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Quantifying the Water Quality Benefits of Riparian Buffers in the Cache River Watershed

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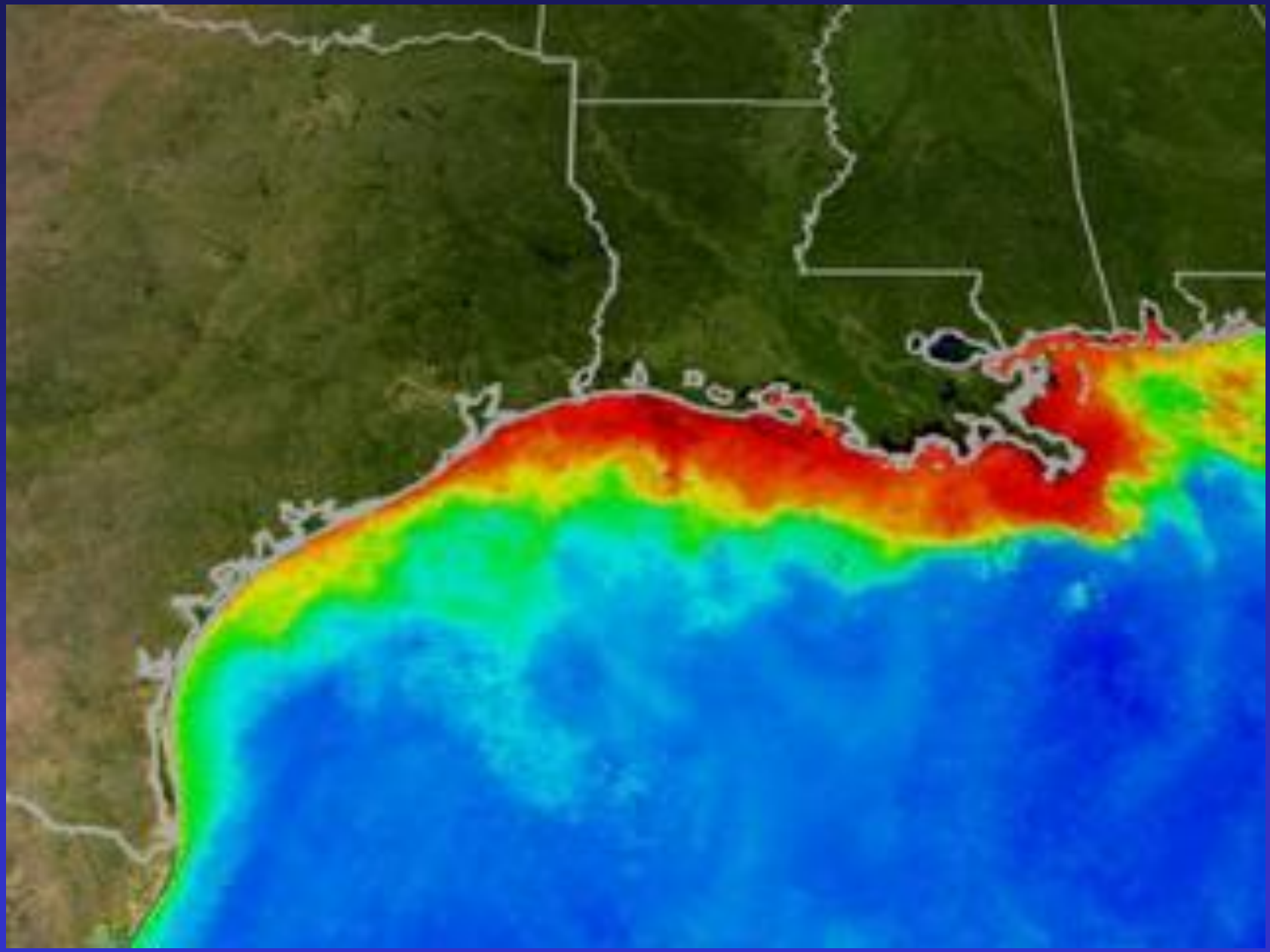
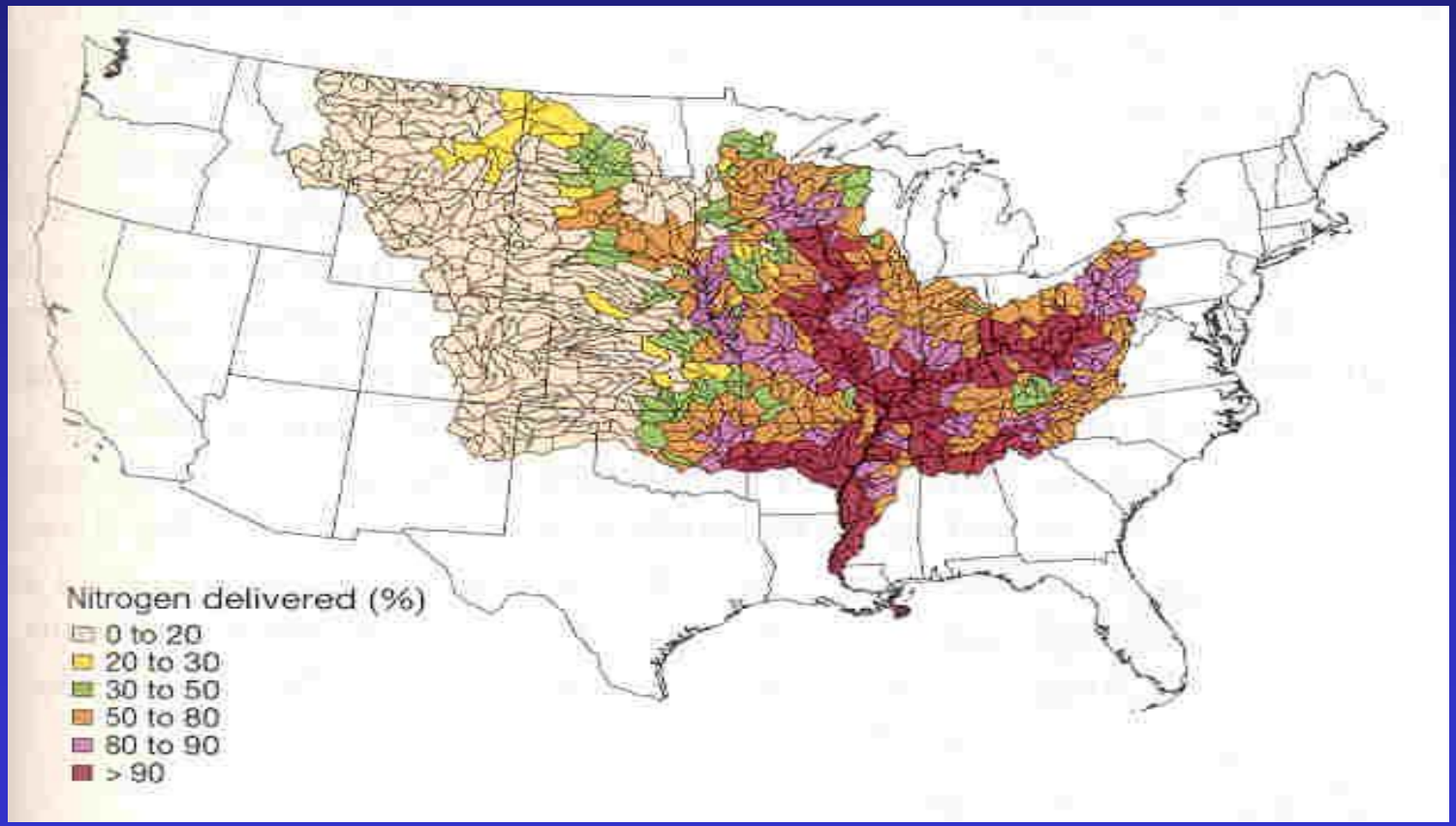
Why are Riparian Buffers Important?

