

The Science Behind the Illinois Nutrient Loss Reduction Strategy

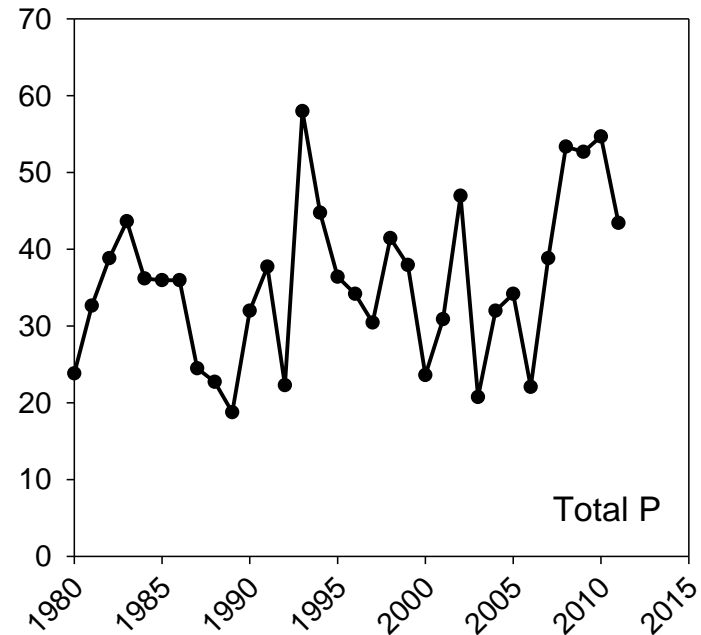
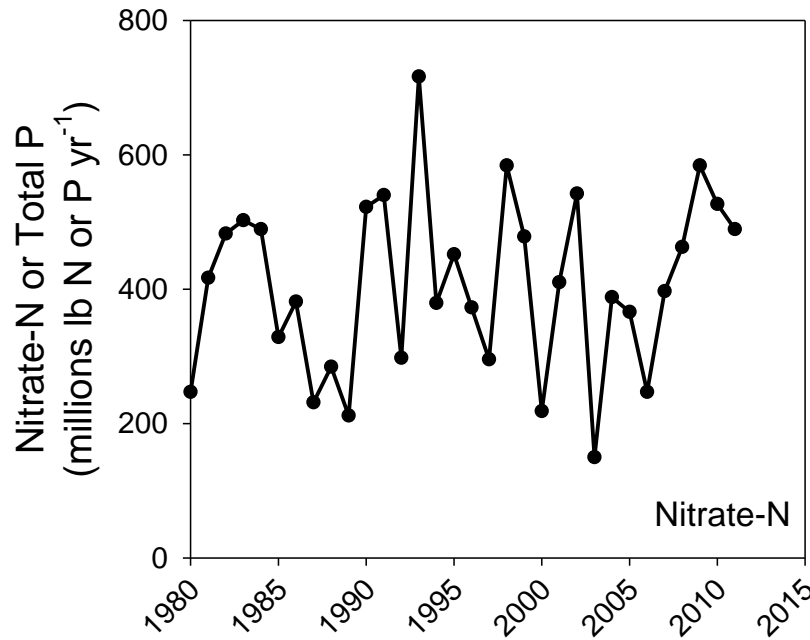
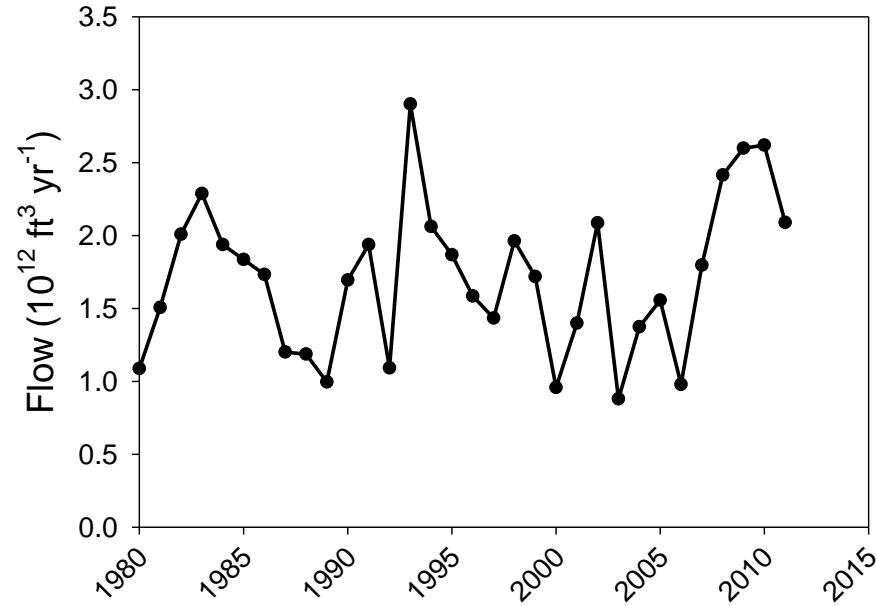
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What we did

