Science Assessment to Support an Illinois Nutrient Loss Reduction Strategy

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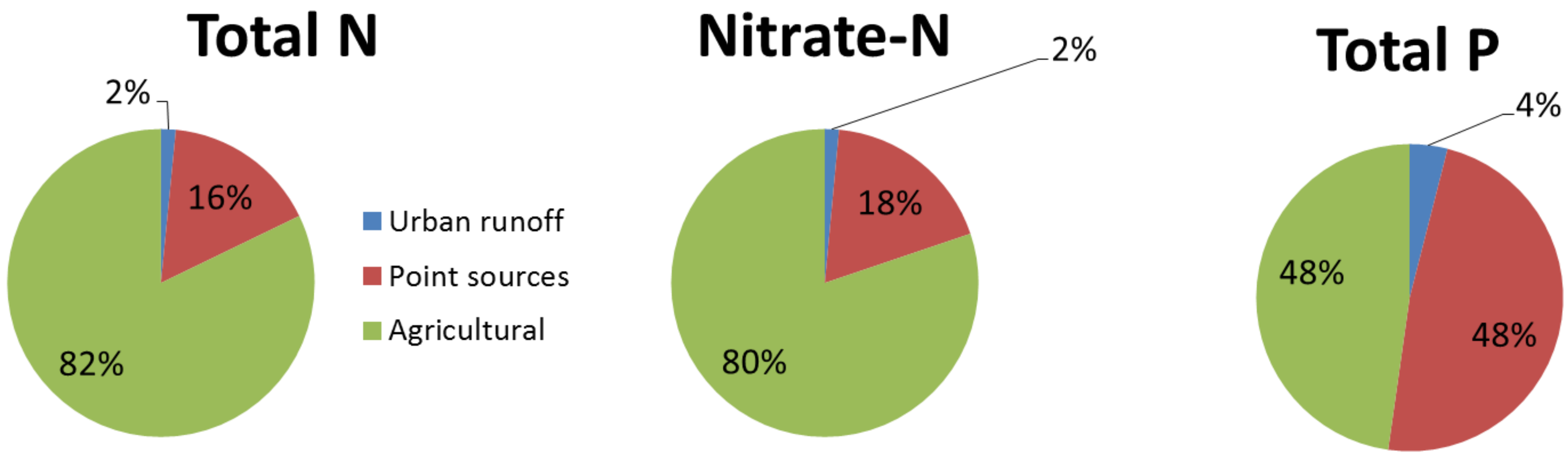
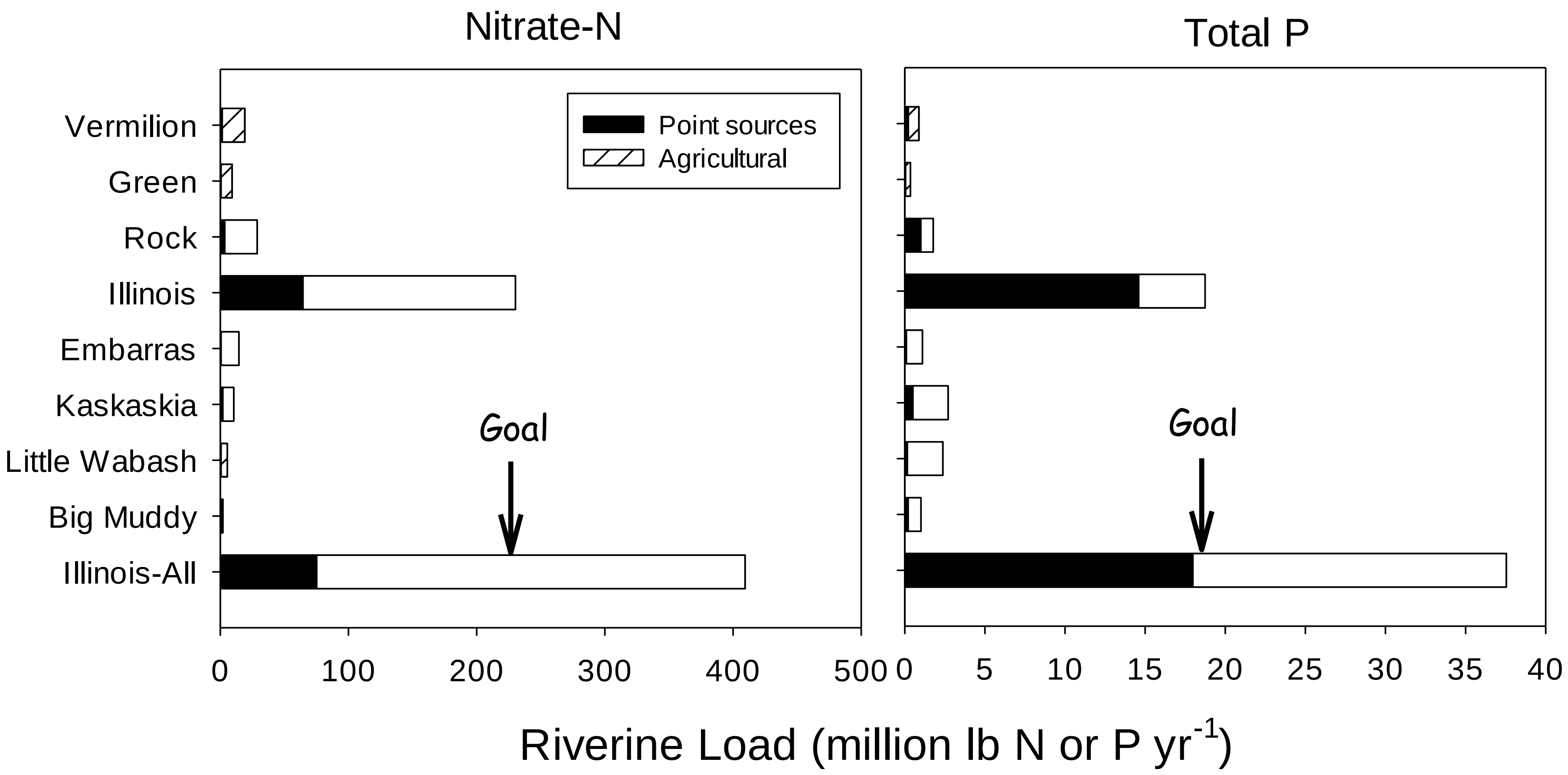
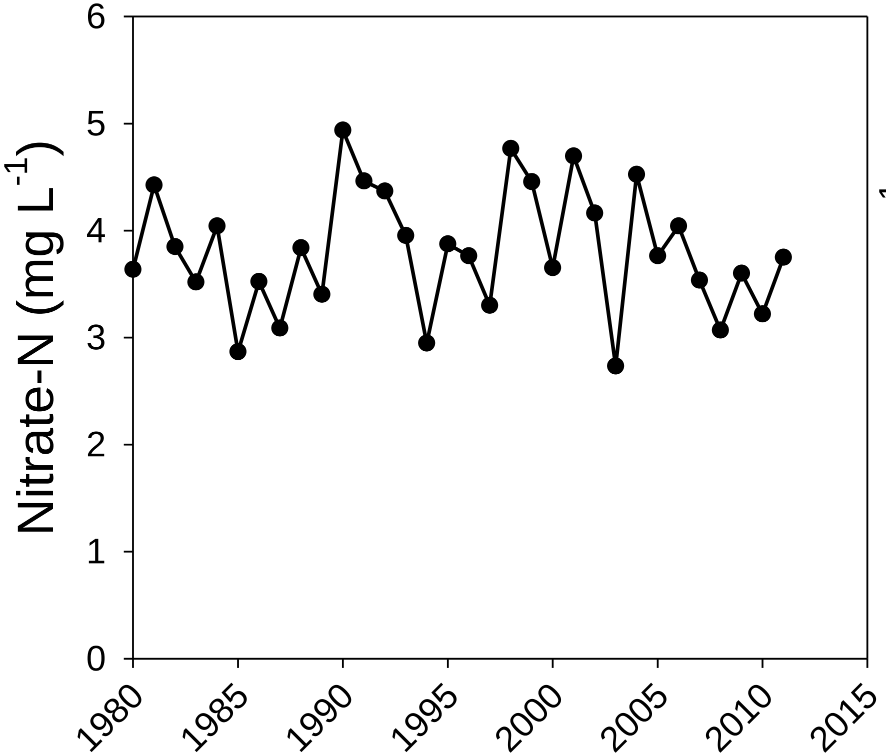
Illinois Nutrient Sources

