

# **Nonpoint Loads from Lower Fox River Tributaries WY 2004-2006**

**Kevin Fermanich**

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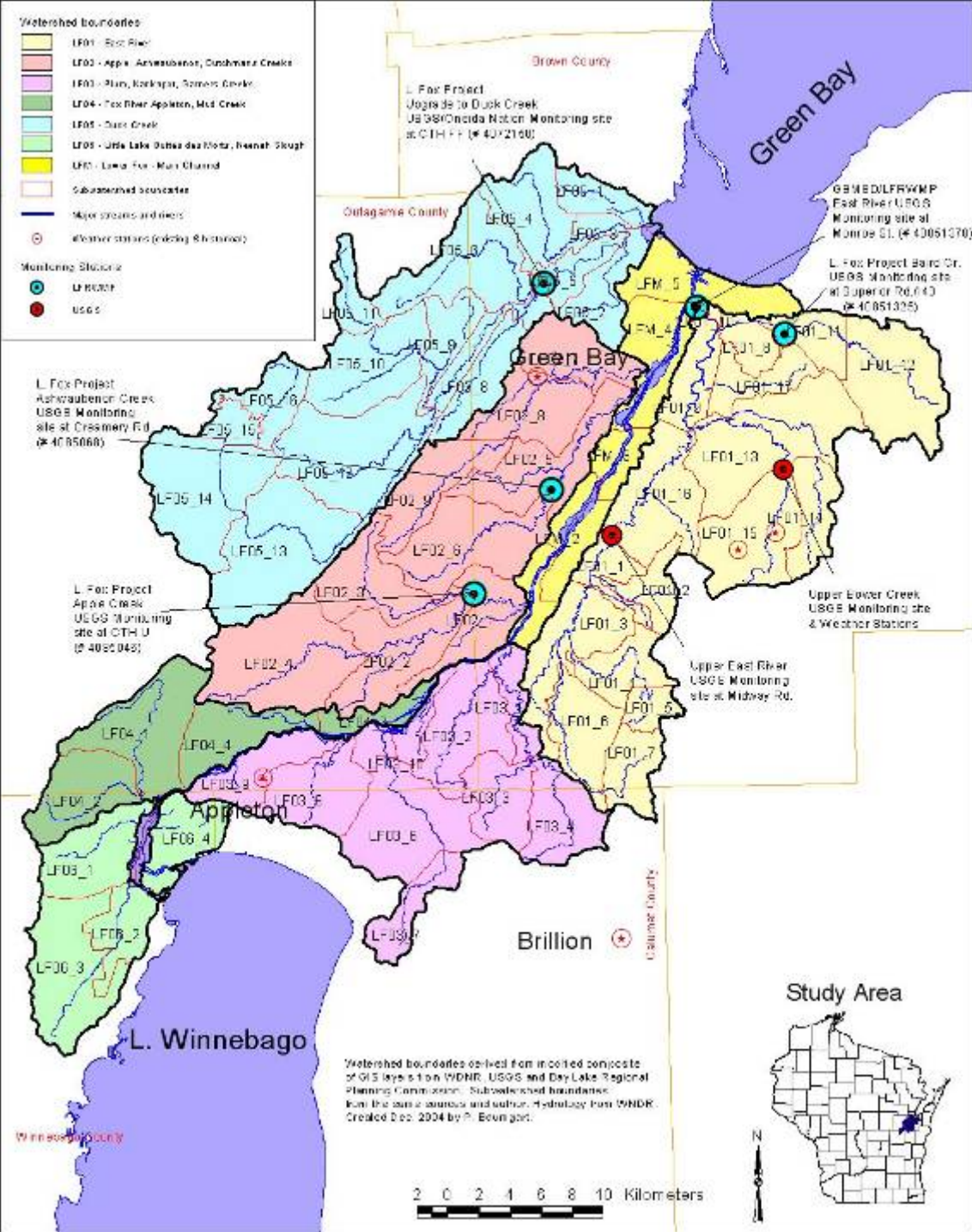
**Natural and Applied Science**

**University of Wisconsin – Green Bay**



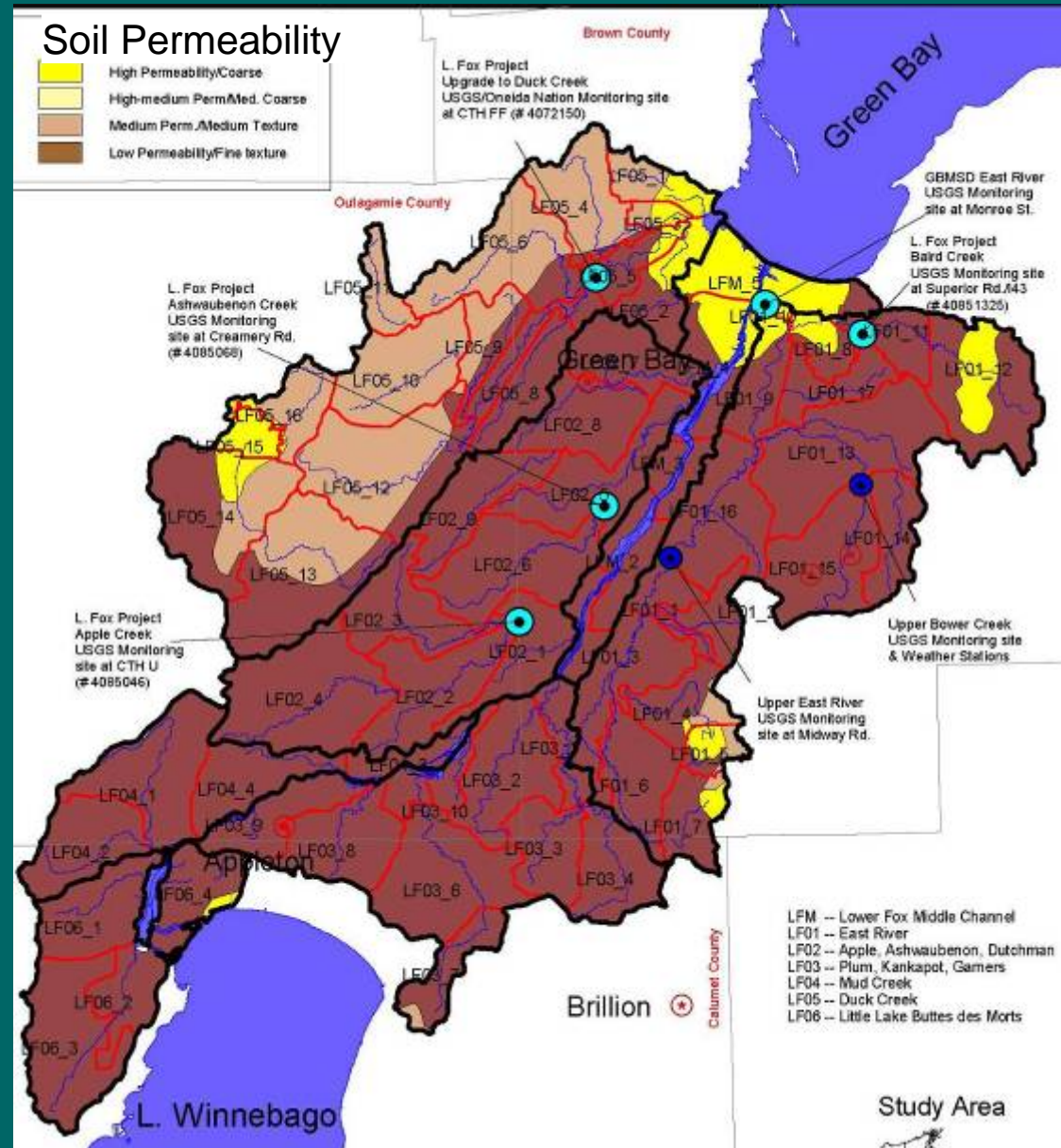
**LFRWMP Symposium/  
FWWA Stormwater Conf.  
March 14, 2007  
Univ. Wisc. – Green Bay**

# Lower Fox River watersheds & subwatersheds

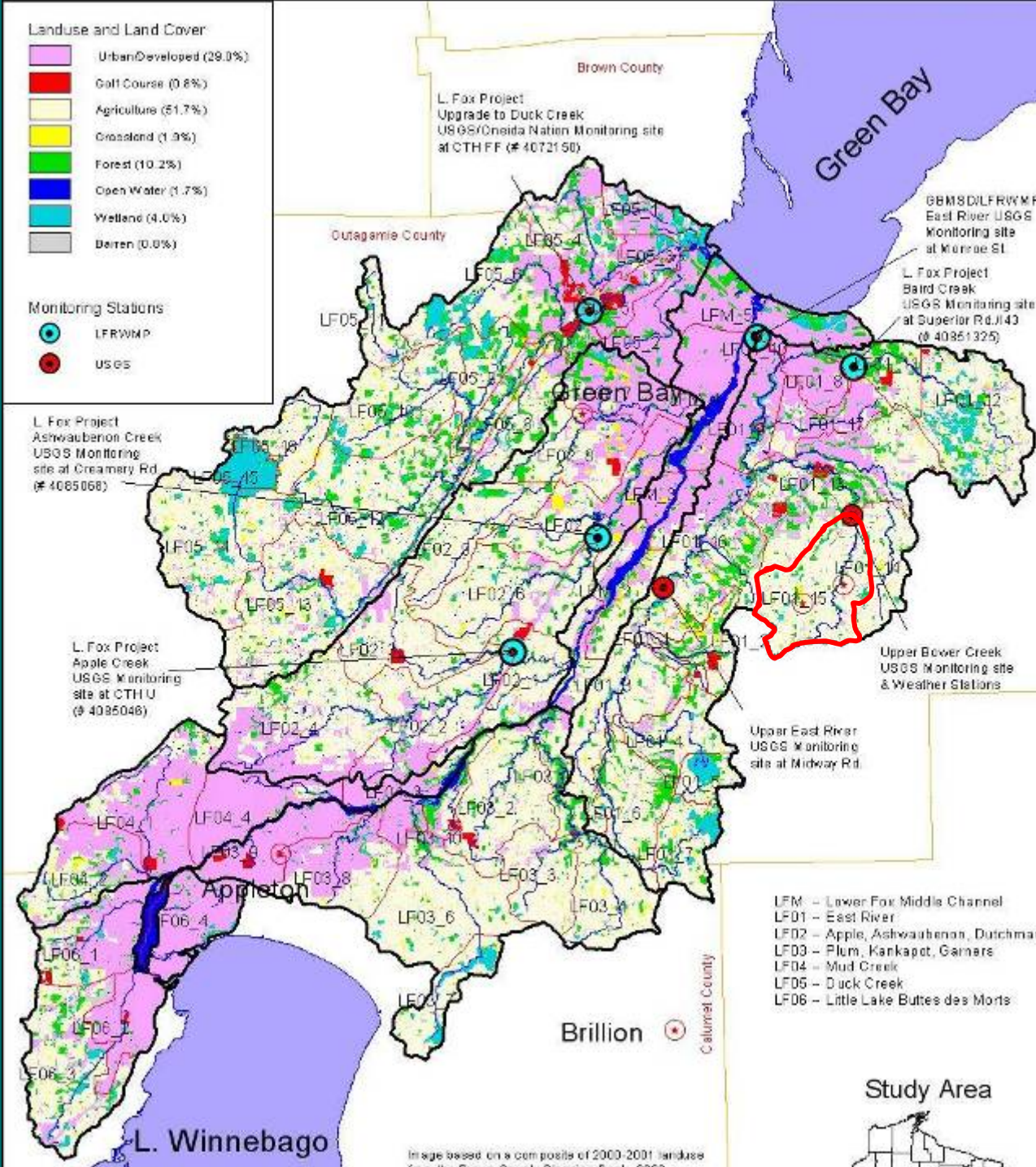


# Watershed background:

- Clay soils
- High % runoff
- 715 mm precip avg
- ~ 200 mm flow
- ~ 30 mm baseflow



# Lower Fox River Year 2000 Landuse and Land cover



Study Area



# Cooperative Project

- UWGB (Nick Reckinger, Nick Coady, Jill Fermanich)
- UW Milwaukee
- Arjo Wiggins Appleton Inc.
- USGS (Dave Graczyk, TR, PR, DR, ...)
- GBMSD
- Oneida Tribe
- 7 High Schools
- EPA



