The Effects of Conservation Practices on Phosphorus Losses from Row Crop Agriculture in the St. Joseph River Watershed, USA

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Conservation Programs in the US

- $57.7 billion for conservation spending in the 2008 farm bill
- $37.38/resident/year
- Conservation Effects Assessment Project (CEAP) to help account for public benefits of conservation spending

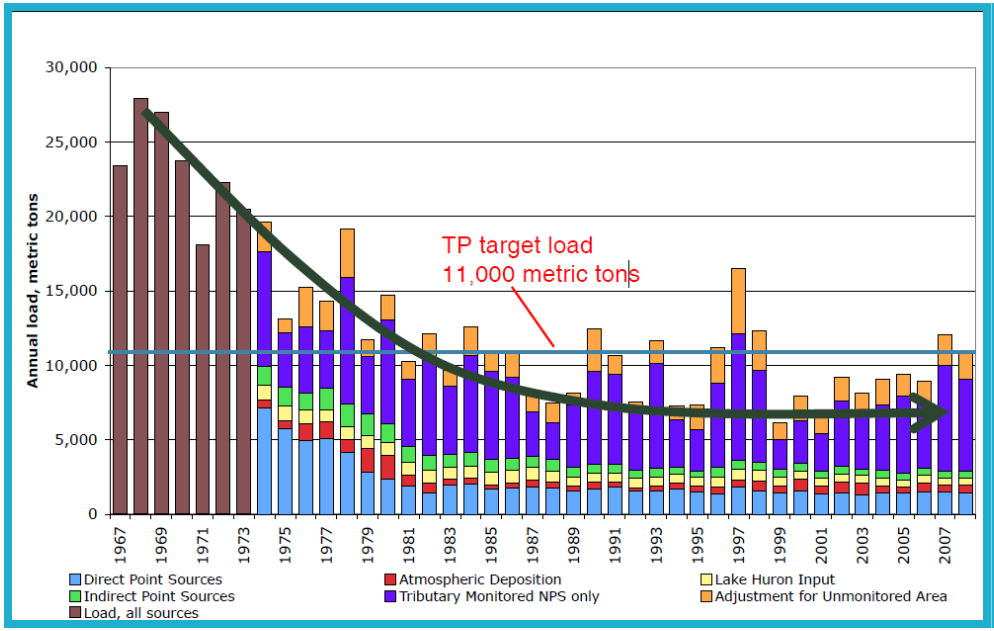
Western Lake Erie Basin

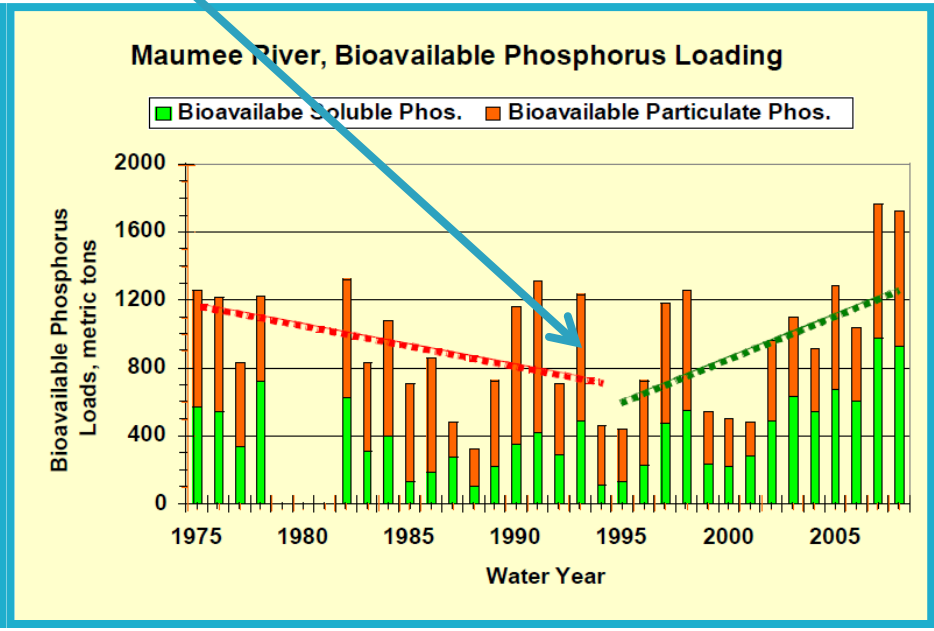
- WLEB = 20,000 km^2
- Aerial P loadings

	DRP (kg/ha/yr)	TP (kg/ha/yr)
Maumee	0.27	1.12
Sandusky	0.31	1.41
Honey Cr.	0.37	1.29
Rock Cr.	0.25	1.38