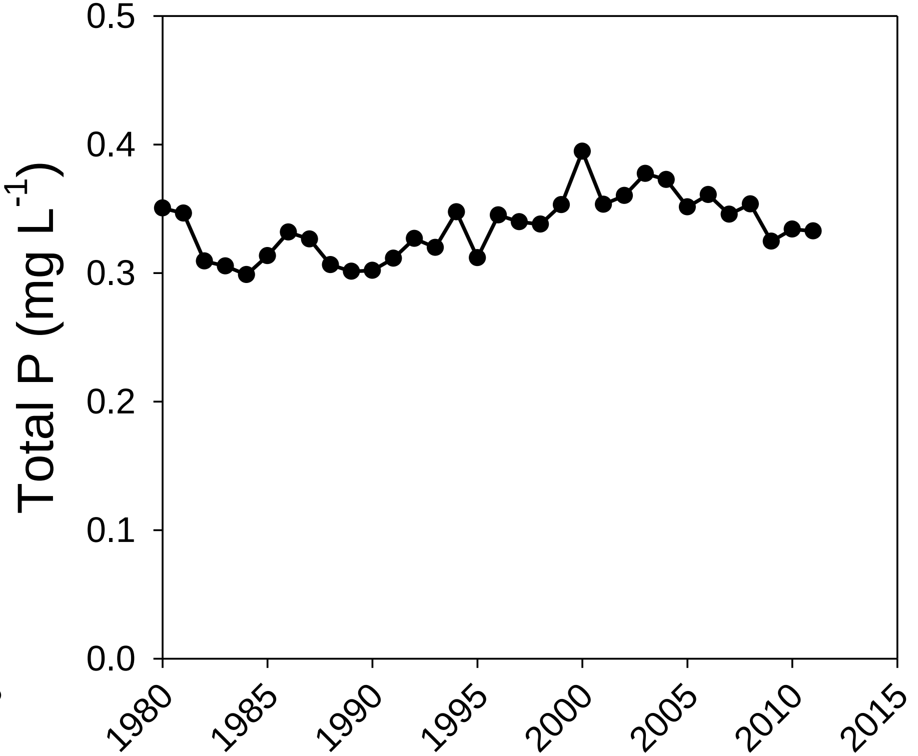


Point and agricultural sources
(1997-2011)