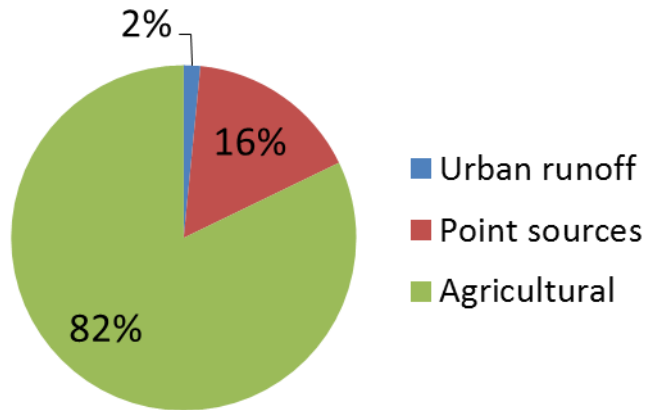
- science based technical assessment of:
 - current conditions in Illinois of nutrient sources and export by rivers
 - methods that could be used to reduce these losses and their effectiveness
 - estimates of the costs to reduce nutrient losses to meet local and Gulf of Mexico goals

Water and nutrients leaving state are variable

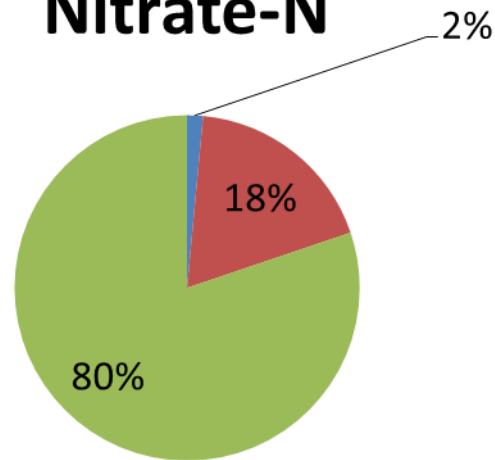


Illinois Nutrient Sources