- "The last line of defense" – like having a great free safety on your football team
- Trap sediment and nutrients in surface runoff
- Process nutrients in groundwater
- Stabilize stream banks
- Shade streams
- Provide wildlife habitat
- Diversify income – hunting leases, timber



Summer phytoplankton conditions along the Gulf Coast – 2002-2004 (NOAA)

Watersheds in close proximity to the Mississippi River and its primary tributaries are important N contributors to the Gulf of Mexico (Alexander et al. 2000) - Southern Illinois



Unique Features of Riparian Areas in Southern Illinois

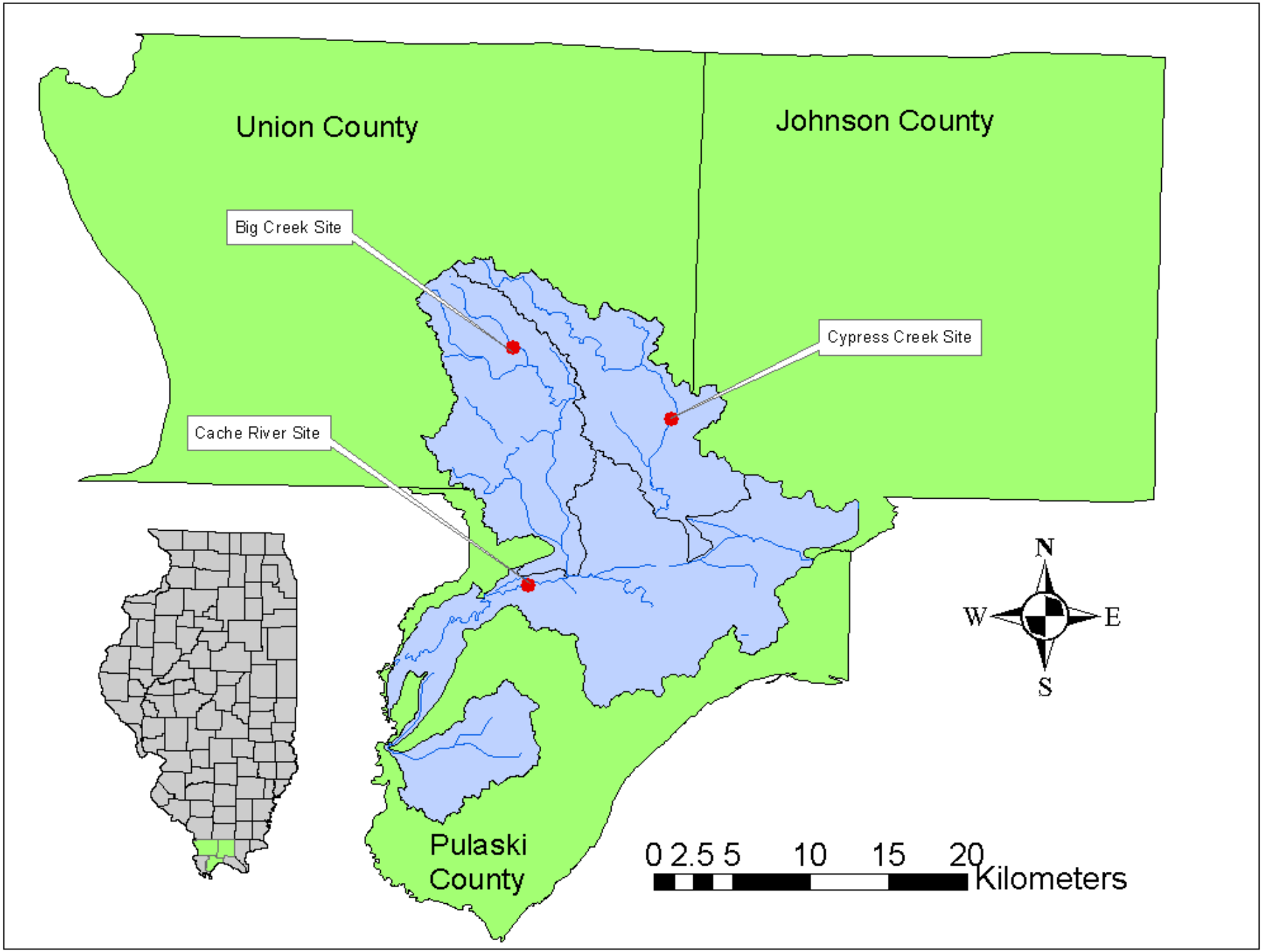
- Relative absence of tile drainage
- Presence of unique native species; giant cane (*Arundinaria gigantea*)

Giant Cane Distribution

Water Quality Benefits of Forest and Cane Riparian Buffers in the Cache River Watershed

