A Summary of 84 Site Years of Field Scale Runoff Data

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The major lesson learned from Discovery Farms is that producers have to be a major part of:

- **Identifying the issues**
- **Designing solutions**
- **Developing the implementation plans**
- **Testing the solutions**

However, there are a lot of contributors to poor water quality.


Agriculture is just one of the sources.

Discovery Farms?

Discovery farms are real-life Wisconsin farms in different geographic areas facing different environmental challenges.

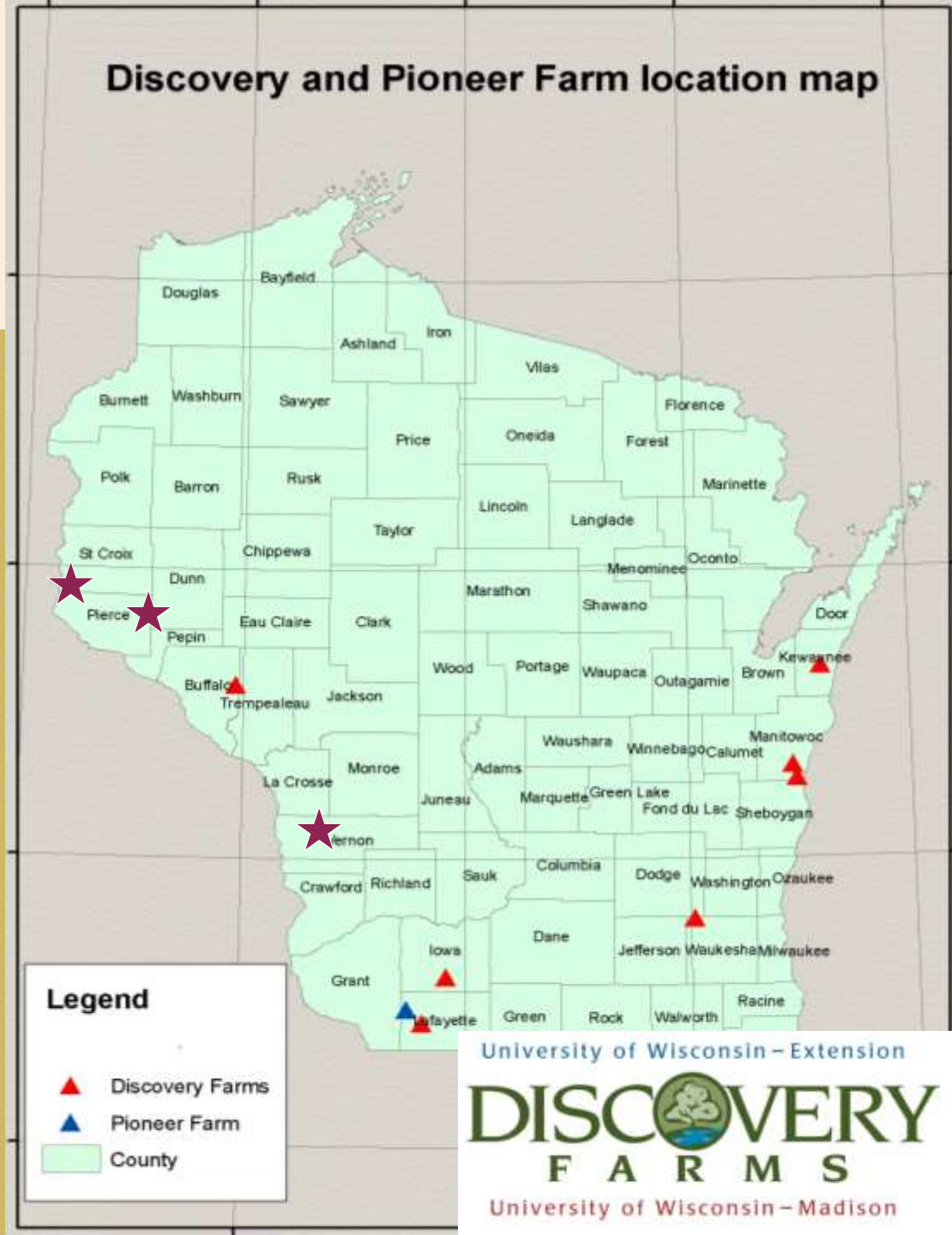
Our goal is to better understand and reduce the sources of phosphorus, nitrogen, and other pollutants that may impair the surface and groundwater.

Farms participate for 5-7 years.