Total and Soluble Phosphorus Loading

"Peak" adoption of no-till





Dave Baker and Pete Richards, Heidelberg University

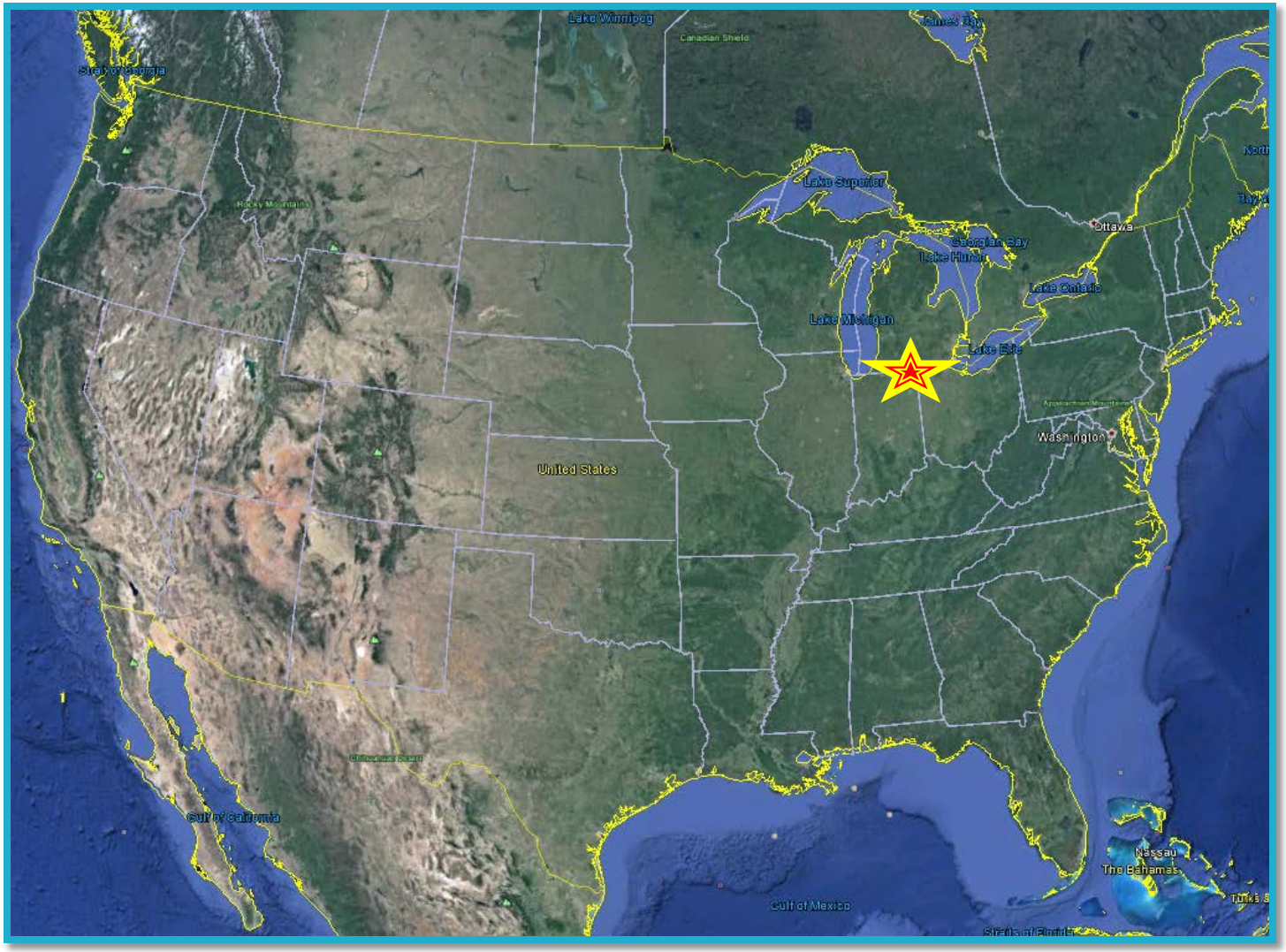
Lake Erie and Harmful Algal Blooms

2011 Central Lake Erie Basin Microcystin bloom

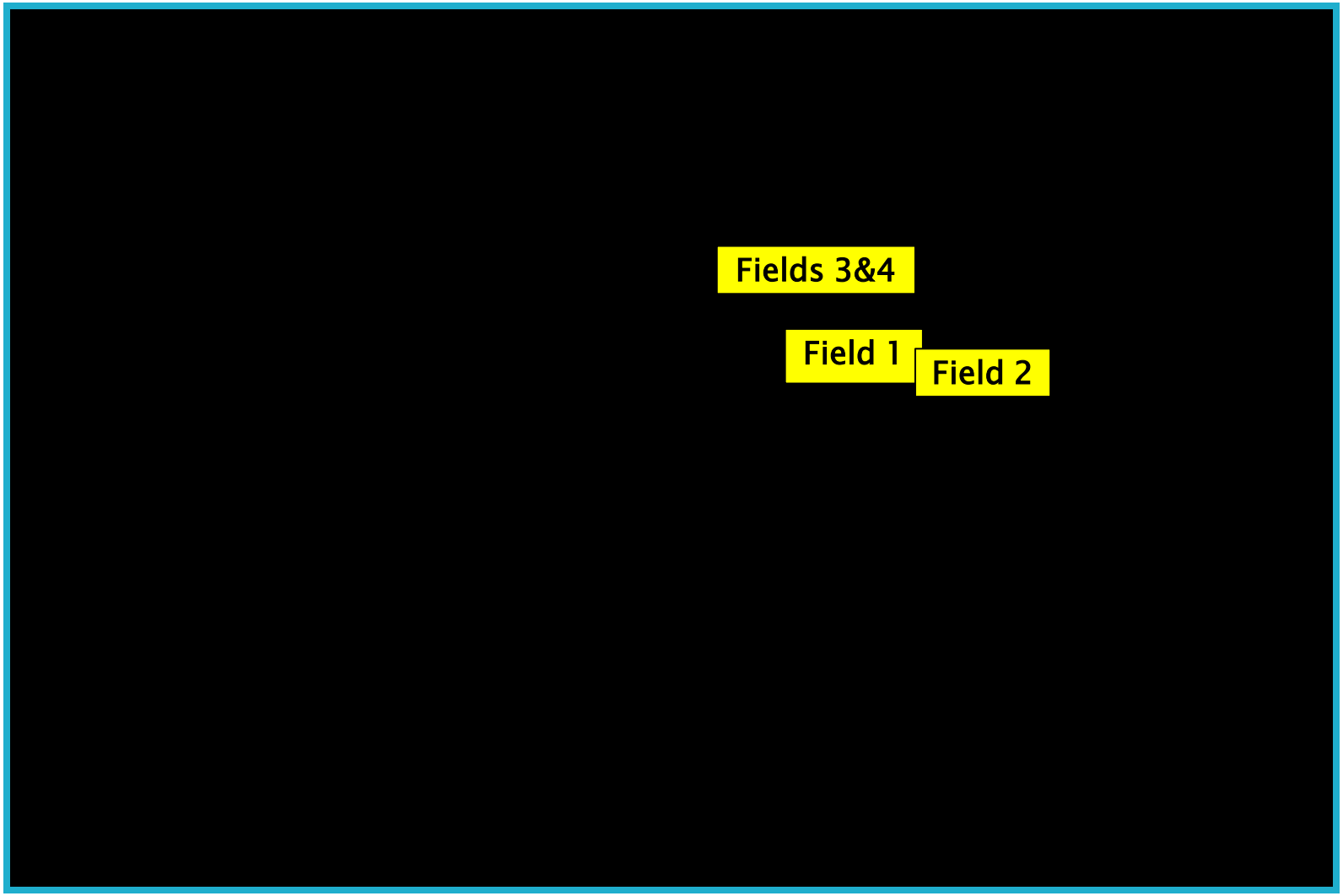
Objectives

- Impacts of Conservation Practices at field scale
  - Grassed Waterway
  - No-till
  - Conservation Crop Rotation
  - Blind Inlet