Objective

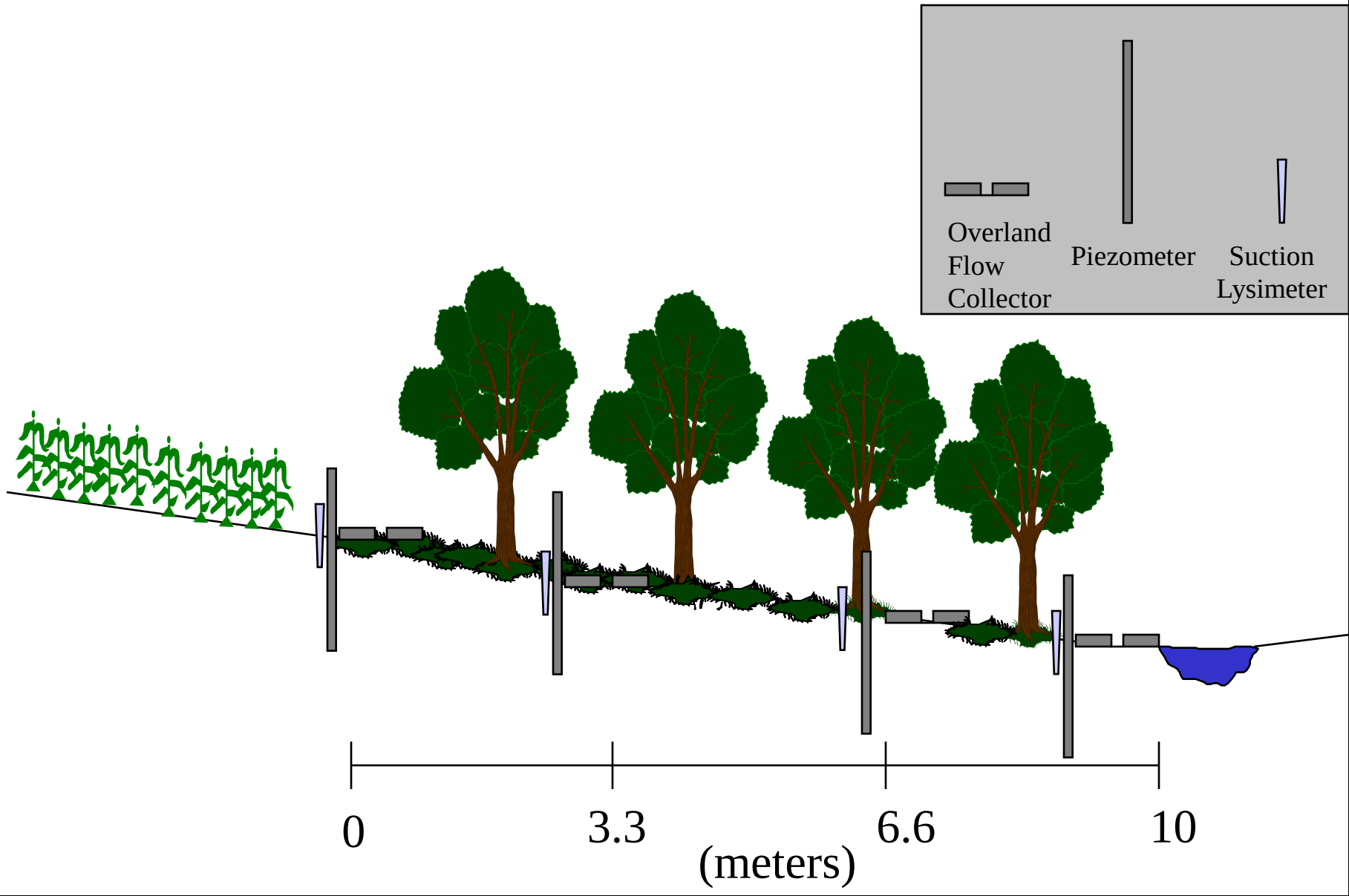
- To determine N, P, and sediment attenuation capabilities of forest and giant cane riparian zones adjacent to row crop agriculture


Union County
Johnson County
Big Creek Site
Cypress Creek Site
Cache River Site
Pulaski County
N
W
E
S
0 2.5 5 10 15 20
Kilometers

Giant cane (*Arundinaria gigantea*) (30 – 40 years old)

Mixed Deciduous Forest (30 - 40 years old)

Study Design



Overland Flow Collectors

Groundwater Wells

Suction Lysimeters

Percent Reduction of Sediment and Nutrients in the Initial 3.3 m of Riparian Buffers

Parameter	Giant Cane	Forest
Overland Flow		
Sediment	97	70
Total PO_4	80	(14)+
Total NH_4-N	81	31
Dissolved NH_4-N	80	44
Dissolved NO_3-N	68	17