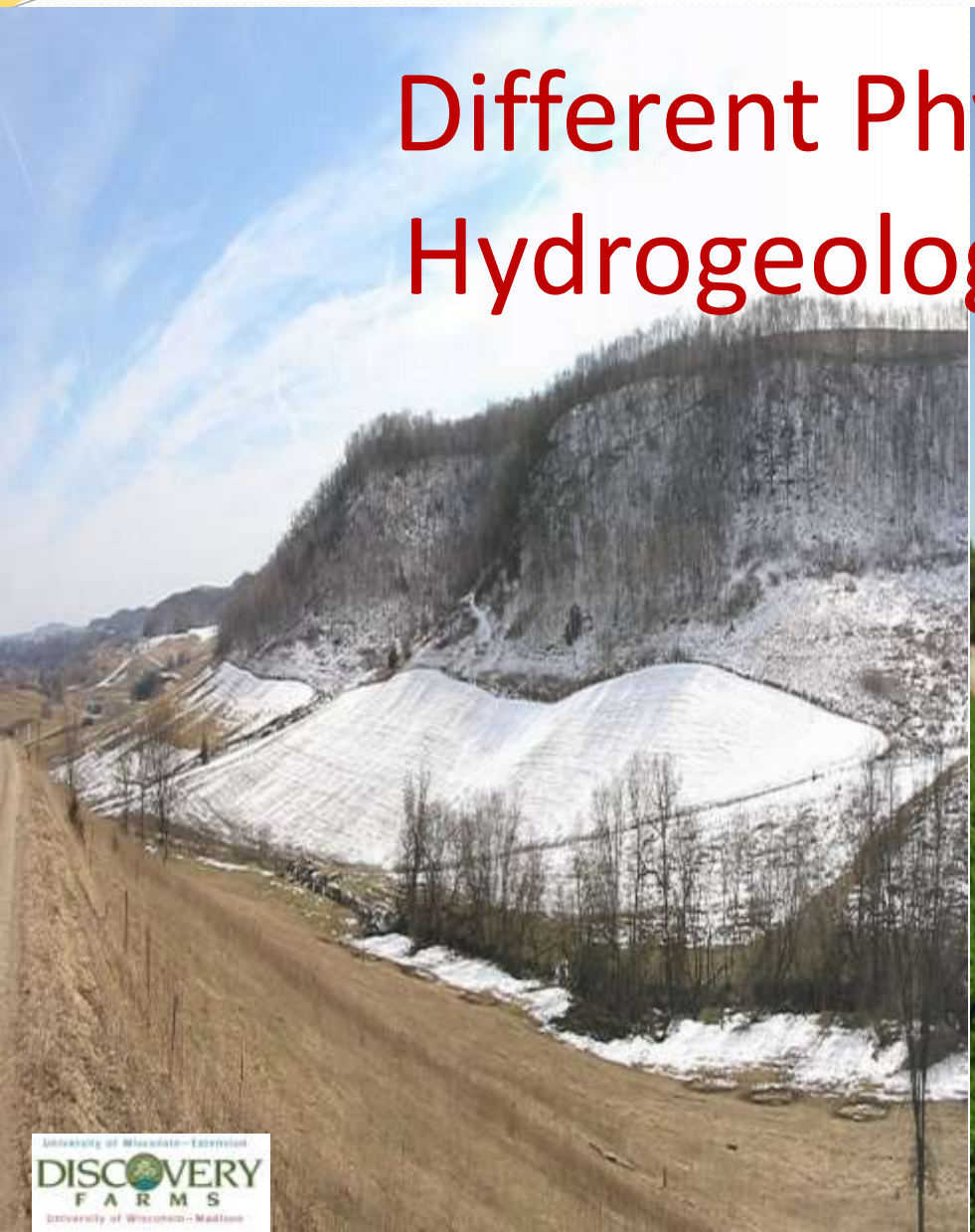
Locations of Discovery Farms Projects

- Beef
- Swine – odor
- Poultry-stacking
- Dairy – grazing
- Dairy - grazing/organic
- Dairy – confinement

- Watersheds



Different Physiographic Hydrogeologic Settings



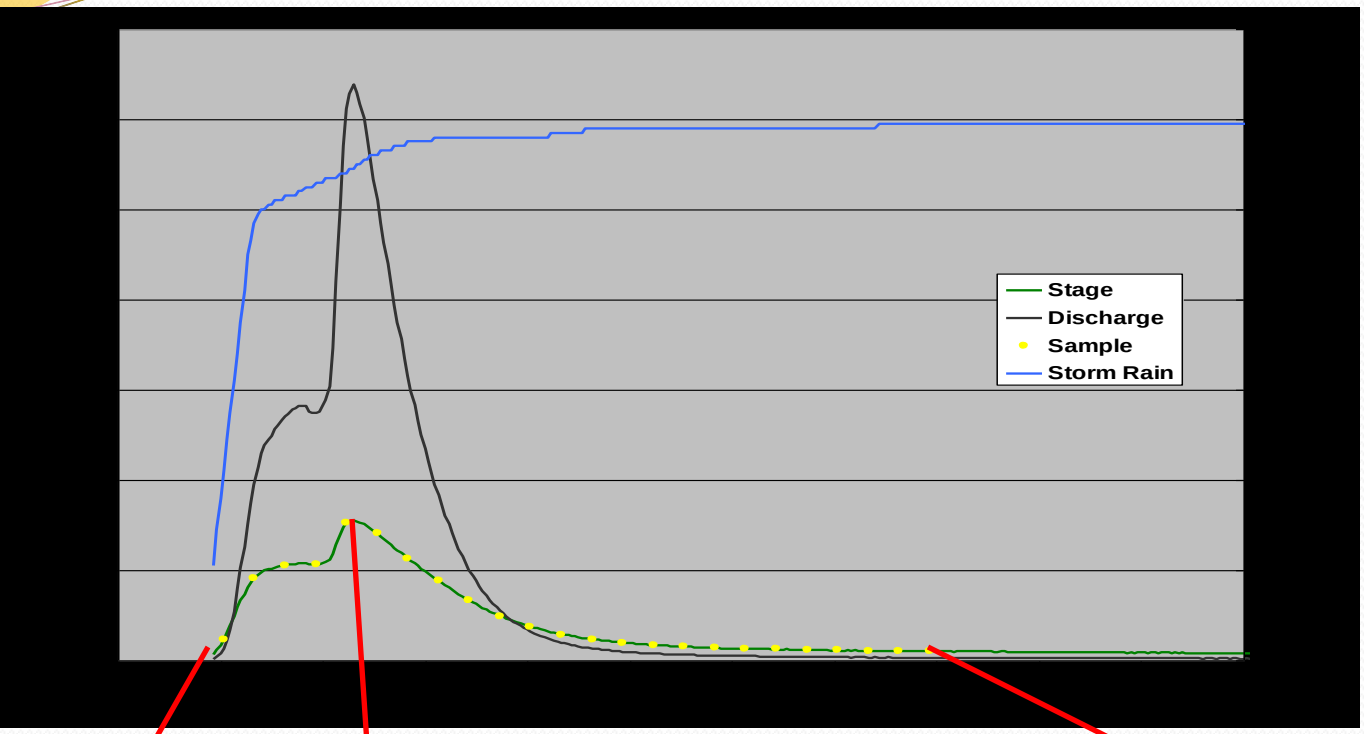

Extension

Surface Water

Tile Water

...the brains of the operation

Meteorological data: precipitation, wind speed and direction, air temperature, solar radiation, relative humidity, soil moisture and temperature