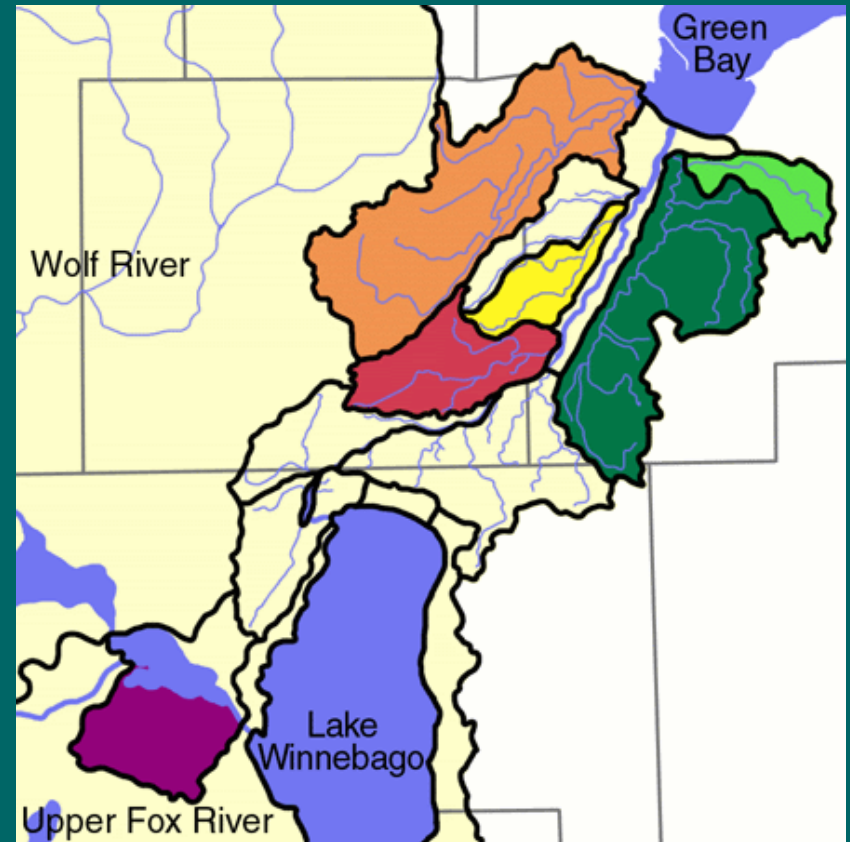
# Major Program Elements

- Continuous monitoring
  - Sediment & P loading
  - Real-time sensors
  - Watershed modeling
- Stream biotic integrity monitoring
- School-based monitoring program
  - hands-on learning, citizen scientists, meaningful data



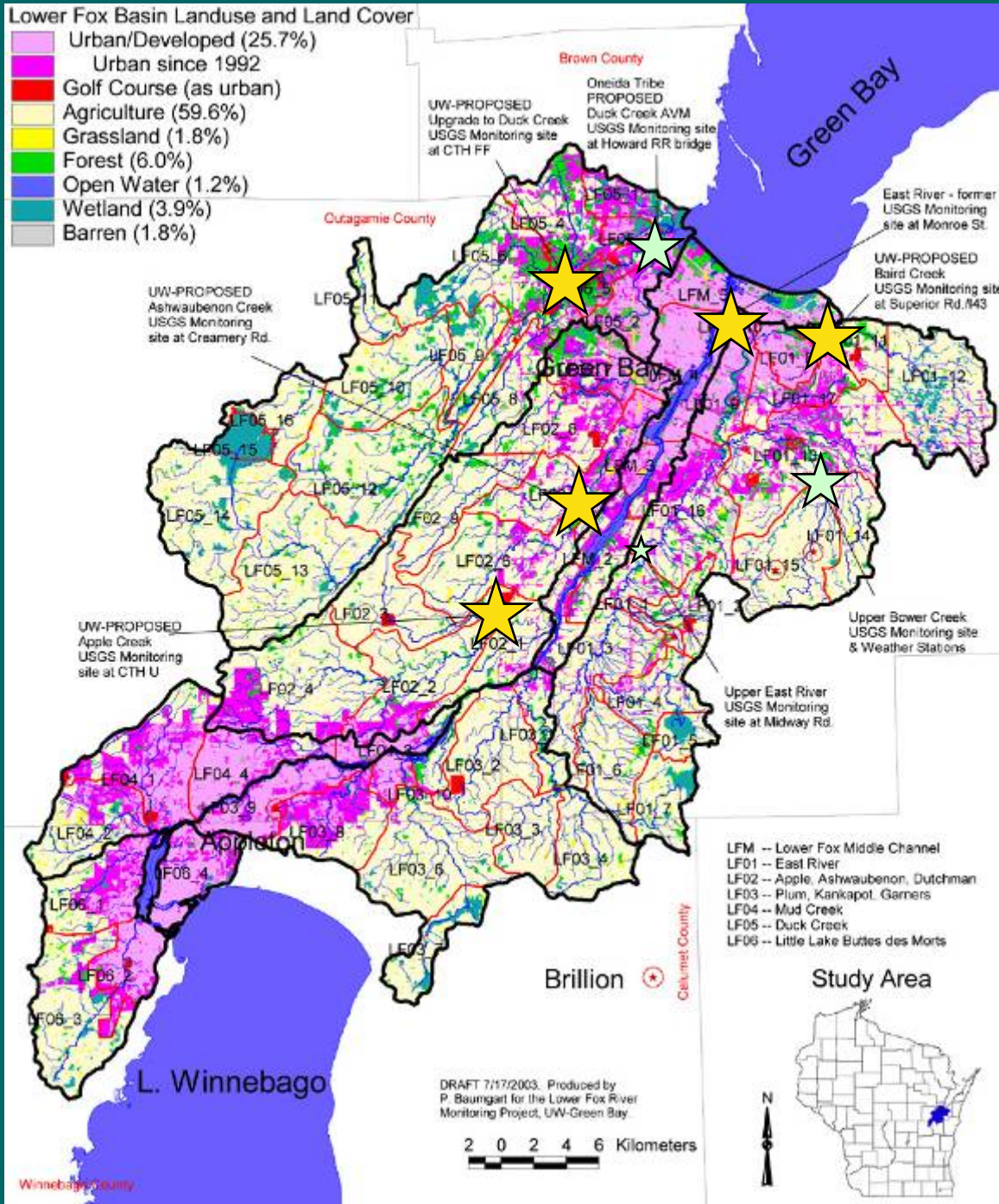
# Monitoring Stations

- 3 water years
  - Oct 2003-Sept 2006
- Watersheds
  - Duck Creek
  - Baird Creek
  - Apple Creek
  - Ashwaubenon Creek
  - East River (GBMSD)



**Lower Fox Basin Landuse and Land Cover**

- Urban/Developed (25.7%)
- Urban since 1992
- Golf Course (as urban)
- Agriculture (59.6%)
- Grassland (1.8%)
- Forest (6.0%)
- Open Water (1.2%)
- Wetland (3.9%)
- Barren (1.8%)



- LFM -- Lower Fox Middle Channel
- LF01 -- East River
- LF02 -- Apple, Ashwaubenon, Dutchman
- LF03 -- Plum, Kankopot, Gamers
- LF04 -- Mud Creek
- LF05 -- Duck Creek
- LF06 -- Little Lake Buttes des Morts

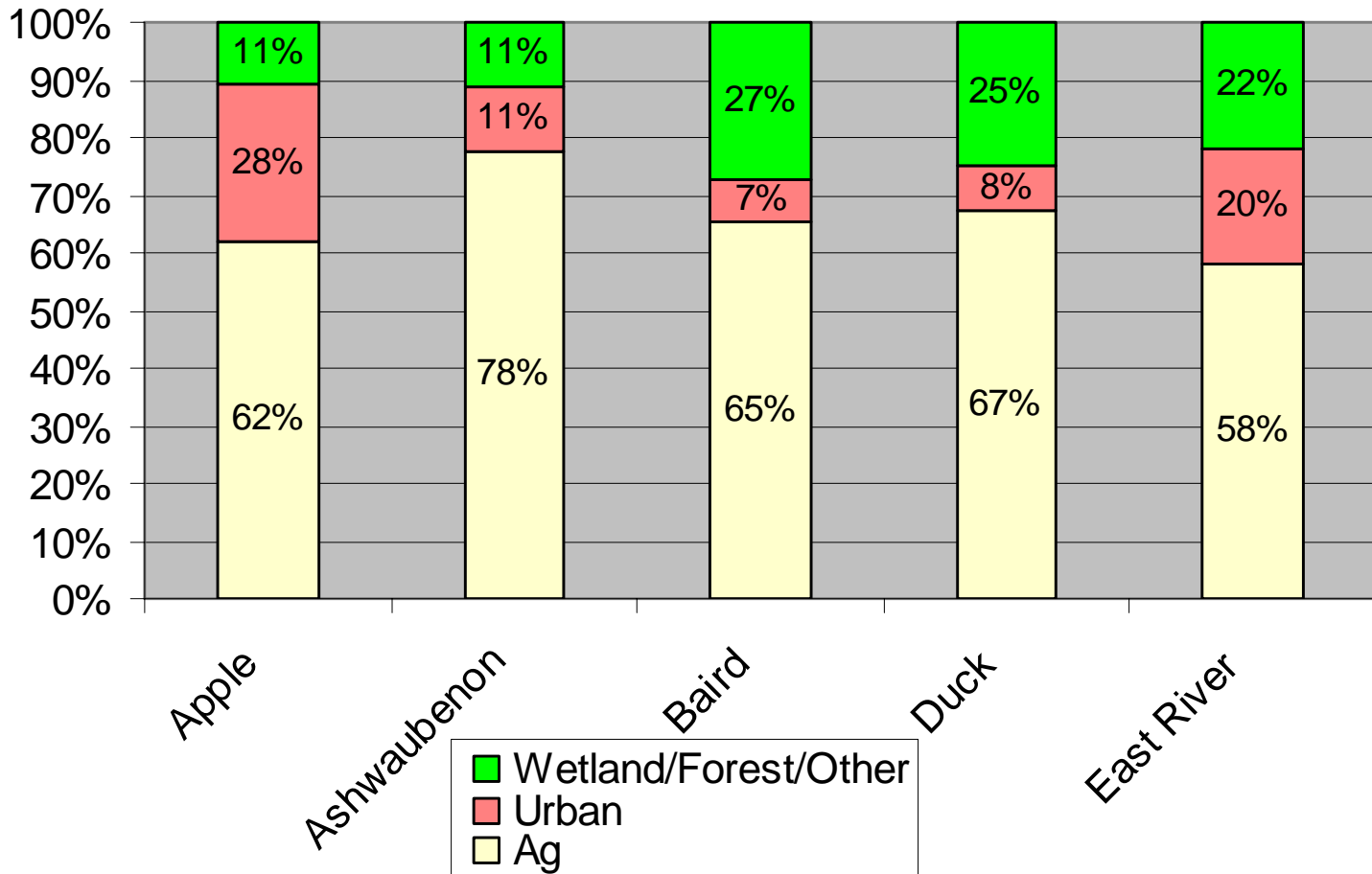


DRAFT 7/17/2003. Produced by P. Baumgart for the Lower Fox River Monitoring Project, UW-Green Bay.