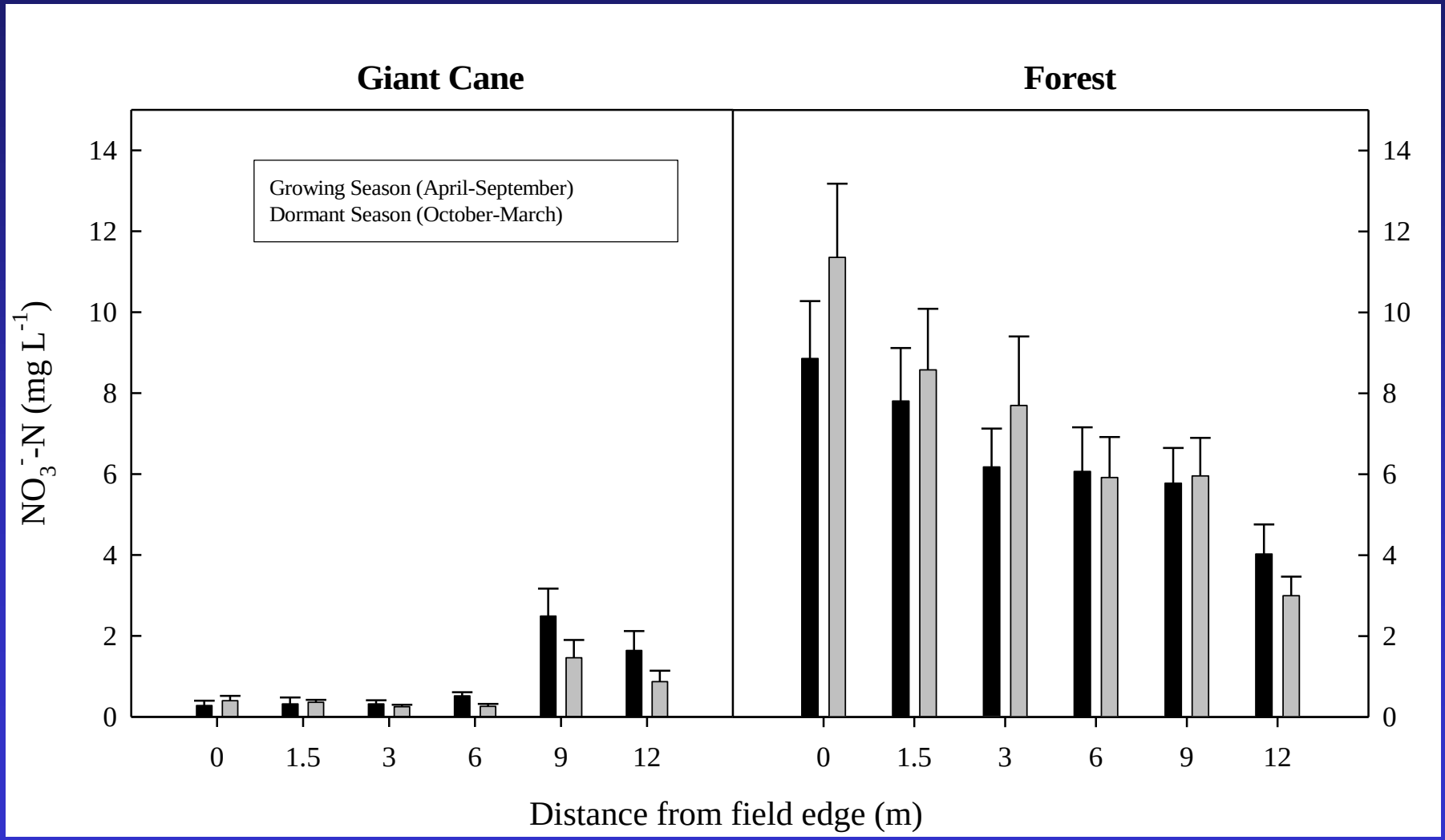
Schoonover et al. 2005, Schoonover et al. 2006

Percent Reduction of Sediment and Nutrients in the Initial 6.6 m of Riparian Buffers

Parameter	Giant Cane	Forest