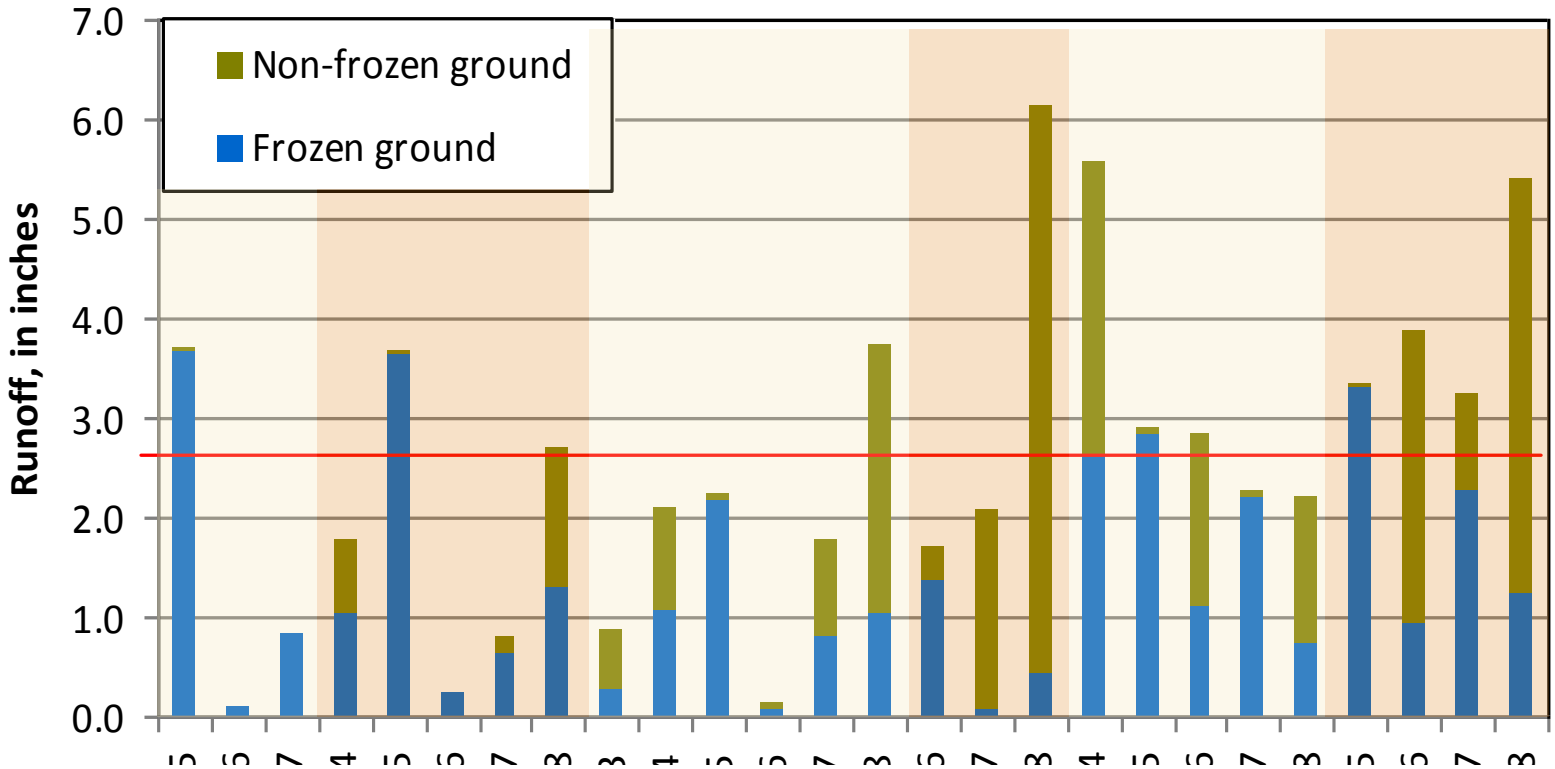
Constituent list

- Suspended sediment
- Total dissolved solids
- TKN
- Ammonium
- Nitrate
- Total P
- Dissolved reactive P
- Chloride
- Total Nitrogen
- Organic Nitrogen

How much runoff ?

- It depends!
  - Location in the state
    - Soil type
    - Slope
  - Farming system
    - Grazing
    - No-till
    - Minimum tillage
  - Weather
    - During snowmelt
    - Storm frequency and intensity
  - Surface water versus tile drainage

26 Farm Years of data - 2003 – 2008



- Average annual runoff was 2.5”
- Average runoff as a percent of annual precipitation: 8%
- Tendency for higher percentages at the northeast farms

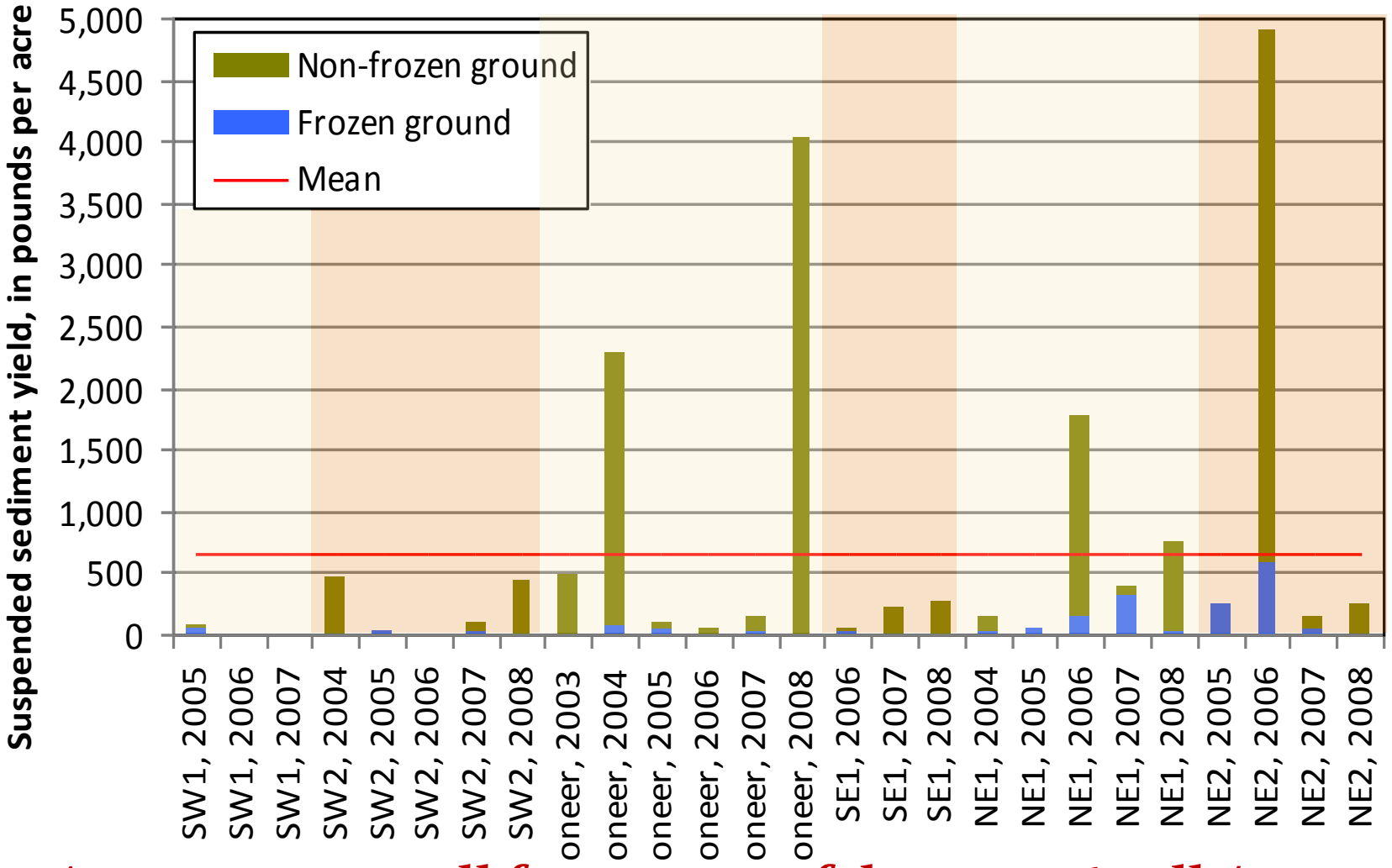
When does runoff occur?

