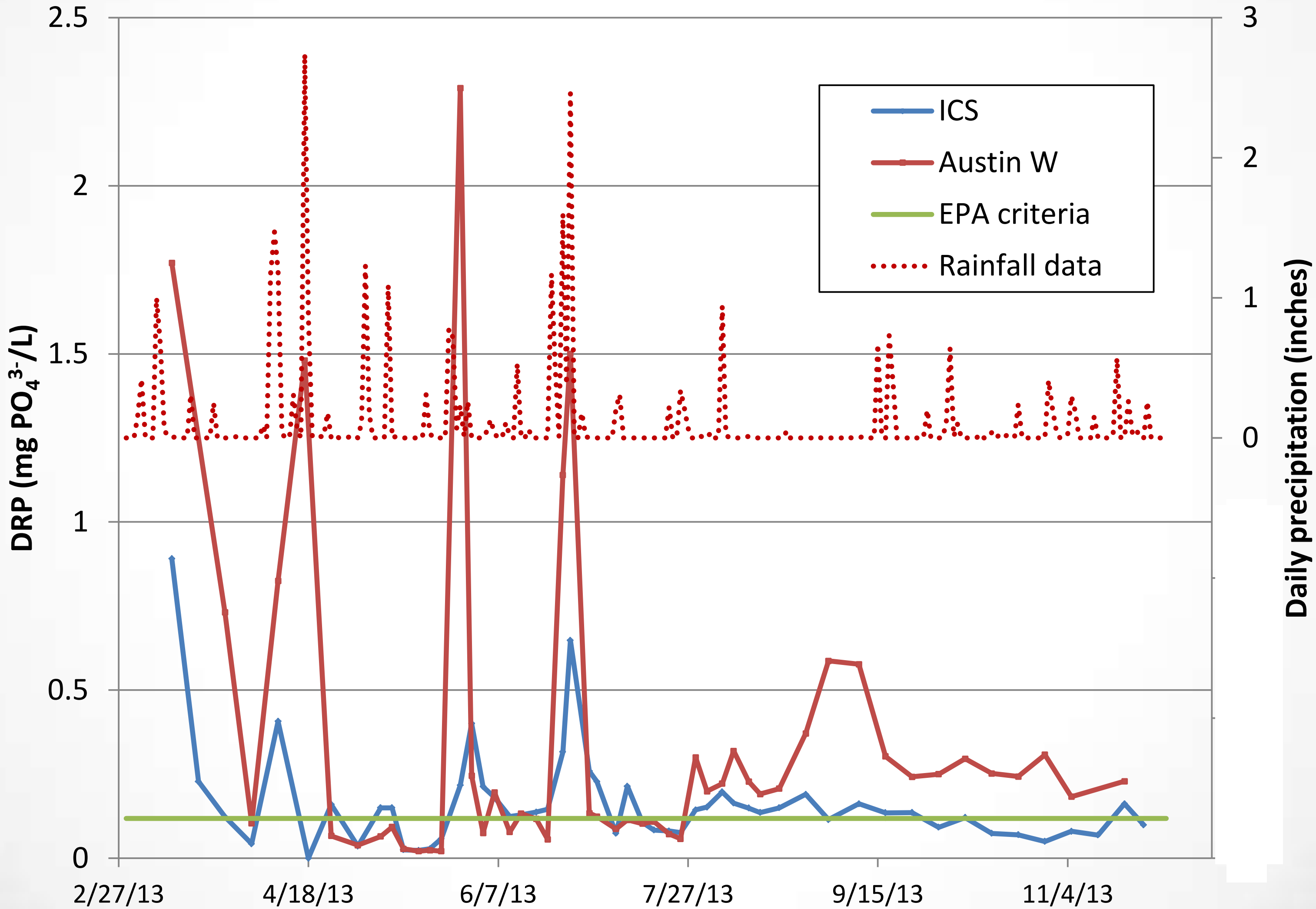
Indian Creek – *E. coli* 2013



Indian Creek – *E. coli* 2016

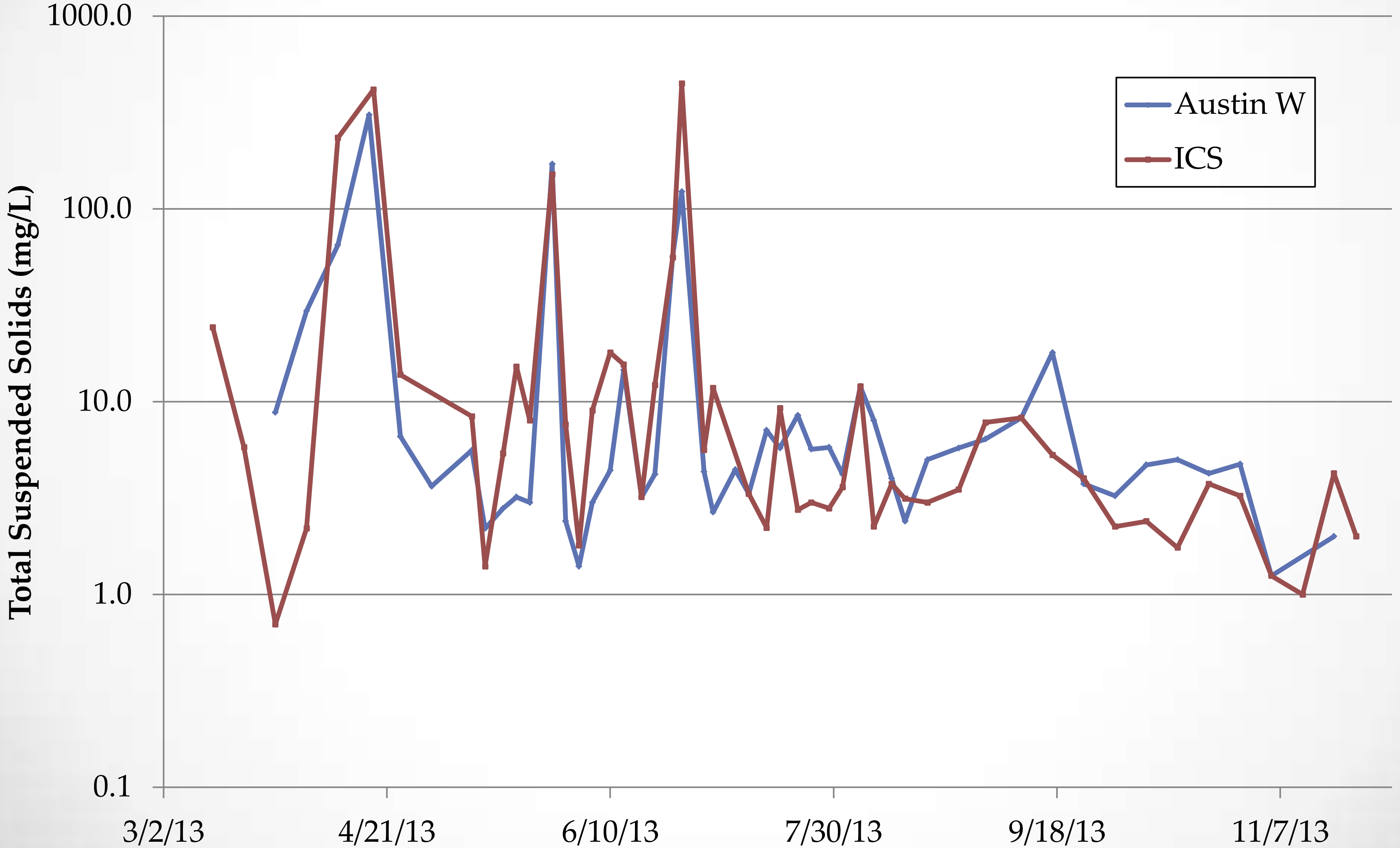


Phosphorus

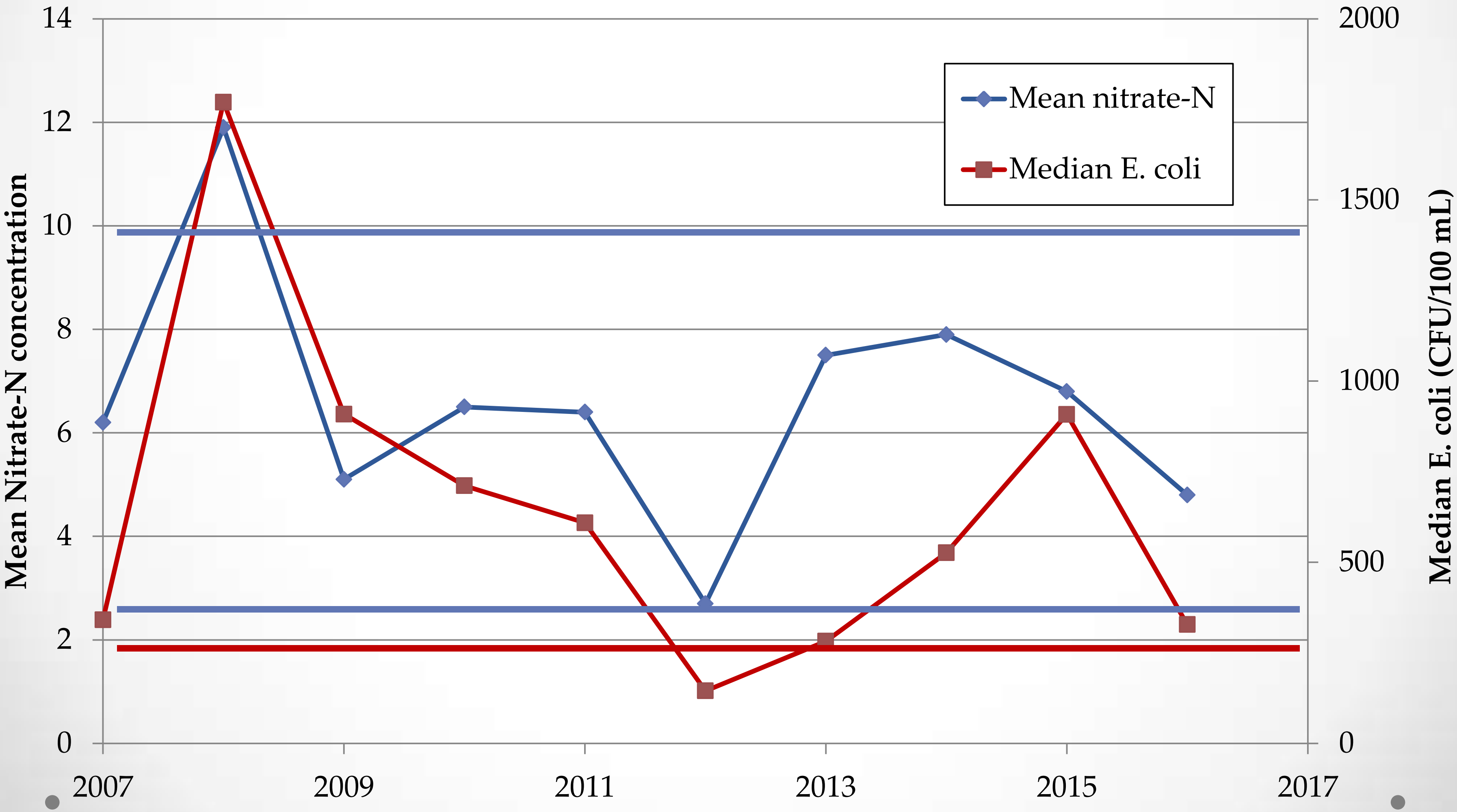


2.5
2
1.5
1
0.5
0
DRP (mg PO4 3-/L)
3
2
1
0
Daily precipitation (inches)
2/27/13
4/18/13
6/7/13
7/27/13
9/15/13
11/4/13
ICS
Austin W
EPA criteria
Rainfall data