Overland Flow		
Sediment	93	95
Total PO_4	79	73
Total NH_4-N	76	70
Dissolved NH_4-N	74	74
Dissolved NO_3-N	36	94

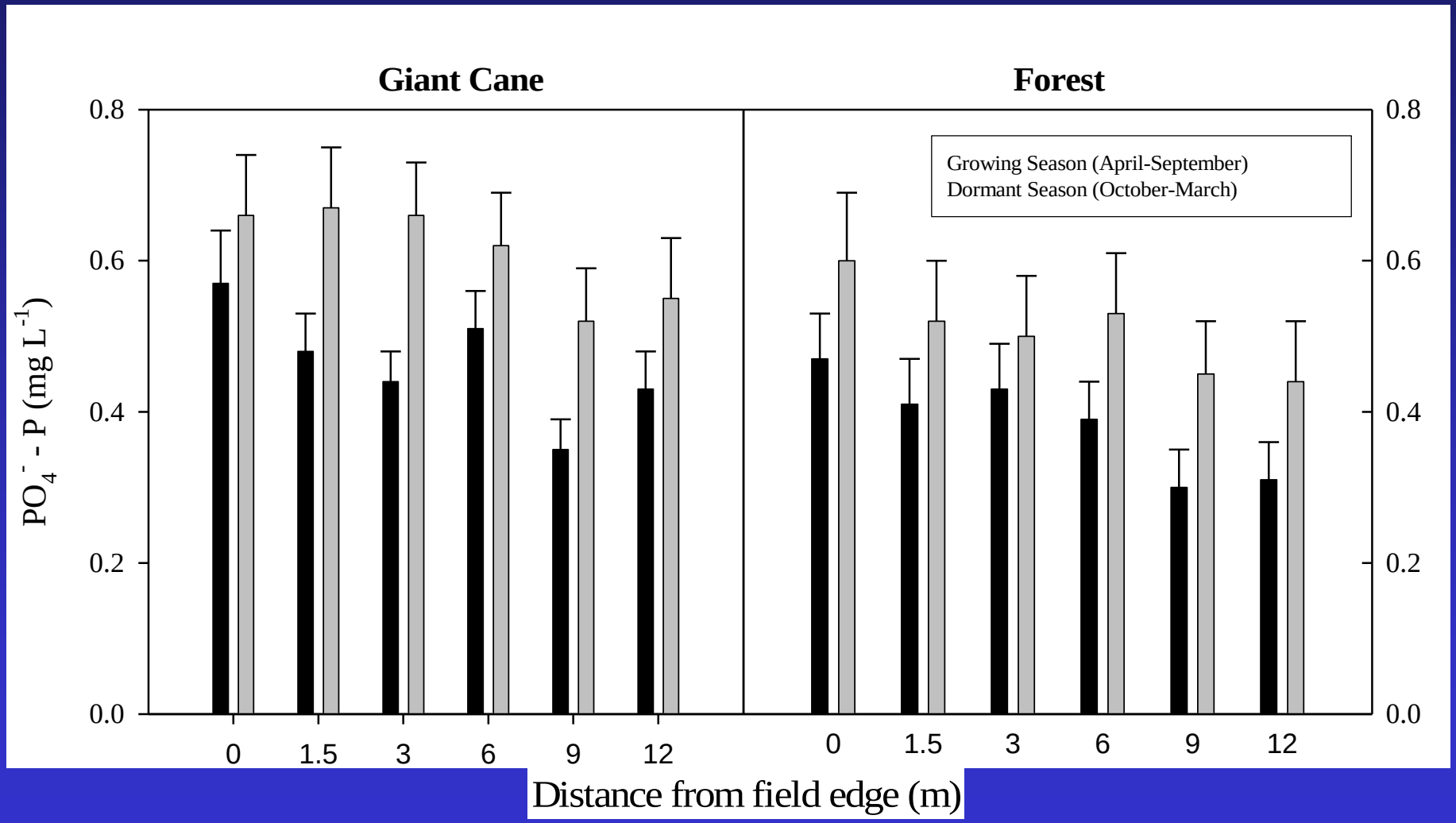
Schoonover et al. 2005, Schoonover et al. 2006