	WY03	WY04	WY05	WY06	WY07	WY08	Average of all 26 Farm Years
Frozen Ground	0.27 (30%)	1.58 (50%)	3.12 (98%)	0.64 (43%)	1.13 (62%)	0.94 (23%)	**54%**
Non-Frozen Ground	0.61 (70%)	1.57 (50%)	0.05 (**2%**)	0.84 (57%)	0.71 (38%)	3.09 (**77%**)	**46%**
Total	**0.88**	**3.15**	**3.17**	**1.48**	**1.84**	**4.04**	**2.55**

Around 90% of the nutrient and sediment losses that occur in any given year happen before the 15th of June.

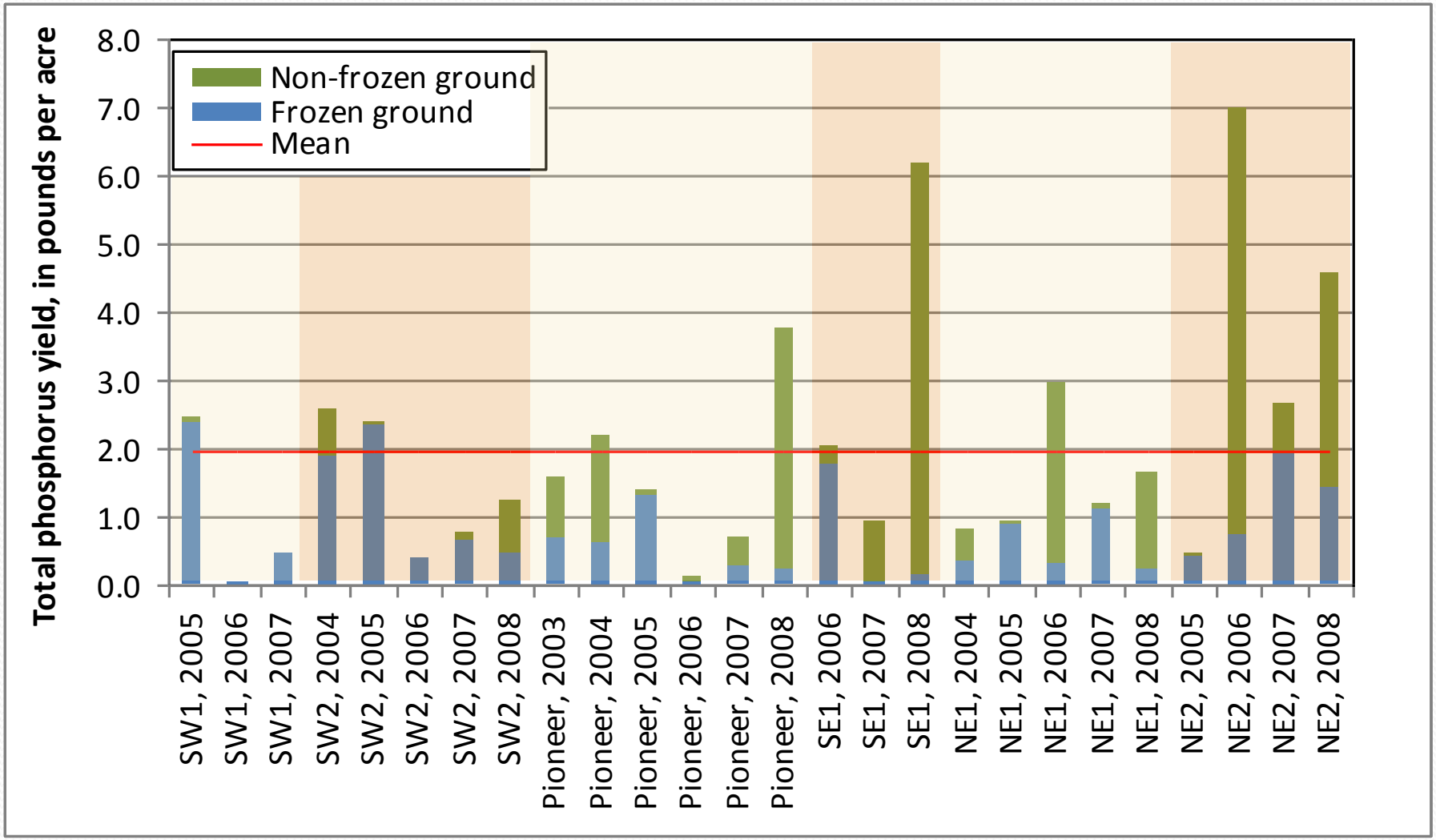
	Mean-Monthly Runoff	Mean-Monthly Runoff as a Percentage of Annual Runoff	Runoff Frequency	Total Precip	Mean-Monthly Runoff as a Percentage of Total Precip
October	0.07	3%	23%	2.32	3%
November	0.02	<1%	15%	2.22	1%
December	0.04	1%	35%	1.73	2%
January	0.1	4%	50%	1.68	6%
February	0.41	16%	58%	1.48	28%
March	0.87	34%	100%	2.22	39%
April	0.11	4%	54%	3.42	3%
May	0.32	12%	38%	3.7	9%
June	0.48	19%	42%	3.83	13%
July	0.07	3%	42%	3.9	2%
August	0.07	3%	19%	3.55	2%
September	<0.01	<1%	19%	2.76	<1%