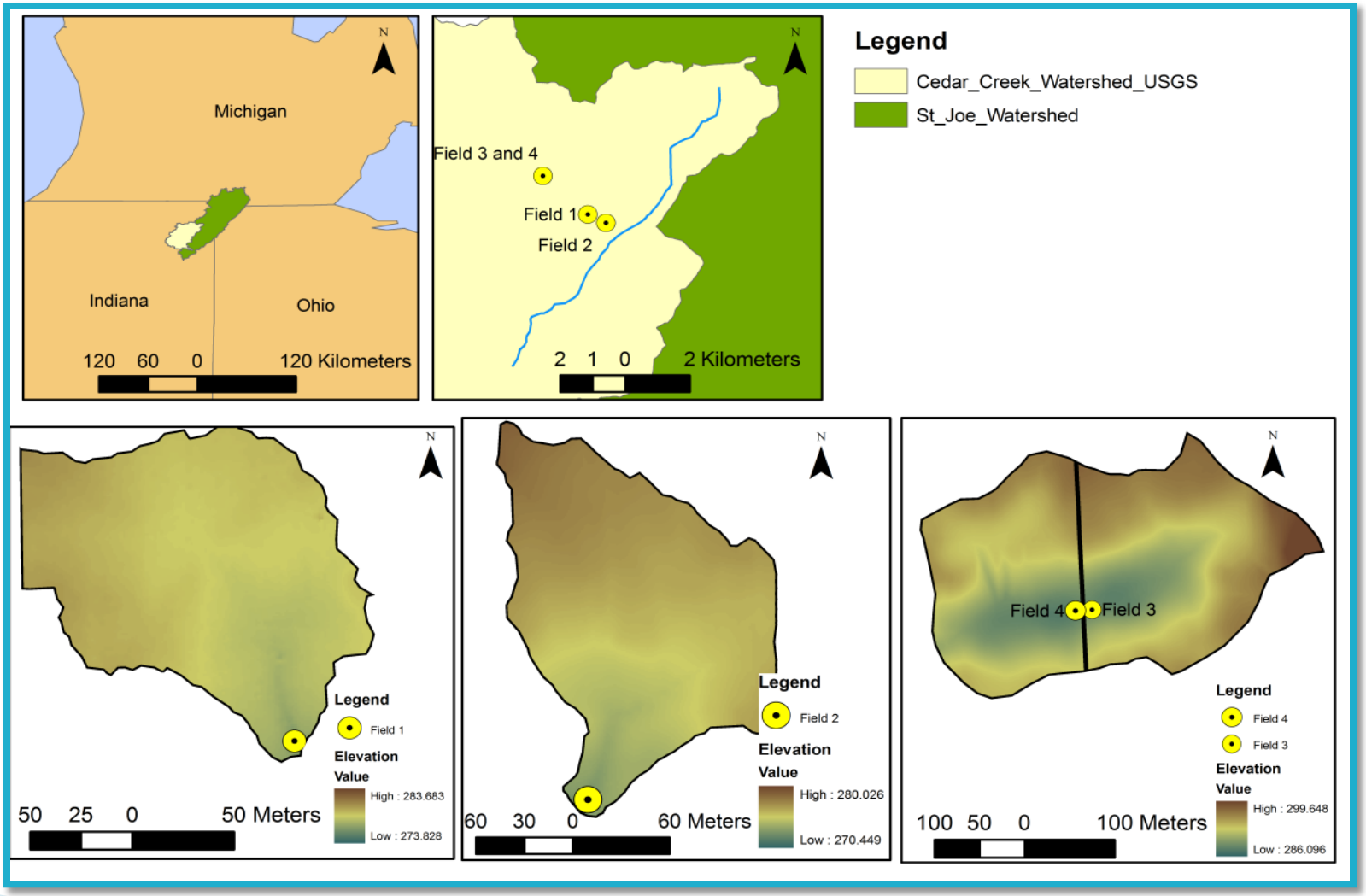
Watershed Location



St. Joseph River Watershed

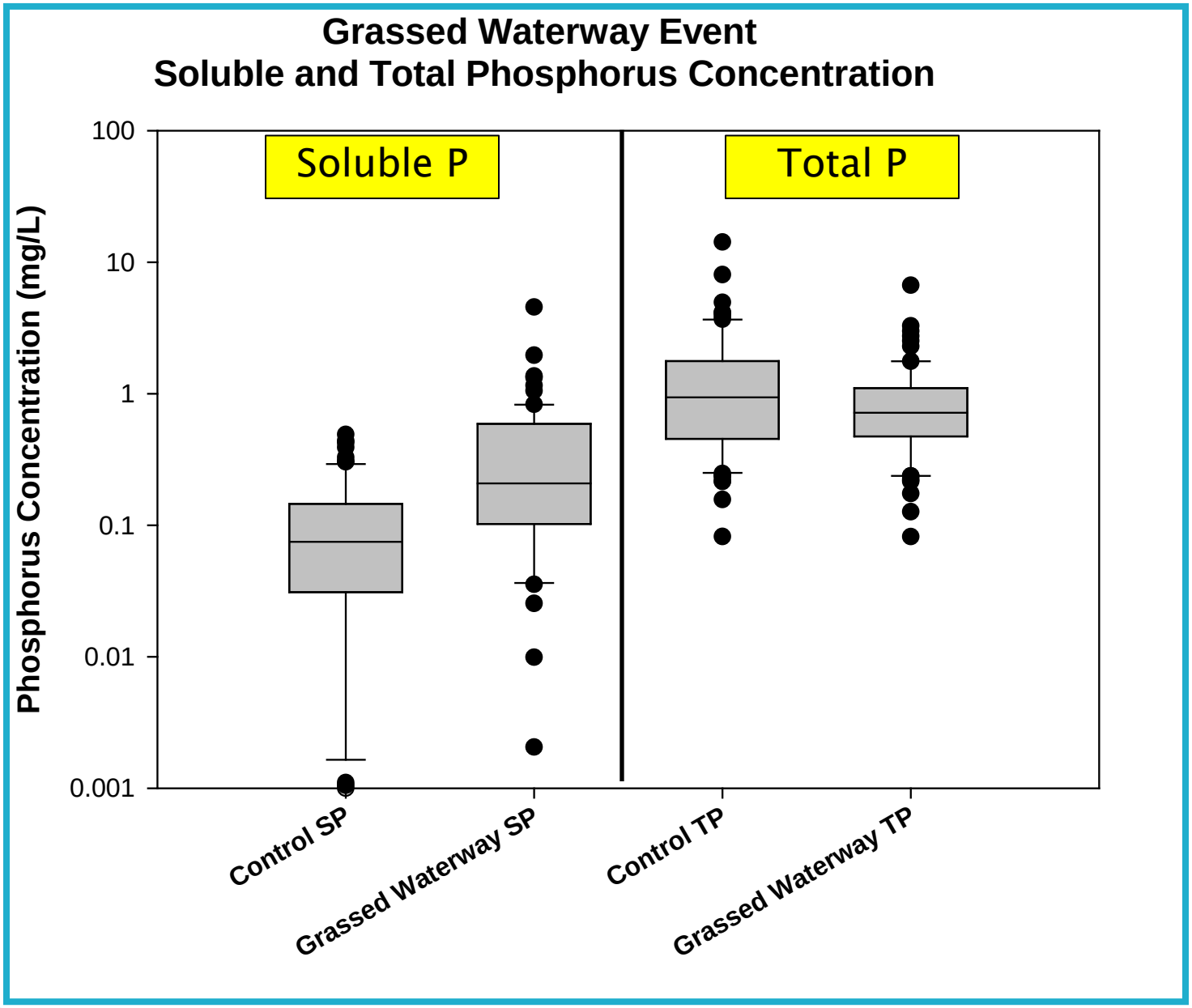


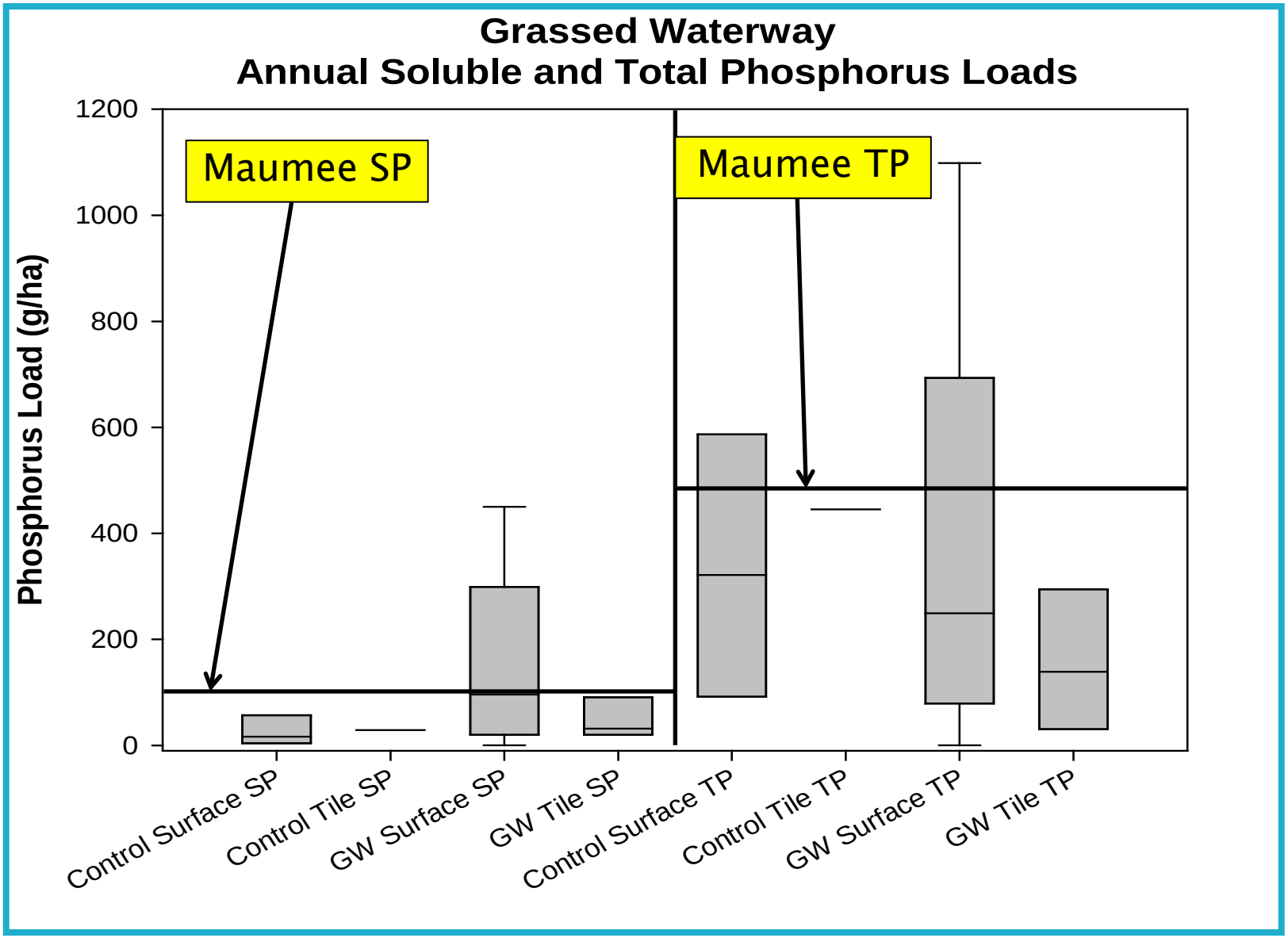
Monitored Fields



Monitoring Site

Grassed Waterway