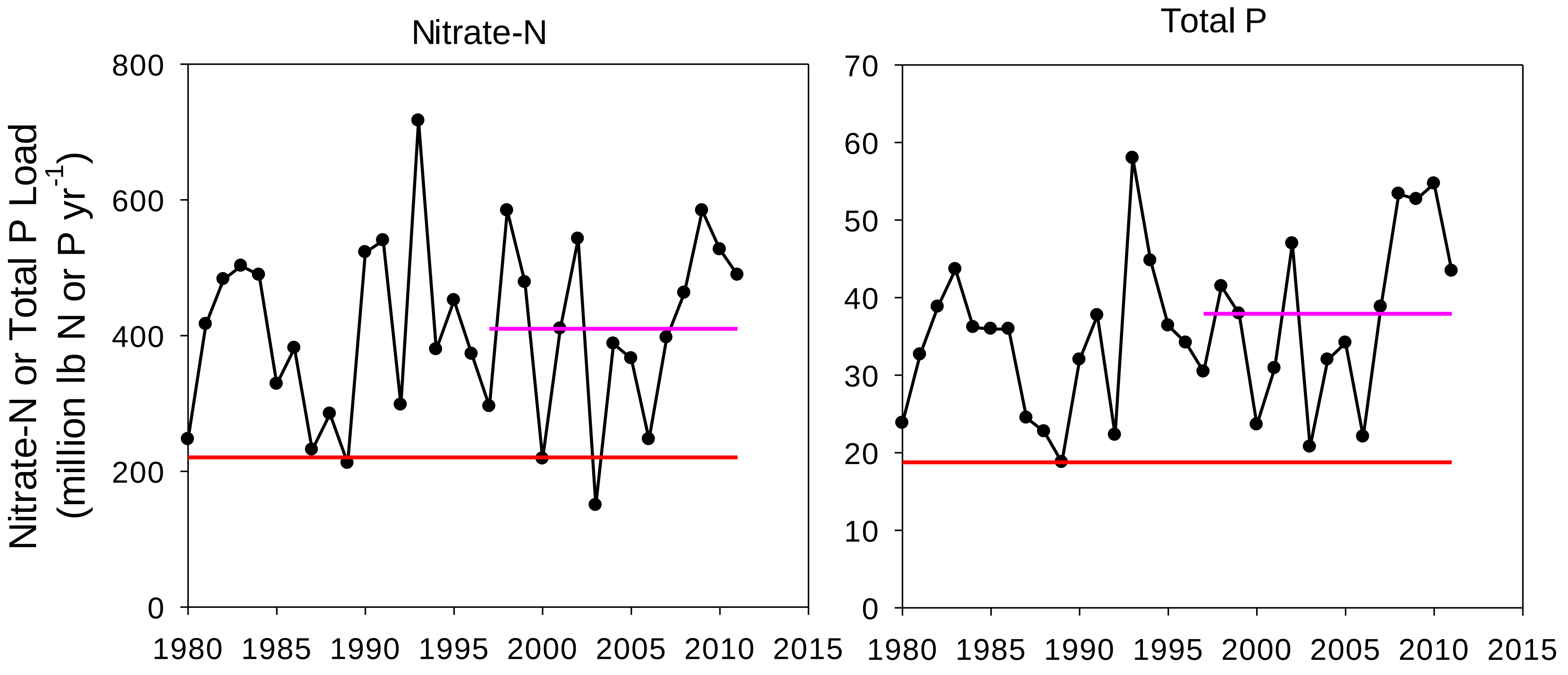


Illinois Nutrient Concentrations (average of all rivers in state)