Suspended sediment losses (yields)

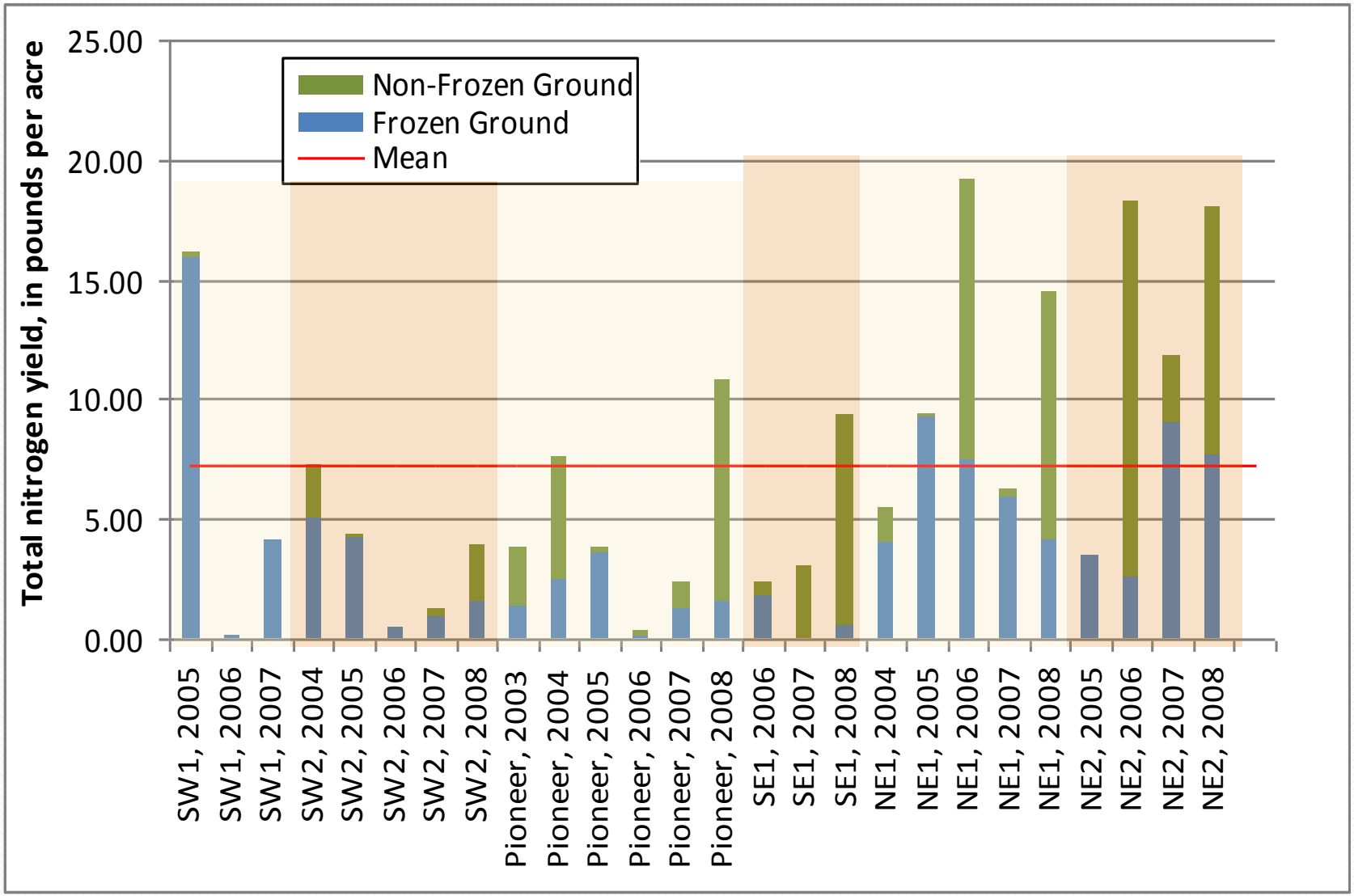


Average across all farm years of data was 670 lb/acre

Phosphorus Loss - Summary



Nitrogen Loss - Summary



Winter 2004

- Mid-Feb runoff
- 5” snow, 1” water equivalent
- Rain on snow

Fall applications

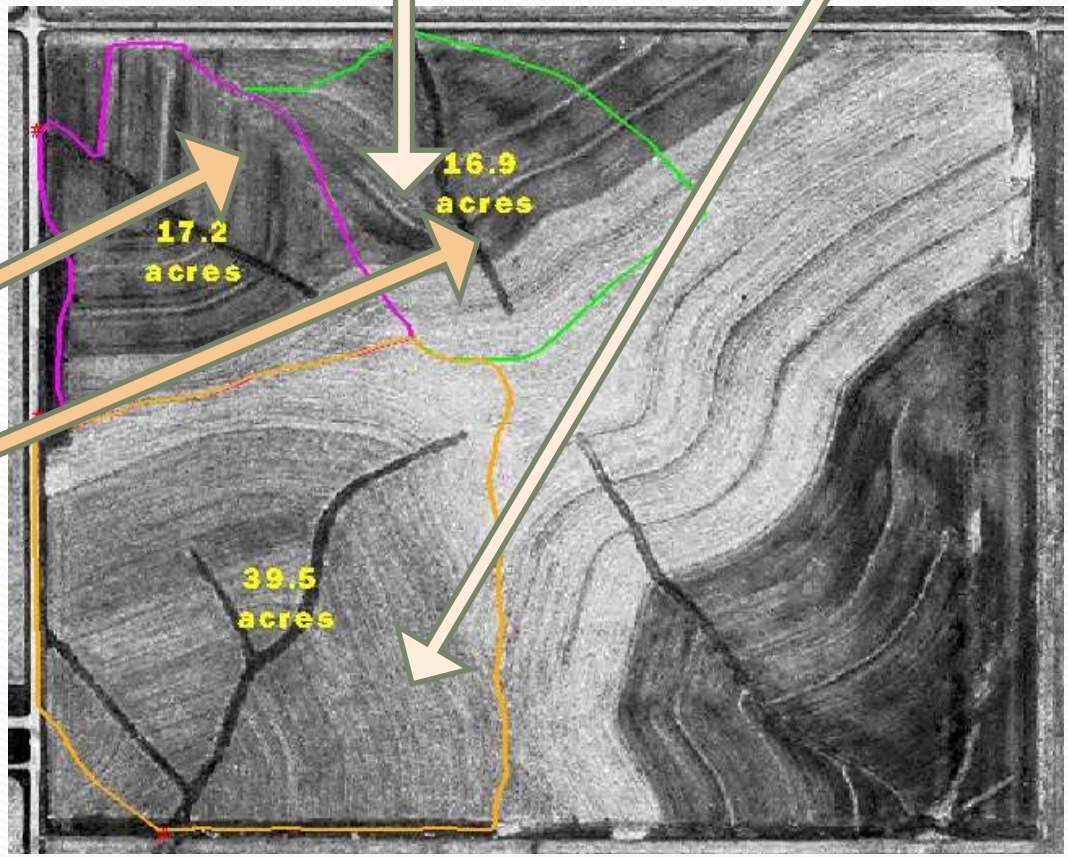
Sep: 6,000 gal/acre

Nov: 7,000 gal/acre