2 0 2 4 6 Kilometers



## Year 2000 Landuse Upstream of Monitoring Sites



# How do we monitor?

- Daily stage / flow
- Low-flow / baseflow samples
- Automated Event Samplers
- Test for
  - Total P, Dissolved P, Sediment



*ISCO Sampler at  
Apple Creek*

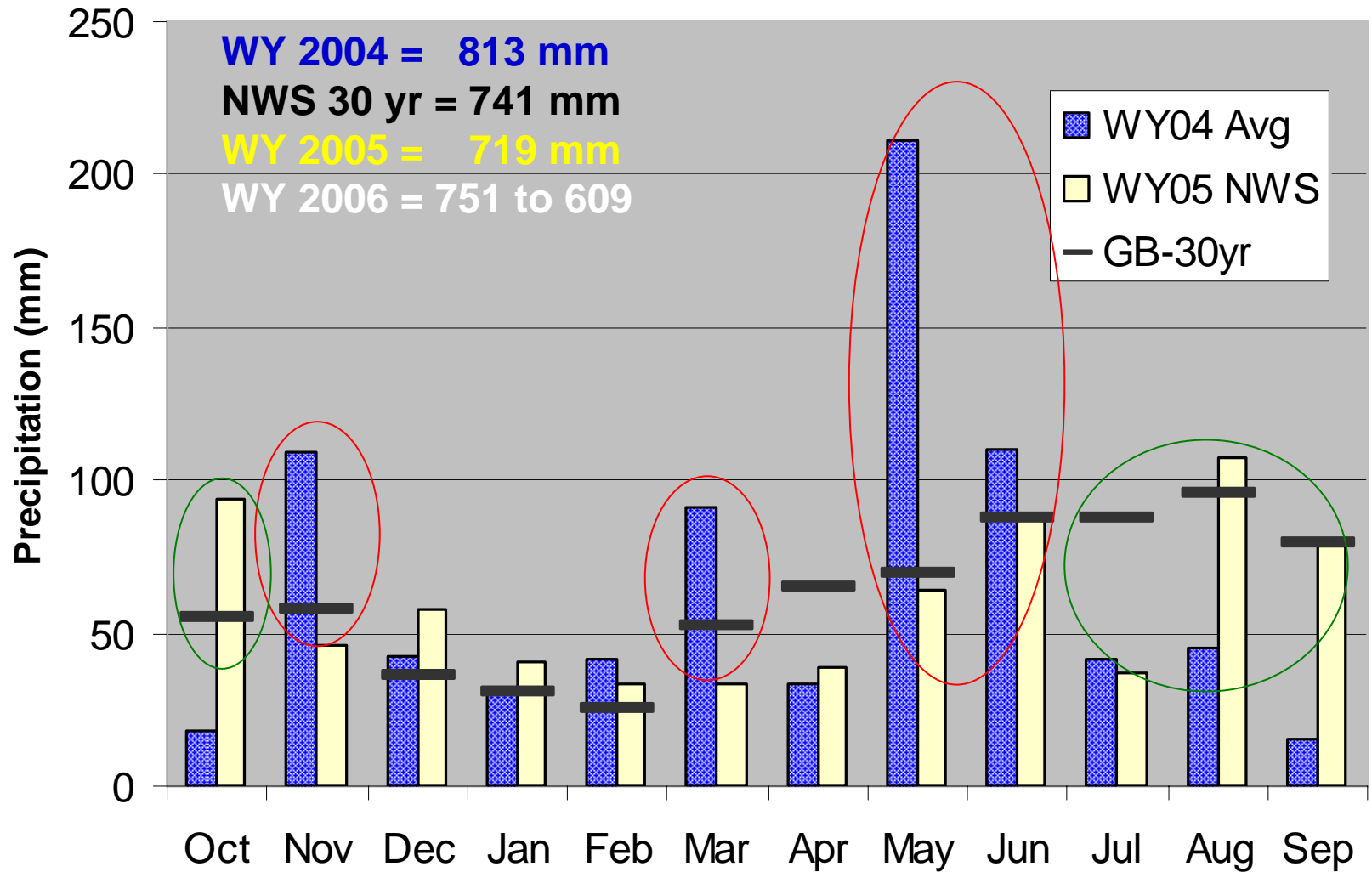


# WY2004-2006 Results

- Precipitation
- Box plots of Concentration Data
- Loads and Yields



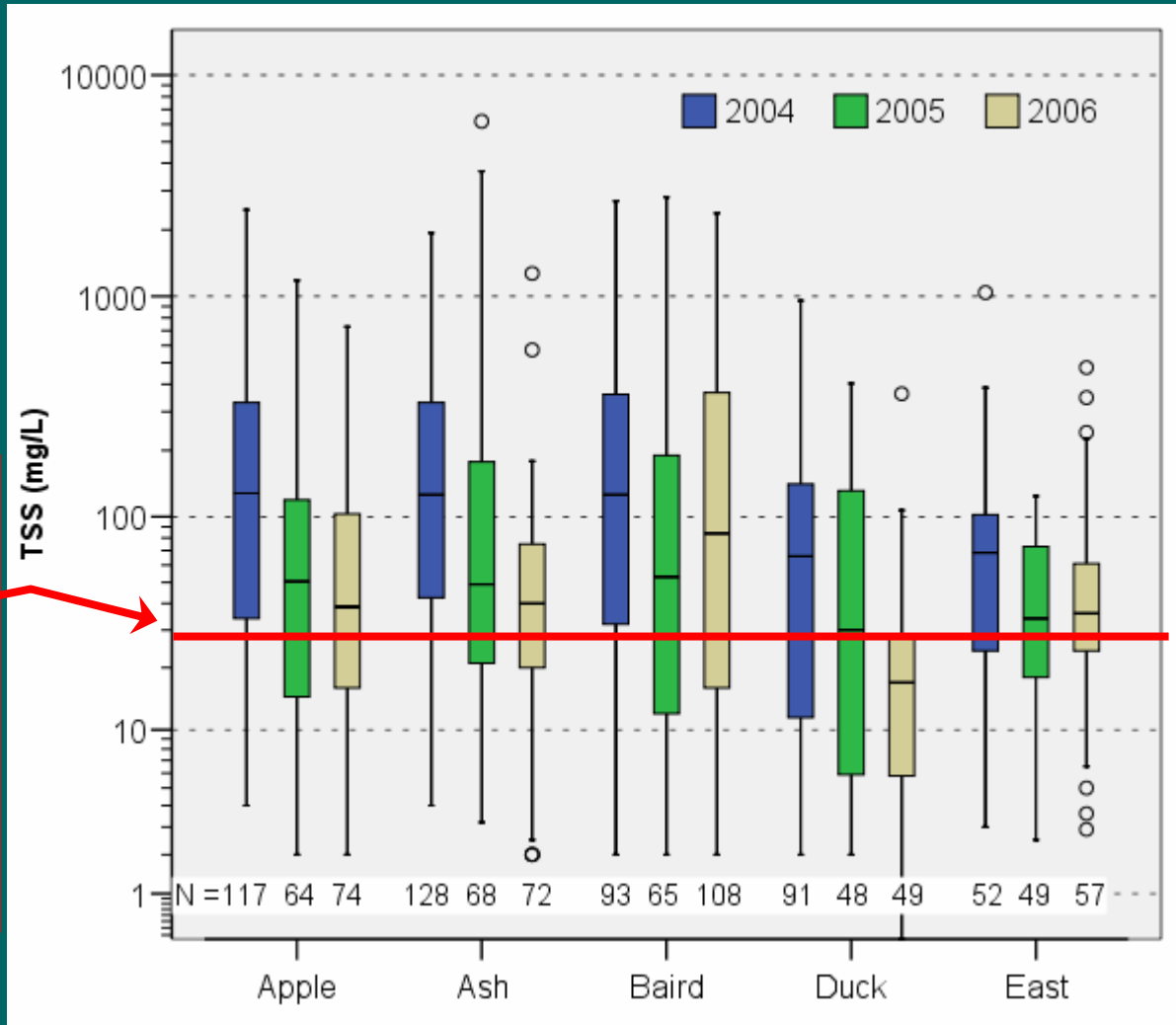
# Precipitation



# Apple Creek trib: May 23 2004 site #3 downstream



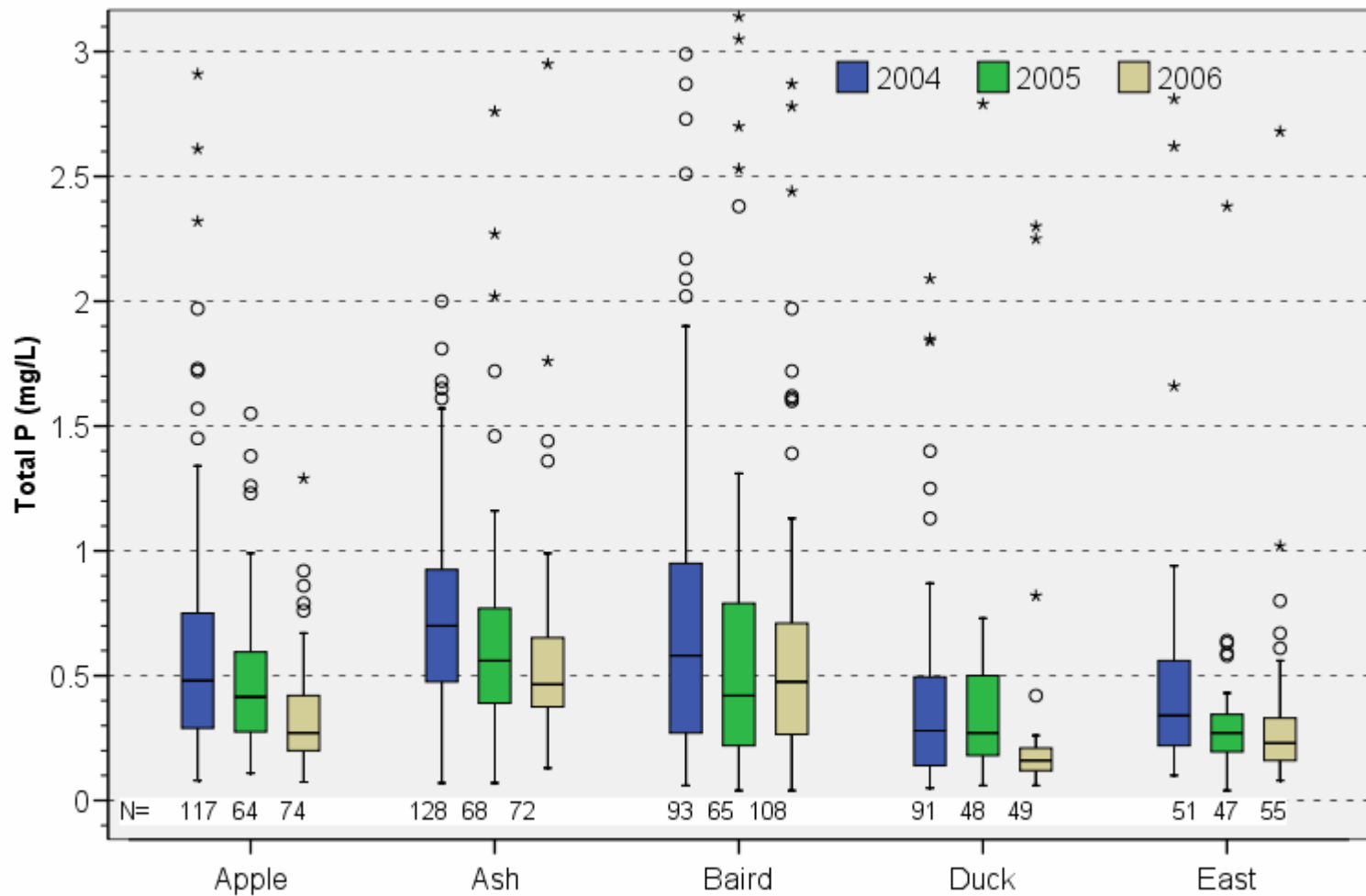