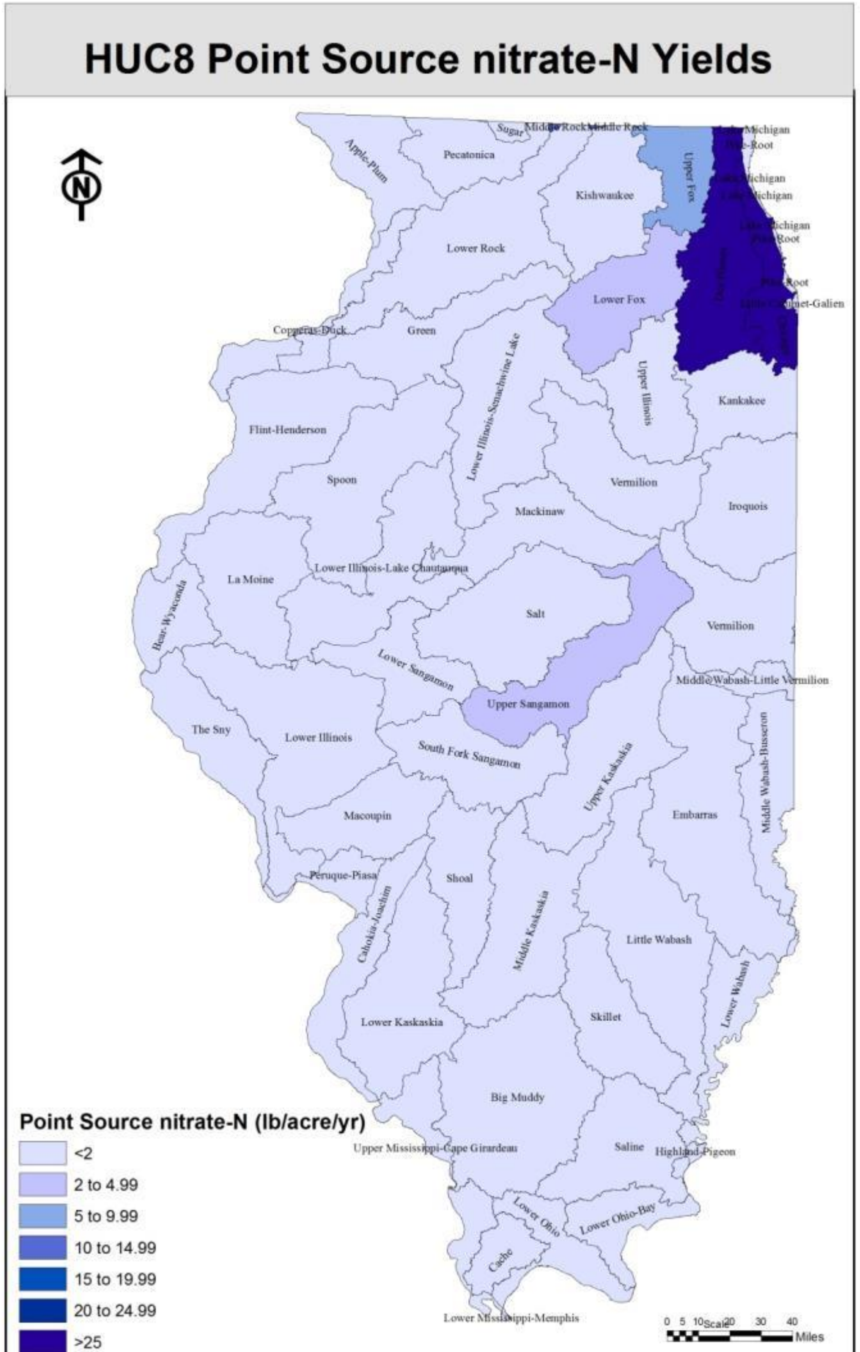




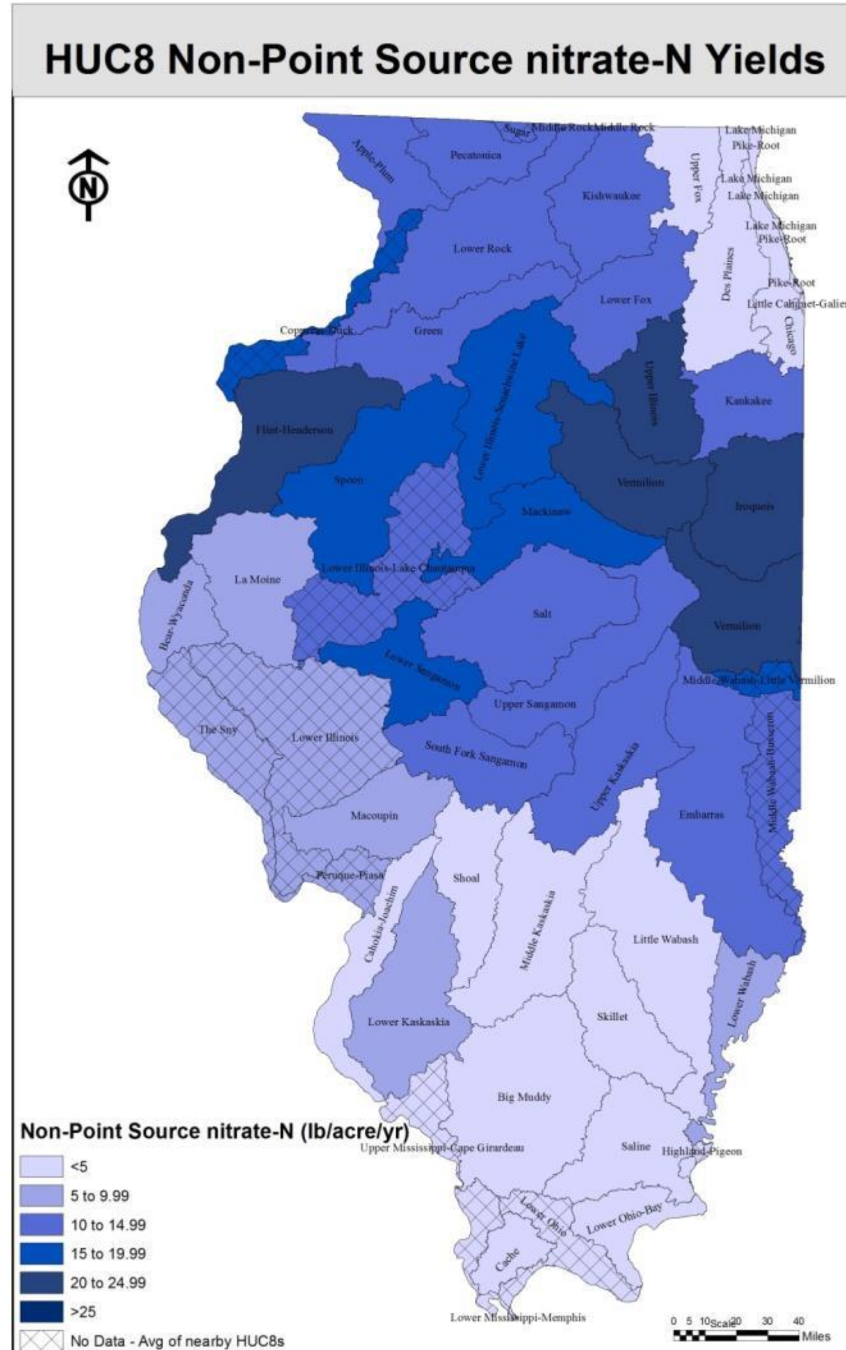
Nitrate-N and Total P Targets