Winter applications

Feb. 14: 4,300 gal/acre

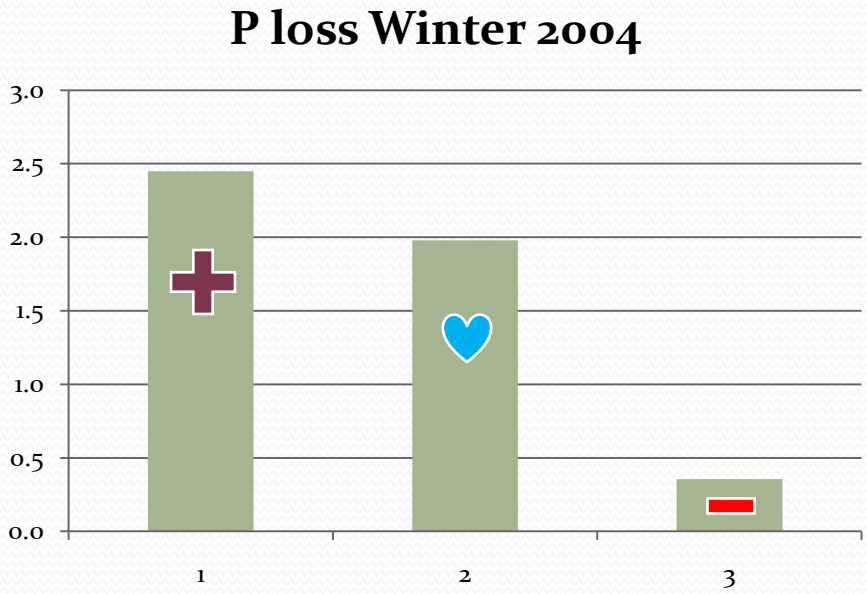
Feb. 13: 7,000 gal/acre

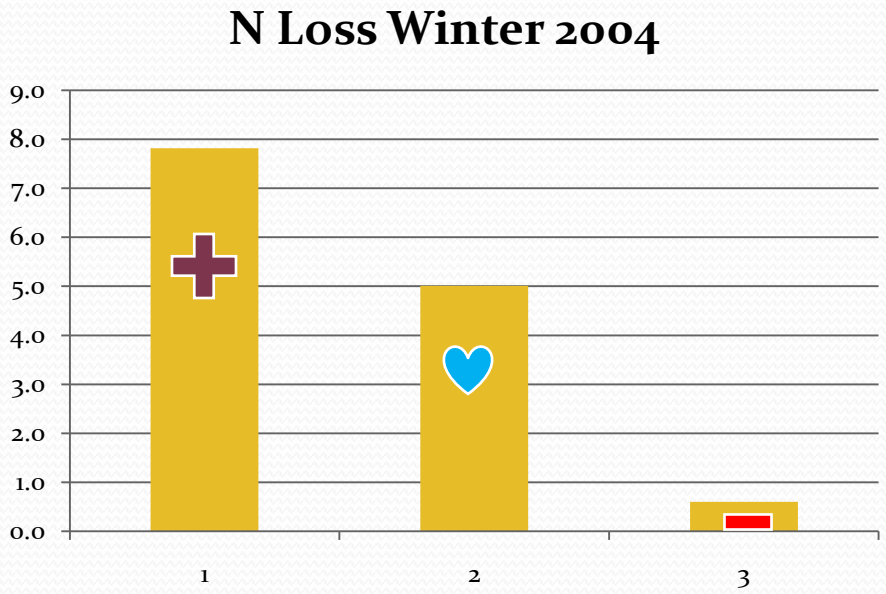


The Outcome

- Samples represent approximately the first two days of snowmelt in 2004

Winter 2004 Nutrient Loss





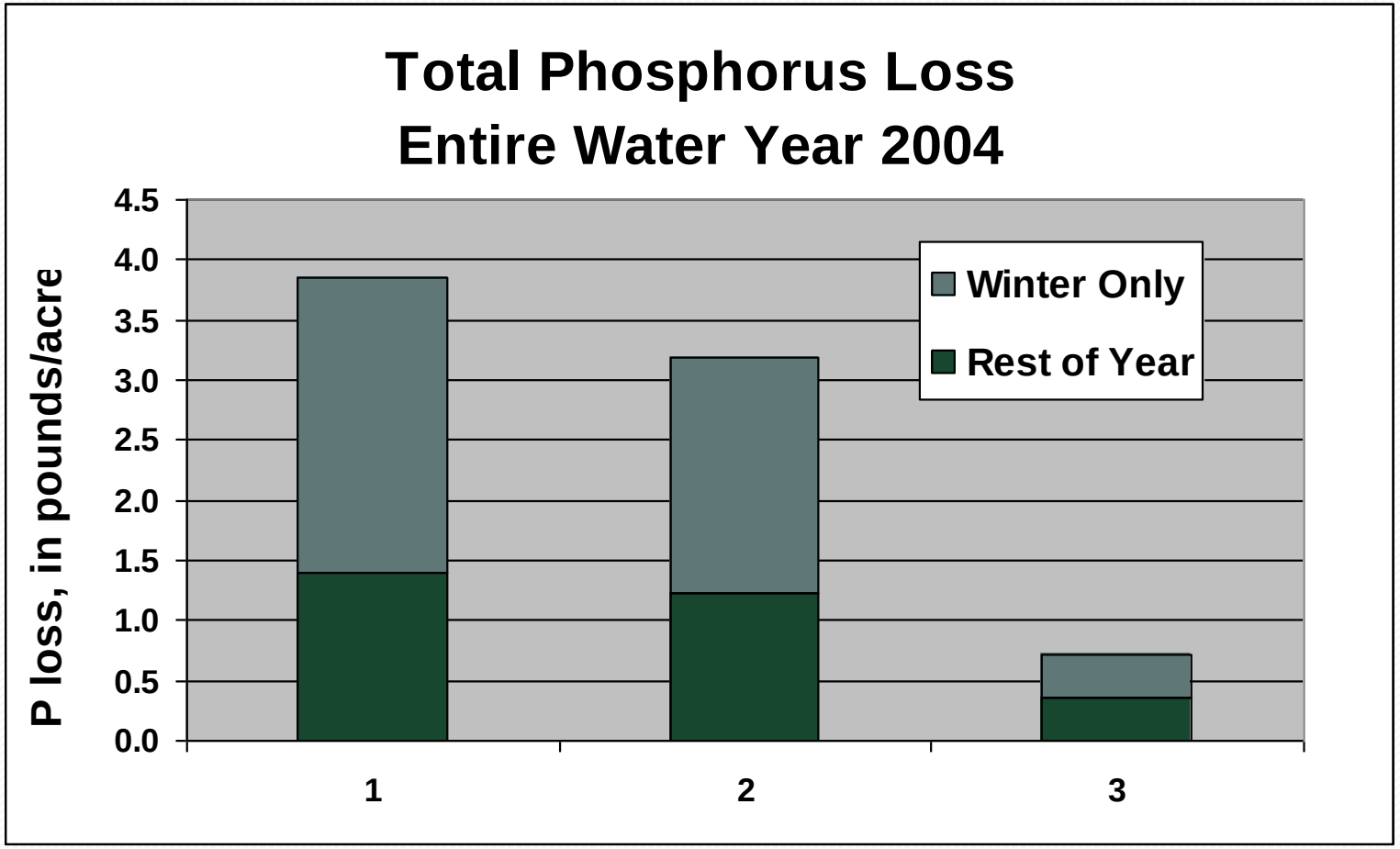
"Effective" Wintertime Application Rates