# Suspended Solids Conc.: All samples



Ref. conc.  
for Great  
Lakes  
Streams  
Robertson  
et al., 2006

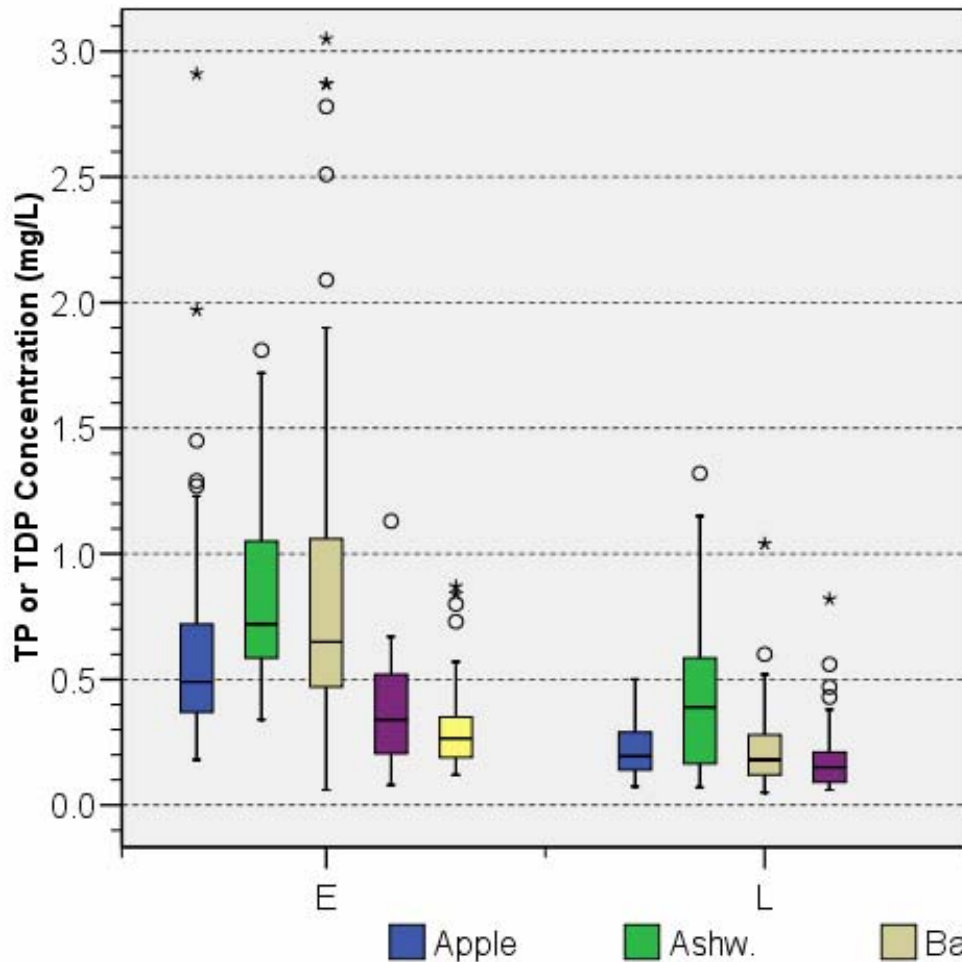


# Total P Concentration WY04-06

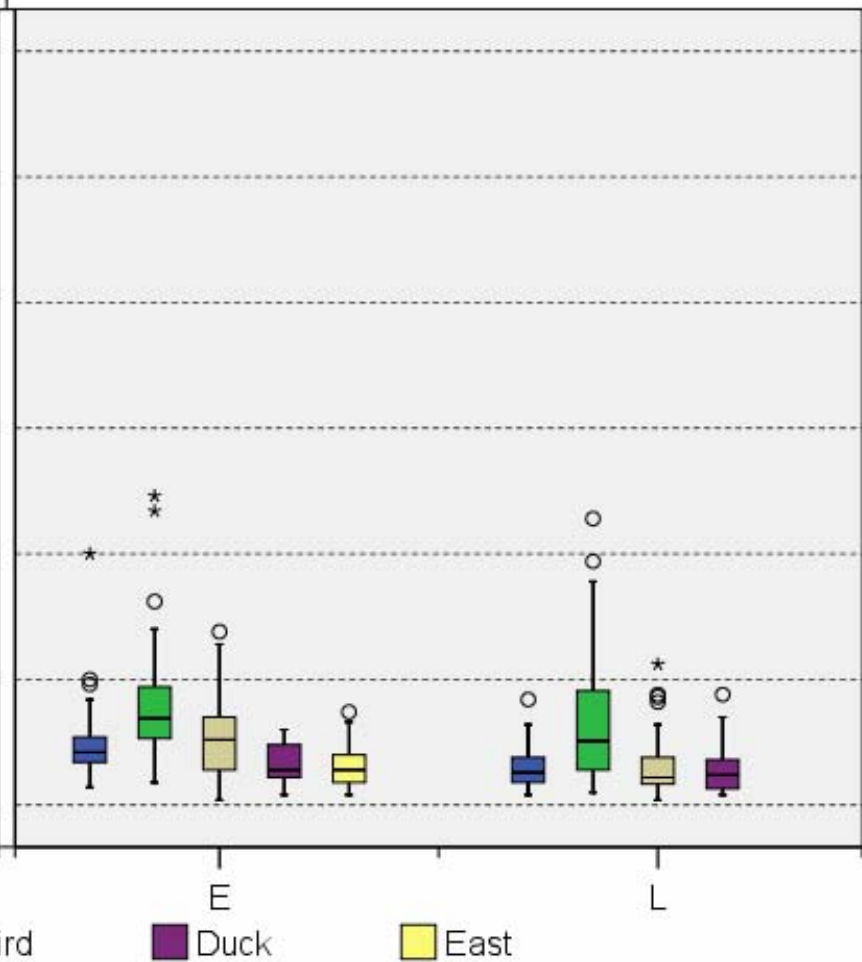


# Event and Low Flow TP & DP WY04-06

## Total P



## Total DP

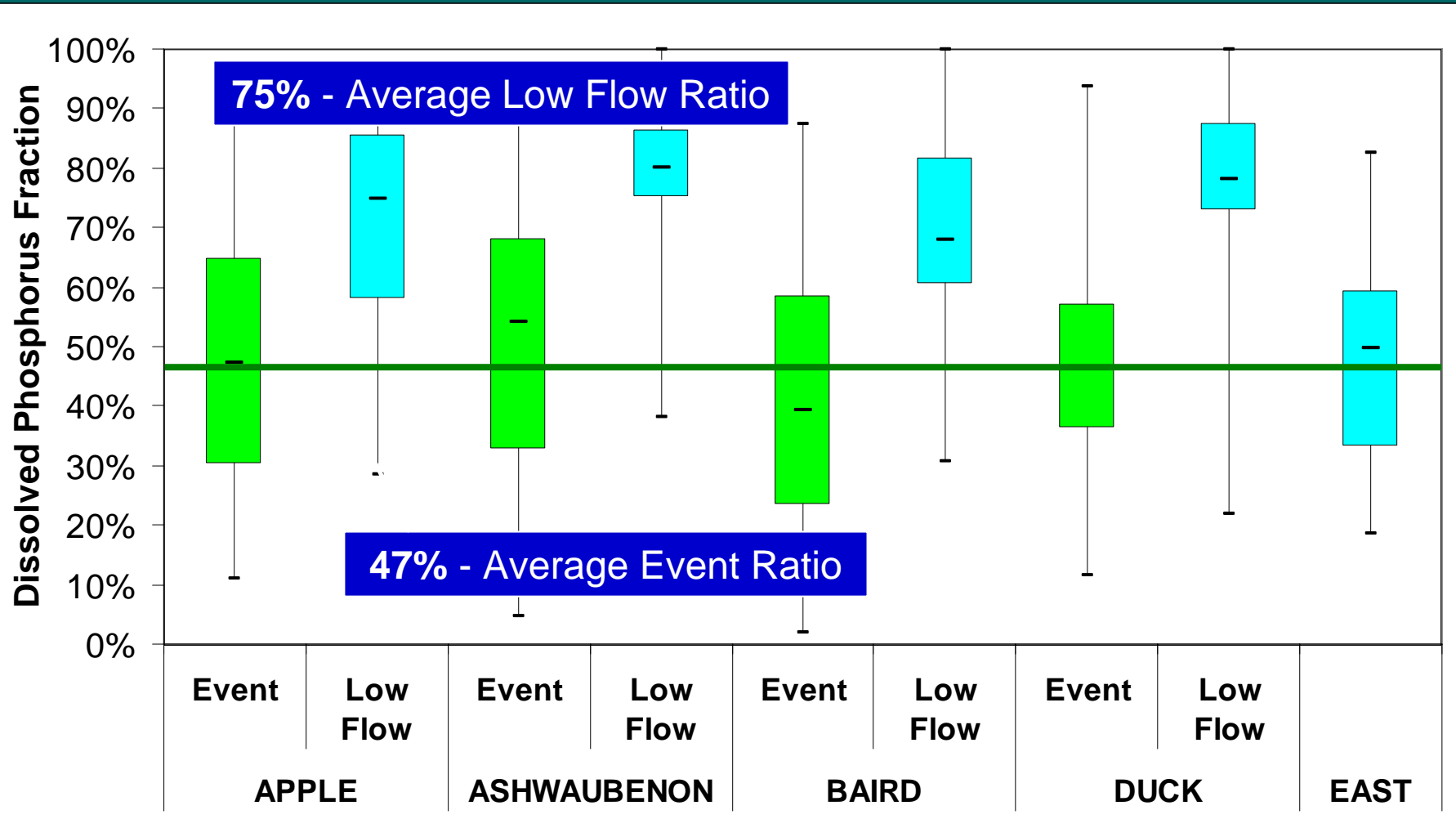




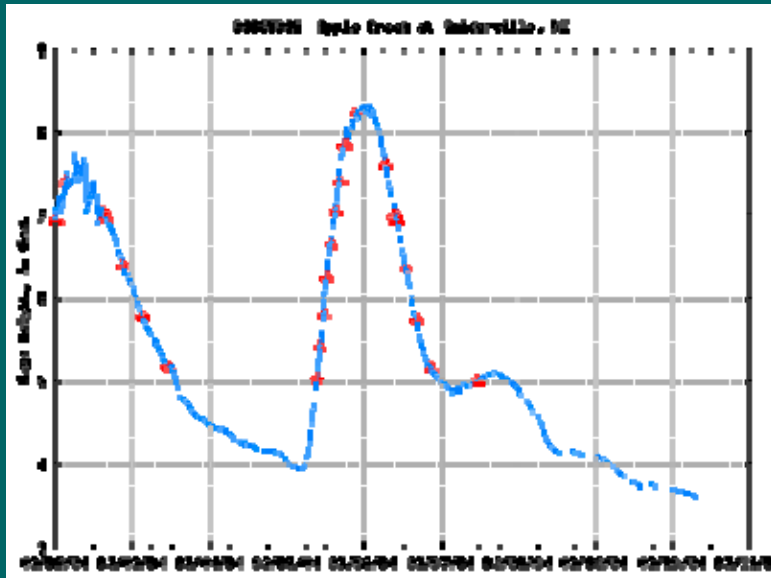
# Dissolved Phosphorus Fraction 2004-2006

Event Flow

Low Flow



# Flow



# Conc.

X

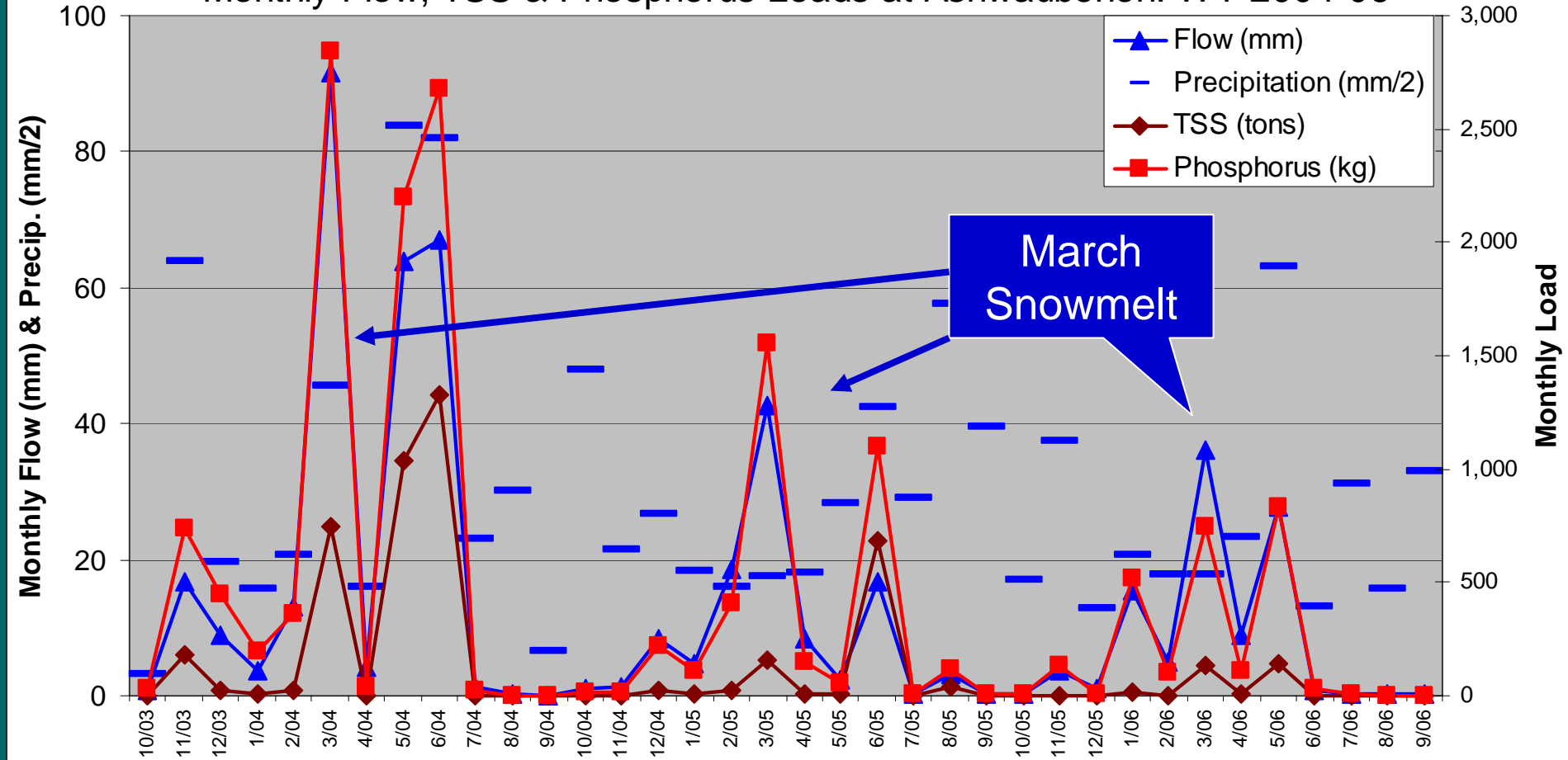


= Mass/time  
“Load”