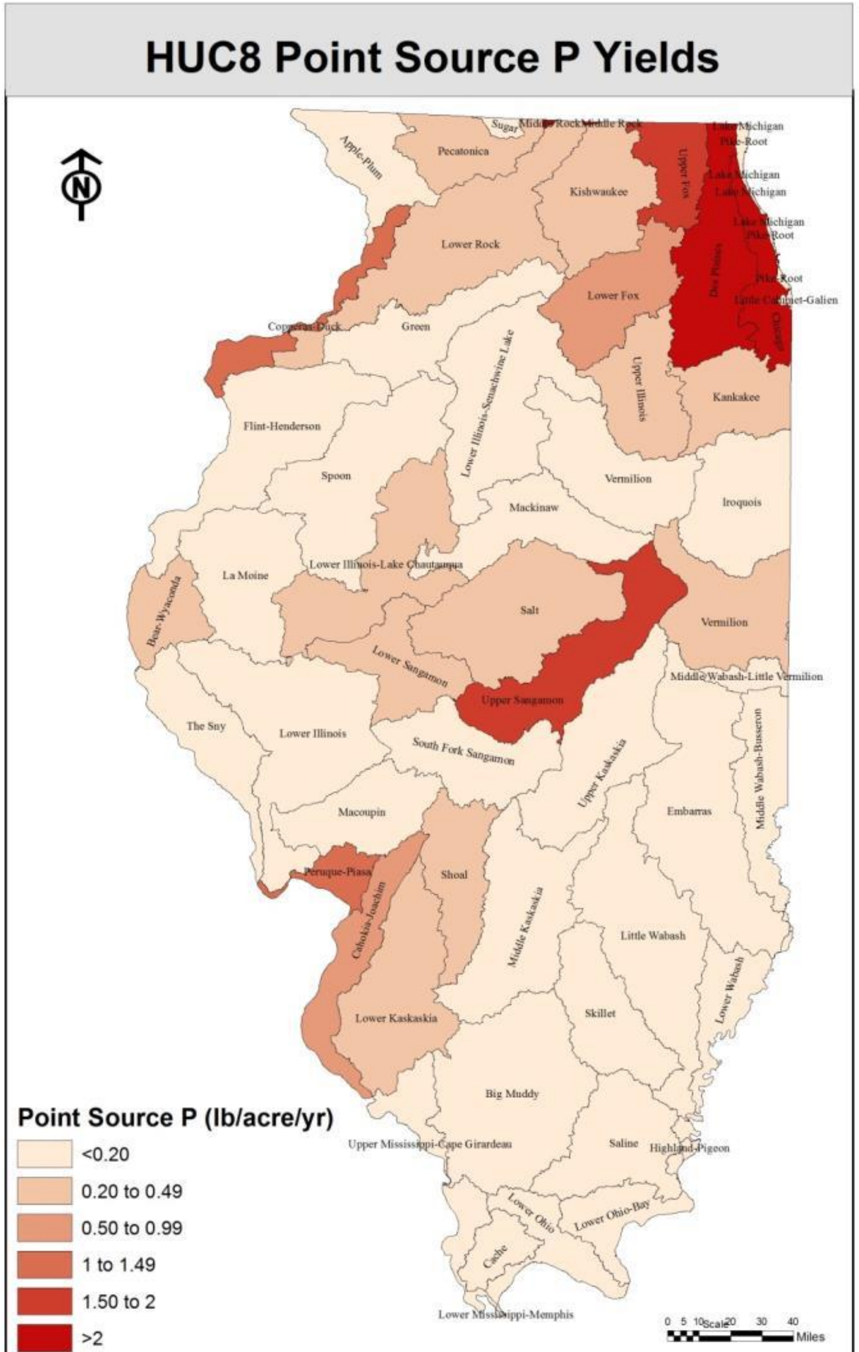
Red line is target, purple is average 1997 to 2011