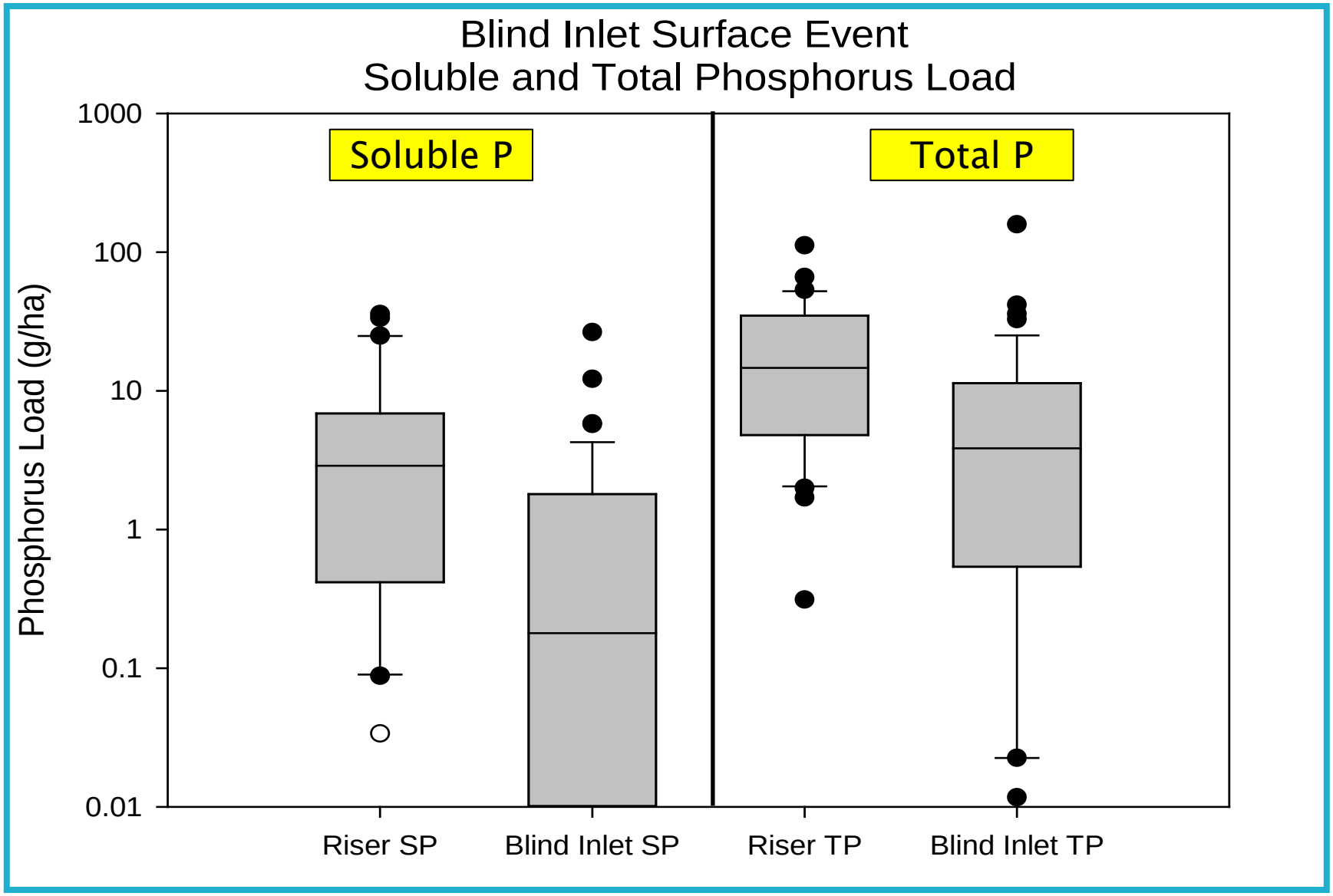

Grassed Waterway Event
Soluble and Total Phosphorus Concentration
Phosphorus Concentration (mg/L)
100
10
1
0.1
0.01
0.001
Soluble P
Total P
Control SP
Grassed Waterway SP
Control TP
Grassed Waterway TP