# When are the big loads?

Monthly Flow, TSS & Phosphorus Loads at Ashwaubenon: WY 2004-06

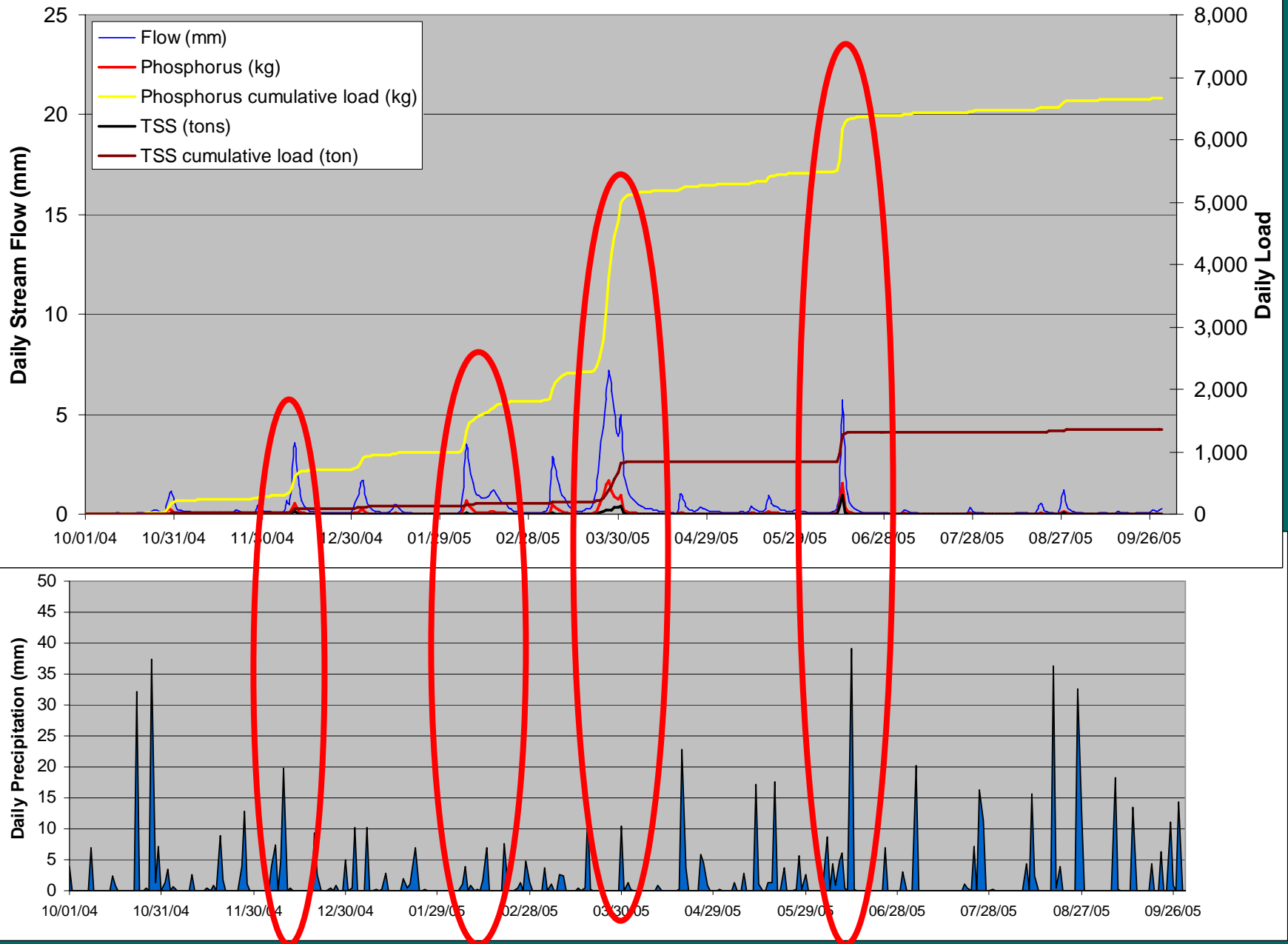


# When are the big loads?

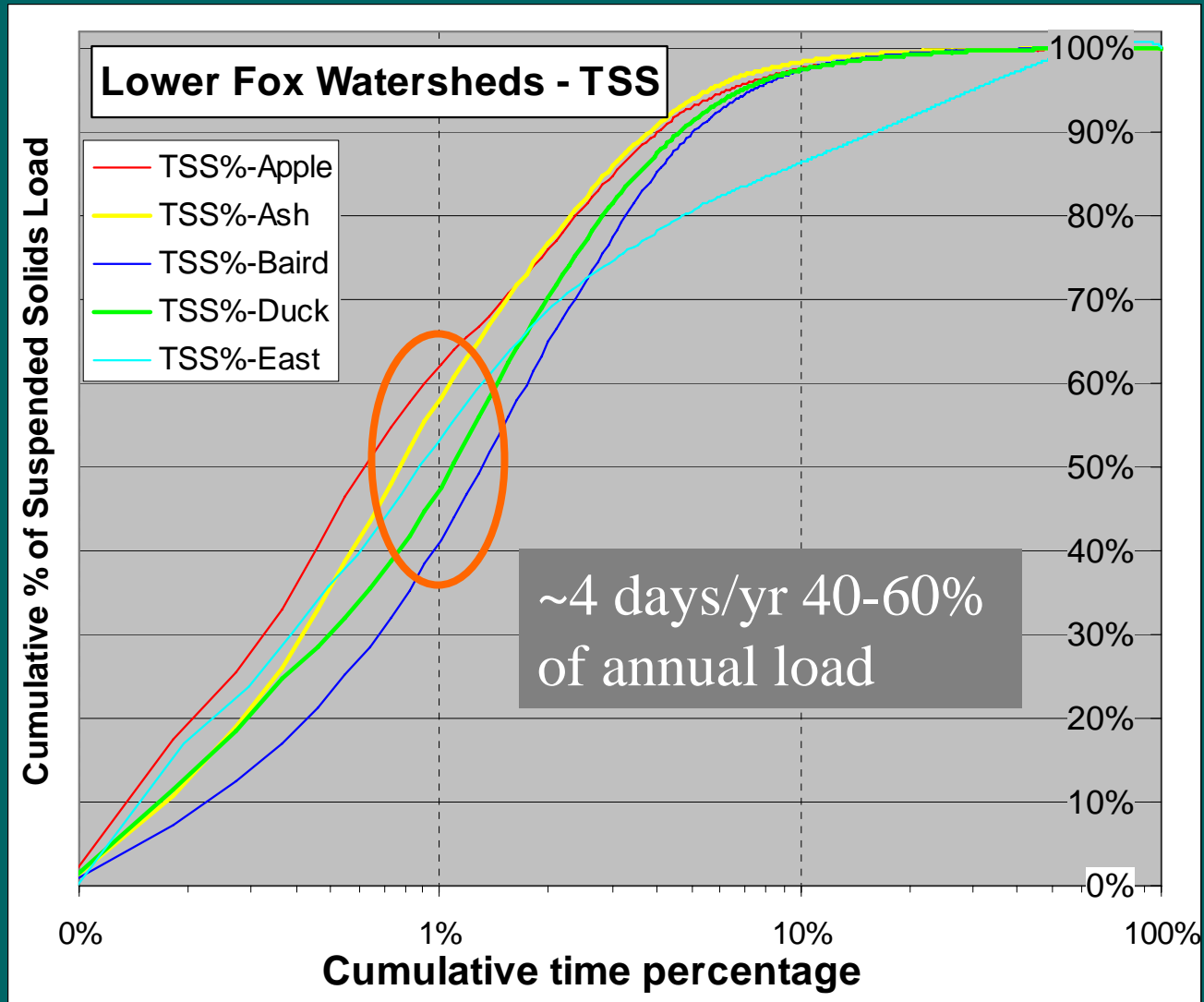
## March Contribution to 2006 Total

	<b>Flow</b>	<b>TSS</b>	<b>total P</b>
<b>Apple</b>	29%	<b>67%</b>	<b>55%</b>
<b>Baird</b>	28%	33%	31%
<b>Duck</b>	30%	29%	<b>55%</b>
<b>Ashwaub.</b>	36%	<b>43%</b>	30%
<b>East River</b>	21%	<b>59%</b>	<b>43%</b>

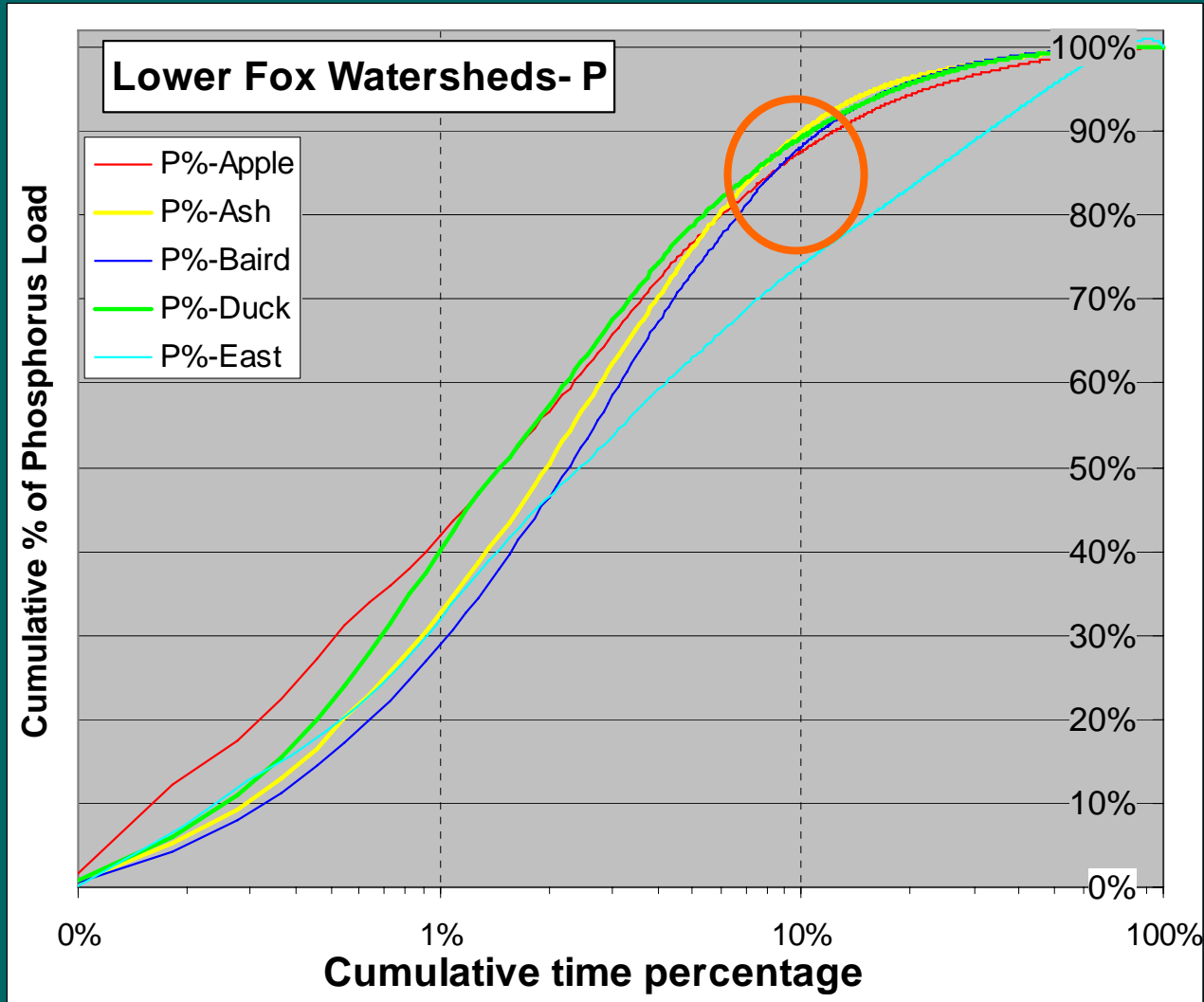
Daily Flow and Loads of TSS and Phosphorus at Apple Creek - WY 2005.