HUC8 Point Source nitrate-N Yields
N
Pecatonica
Kishwaukee
Upper Fox
Lake Michigan
Pike-Root
Lower Rock
Lower Fox
Des Plaines
Little Calumet-Galien
Chicago
Green
Copperas-Duck
Upper Illinois
Kankakee
Flint-Henderson
Lower Illinois-Senachwine Lake
Spoon
Vermilion
Mackinaw
Iroquois
La Moine
Lower Illinois-Lake Chautauqua
Salt
Bear-Wyaconda
Lower Sangamon
Upper Sangamon
Middle Wabash-Little Vermilion
The Sny
Lower Illinois
South Fork Sangamon
Upper Kaskaskia
Macoupin
Embarras
Middle Wabash-Busseron
Peruque-Piasa
Shoal
Cahokia-Joachim
Middle Kaskaskia
Little Wabash
Lower Wabash
Lower Kaskaskia
Skillet
Big Muddy
Upper Mississippi-Cape Girardeau
Saline
Highland-Pigeon
Lower Ohio
Lower Ohio-Bay
Cache
Lower Mississippi-Memphis
Point Source nitrate-N (lb/acre/yr)
<2
2 to 4.99
5 to 9.99
10 to 14.99
15 to 19.99
20 to 24.99
>25
0 5 10 20 30 40
Scale
Miles



HUC8 Non-Point Source nitrate-N Yields
N
Apple-Plum
Pecatonica
Kishwaukee
Upper Fox
Lake Michigan
Pike-Root
Lower Rock
Lower Fox
Des Plaines
Little Calumet-Galien
Chicago
Green
Copperas-Duck
Upper Illinois
Kankakee
Flint-Henderson
Lower Illinois-Senachwine Lake
Spoon
Vermilion
Mackinaw
Iroquois
La Moine
Lower Illinois-Lake Chautauqua
Salt
Bear-Wyaconda
Lower Sangamon
Upper Sangamon
Middle Wabash-Little Vermilion
The Sny
Lower Illinois
South Fork Sangamon
Upper Kaskaskia
Macoupin
Embarras
Middle Wabash-Busseron
Peruque-Piasa
Shoal
Cahokia-Joachim
Middle Kaskaskia
Little Wabash
Lower Wabash
Lower Kaskaskia
Skillet
Big Muddy
Upper Mississippi-Cape Girardeau
Saline
Highland-Pigeon
Lower Ohio
Lower Ohio-Bay
Cache
Lower Mississippi-Memphis
Non-Point Source nitrate-N (lb/acre/yr)
<5
5 to 9.99
10 to 14.99
15 to 19.99
20 to 24.99
>25
No Data - Avg of nearby HUC8s
0 5 10 20 30 40
Scale
Miles


HUC8 Point Source P Yields
Point Source P (lb/acre/yr)
<0.20
0.20 to 0.49
0.50 to 0.99
1 to 1.49
1.50 to 2
>2
Apple-Plum
Pecatonica
Sugar
Kishwaukee
Upper Fox
Lake Michigan
Pike-Root
Lower Rock
Lower Fox
Des Plaines
Little Calumet-Galien
Chicago
Copperas-Duck
Green
Upper Illinois
Kankakee
Flint-Henderson
Lower Illinois-Senachwine Lake
Spoon
Vermilion
Mackinaw
Iroquois
La Moine
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Skillet
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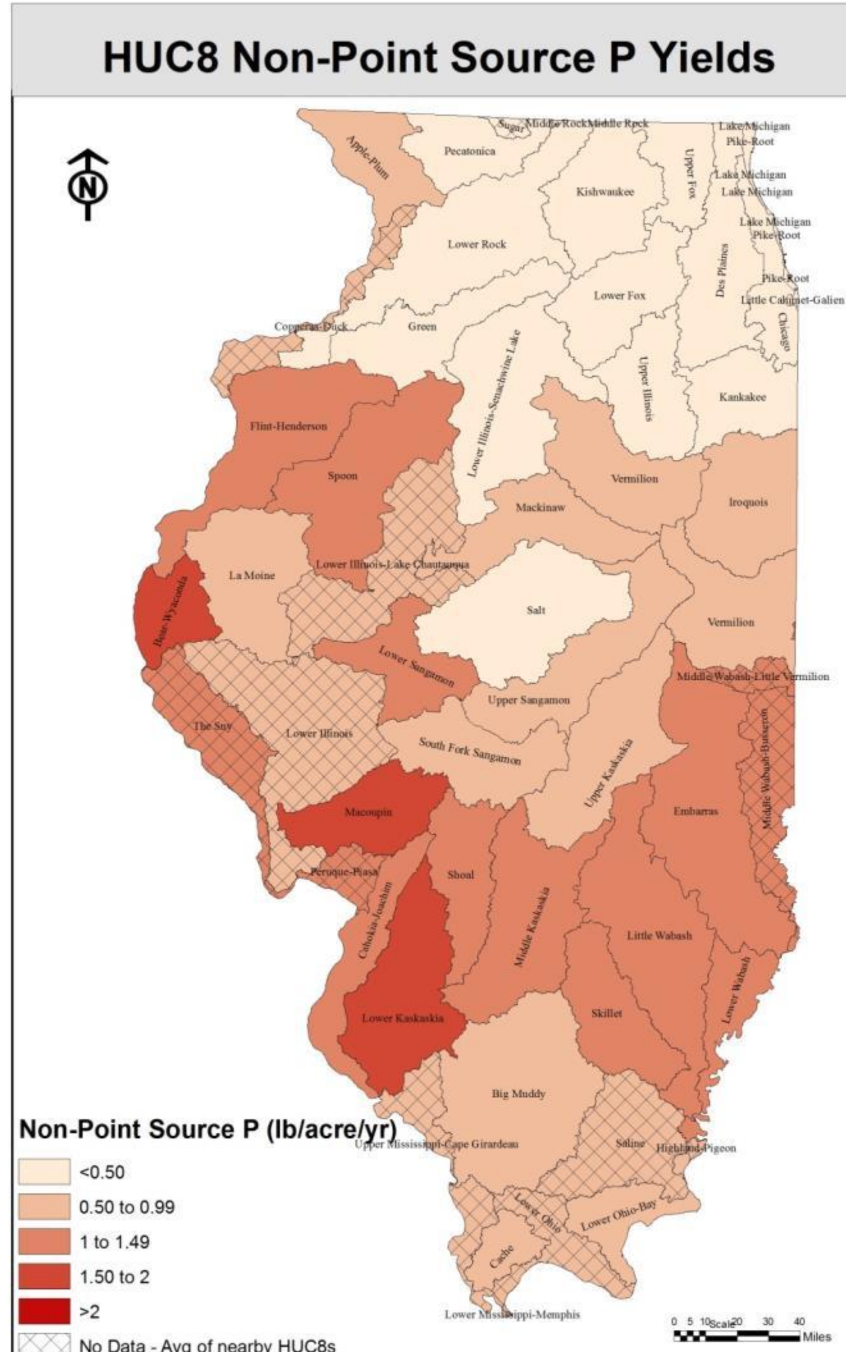
Big Muddy
Upper Mississippi-Cape Girardeau
Saline
Highland-Pigeon
Lower Ohio
Lower Ohio-Bay
Cache
Lower Mississippi-Memphis
0 5 10 20 30 40
Scale
Miles