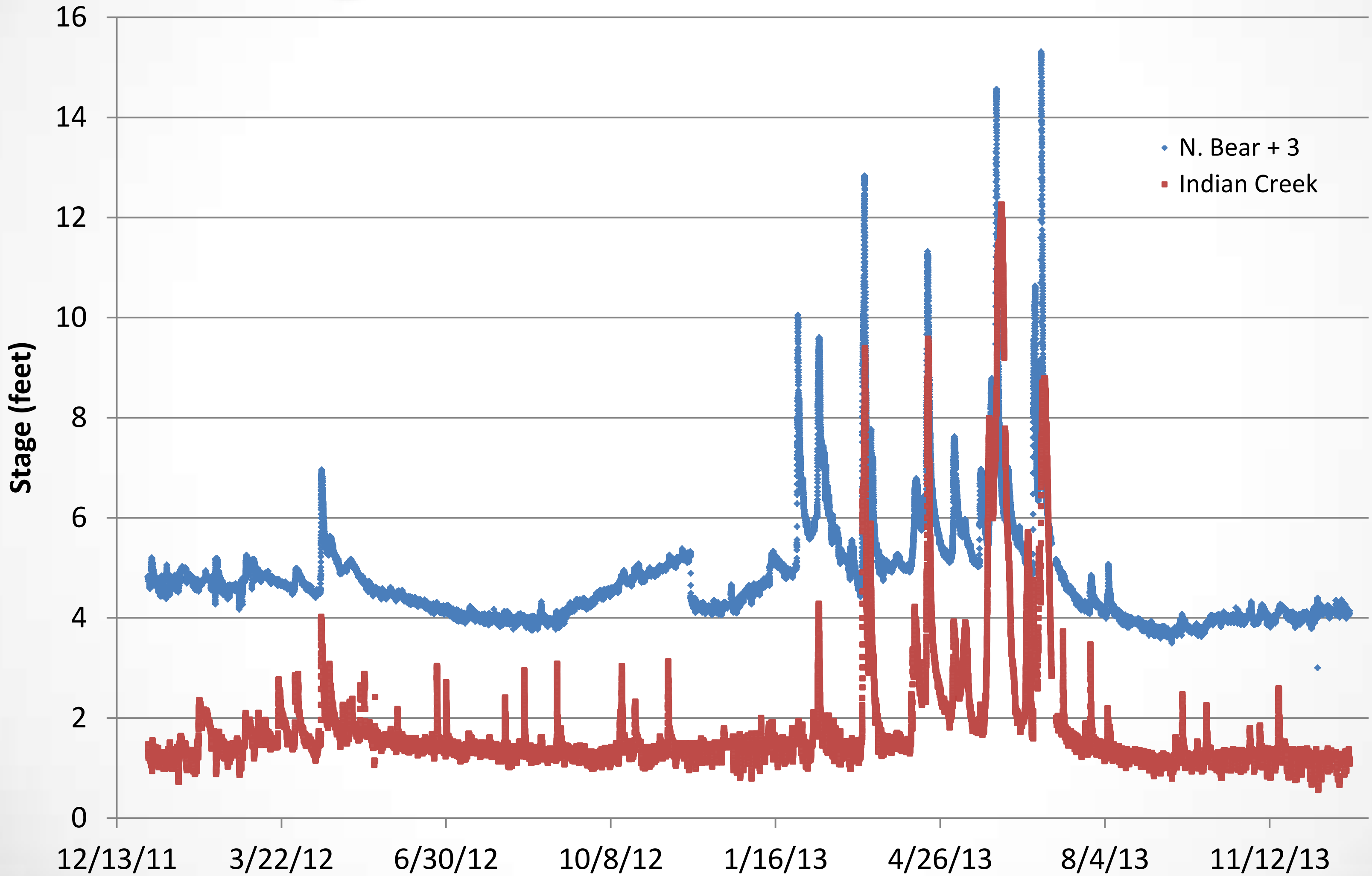
Total Suspended Solids



Indian Creek trends

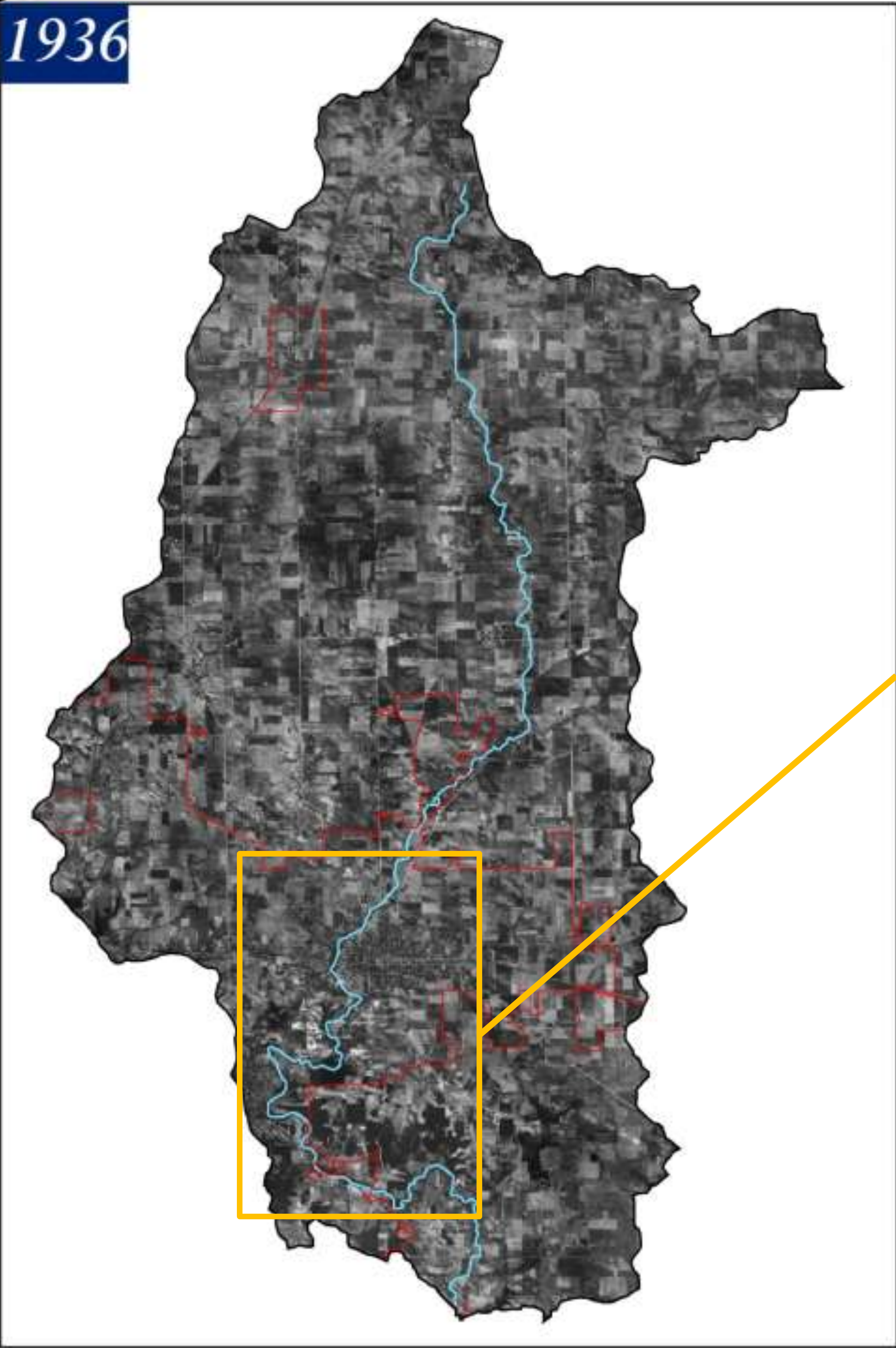


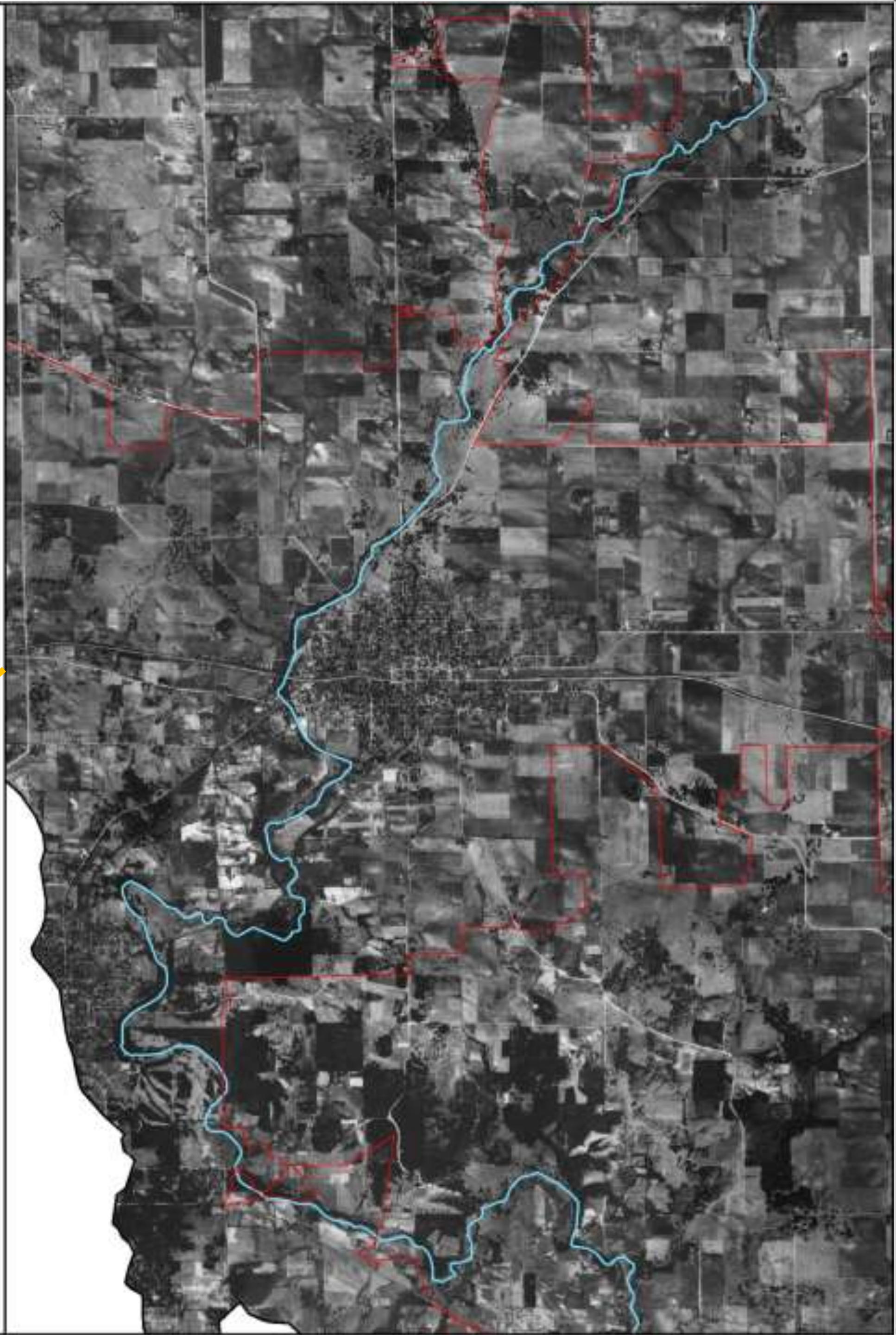
Stage measurements

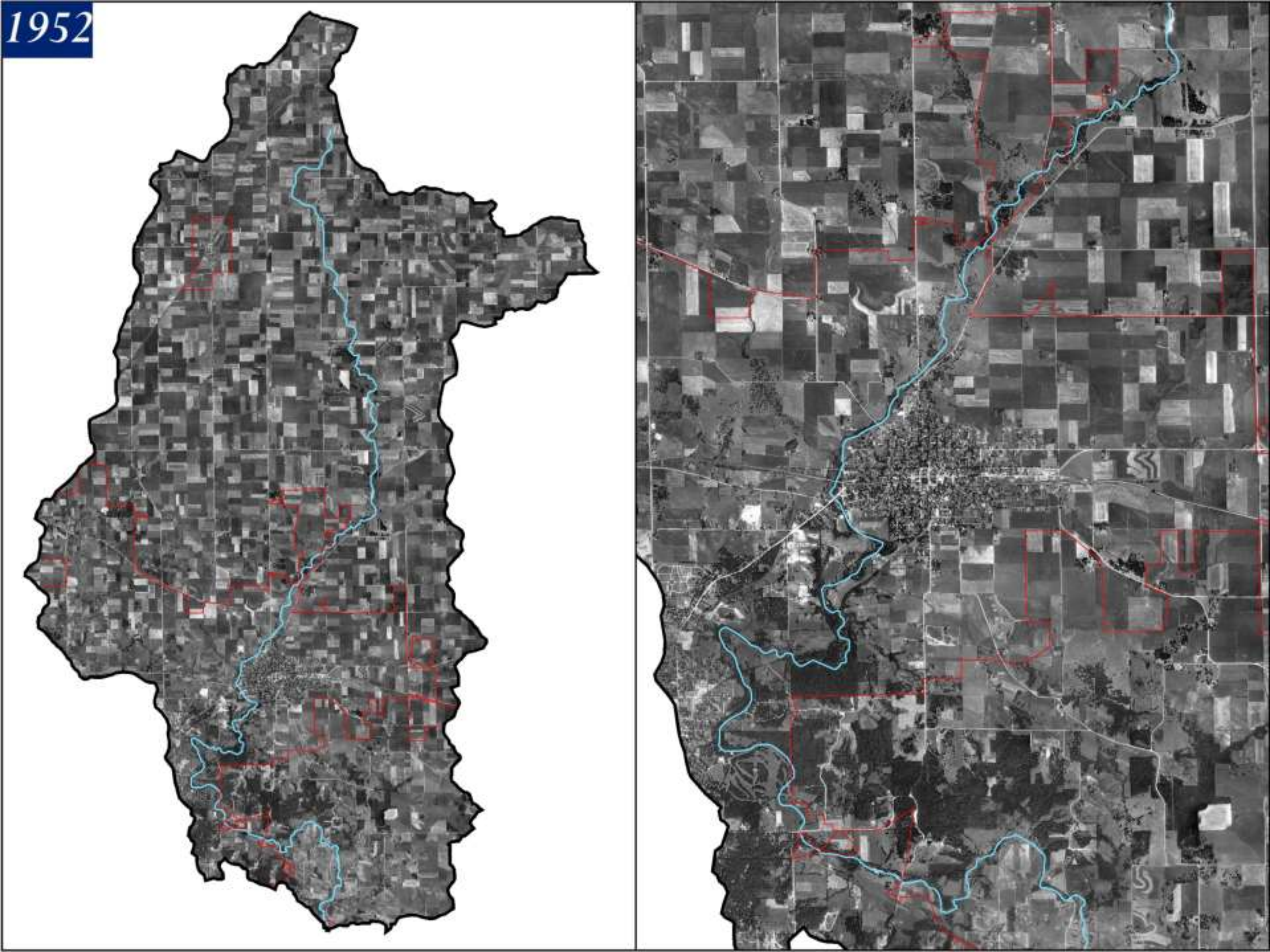