Mean Nitrate-N in Groundwater



Schoonover et al. 2010

Mean Phosphate in Groundwater



Schoonover et al. 2010

Southern Illinois

- Region with relatively high stream DRP concentrations (tributaries of the Kaskaskia and Big Muddy river basins).
- Several watersheds with mean DRP concentrations >1.00 mg L^{-1} over the past 2 decades (Short 1999).
- Mean DRP concentration of the state of Illinois = 0.25 mg L^{-1} (Short 1999).

Mean Stream Phosphate Concentrations

	Big Creek	Cypress Creek	Cache River
DRP Conc. (mg L^{-1})	0.69 ± 0.07	0.54 ± 0.06	0.65 ± 0.07

Number of samples:12

Importance of Type of Surface Runoff Entering Buffer

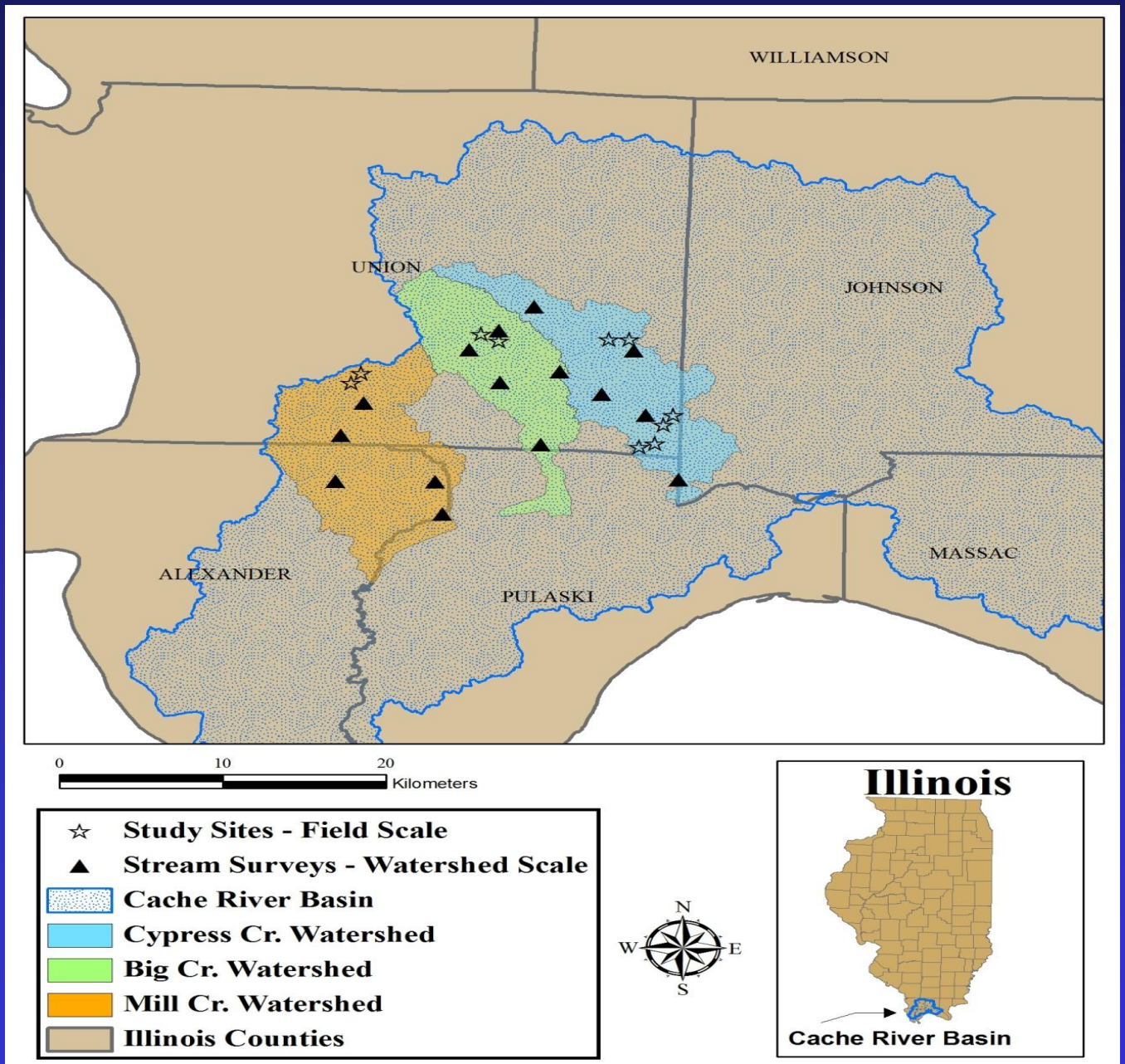
Sheet Flow

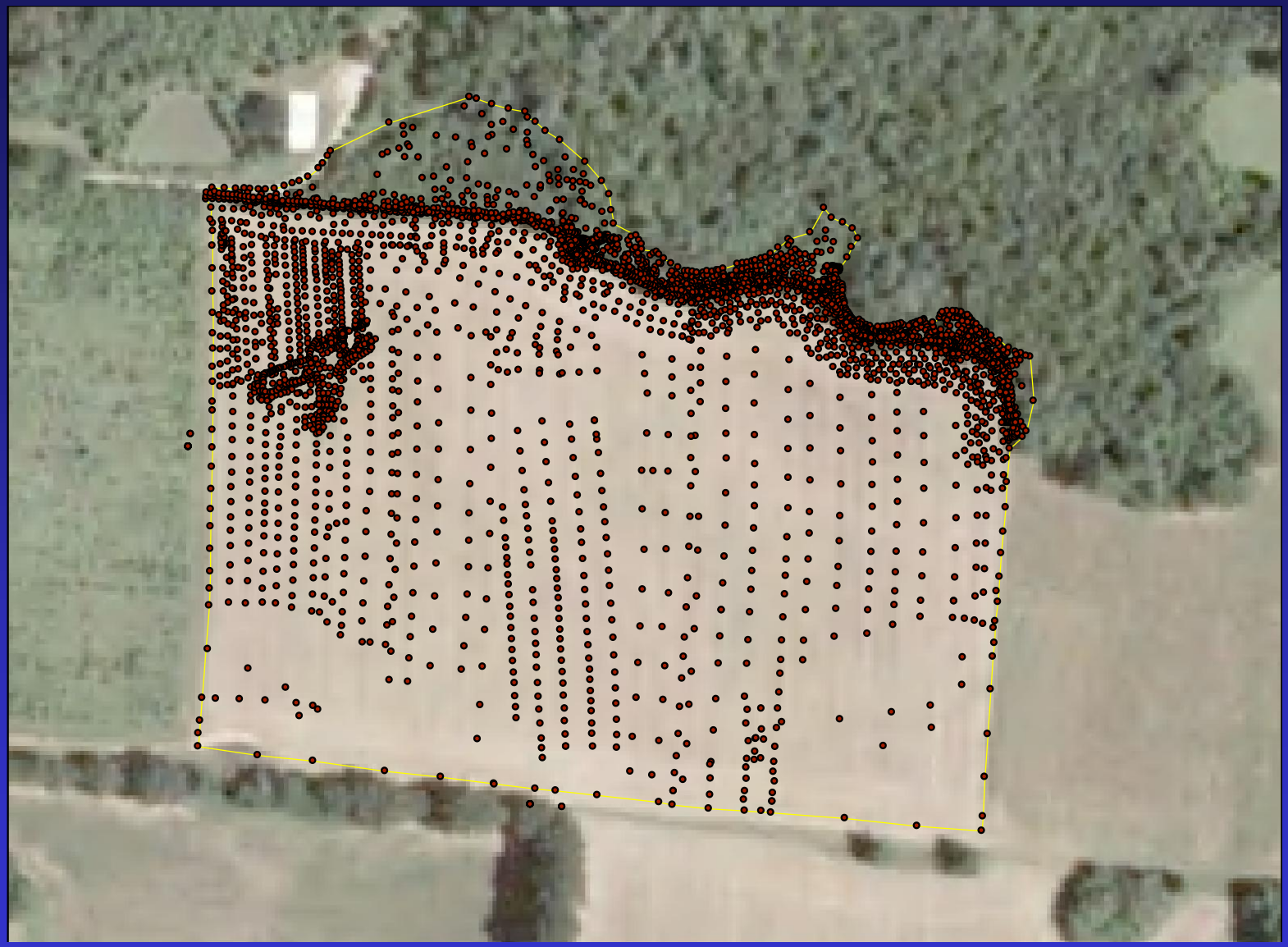
Concentrated Flow

What proportion of an agricultural field is drained by concentrated flow?

- Ryan Pankau – M.S. Thesis at SIUC 2010