HUC8 Non-Point Source P Yields
Non-Point Source P (lb/acre/yr)
<0.50
0.50 to 0.99
1 to 1.49
1.50 to 2
>2
No Data - Avg of nearby HUC8s
Apple-Plum
Pecatonica
Sugar
Kishwaukee
Upper Fox
Lake Michigan
Pike-Root
Lower Rock
Lower Fox
Des Plaines
Little Calumet-Galien
Chicago
Copperas-Duck
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Lower Ohio
Lower Ohio-Bay
Cache
Lower Mississippi-Memphis
0 5 10 20 30 40
Scale
Miles

What agricultural practices are available?

- given,
  - it is not typically over fertilization based on current rates and yields
  - may be zero or negative N & P balances in some tile-drained areas of Illinois

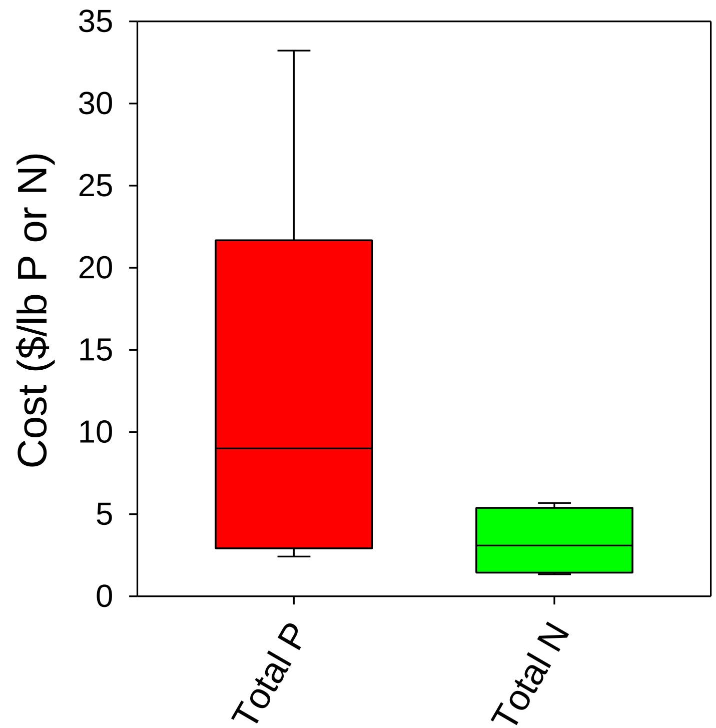
- three types of conservation practices could help
  - nutrient-use efficiency (4Rs)
  - in-field management
  - off-site measures

Cover crops - annual ryegrass and radish
- aerial seeding 09-08-12

Woodchip bioreactors

Constructed wetlands

Point source P and N removal



$13.71/lb for total P at 1.0 mg/L

$3.30/lb for total N at 10 mg/L

Example Statewide Results for N

	Practice/Scenario	Nitrate-N reduction per acre (%)	Nitrate-N reduced (million lb N)	Nitrate-N Reduction % (from baseline)	Cost ($/lb N removed)
	Baseline		410		
In-field	Reducing N rate from background to the MRTN (10% of acres)	10	2.3	0.6	-4.25
	Nitrification inhibitor with all fall applied fertilizer on tile-drained corn acres	10	4.3	1.0	2.33
	Split (50%) fall and spring (50%) on tile-drained corn acres	7.5 to 10	13	3.1	6.22
	Fall to spring on tile-drained corn acres	15 to 20	26	6.4	3.17
	Cover crops on all corn/soybean tile-drained acres	30	84	20.5	3.21
	Cover crops on all corn/soybean non-tiled acres	30	33	7.9	11.02