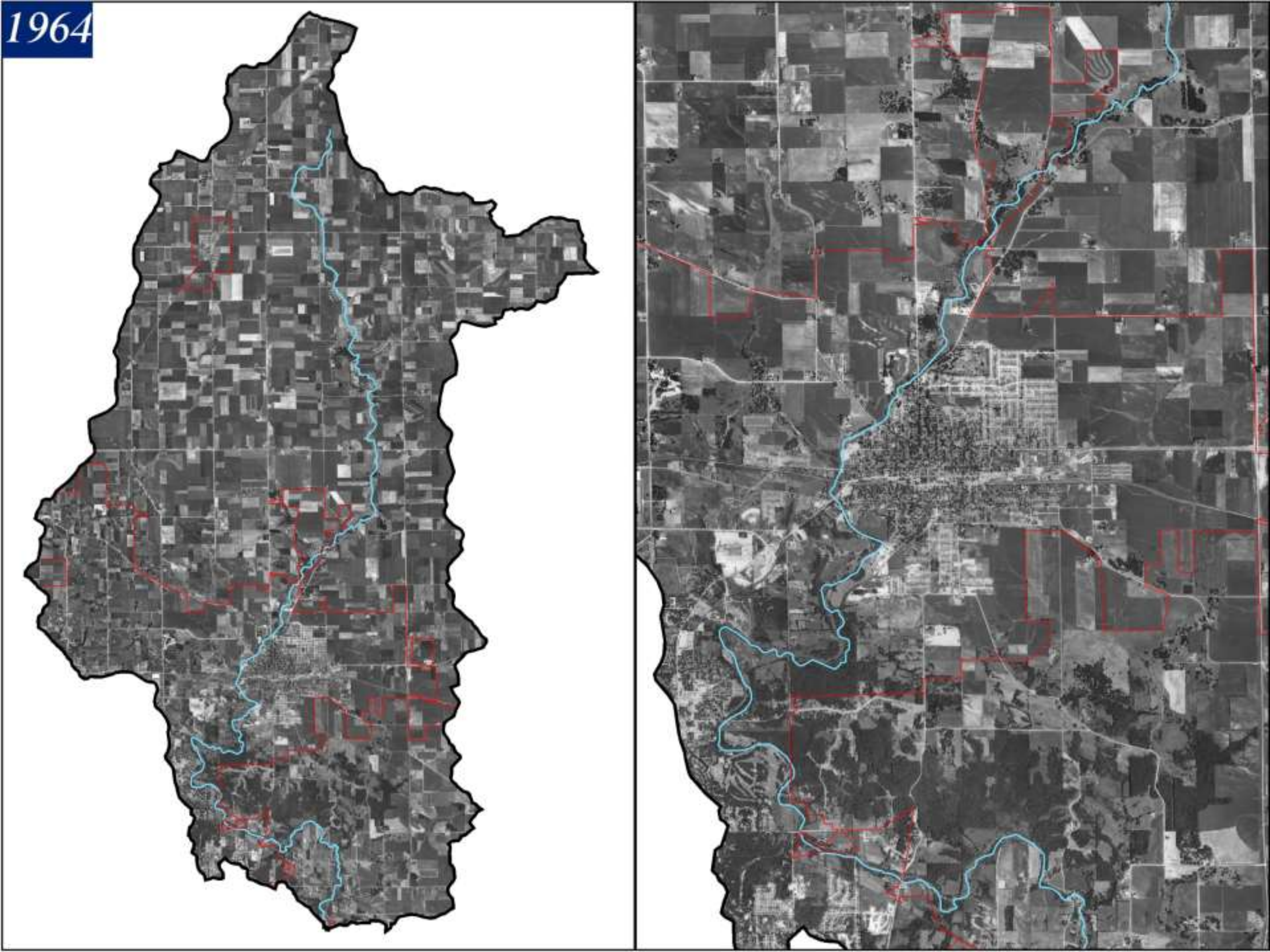
Data from IFIS

1936

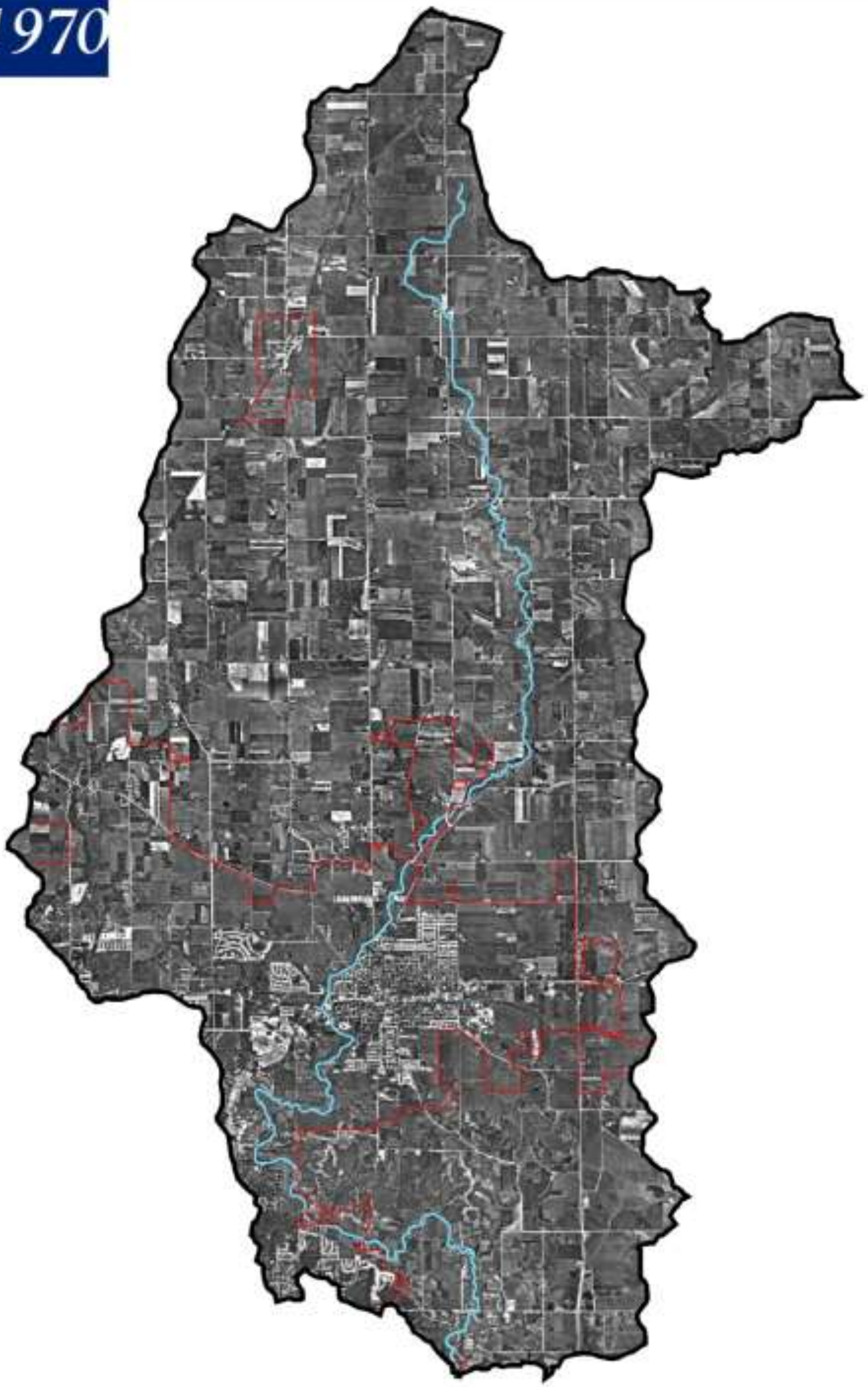


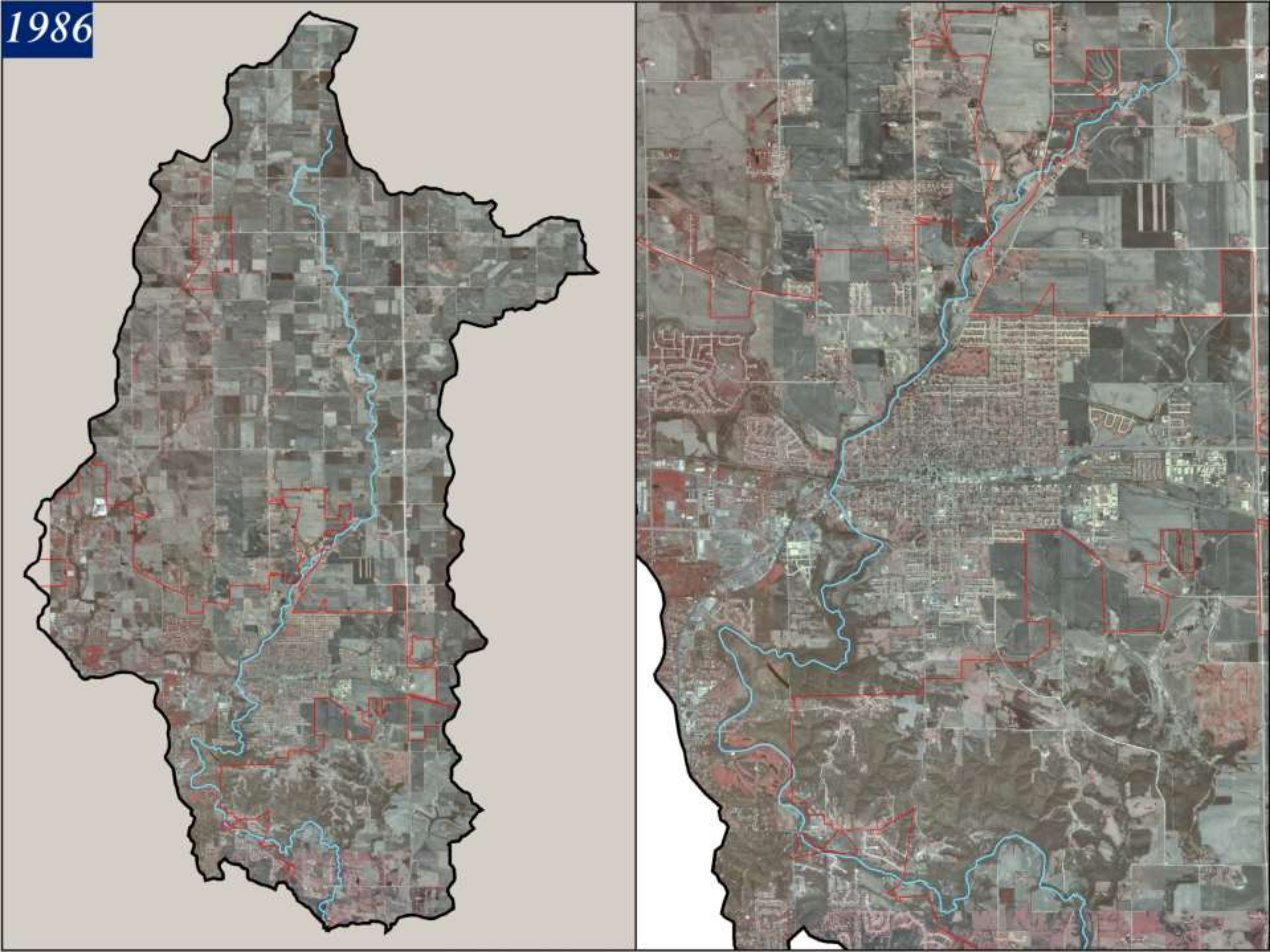


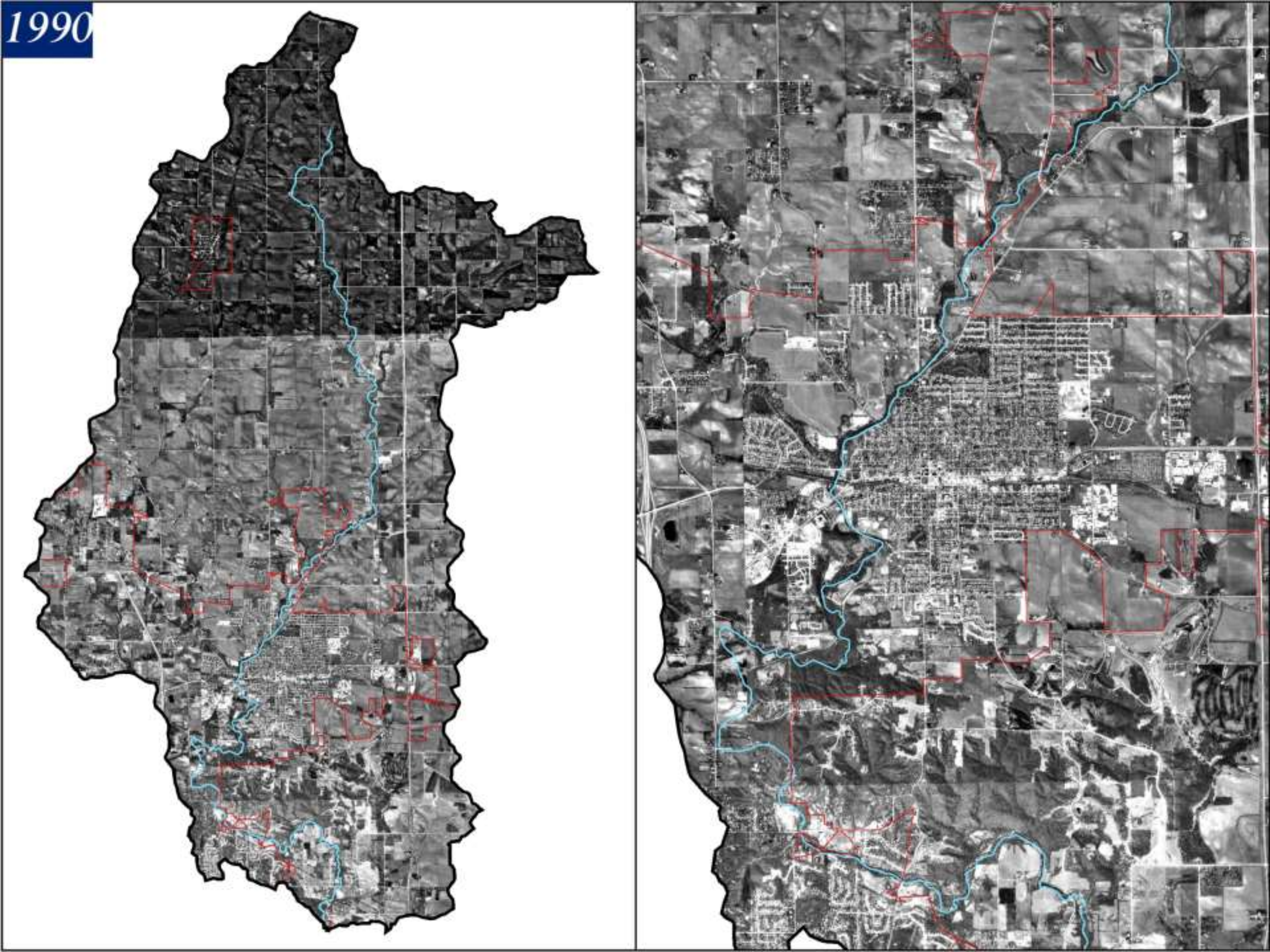

1952

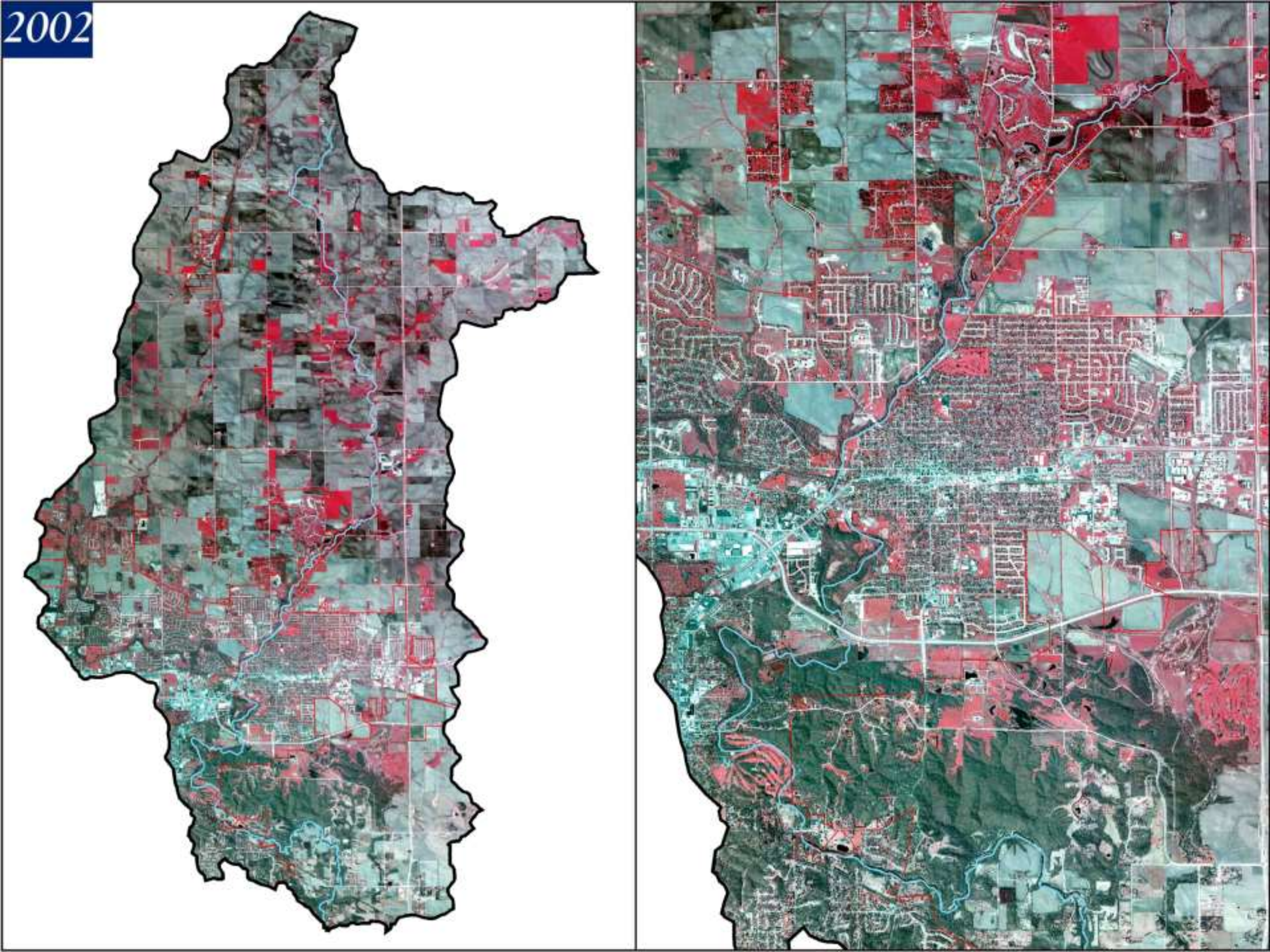

1964

1970

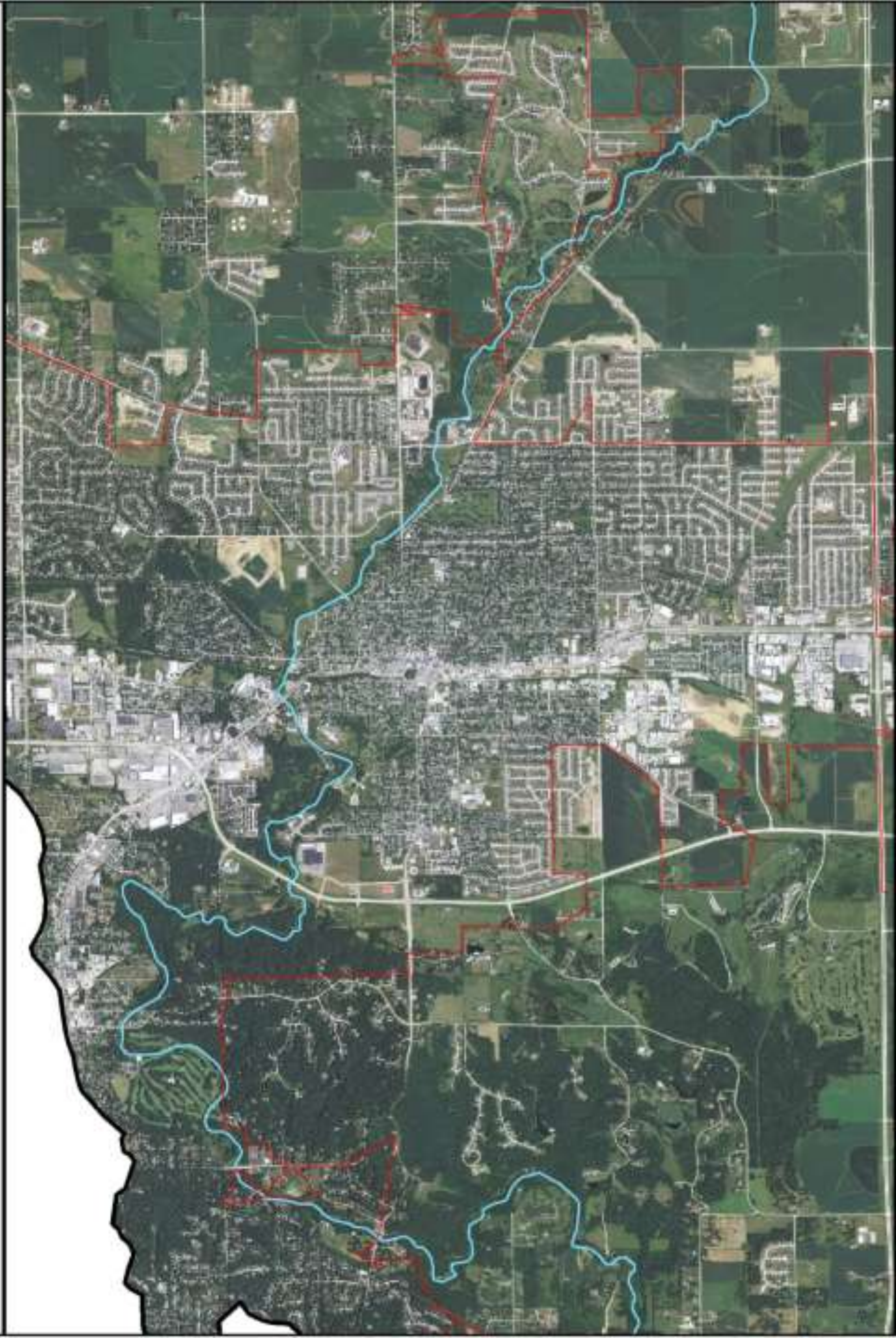