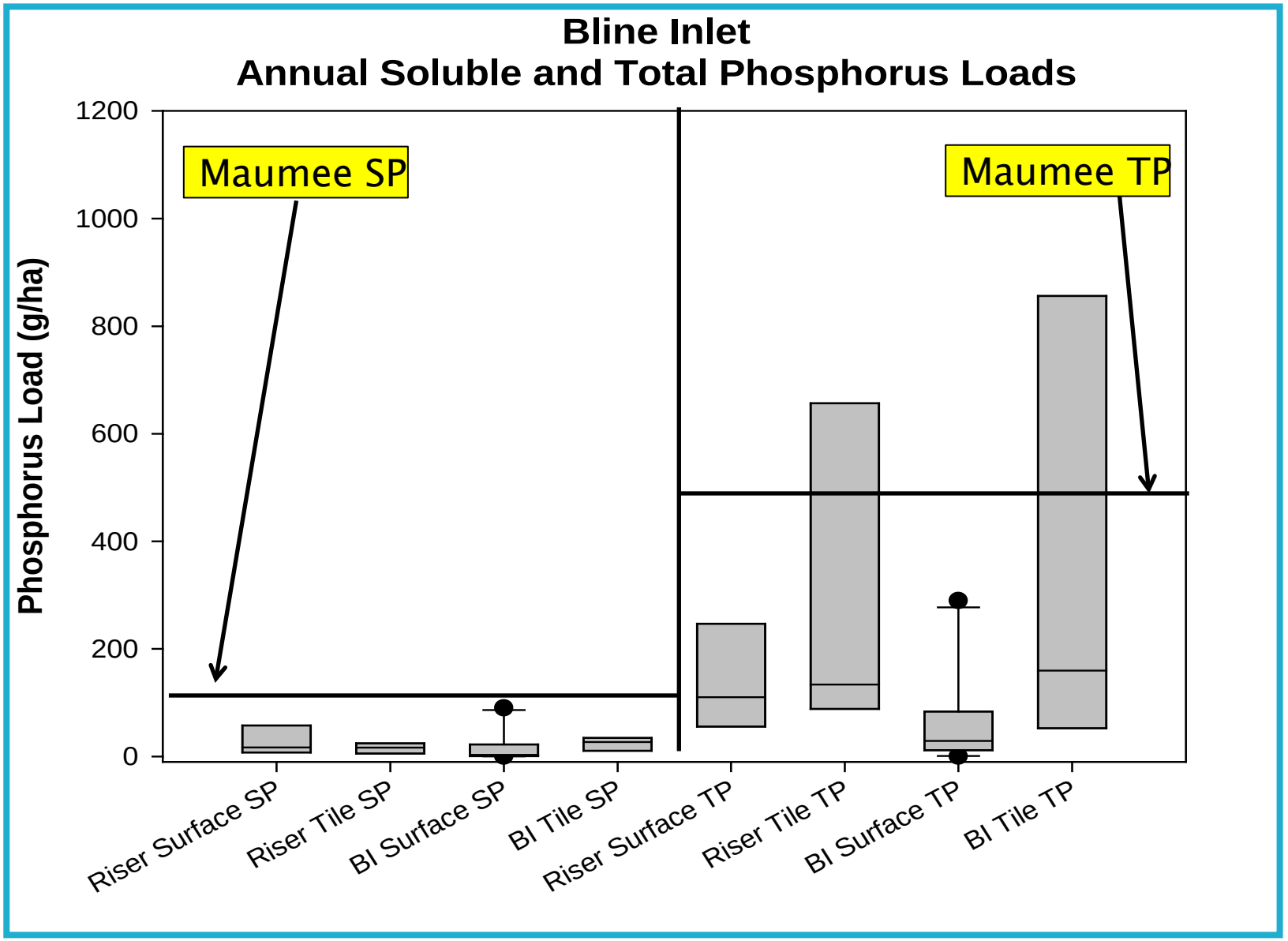

Grassed Waterway
Annual Soluble and Total Phosphorus Loads
Phosphorus Load (g/ha)
1200
1000
800
600
400
200
0
Maumee SP
Maumee TP
Control Surface SP
Control Tile SP
GW Surface SP
GW Tile SP
Control Surface TP
Control Tile TP
GW Surface TP
GW Tile TP

Alternative Surface Drainage

Tile Riser

Blind Inlet

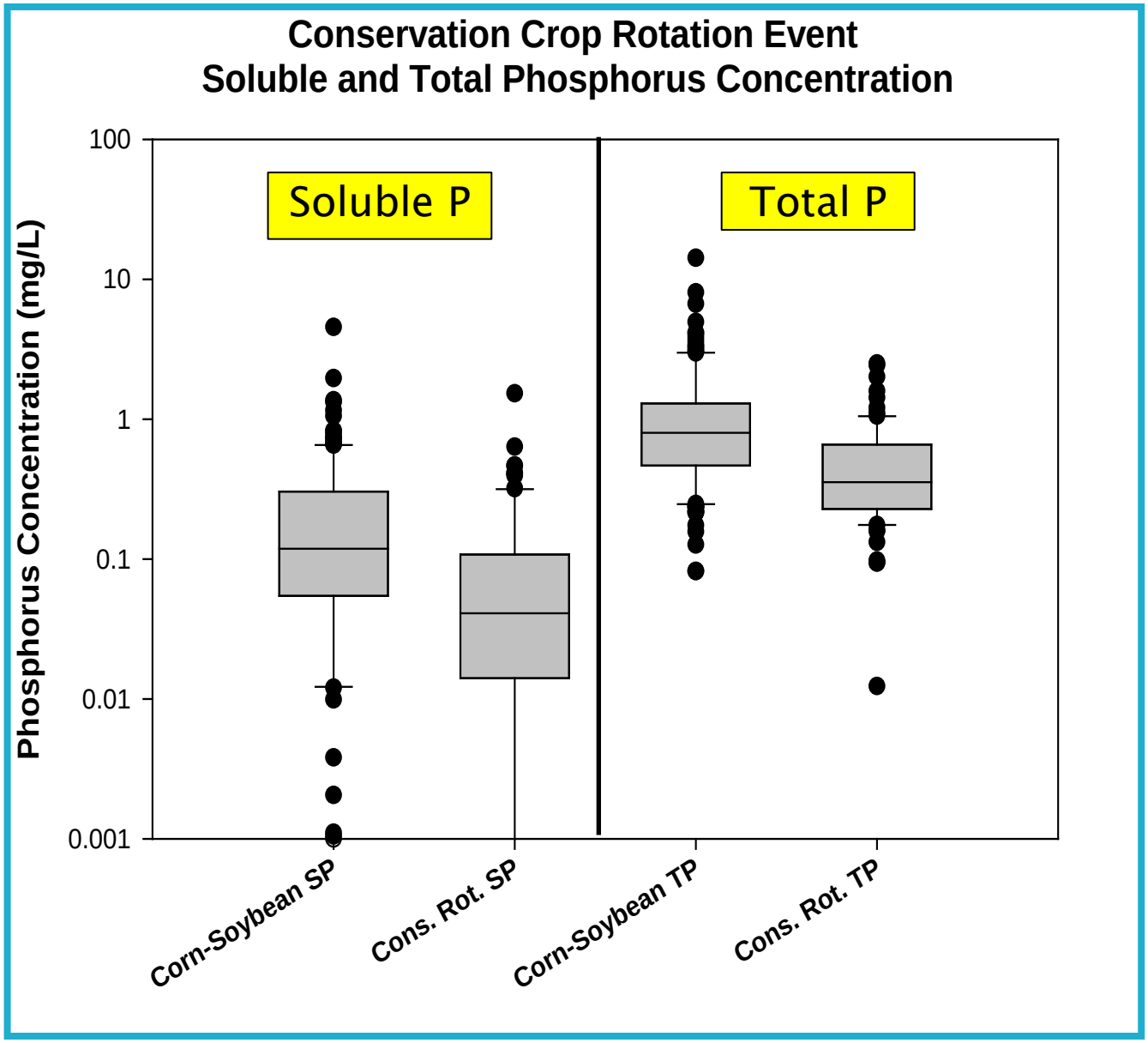

Blind Inlet Surface Event
Soluble and Total Phosphorus Load
Soluble P
Total P
Phosphorus Load (g/ha)
1000
100
10
1
0.1
0.01
Riser SP
Blind Inlet SP
Riser TP
Blind Inlet TP