Feb. 14: 5,200 gal/acre

Feb. 14: 4,800 gal/acre

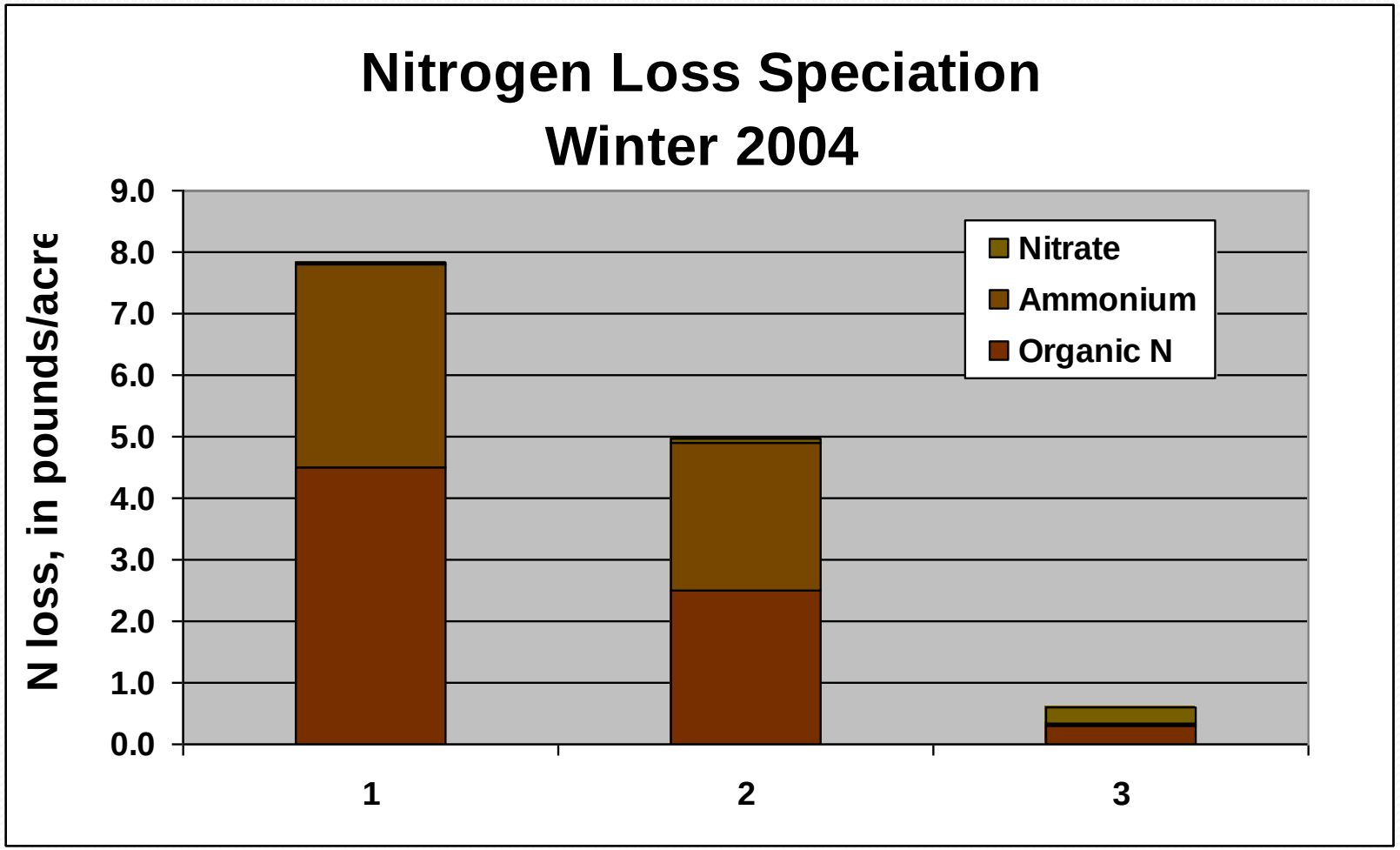
Feb. 14: 1,550 gal/acre

P Losses for Entire 2004



A manure management decision can have a big impact to annual nutrient losses.

Nitrogen Speciation



Manure applications on frozen/snow-covered ground: What the data show

- Runoff is more likely in February and March than in early winter.
- Wintertime runoff can comprise a significant amount of annual surface water runoff and nutrient losses.
- The shorter the time between a manure application and a runoff event, the greater potential for nutrient losses.

Why not ban winter spreading?

- Having all livestock farms apply manure in a narrow window greatly increases the risk.
- Spreading entire field versus portions of a field can increase risk.