1986


1990

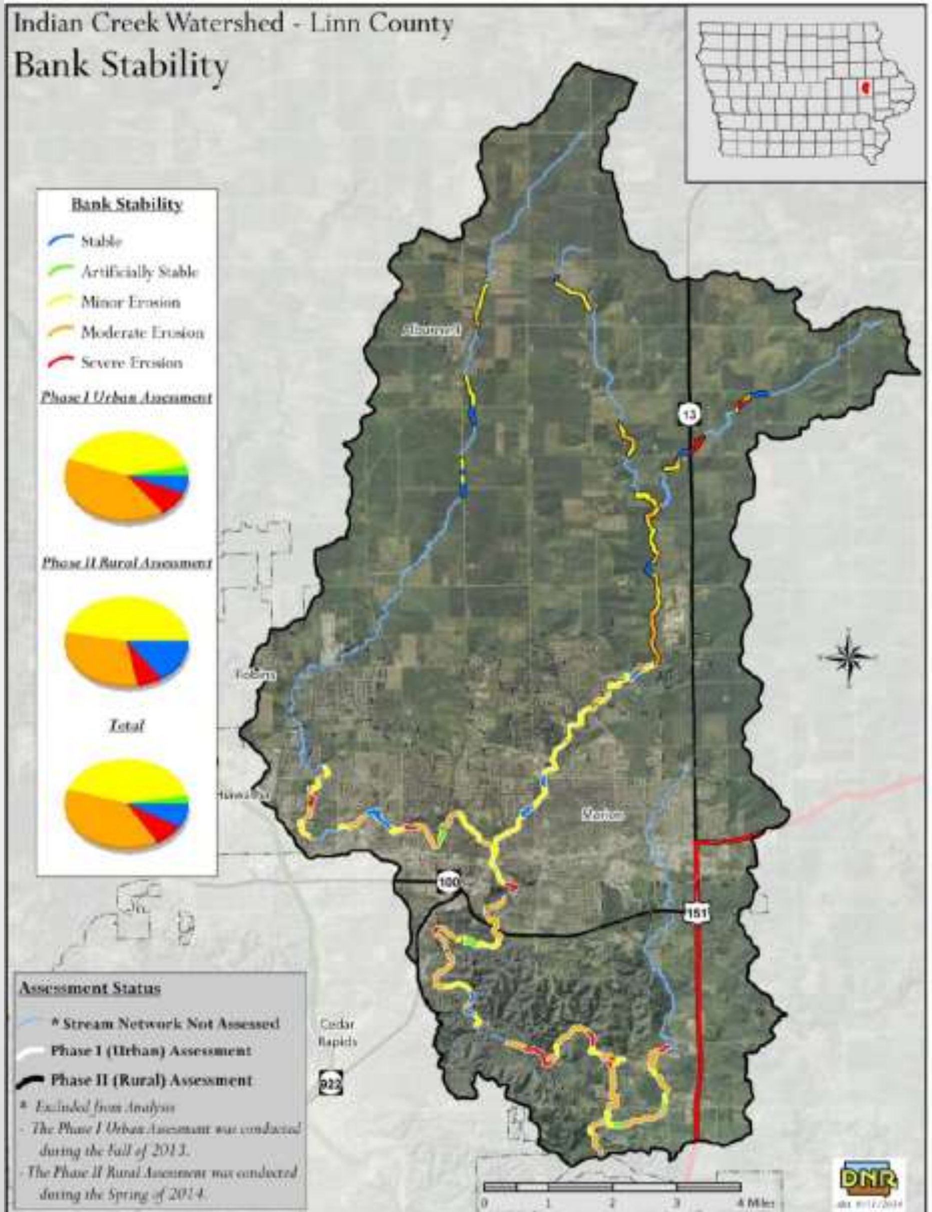

2002

2011

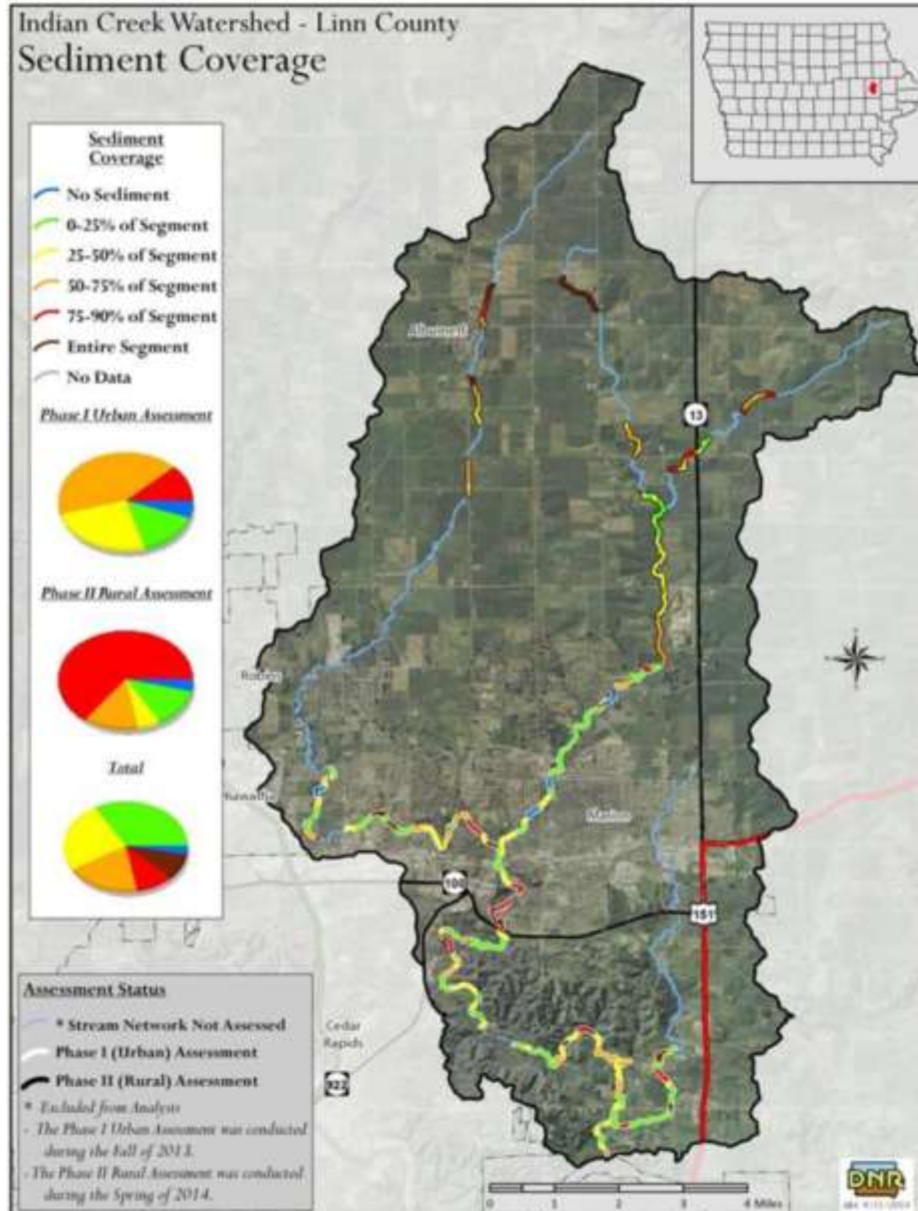


Physical assessment

- RASCAL
  - **R**apid **A**ssessment of **S**tream **C**onditions **A**long **L**ength
  - Assessment and mapping of bank and streambed conditions using a standardized protocol
    - stream substrate, pool frequency, canopy cover, bank type, bank height, neighboring land cover, livestock access, etc.
  - Identify areas with potential for remediation