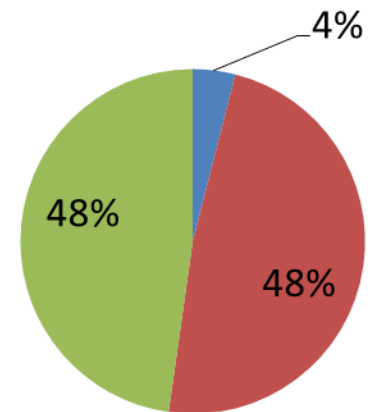
Total N



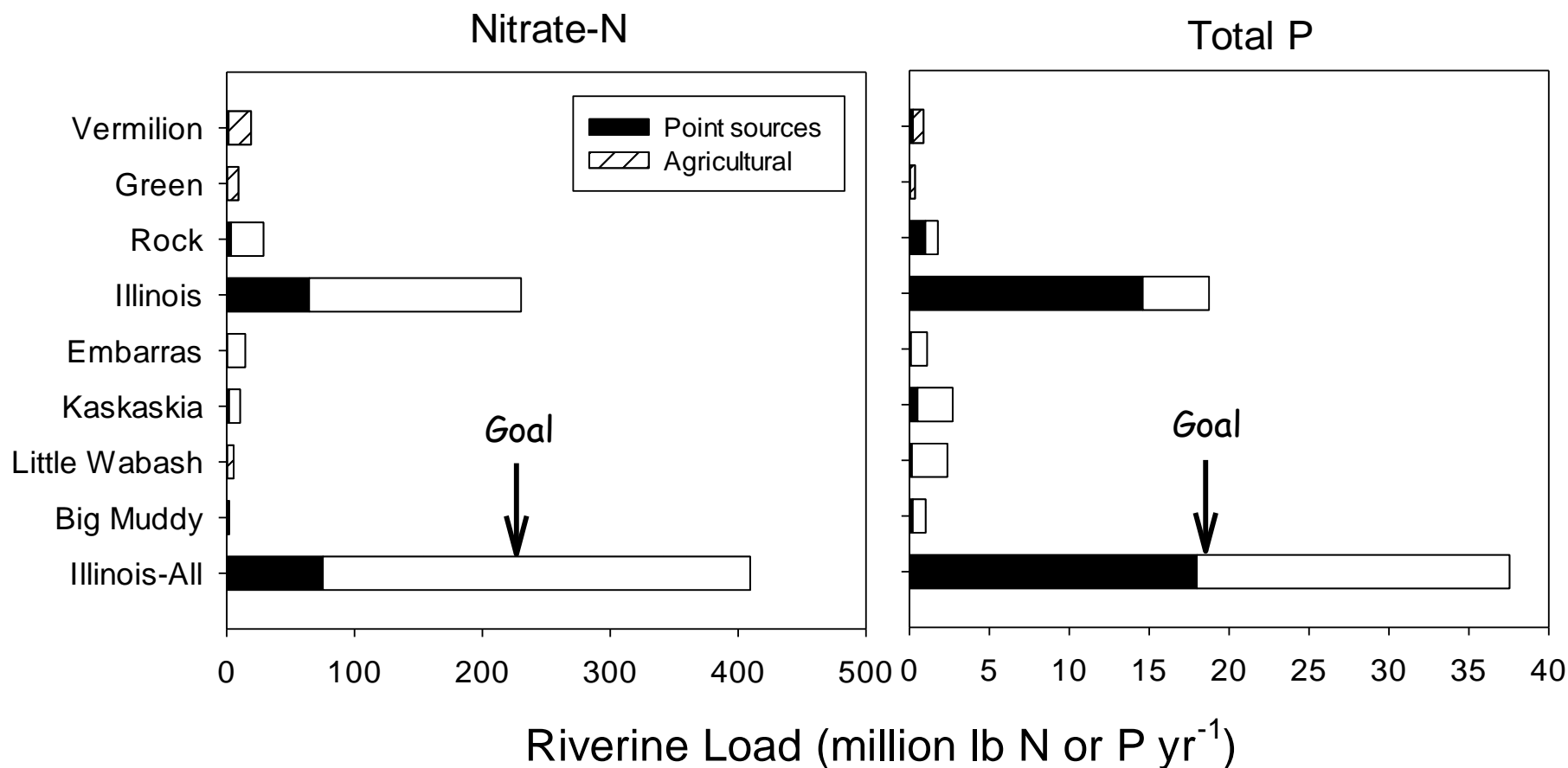
Nitrate-N



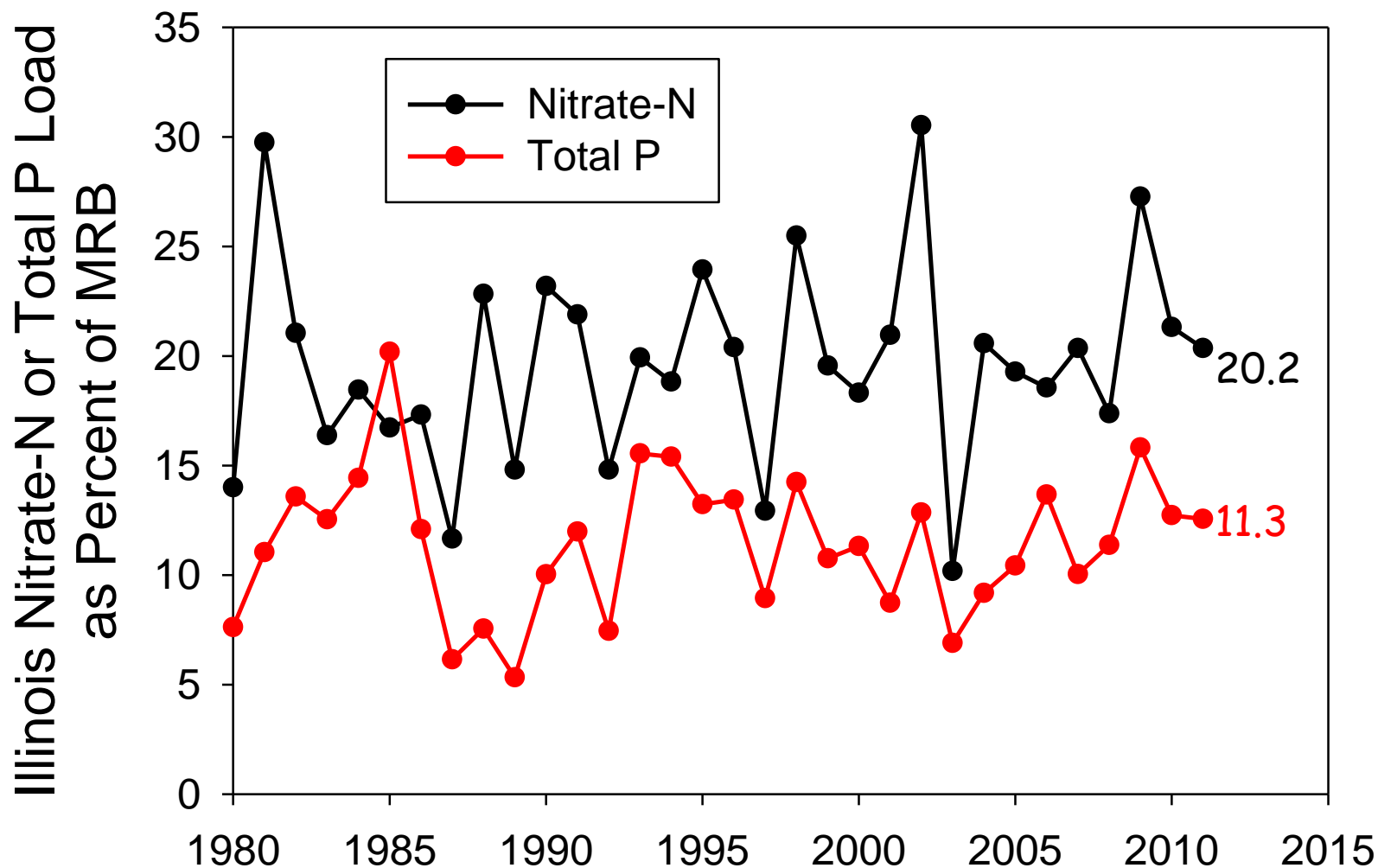
Total P



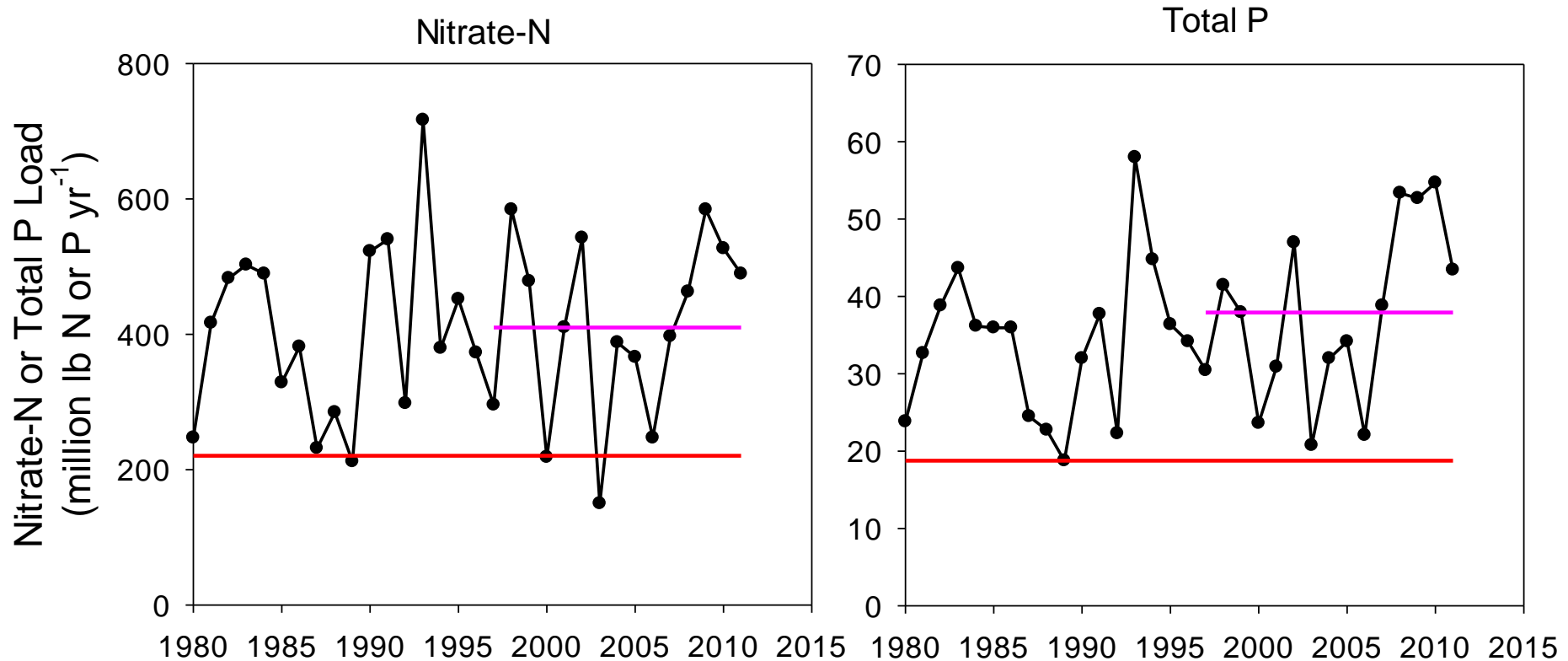
Point and agricultural sources