# WY04-06: 50% of sediment load in 1% of time



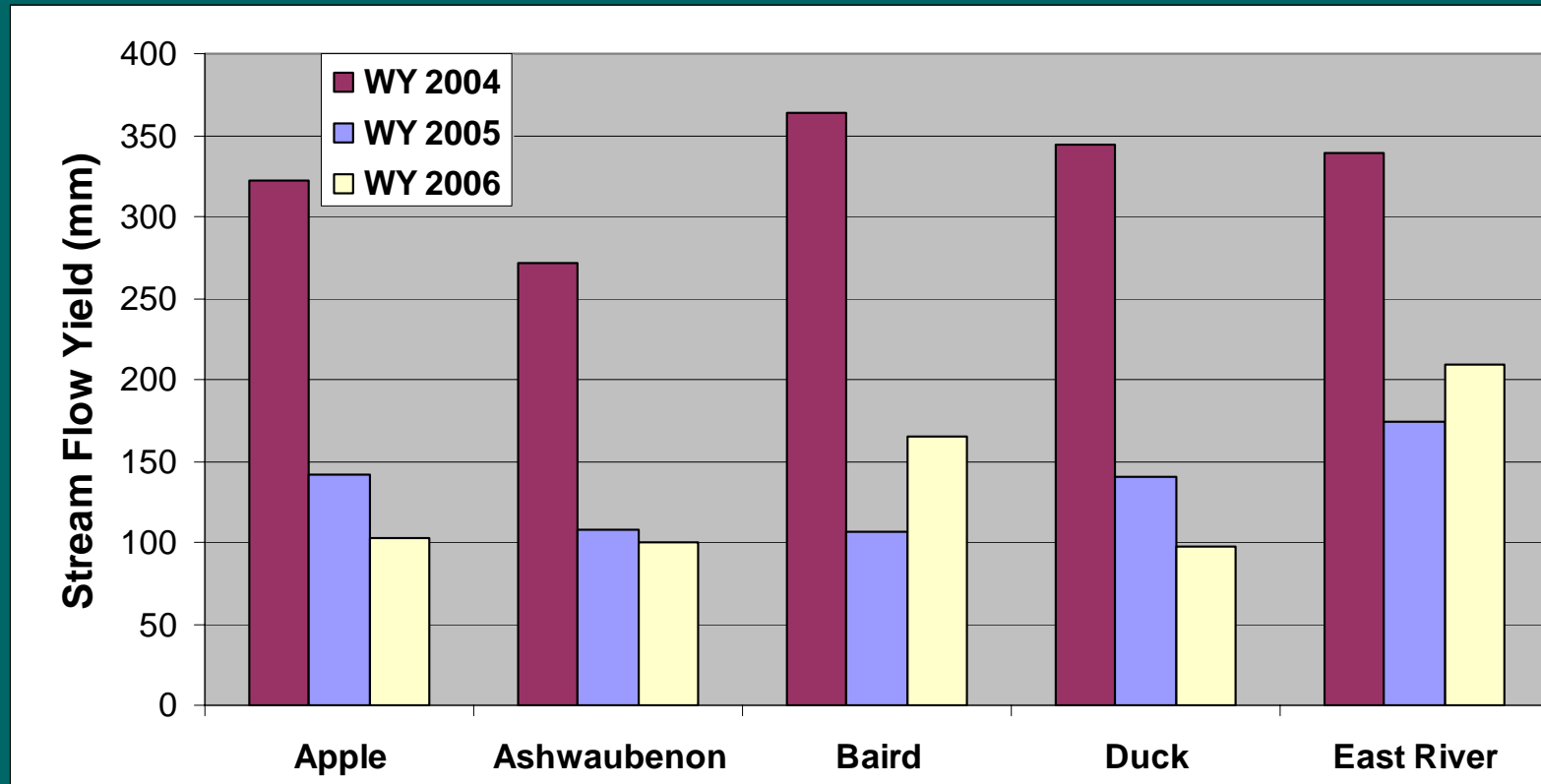
# WY04-06: 90% of P load in 10% of time (110 days out of 1095 days; 36 d/yr)



- 42% to 55% in the form of DP



# Stream Flow Yields (annual total flow/area of watershed)

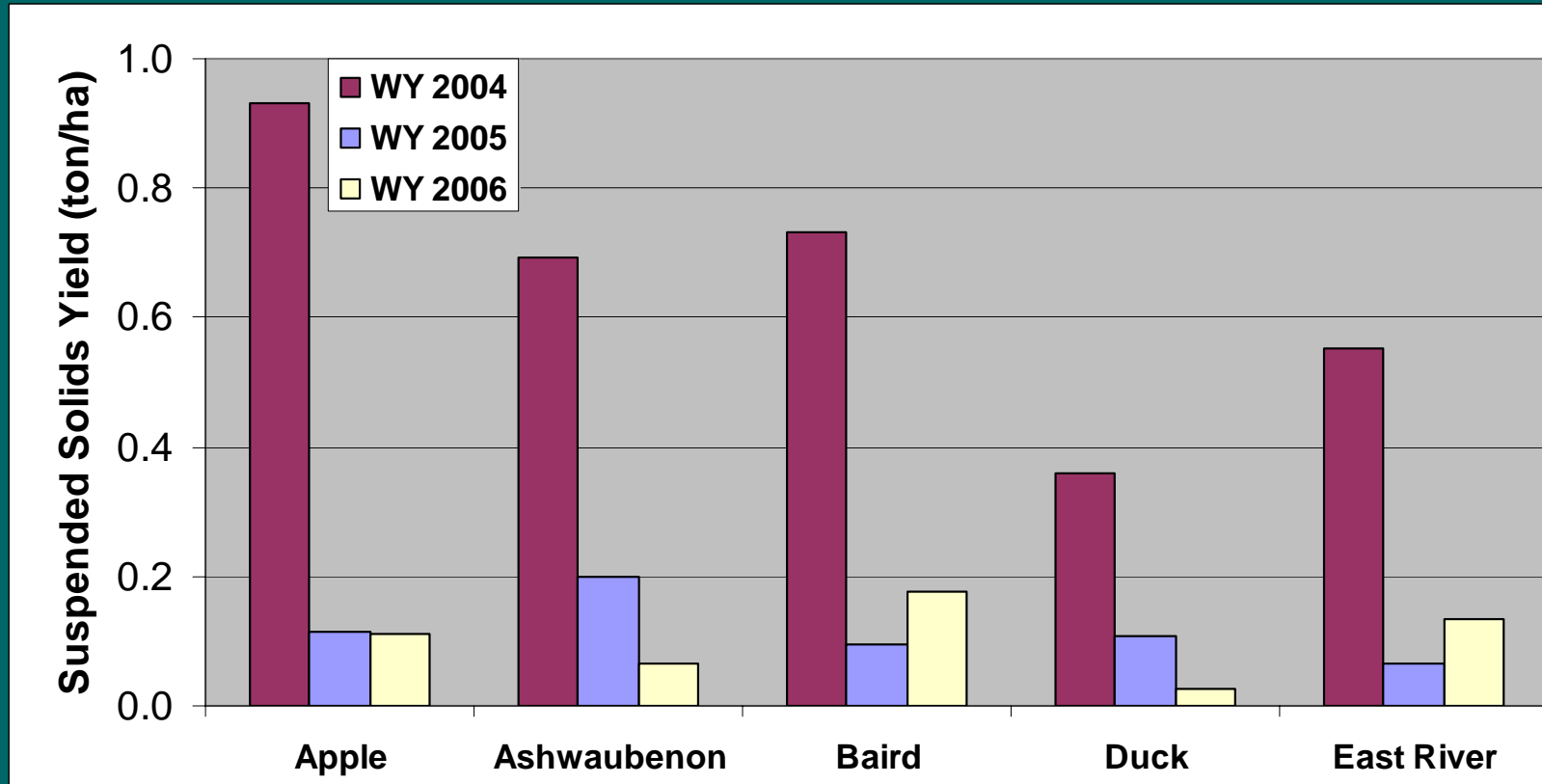


- 2005 & '06 → 30 to 60% of 2004





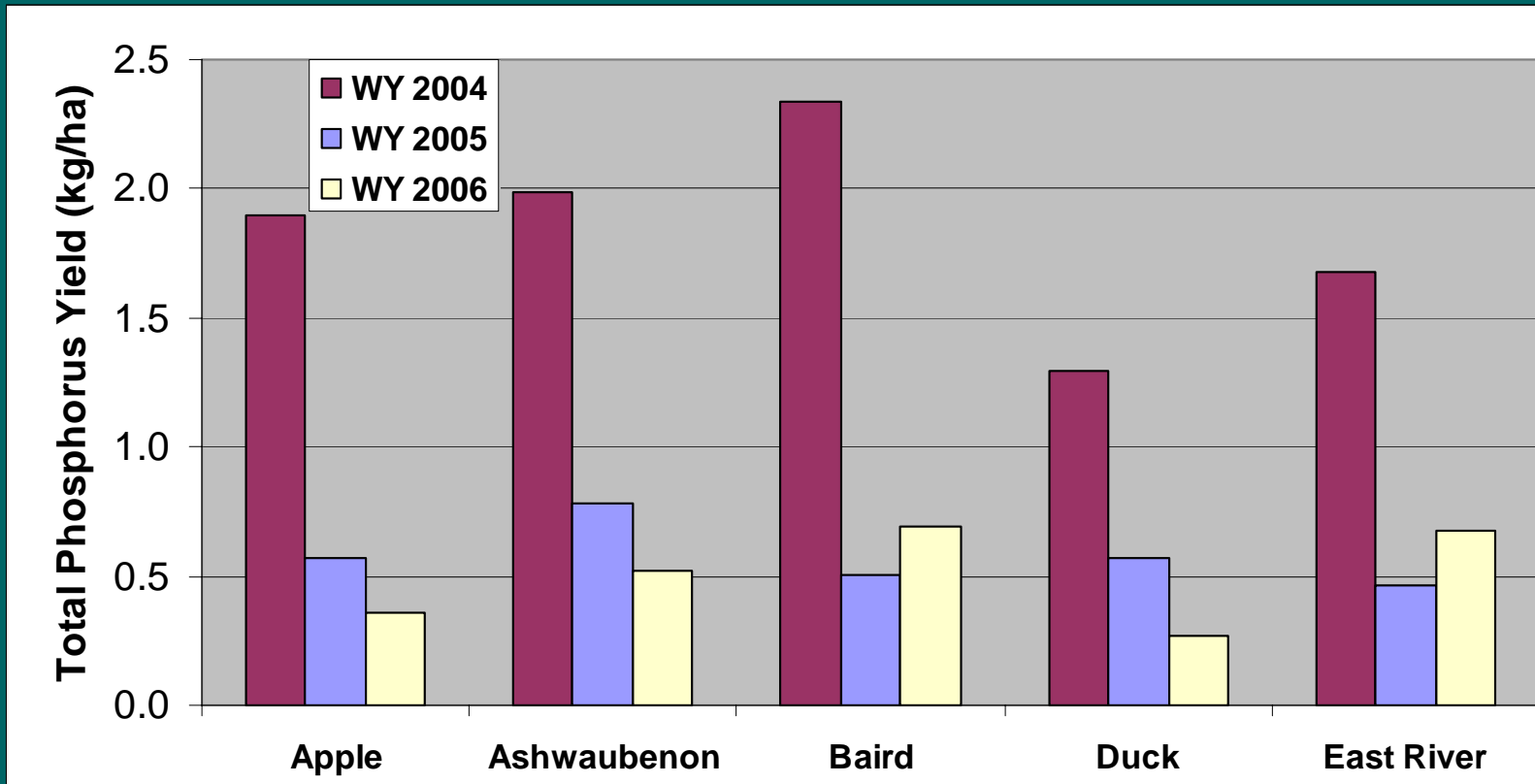
# Sediment exported per ha of watershed



- 2005-06 WY  $\rightarrow$  <30% of 2004
- 0.1 ton/ha = reference yield for Great Lakes streams (Robertson et al., 2006)



# Total Phosphorus Yield (kg/ha)



- 2005 & '06 → 20 to 40% less than WY04
- Baird and East '06 greater than '05 → more precip.