Indian Creek Watershed - Linn County
Bank Stability
Bank Stability
Stable
Artificially Stable
Minor Erosion
Moderate Erosion
Severe Erosion
Phase I Urban Assessment
Phase II Rural Assessment
Total
Alburnett
Robins
Hiawatha
Marion
Cedar Rapids
13
100
151
Assessment Status
* Stream Network Not Assessed
Phase I (Urban) Assessment
Phase II (Rural) Assessment
* Excluded from Analysis
- The Phase I Urban Assessment was conducted during the Fall of 2013.
- The Phase II Rural Assessment was conducted during the Spring of 2014.
0 1 2 3 4 Miles
DNR



Indian Creek Watershed - Linn County
Sediment Coverage
Sediment Coverage
No Sediment
0-25% of Segment
25-50% of Segment
50-75% of Segment
75-90% of Segment
Entire Segment
No Data
Phase I Urban Assessment
Phase II Rural Assessment
Total
Alburnett
Robins
Hiawatha
Marion
Cedar Rapids
13
100
151
Assessment Status
* Stream Network Not Assessed
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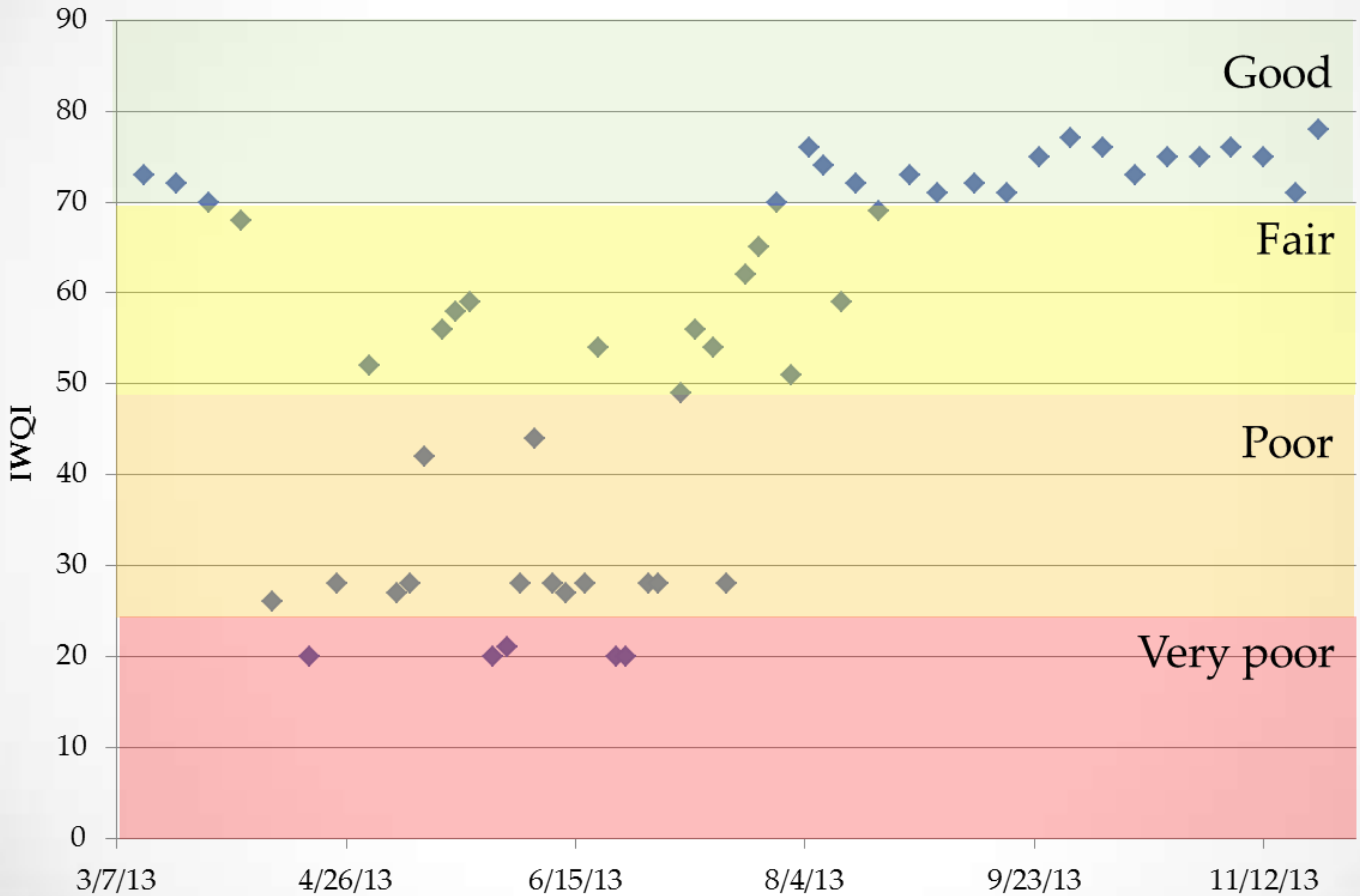
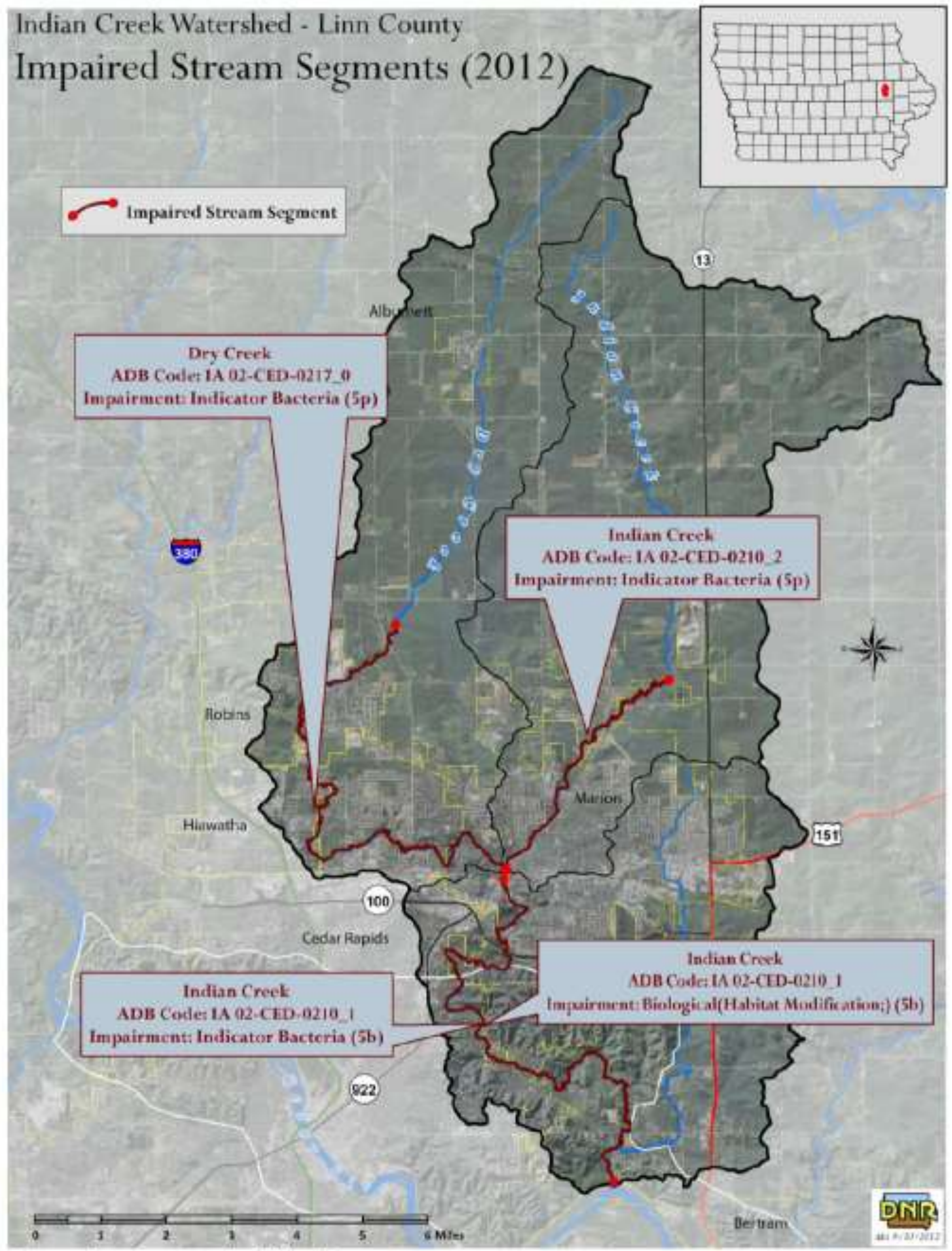
0 1 2 3 4 Miles
DNR

Sediment sources

5′8″

Iowa Water Quality Index – ICS (MV Rd.)





Source: Iowa Department of Natural Resources

Top Causes of Impairment in Rivers/Streams

Rank	Cause Name	Number of Stream/ River Segments *
1	Bacteria	378
2	Biological	126
3	Fish kill	94
4	Mercury (in fish)	30
5	Low dissolved oxygen	21
6	pH	17
7	Habitat/hydrology	16
8	Ammonia	9
9	Temperature	7
10	Nitrate	5