Illinois as % of MRB

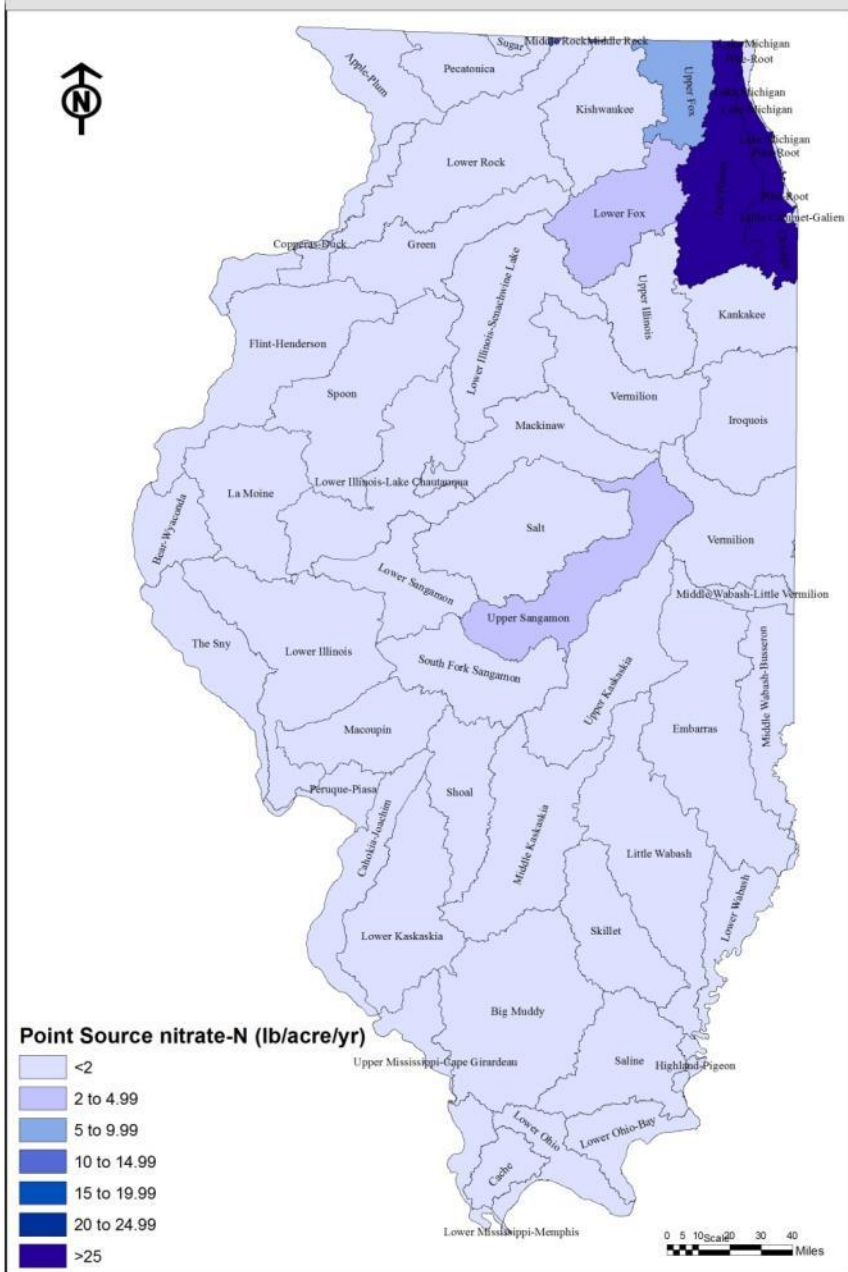


Targets call for large reductions

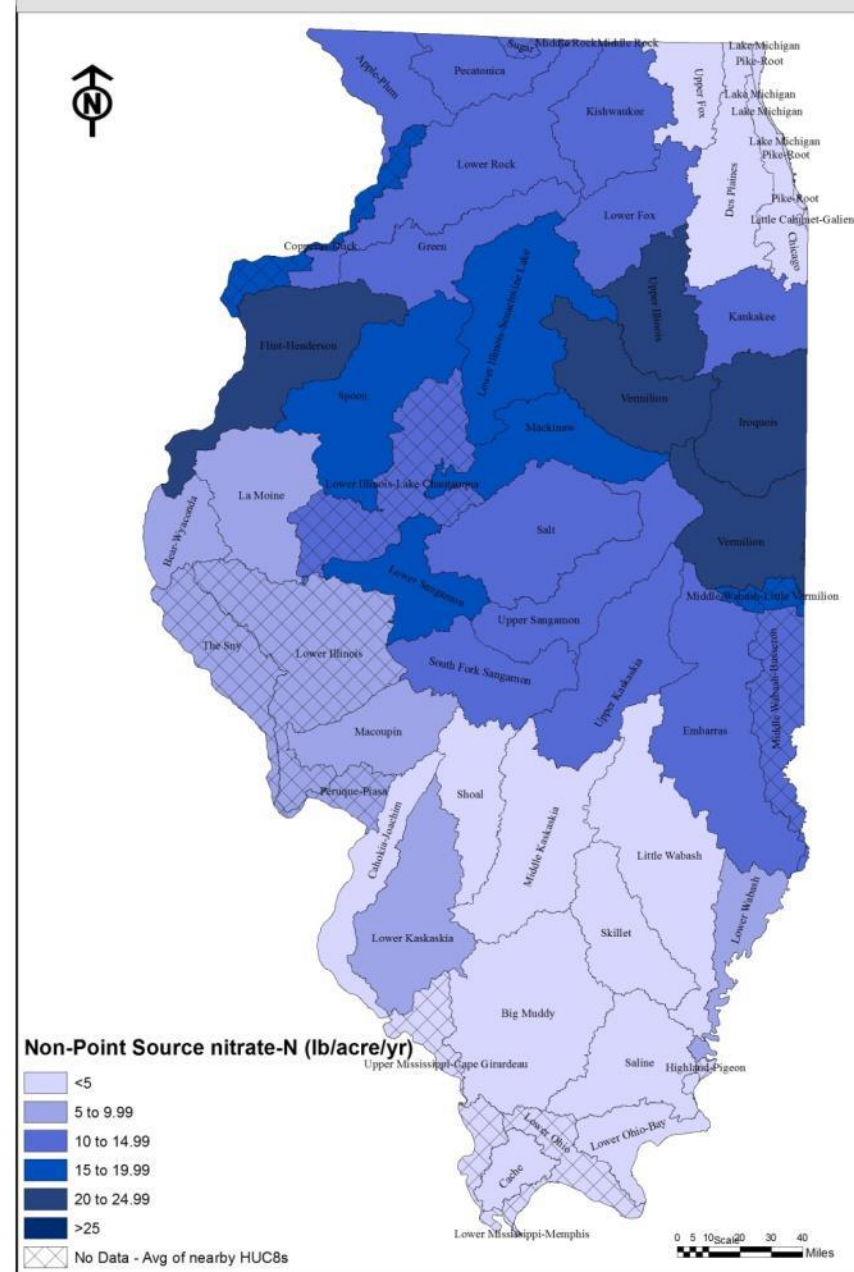


Red line is target, purple is average 1997 to 2011