# Estimate of Lower Fox River Watershed Loads

<b>Annual Load Extrapolatd to Fox</b>			
	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>TSS load (tons)</b>	104,700	17,700	13,700
<b>Phosphorus load (kg)</b>	265,700	89,500	67,900

- Highly dependent on timing and amount of precipitation



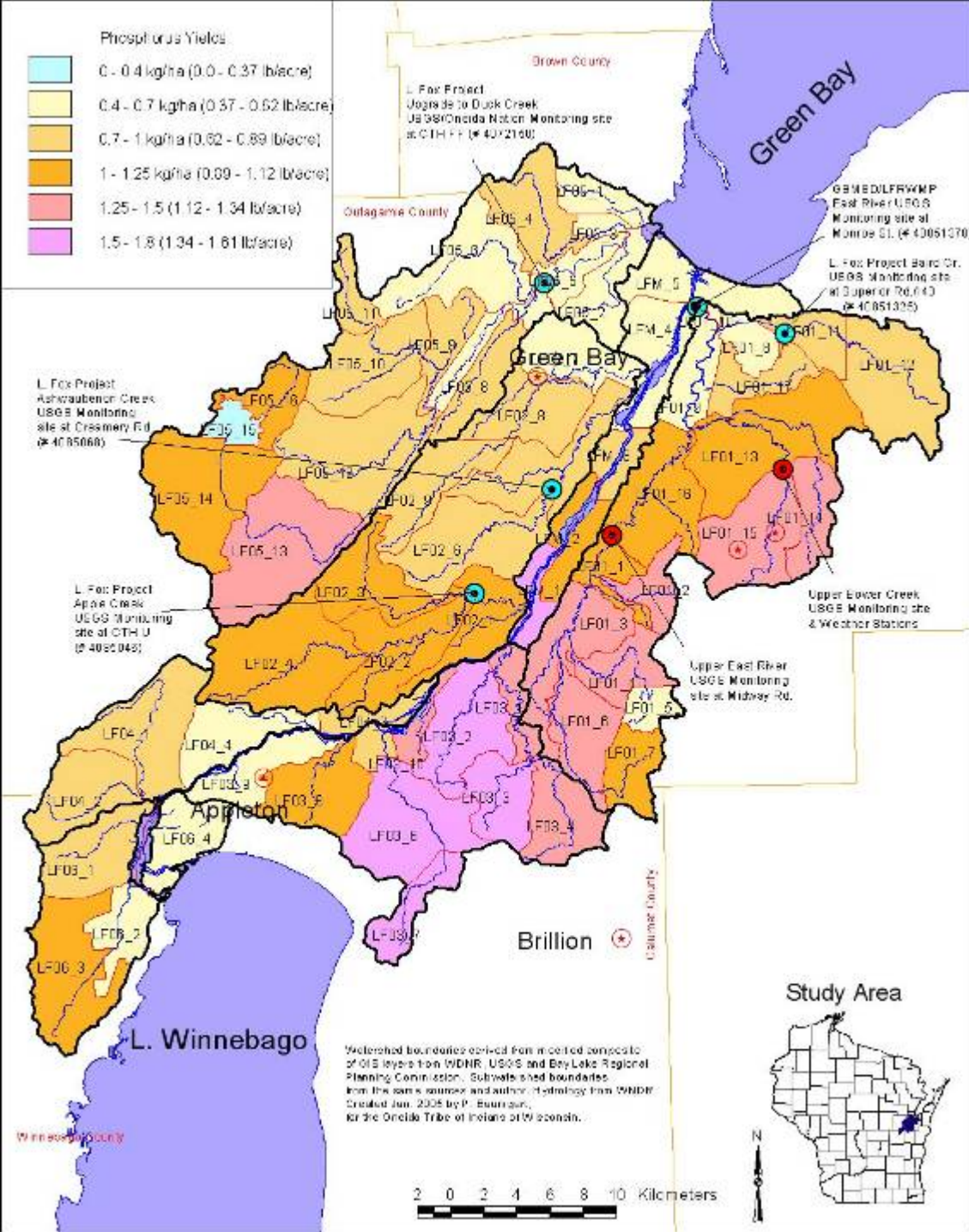
# Data Used to Improve Computer Simulation Models

Models integrate important factors & relationships.

Confidence in Models improves with robust local monitoring data

What if?

Phosphorus Yield (kg/ha)  
(Baseline 2000 conditions)



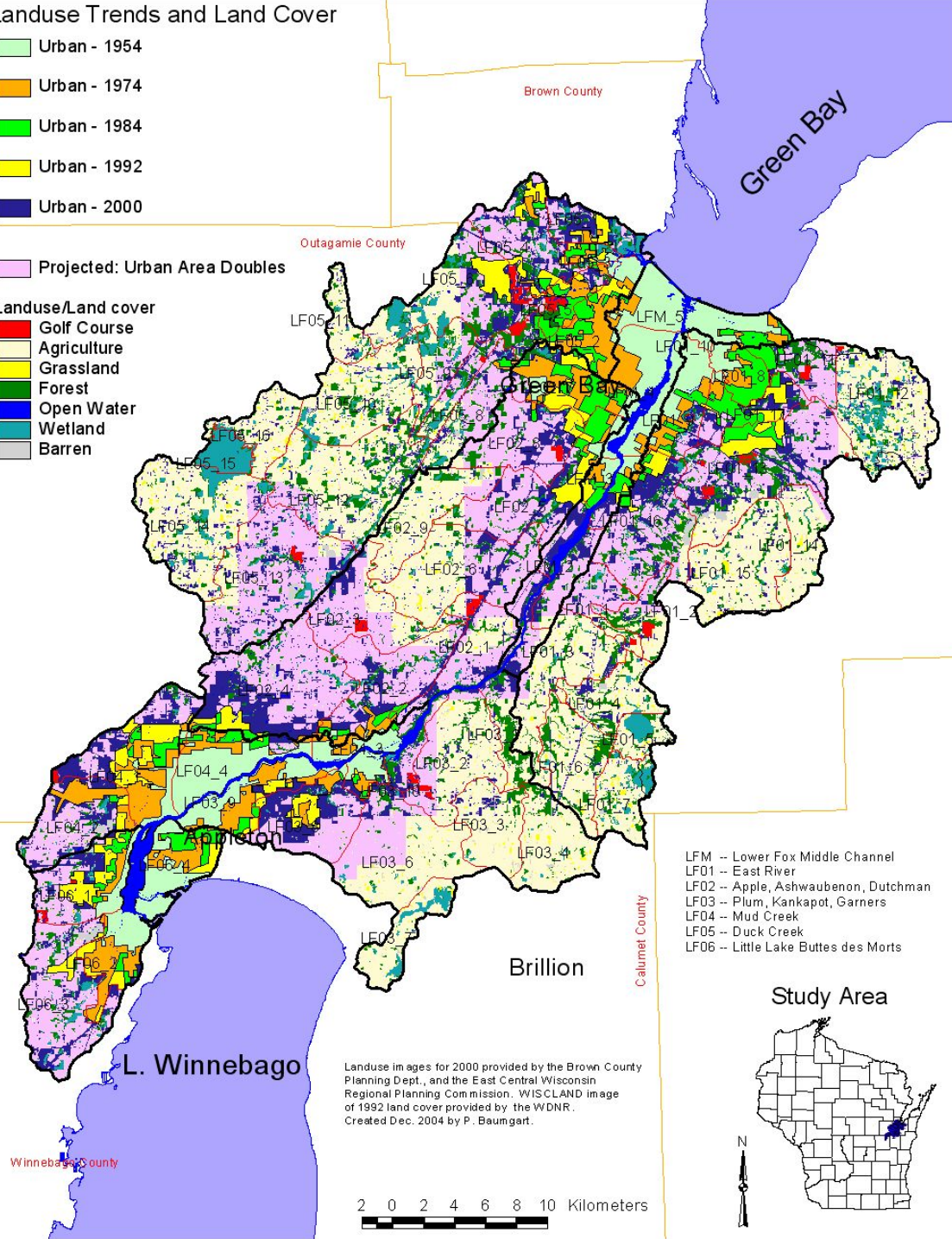
Landuse Trends and Land Cover

- Urban - 1954
- Urban - 1974
- Urban - 1984
- Urban - 1992
- Urban - 2000

Projected: Urban Area Doubles

Landuse/Land cover

- Golf Course
- Agriculture
- Grassland
- Forest
- Open Water
- Wetland
- Barren

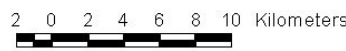


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Study Area



Landuse images for 2000 provided by the Brown County Planning Dept., and the East Central Wisconsin Regional Planning Commission. WISCLAND image of 1992 land cover provided by the WDNR. Created Dec. 2004 by P. Baumgart.



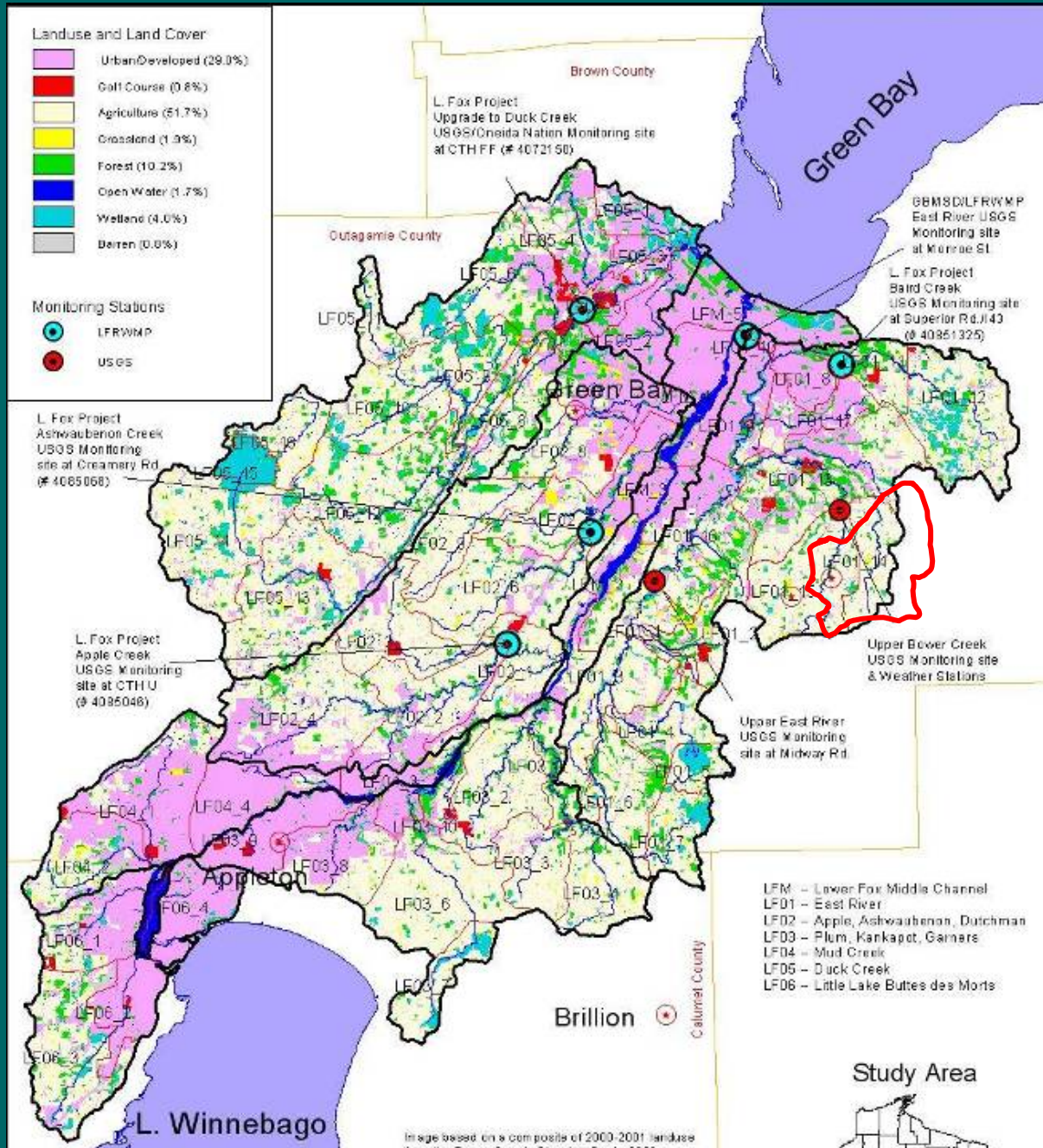
**Lower Fox River  
Year 2000 Landuse  
Trends  
1954 to 2000,  
urbanization =  
2.6%/year**