"Understanding Iowa's Impaired Waters", Iowa DNR


ENTERING
INDIAN CREEK
WATERSHED
PROTECT WATER
QUALITY
Animal
Medical

Wicked problems

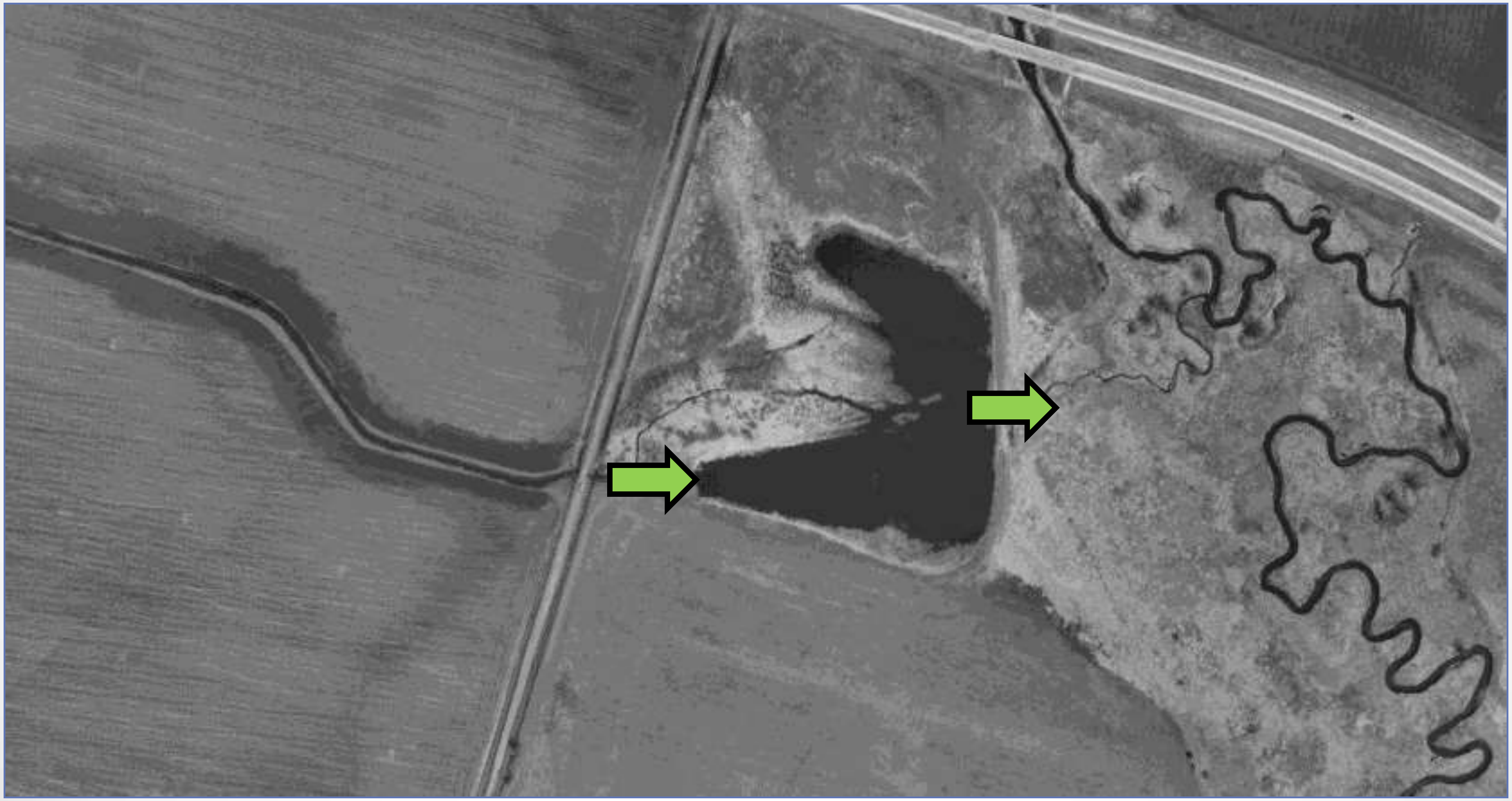
- "A wicked problem is a social or cultural problem that is **difficult or impossible to solve** for as many as four reasons:
  - incomplete or contradictory knowledge,
  - the number of people and opinions involved,
  - the large economic burden,
  - the interconnected nature of these problems with *other* problems."
- Solutions to wicked problems can be only good or bad, not true or false. There is no idealized end state to arrive at, and so approaches to wicked problems should be tractable ways to *improve* a situation rather than solve it.

Iowa Strategy to Reduce Nutrient Loss: Nitrogen Practices

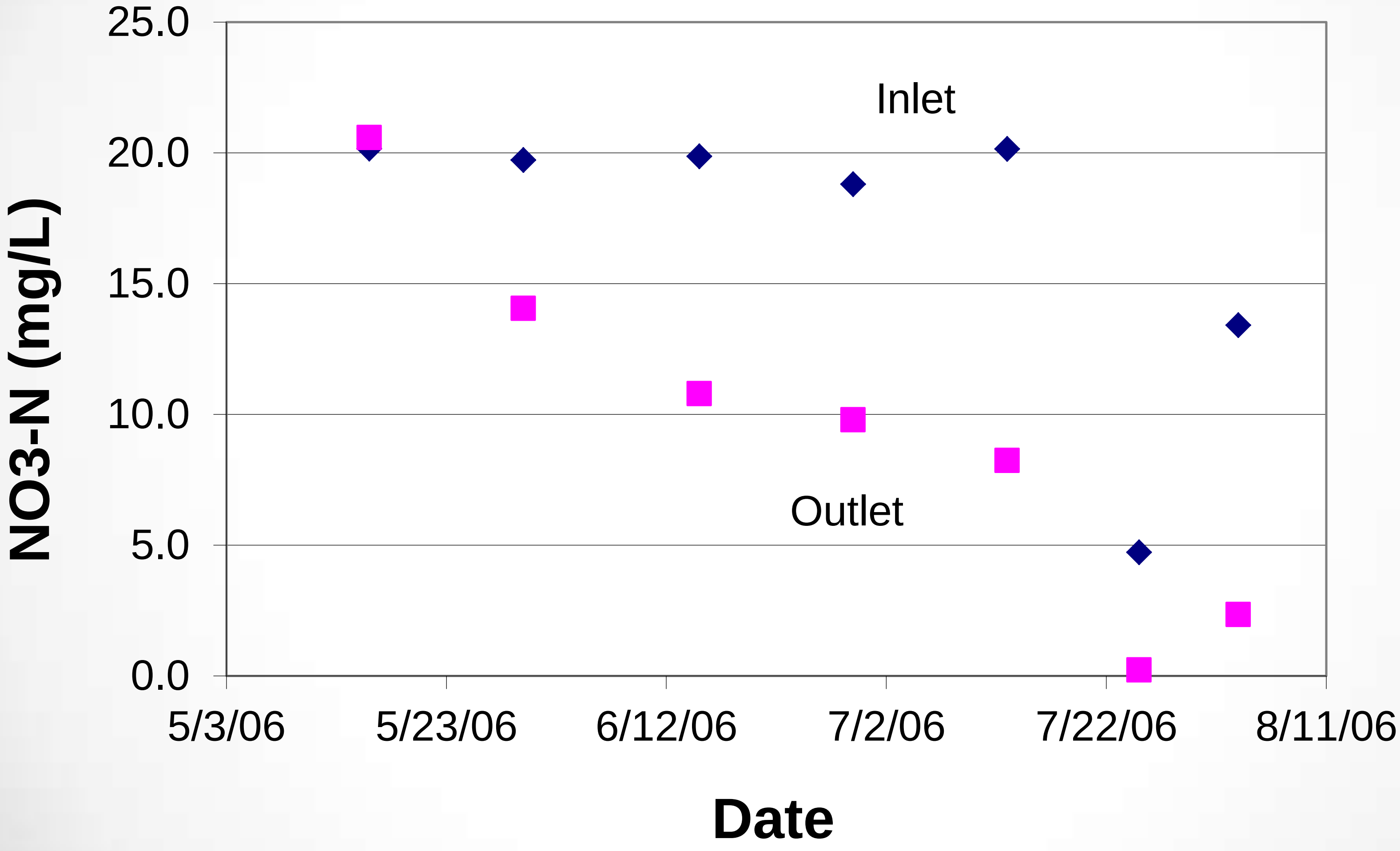
This table lists practices with the largest potential impact on nitrate-N concentration reduction (except where noted). Corn yield impacts associated with each practice also are shown as some practices may be detrimental to corn production. If using a combination of practices, the reductions are not additive. Reductions are field level results that may be expected where practice is applicable and implemented.

	Practice	Comments	% Nitrate-N Reduction⁺	% Corn Yield Change⁺⁺
			Average (SD*)	Average (SD*)
Nitrogen Management	Timing	Moving from fall to spring pre-plant application	6 (25)	4 (16)
		Spring pre-plant/sidedress 40-60 split Compared to fall-applied	5 (28)	10 (7)
		Sidedress – Compared to pre-plant application	7 (37)	0 (3)
		Sidedress – Soil test based compared to pre-plant	4 (20)	13 (22)**
	Source	Liquid swine manure compared to spring-applied fertilizer	4 (11)	0 (13)
		Poultry manure compared to spring-applied fertilizer	-3 (20)	-2 (14)
	Nitrogen Application Rate	Nitrogen rate at the MRTN (0.10 N:corn price ratio) compared to current estimated application rate. (ISU Corn Nitrogen Rate Calculator – http://cnrc.agron.iastate.edu can be used to estimate MRTN but this would change Nitrate-N concentration reduction)	10	-1
	Nitrification Inhibitor	Nitrapyrin in fall – Compared to fall-applied without Nitrapyrin	9 (19)	6 (22)
	Cover Crops	Rye	31 (29)	-6 (7)
		Oat	28 (2)	-5 (1)
	Living Mulches	e.g. Kura clover – Nitrate-N reduction from one site	41 (16)	-9 (32)
Land Use	Perennial	Energy Crops – Compared to spring-applied fertilizer	72 (23)	
		Land Retirement (CRP) – Compared to spring-applied fertilizer	85 (9)	
	Extended Rotations	At least 2 years of alfalfa in a 4 or 5 year rotation	42 (12)	7 (7)
	Grazed Pastures	No pertinent information from Iowa – assume similar to CRP	85	
Edge-of-Field	Drainage Water Mgmt.	No impact on concentration	33 (32)	
	Shallow Drainage	No impact on concentration	32 (15)	
	Wetlands	Targeted water quality	52	
	Bioreactors		43 (21)	
	Buffers	Only for water that interacts with the active zone below the buffer. This would only be a fraction of all water that makes it to a stream.	91 (20)	
	Saturated Buffers	Divert fraction of tile drainage into riparian buffer to remove Nitrate-N by denitrification.	50 (13)	