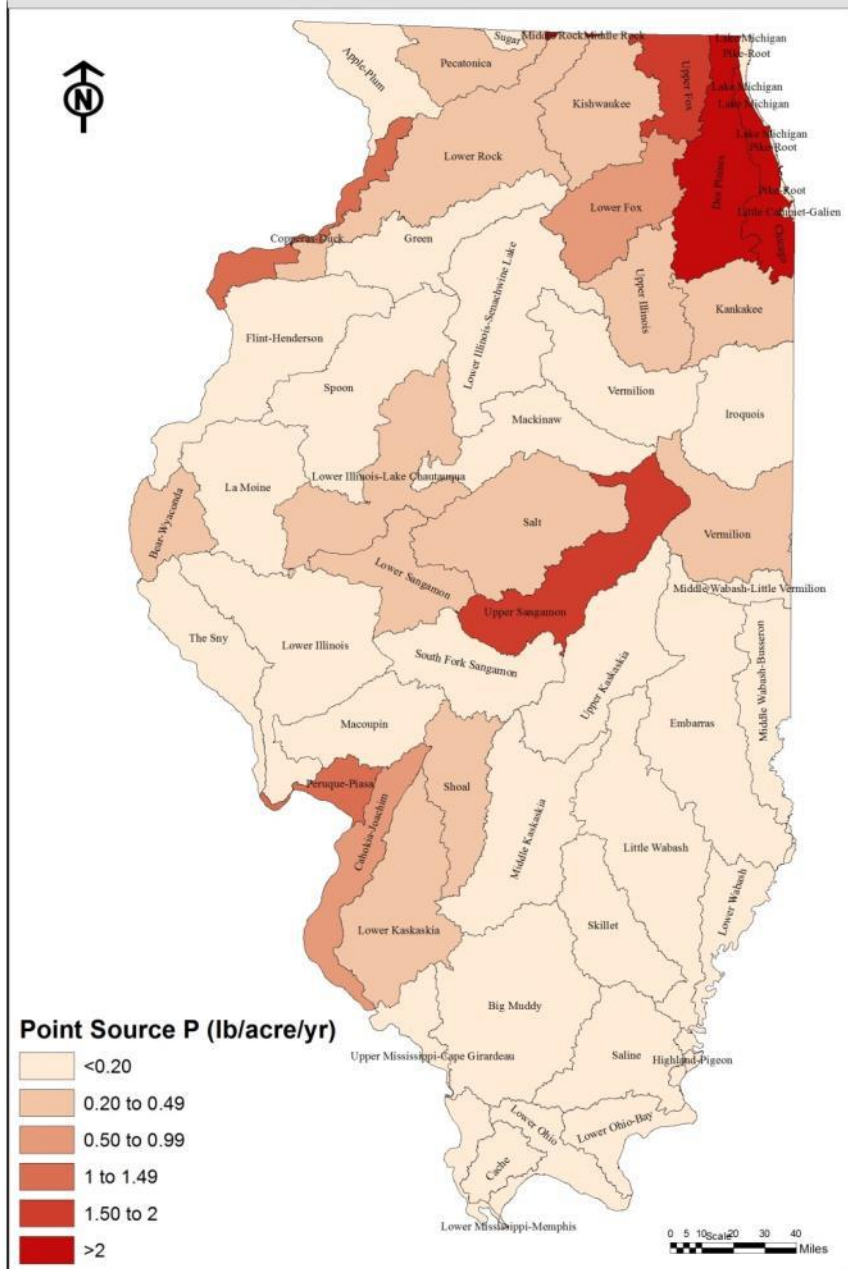
HUC8 Point Source nitrate-N Yields



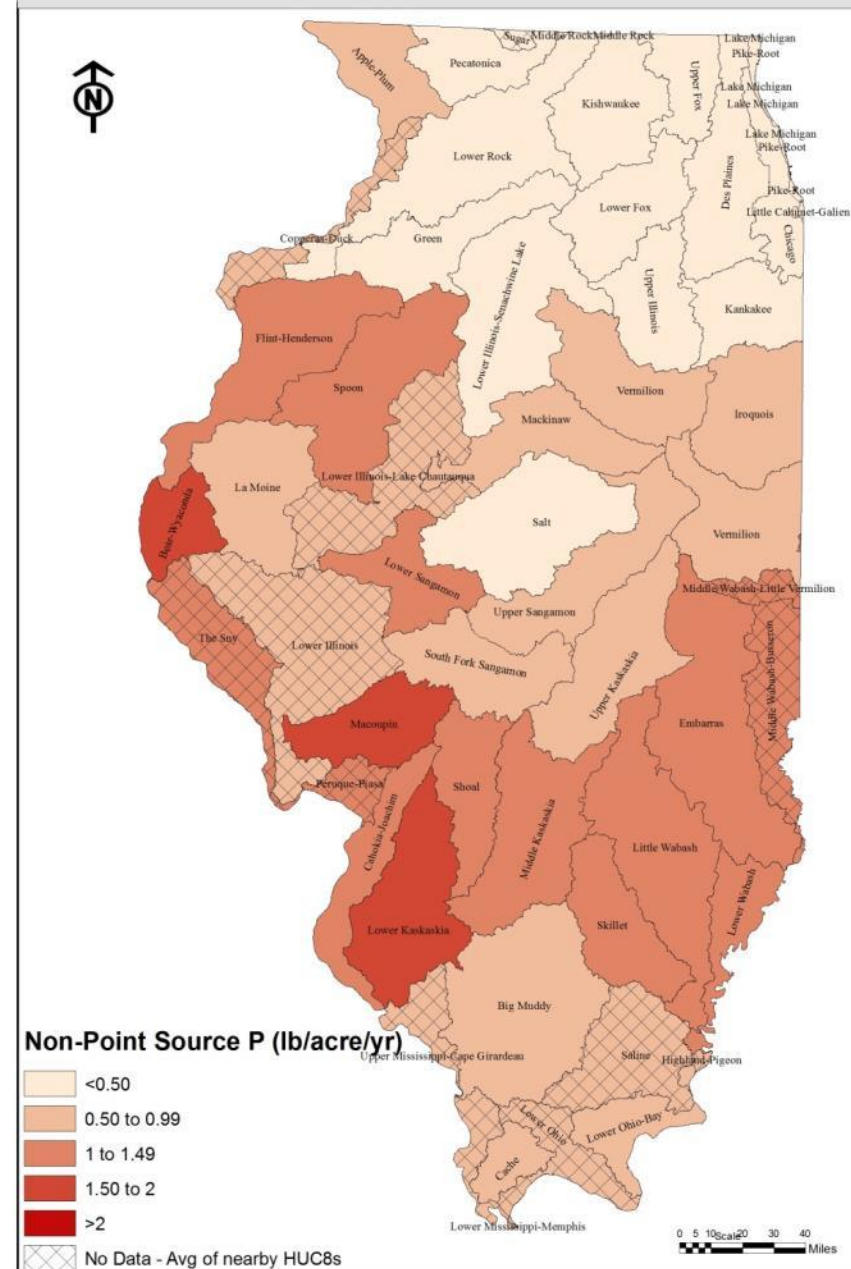
HUC8 Non-Point Source nitrate-N Yields



HUC8 Point Source P Yields



HUC8 Non-Point Source P Yields