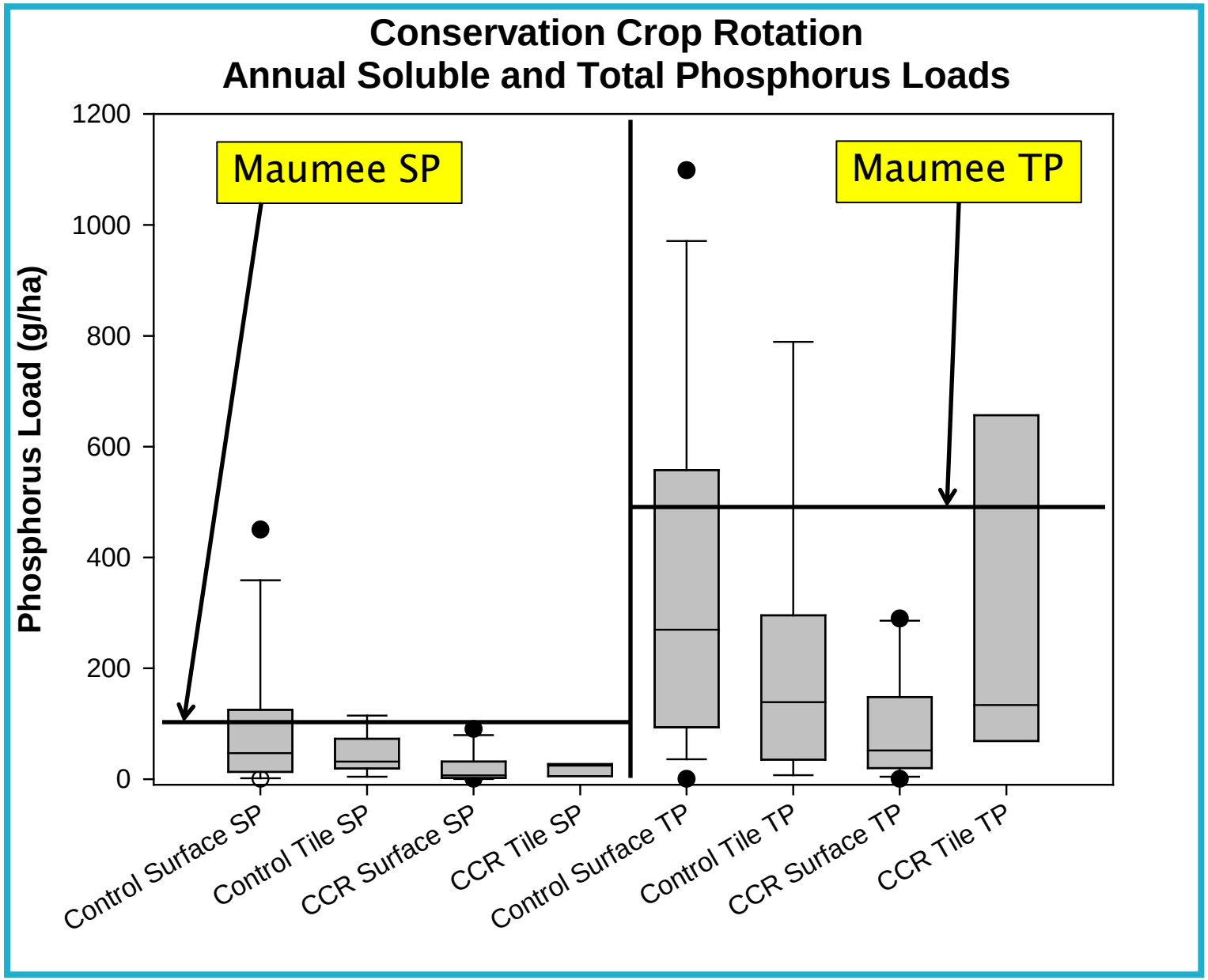

Bline Inlet
Annual Soluble and Total Phosphorus Loads
Phosphorus Load (g/ha)
1200
1000
800
600
400
200
0
Maumee SP
Maumee TP
Riser Surface SP
Riser Tile SP
BI Surface SP
BI Tile SP
Riser Surface TP
Riser Tile TP
BI Surface TP
BI Tile TP

Conservation Crop Rotation

Conventional

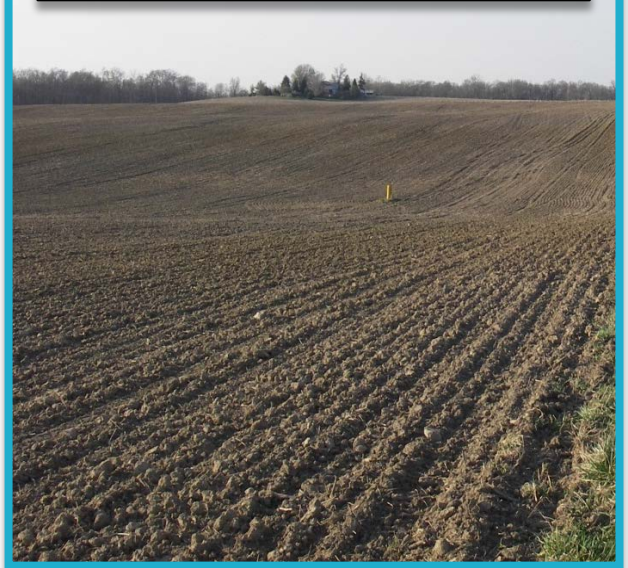
Conservation Rotation


Conservation Crop Rotation Event
Soluble and Total Phosphorus Concentration
Phosphorus Concentration (mg/L)
100
10
1
0.1
0.01
0.001
Soluble P
Total P
Corn-Soybean SP
Cons. Rot. SP
Corn-Soybean TP
Cons. Rot. TP

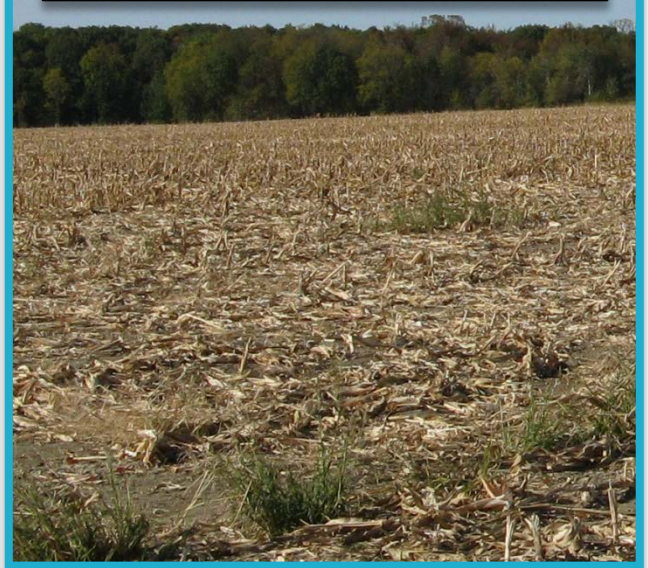

Conservation Crop Rotation
Annual Soluble and Total Phosphorus Loads
Phosphorus Load (g/ha)
1200
1000
800
600
400
200
0
Maumee SP
Maumee TP
Control Surface SP
Control Tile SP
CCR Surface SP
CCR Tile SP
Control Surface TP
Control Tile TP
CCR Surface TP
CCR Tile TP