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In-field	Cover crops on all corn/soybean non-tiled acres	30	33	7.9	11.02
Edge-of-field	Bioreactors on 50% of tile-drained land	40	56	13.6	1.38
Edge-of-field	Wetlands on 25% of tile-drained land	40	28	6.8	5.06
Edge-of-field	Buffers on all applicable crop land (reduction only for water that interacts with active area)	90	36	8.7	1.63

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	Wetlands on 25% of tile-drained land	40	28	6.8	5.06
	Buffers on all applicable crop land (reduction only for water that interacts with active area)	90	36	8.7	1.63
Land use change	Perennial/energy crops equal to pasture/hay acreage from 1987	90	10	2.6	9.34
	Perennial/energy crops on 10% of tile-drained land	90	25	6.1	3.18

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	Cover crops on all corn/soybean non-tiled acres	30	33	7.9	11.02
Edge-of-field	Bioreactors on 50% of tile-drained land	40	56	13.6	1.38
	Wetlands on 25% of tile-drained land	40	28	6.8	5.06
	Buffers on all applicable crop land (reduction only for water that interacts with active area)	90	36	8.7	1.63
Land use change	Perennial/energy crops equal to pasture/hay acreage from 1987	90	10	2.6	9.34
	Perennial/energy crops on 10% of tile-drained land	90	25	6.1	3.18
Point source	Point source reduction to 10 mg nitrate-N/L		14	3.4	3.30
	Point source reduction in N due to biological nutrient removal for P		8	1.8	

Example Statewide Results for P

	Practice/Scenario	Total P reduction per acre (%)	Total P reduced (million lb P)	Total P Reduction % (from baseline)	Cost ($/lb P removed)
	Baseline		37.5		
In-field	Convert 1.8 million acres of conventional till eroding >T to reduced, mulch or no-till	50	1.8	5.0	-16.60
In-field	P rate reduction on fields with soil test P above the recommended maintenance level	7	1.9	5.0	-48.75
In-field	Cover crops on all corn/soybean acres	30	4.8	12.8	130.40
In-field	Cover crops on 1.6 million acres eroding>T currently in reduced, mulch or no-till	50	1.9	5.0	24.50
Edge-of-field	Wetlands on 25% of tile-drained land	0	0	0.0	
Edge-of-field	Buffers on all applicable crop land	25-50	4.8	12.9	11.97
Land use change	Perennial/energy crops equal to pasture/hay acreage from 1987	90	0.9	2.5	102.30
Land use change	Perennial/energy crops on 1.6 million acres>T currently in reduced, mulch or no-till	90	3.5	9.0	40.40
Land use change	Perennial/energy crops on 10% of tile-drained land	50	0.3	0.8	250.07
Point source	Point source reduction to 1.0 mg total P/L (majors only)		8.3	22.1	13.71

USLE method

Example Statewide N & P Scenarios

Name	Combined Practices and/or Scenarios	Nitrate-N (% reduction)	Total P (% reduction)	Cost of Reduction ($/lb)	Annualized Costs (million $/year)
NP1	MRTN, fall to spring, bioreactors 50%, wetlands 25%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, buffers on all applicable lands, point source to 1.0 mg TP/L and 10 mg nitrate-N/L	35	45	**	383
NP2	MRTN, fall to spring, bioreactors 50%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, cover crops on all CS, point source to 1.0 mg TP/L and 10 mg nitrate-N/L	45	45	**	810
NP3	MRTN, fall to spring, bioreactors 15%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, cover crops on 87.5% of CS, buffers on all applicable lands, perennial crops on 1.6 million ac >T, and 0.9 million additional ac.	45	45	**	791

Example Statewide N & P Scenarios

Name	Combined Practices and/or Scenarios	Nitrate-N (% reduction)	Total P (% reduction)	Cost of Reduction ($/lb)	Annualized Costs (million $/year)
NP1	MRTN, fall to spring, bioreactors 50%, wetlands 25%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, buffers on all applicable lands, point source to 1.0 mg TP/L and 10 mg nitrate-N/L	35	45	**	383
NP2	MRTN, fall to spring, bioreactors 50%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, cover crops on all CS, point source to 1.0 mg TP/L and 10 mg nitrate-N/L	45	45	**	810
NP3	MRTN, fall to spring, bioreactors 15%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, cover crops on 87.5% of CS, buffers on all applicable lands, perennial crops on 1.6 million ac >T, and 0.9 million additional ac.	45	45	**	791
NP4	MRTN, fall to spring N, bioreactors 35%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, buffers on 80% of all applicable land	20	20	**	48
NP5	MRTN, fall to spring N, bioreactors 30%, wetlands 15%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, point source to 1.0 mg TP/L and 10 mg nitrate-N/L on 45% of discharge	20	20	**	66
NP6	MRTN, fall to spring N, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, cover crops on 1.6 million ac eroding >T and 40% of all other CS	24	20	**	244

Conclusions

- no simple solution, or one method to achieve goals
- will take a range of point and non point source reductions to meet targets
- initial focus could be:
  - point source P reductions ($114 million per year)
  - tile-drained nitrate reductions by agriculture (range of costs)
- strategy will get us started