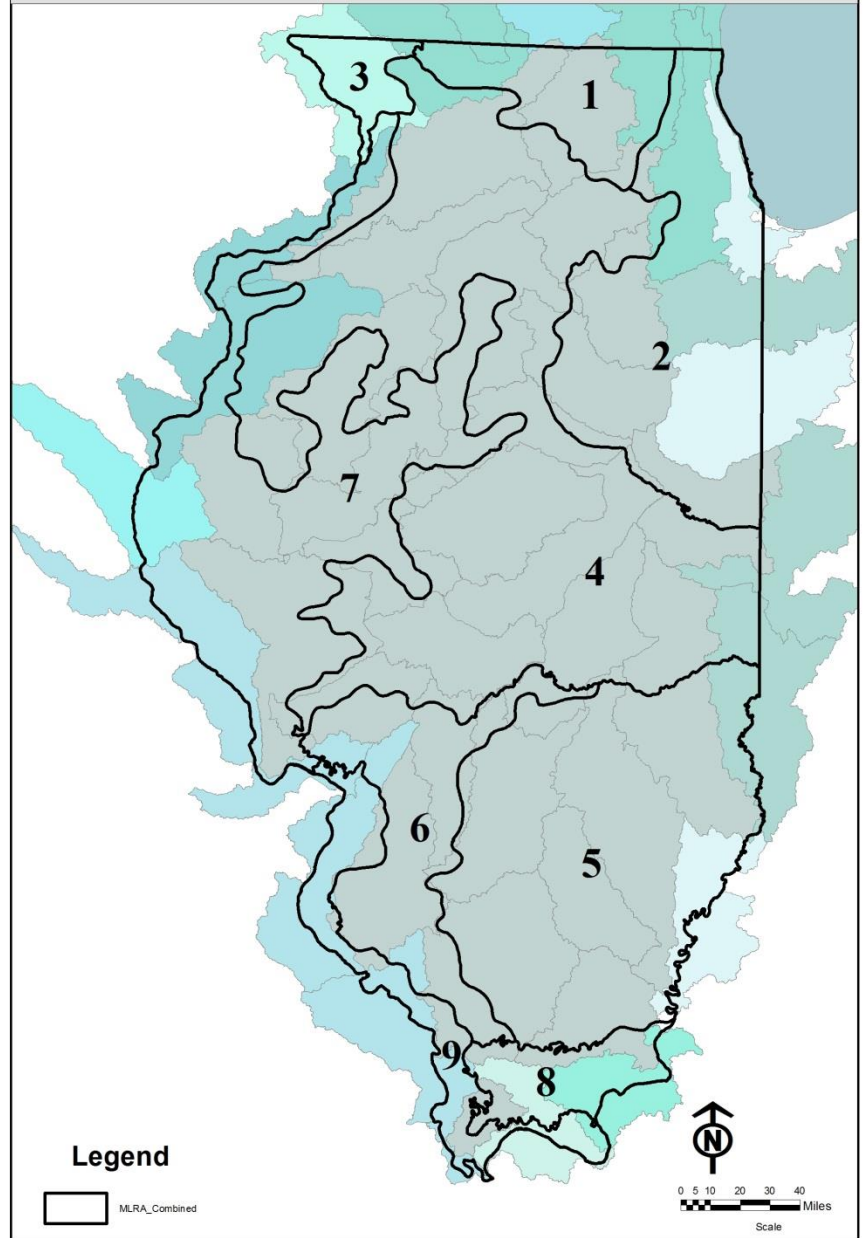
Major Land Resource Areas (MLRAs) in Illinois are shown by combinations to be used for analysis (15 combined into 9). Bold MLRAs are the numbers that will be used throughout our analysis.