- Intensive surveying of 10 agricultural fields to create detailed digital elevation models and drainage areas of concentrated flow channels

Cache River Basin

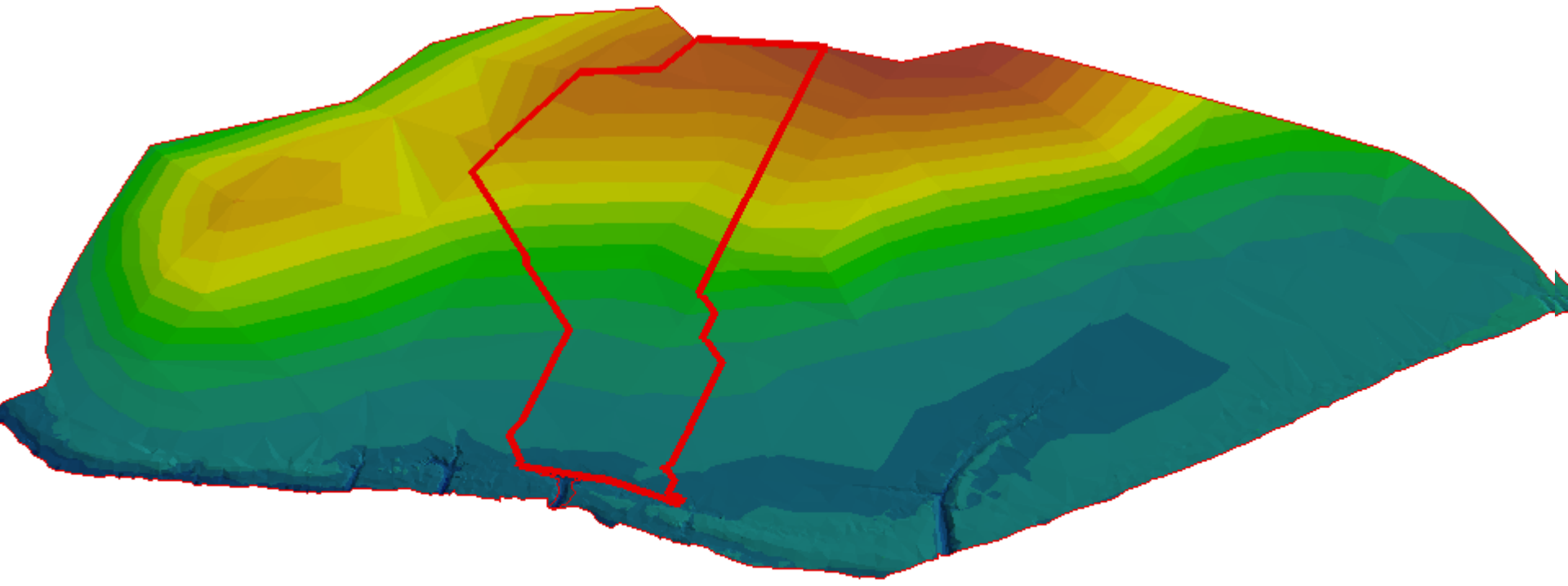




4,080 Survey Points

Concentrated Flow Paths: Drainage Area Calculation

- 82 – 100% of the fields were drained by concentrated flow



Sediment Berms

Conclusions

- Relatively narrow buffers can yield significant water quality benefits.
  - Surface runoff: promotes infiltration
  - Groundwater: plant assimilation and microbial processing
- Giant cane buffers performed equally as well or better than forest buffers in terms of water quality benefits.
- In southern Illinois, P tends to be more of a stream water quality issue than N.
- Riparian buffers need to be designed to handle concentrated flow from agricultural fields.

Acknowledgements

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Questions