Wetlands

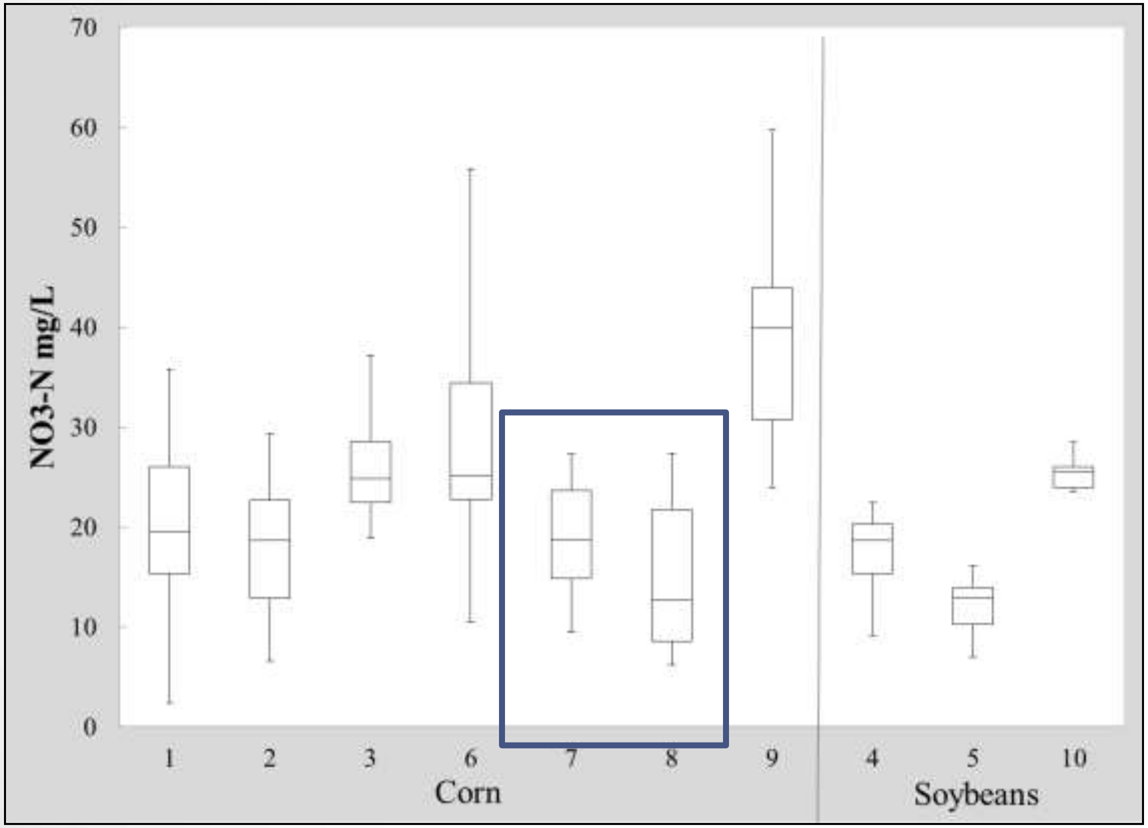


Wetlands

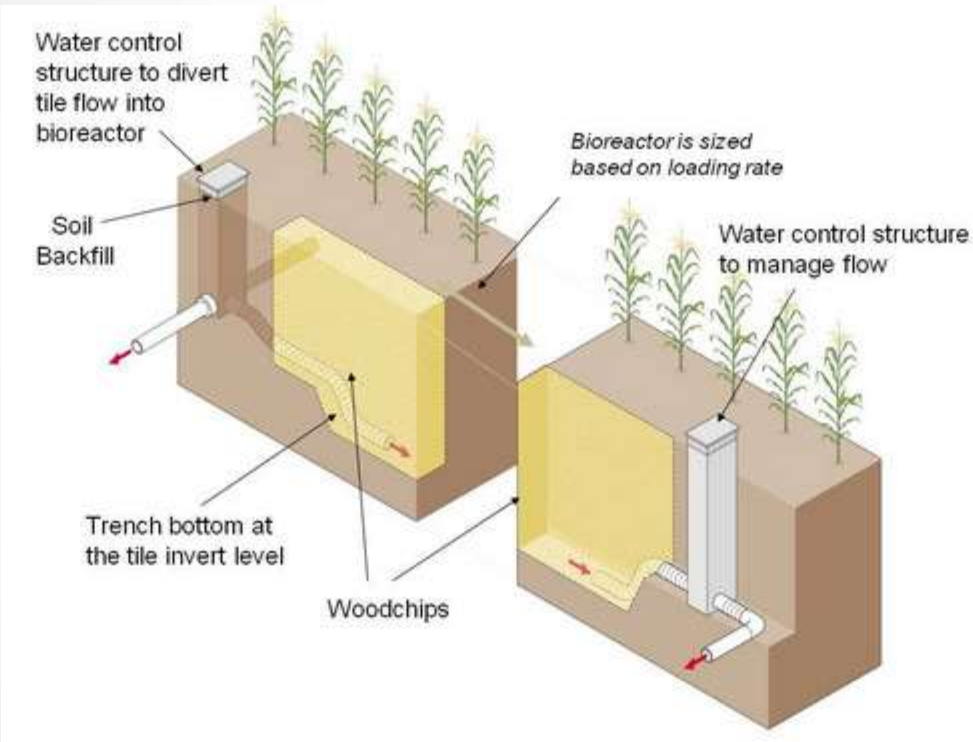


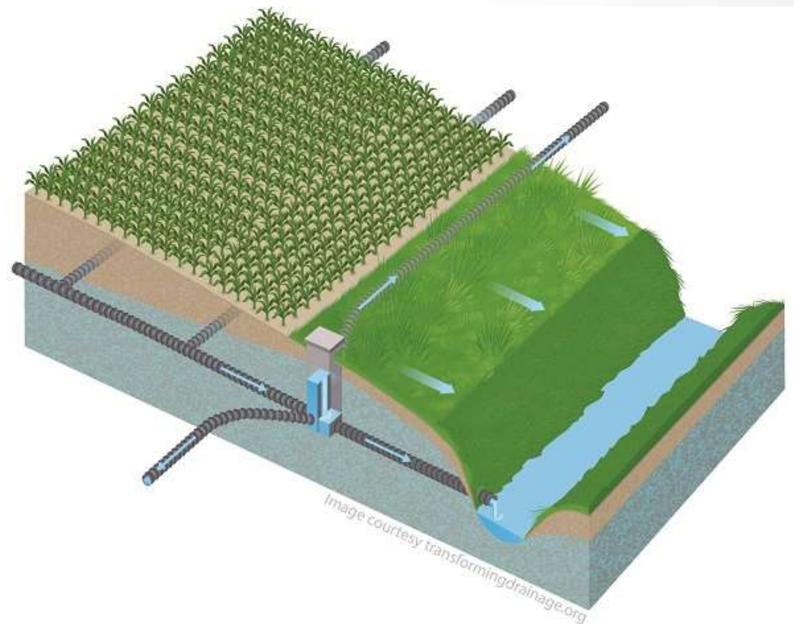
25.0
20.0
15.0
10.0
5.0
0.0
NO3-N (mg/L)
Inlet
Outlet
5/3/06
5/23/06
6/12/06
7/2/06
7/22/06
8/11/06
Date

Cover crops



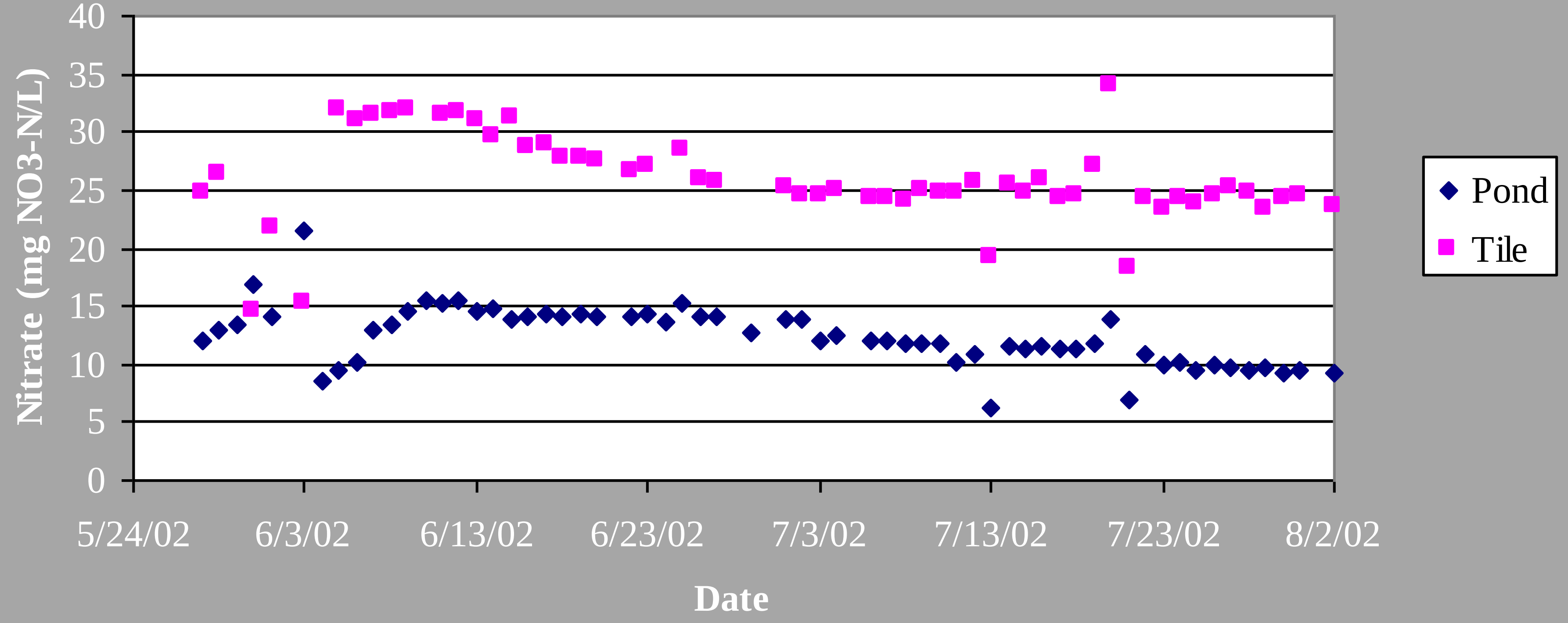
Bioreactors and saturated buffers





Ponds

Ponds



40
35
30
25
20
15
10
5
0
Nitrate (mg NO3-N/L)
5/24/02
6/3/02
6/13/02
6/23/02
7/3/02
7/13/02
7/23/02
8/2/02
Date
Pond
Tile

MCPP | PARTNERING FOR SUCCESS
EXECUTING THE PLAN

16,539 acres of cover crops

- 134% increase in cover crops acres from 2015 to 2016.
- Approximately 15% of total crop acres in MCPP area are in cover crop program

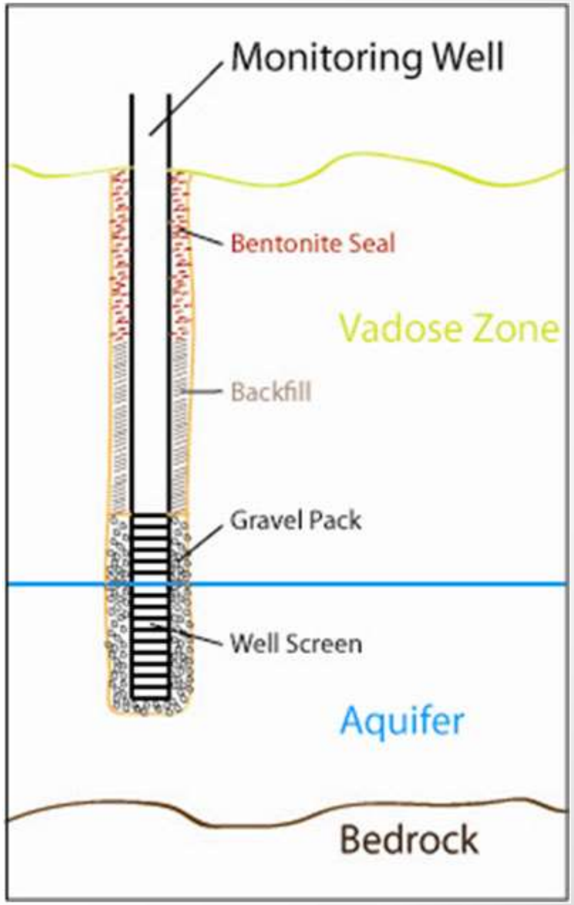
6,522 acres of nutrient management plans or practices

9,173 acres of no-till, strip-till or reduced tillage practices

2 saturated buffers and 1 bioreactor

Can we make better use of our roadsides?

- Project underway in collaboration with Keith Schilling, Matthew Streeter, Laura Jackson
- Tile drainage empties into roadside ditches – can those soils and plant communities process the nutrients?



What about urban?

- Typical urban pollutants
  - Oil and grease
  - Thermal pollution
  - Sediment
  - E. coli
- How do we prevent them from reaching the stream?
  - Minimize sources
  - Minimize the amount of stormwater reaching our streams



Conclusions

- Indian Creek
  - Has elevated levels of nutrients, bacteria, and sediment
  - Leads to impairments in its intended usage
  - Sources are both urban and rural
- Solutions
  - Nutrient Reduction Strategy has many of the strategies which will reduce nutrient loading
  - Need technical, financial, and policy help to increase implementation
  - BMPs also available to reduce urban inputs
- Acknowledgements
  - Financial support from Cedar Rapids Utilities, IDNR, ICWMA
    - Find out more at http://indiancreekwatershed.weebly.com/
  - Coe College
  - Students