MLRA	Description	Landscape		Climate		
		Elevation m (ft)	Local Relief m (ft)	Precipitation mm (inches)	Annual Temperature °C (°F)	Freeze Free Days
95B	Southern Wisconsin and Northern Illinois Drift Plain	200 to 300 (660 to 980)	8 (25)	760 to 965 (30 to 38)	6 to 9 (43 to 48)	170
97	Southwestern Michigan Fruit and Truck Crop Belt	200 to 305 (600 to 1000)	2 to 5 (5 to 15)	890 to 1,015 (35 to 40)	8 to 11 (47 to 52)	200
98	Southern Michigan and Northern Indiana Drift Plain	175 to 335 (570 to 1,100)	15 (5)	735 to 1,015 (29 to 40)	7 to 10 (44 to 50)	175
110	Northern Illinois and Indiana Heavy Till Plain	200 (650)	3 to 8 (10 to 25)	785 to 1,015 (31 to 40)	7 to 11 (42 to 52)	185
105	Northern Mississippi Valley Loess Hills	200 to 400 (660 to 1,310)	3 to 6 (10 to 20)	760 to 965 (30 to 38)	6 to 10 (42 to 50)	175
108A	Illinois and Iowa Deep Loess and Drift, Eastern Part	200 to 300 (660 to 985)	1 to 3 (3 to 10)	890 to 1,090 (35 to 43)	8 to 12 (47 to 54)	195
108B	Illinois and Iowa Deep Loess and Drift, East-Central Part	200 to 300 (660 to 985)	1 to 3 (3 to 10)	840 to 990 (33 to 39)	8 to 12 (47 to 54)	185
113	Central Claypan Areas	200 (660)	1.5 to 3 (5 to 10)	915 to 1,170 (36 to 46)	11 to 14 (51 to 57)	205
115A	Central Mississippi Valley Wooded Slopes, Eastern Part	100 to 310 (320 to 1,020)	3 to 15 (10 to 50)	1,015 to 1,195 (40 to 47)	11 to 14 (53 to 57)	210
114B	Southern Illinois and Indiana Thin Loess and Till Plain, Western Part	105 to 365 (350 to 1,190)	3 to 15 (10 to 50)	940 to 1,170 (37 to 46)	11 to 14 (52 to 56)	210
115C	Central Mississippi Valley Wooded Slopes, Northern Part	130 to 270 (420 to 885)	3 to 6 (10 to 20)	865 to 1,015 (34 to 40)	9 to 13 (48 to 55)	200
120A	Kentucky and Indiana Sandstone and Shale Hills and Valleys, Southern Part	105 to 290 (345 to 950)	Varies widely	1,145 to 1,370 (45 to 54)	13 to 14 (55 to 58)	210
115B	Central Mississippi Valley Wooded Slopes, Western Part	100 to 310 (320 to 1,020)	3 to 15 (10 to 50)	965 to 1,220 (38 to 48)	12 to 14 (53 to 57)	205
131A	Southern Mississippi River Alluvium	0 to 100 (0 to 330)	Max 5 (15)	1,170 to 1,525 (46 to 60)	14 to 21 (56 to 69)	210 (North)
134	Southern Mississippi Valley Loess	25 to 185 (80 to 600)	3 to 6 (10 to 20)	1,195 to 1,525 (47 to 60)	14 to 20 (57 to 68)	215 (North)

Major Land Resource Areas (MLRAs) from NRCS

Compiled
agricultural
data at various
scales,
combined using
GIS to nine
MLRAs

Combined MLRAs for Illinois
(Overlaid with HUC 8s & Counties)



Agricultural Management by MLRA

Combined MLRA	Description	Corn (acres)	Soybean (acres)	Wheat (acres)	Drained acres (% of crop acres)	Corn yield (bushels /acre)	Soybean yield (bushels /acre)
MLRA 1	Northern Illinois drift plain	515,905	224,186	20,192	288,491 (39)	161	48
MLRA 2	Northeastern Illinois heavy till plain	1,532,100	1,111,885	42,404	2,063,695 (78)	150	39
MLRA 3	Northern Mississippi Valley	163,507	52,432	1,975	20,942 (10)	160	50
MLRA 4	Deep loess and drift	5,579,980	3,343,444	76,078	5,437,807 (61)	164	52
MLRA 5	Claypan	1,609,633	1,991,939	352,839	310,087 (9)	128	39
MLRA 6	Thin loess and till	664,242	689,773	161,180	226,971 (17)	130	42
MLRA 7	Central Mississippi Valley, Northern Part	2,058,853	1,288,686	73,884	1,284,588 (38)	155	49
MLRA 8	Sandstone and shale hills and valleys	83,969	115,244	10,658	49,565 (25)	103	33
MLRA 9	Central Mississippi Valley, Western Part	203,736	314,662	78,250	23,769 (5)	125	39
Sum		12,411,925	9,132,251	817,460	9,705,916 (43)		

Average crop acres and yields 2008 through 2012

Nitrate Yield by MLRA

Combined MLRA	Description	Drained cropland (acres)	Nitrate-N yield per row crop acre (lb N/acre/yr)	Nitrate-N yield per tile drained acre (lb N/acre/yr)	Nitrate-N yield from non-tiled land (lb N/acre/yr)
MLRA 1	Northern Illinois drift plain	288,491	20.4	43	6.6
MLRA 2	Northeastern Illinois heavy till plain	2,063,695	25.0	29	10.8
MLRA 3	Northern Mississippi Valley	20,942	31.3		31.3
MLRA 4	Deep loess and drift	5,437,807	19.6	26	9.9
MLRA 5	Claypan	310,087	6.6		6.6
MLRA 6	Thin loess and till	226,971	7.4	30	3.5
MLRA 7	Central Mississippi Valley, Northern Part	1,284,588	24.5	46	11.8
MLRA 8	Sandstone and shale hills and valleys	49,565	3.9		3.9
MLRA 9	Central Mississippi Valley, Western Part	23,769	4.0		4.0

Agricultural Cost Estimates

- No changes in corn and soybean yields across scenarios
- No reduction in nitrogen application rates with timing changes
- Up front costs amortized over 20 years at 6% interest rate

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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	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

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	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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	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
	P rate reduction on fields with soil test P above the recommended maintenance level	7	1.9	5.0	-48.75
	Cover crops on all corn/soybean acres	30	4.8	12.8	130.40
	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	
	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
	Perennial/energy crops on 1.6 million acres>T currently in reduced, mulch or no-till	90	3.5	9.0	40.40
	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

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

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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

Final comments

- no simple solution, or one method to achieve goals
 - no one practice works for every acre, but every acre needs at least one new practice
- will take a range of point and non point source reductions to meet targets
- strategy will get us started

Thank you

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