Tillage

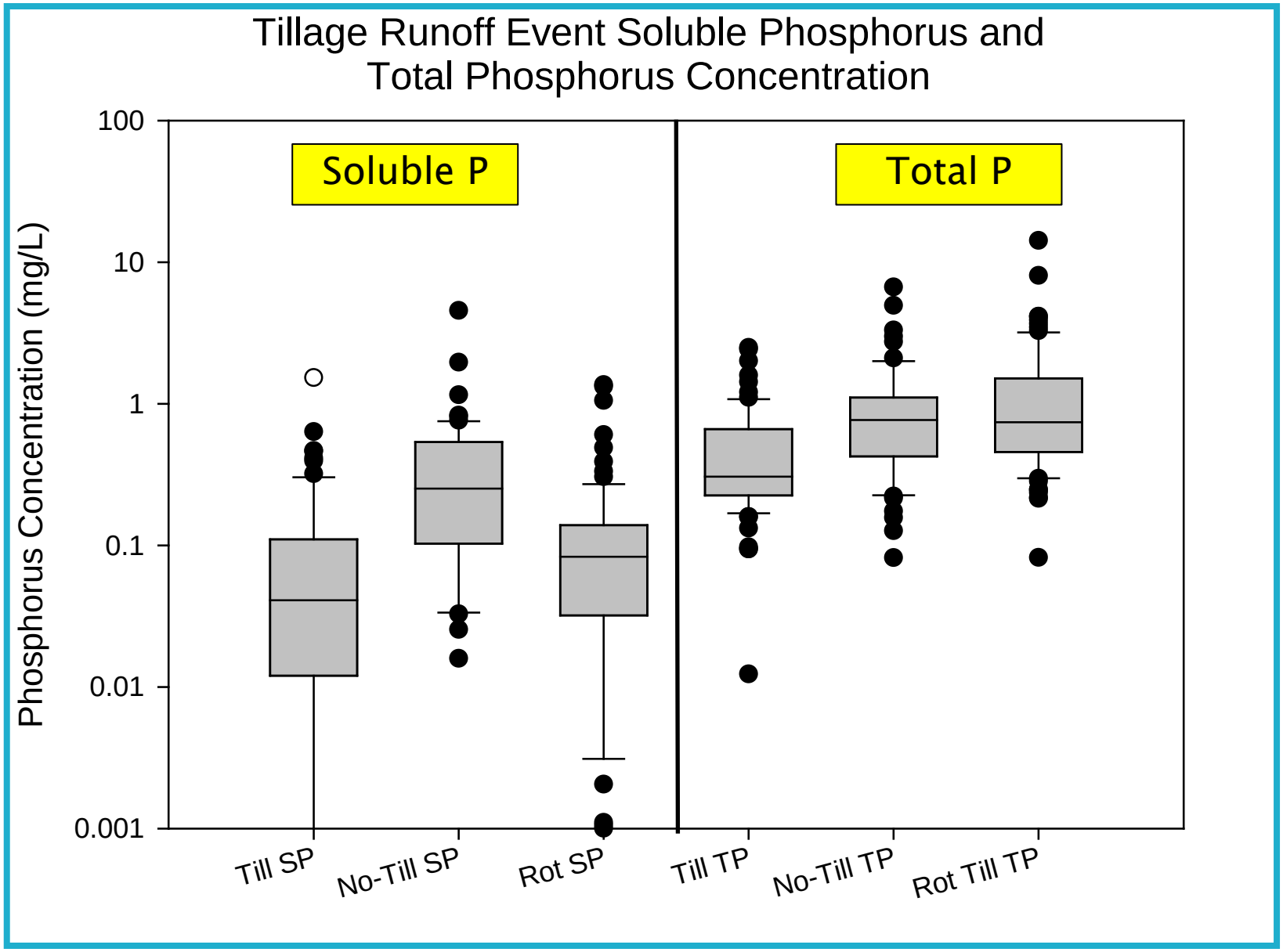
Tilled

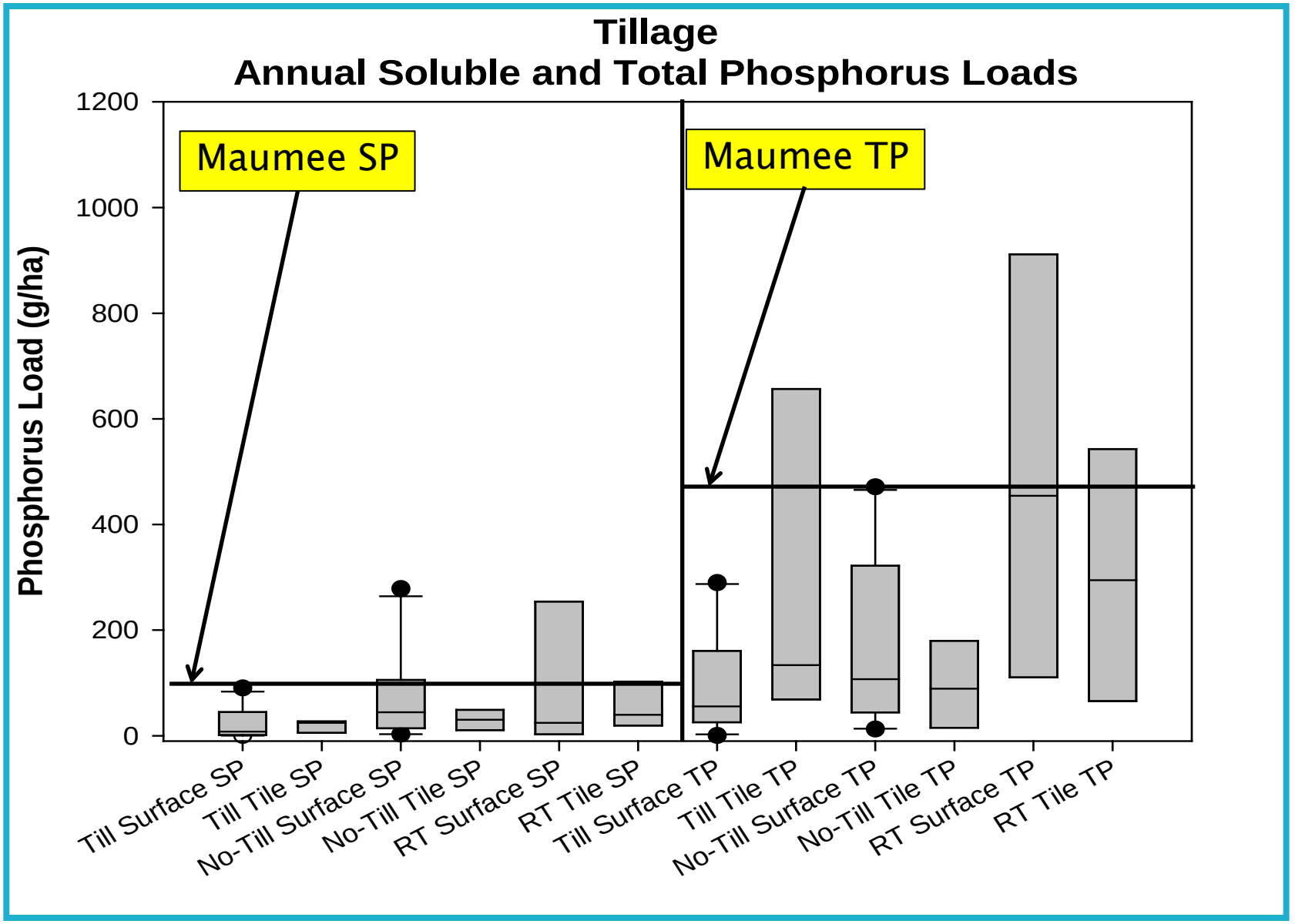


Continuous No-Till



Rotational Tillage


Tillage Runoff Event Soluble Phosphorus and Total Phosphorus Concentration
Phosphorus Concentration (mg/L)
100
10
1
0.1
0.01
0.001
Soluble P
Total P
Till SP
No-Till SP
Rot SP
Till TP
No-Till TP
Rot Till TP