**Projected urban area  
doubles by 2025 to  
2030**



# Ongoing & Future Activities:

- Baird, Bower Duck, East through Sept 07
- Report summarizing 3 WY data
- School Monitoring
- P-forms study
- Sediment source tracking
- SWAT modeling



[www.uwgb.edu/WATERSHED](http://www.uwgb.edu/WATERSHED)

# Questions?

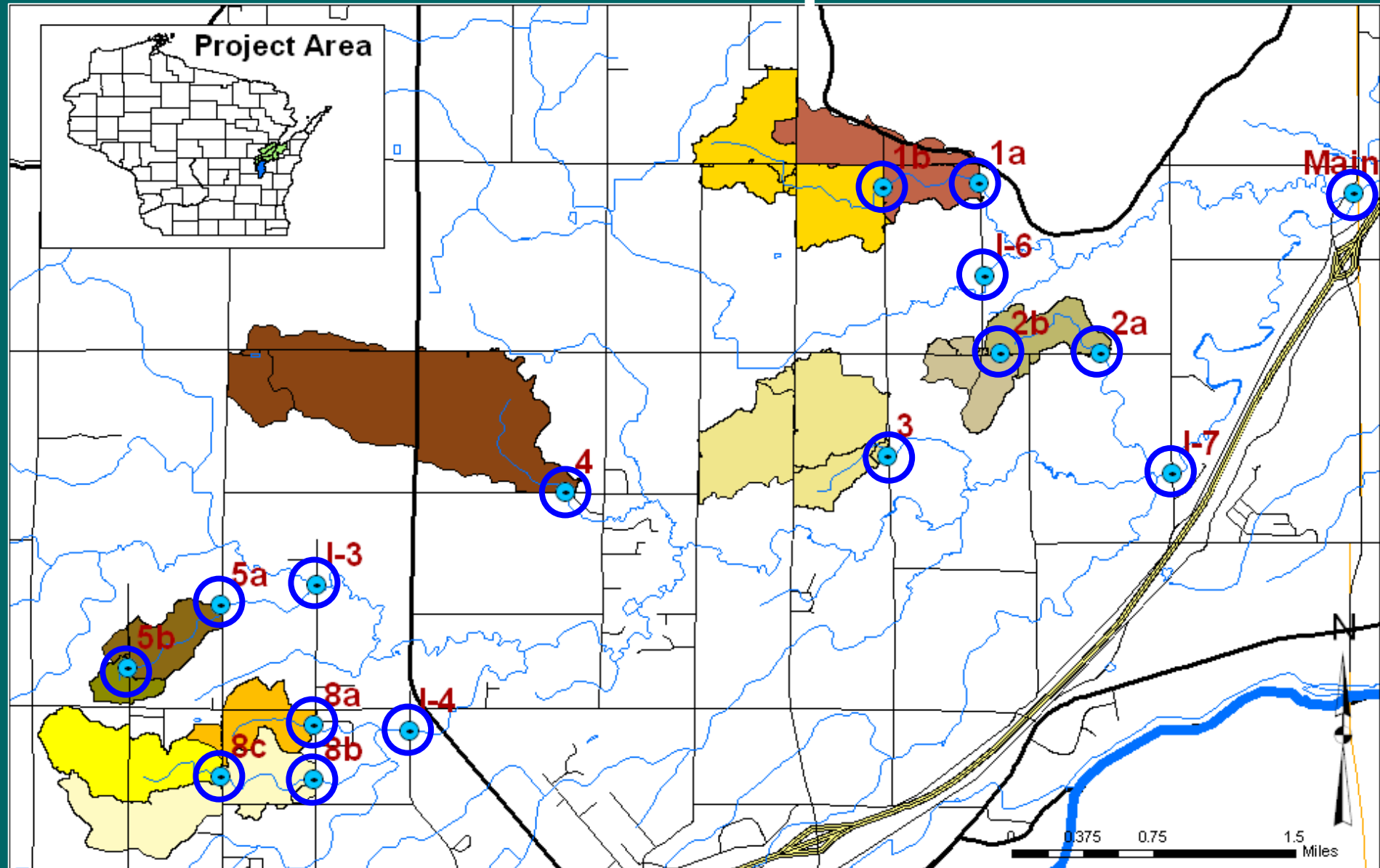
THE LOWER FOX RIVER



Watershed  
Monitoring  
Program



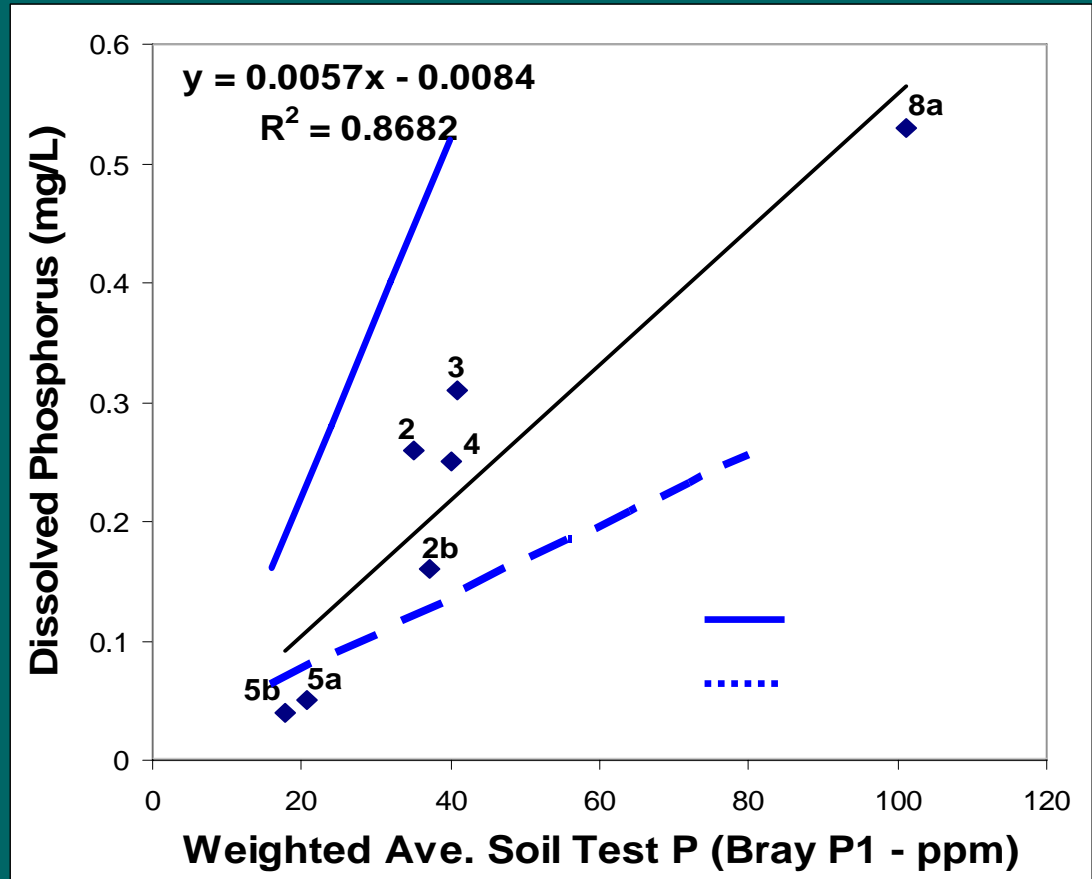
# Apple Creek P-Forms Study Sites – Close up



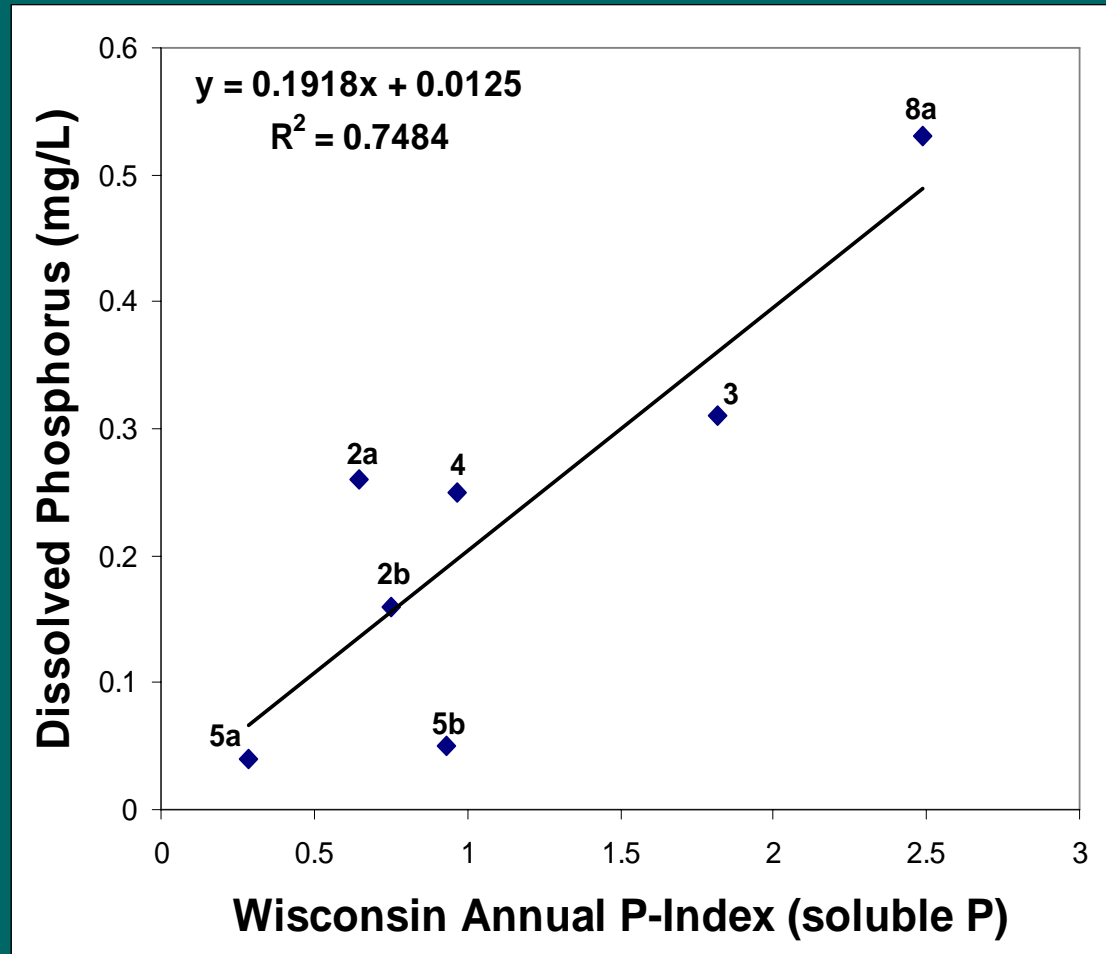


# Soil Test P vs. DP in Streams

- Strong response to increasing STP on DP in streams
- Andraski and Bundy. 2002. JEQ



# Soluble PI vs. Dissolved P in Stream



- Relationship between Soluble P-Index and median DP concentrations at sub-watershed outlets (5 events - 2004)