Tillage
Annual Soluble and Total Phosphorus Loads
Phosphorus Load (g/ha)
1200
1000
800
600
400
200
0
Maumee SP
Maumee TP
Till Surface SP
Till Tile SP
No-Till Surface SP
No-Till Tile SP
RT Surface SP
RT Tile SP
Till Surface TP
Till Tile TP
No-Till Surface TP
No-Till Tile TP
RT Surface TP
RT Tile TP

Field Scale APEX modeling of Conservation Practices

Impact of Conservation Practices at the St. Joseph River Watershed															
Single Practice Effect															
		Baseline Scenario	329	412	340	327	329B	612	590	393	WQL07	410	511/512	328	Sum of Conservation Practice	Estimated Total Reductions Compared to Baseline
Sediment	Estimated Sediment (Mg/ha)	0.4	0.23	0.29	0.05	0.03	0.39	0.12	0.39	0.25	0.31	0.38	0.03	0.24		
	Total Sediments at watershed (Mg)	31551	6028	11	209	47	2259	160	3715	85	353	256	46	6077	19246	12000
TP	Estimated TP (kg/ha)	0.44	0.40	0.37	0.09	0.34	0.64	0.28	0.42	0.62	0.38	0.44	0.08	0.44		
	Total TP at watershed (kg)	34499	10522	15	436	486	3643	383	4028	209	433	293	115	11065	31627	2500
SP	Estimated SP (kg/ha)	0.18	0.20	0.17	0.09	0.08	0.22	0.02	0.18	0.33	0.19	0.18	0.08	0.21		
	Total SP at watershed (kg)	14242	5323	7	395	113	1236	26	1679	112	218	121	114	5408	14752	-700
SN	Estimated SN (kg/ha)	1.38	1.65	1.23	0.28	0.66	3.28	0.13	2.82	3.08	1.90	1.38	0.83	2.82		
	Total SP at watershed (kg)	108710	43301	49	1291	941	18770	178	26908	1039	2155	924	1132	71724	168412	-61000
SN-Tile	Estimated SN-tile (kg/ha)	28.01	26.65	25.65	6.84	20.4	27.4	53.52	24.43	18.96	21.97	27.96	20.26	13.05		
	Total SN-tile at Watershed	2206697	700888	1018	31649	29249	156730	73623	233048	6391	24937	18763	27716	331846	1635857	550000

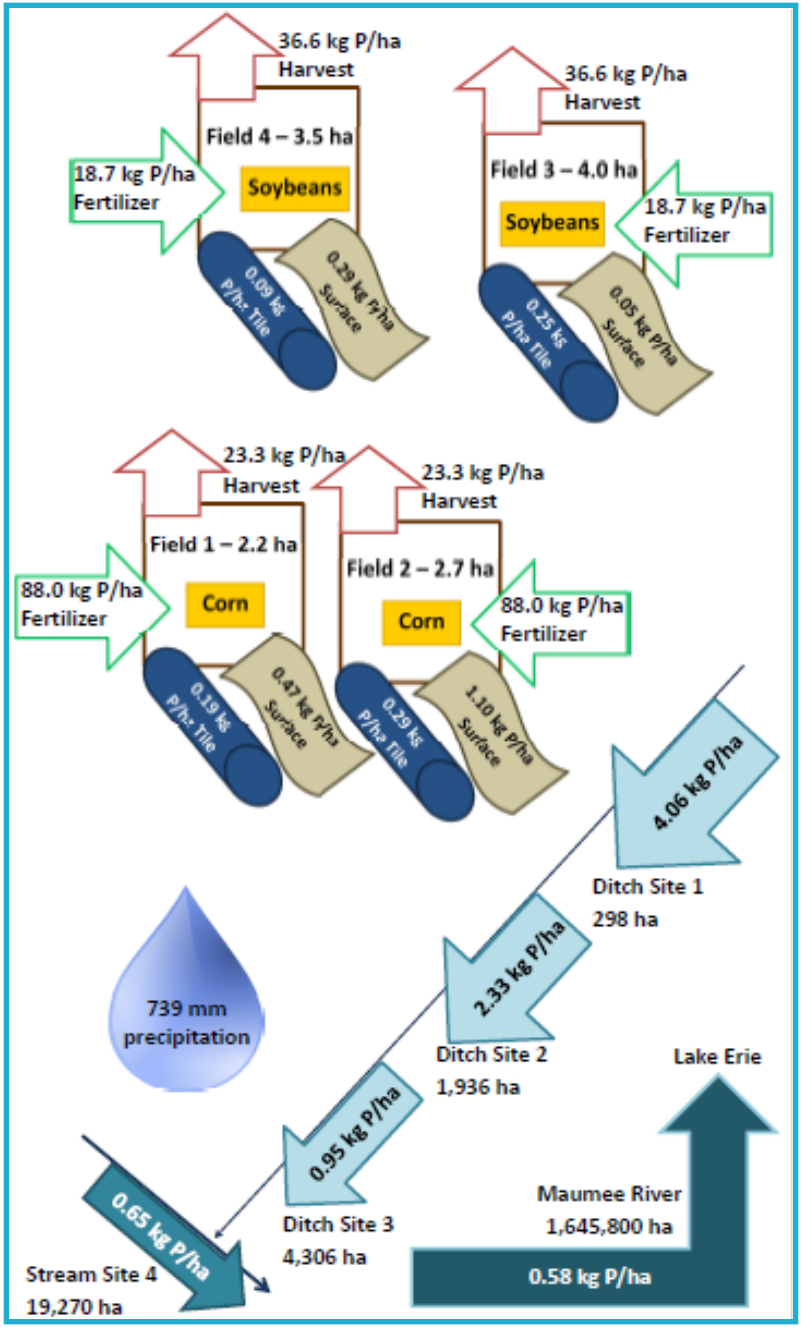
Field Scale APEX modeling of Conservation Practices

Summary of the mass of sediment and nutrients retained in agricultural fields resulting from the placement of conservation practices in agricultural fields based on APEX modeling results.

Parameter	Units	Baseline Scenario	Sum of Conservation Practice	Estimated Total Reductions Compared to Baseline	Percent Reduction
Sediment	(Mg)	48,600	23,900	24,700	51%
Phosphorus	(kg)	52,900	36,900	16,000	30%
Nitrogen	(kg)	3,560,000	2,050,000	1,510,000	42%

Field v. Watershed

- Field scale P transport is roughly similar to watershed (20,000 to >1,000,000 ha) P transport
- Headwater agricultural streams higher loading that field or large watersheds
- 50% of sediment in streams water from “bank”
  - **50% of P?**



Conclusions

- Practices intended as erosion control decrease total P, but can increase soluble P
- Conservation Crop Rotation can decrease surface runoff P loads and concentrations
- Replacing tile risers with blind inlets can effectively decrease soluble and total P

Conclusions

- Combinations of practices work better than single practices
  - Address multiple resource concerns
- Address no-till system with fertilizer mgmt
- Need to address landscape conservation


Thank You!