- Storage does not reduce the risk of a runoff event – management reduces risk.
- Work with producers to limit spreading in high risk periods, offer options to storage:

  stacking, spreading fields with limited risk, etc.

What is the distribution of runoff for various soil conditions?

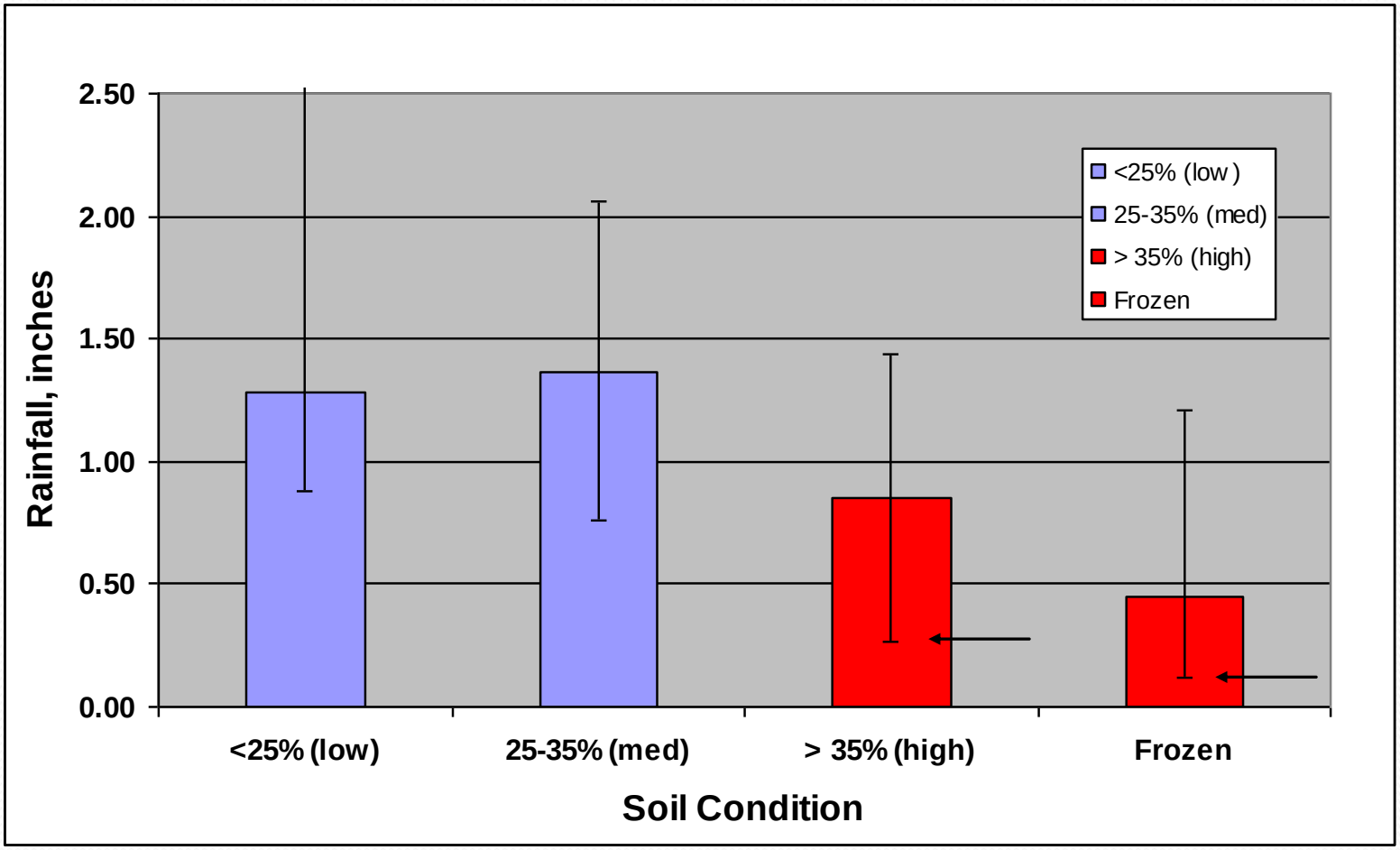
Example: No-till farm in SW Wisconsin (2003-2008)

- Frozen ground: 80%, Non-Frozen Ground: ~ 20%
  - Of the frozen ground runoff, about ¾ has occurred in February and March

- Of the non-frozen ground runoff:
  - 83% occurred when soils were "Wet" (>35%)
  - 10% occurred when soils were "Medium" (25-35%)
  - 7% occurred when soils were "Dry" (<25%)

How much rain does it take to produce runoff for a given soil condition?

Example: No-till farm in SW Wisconsin (2003-2008)

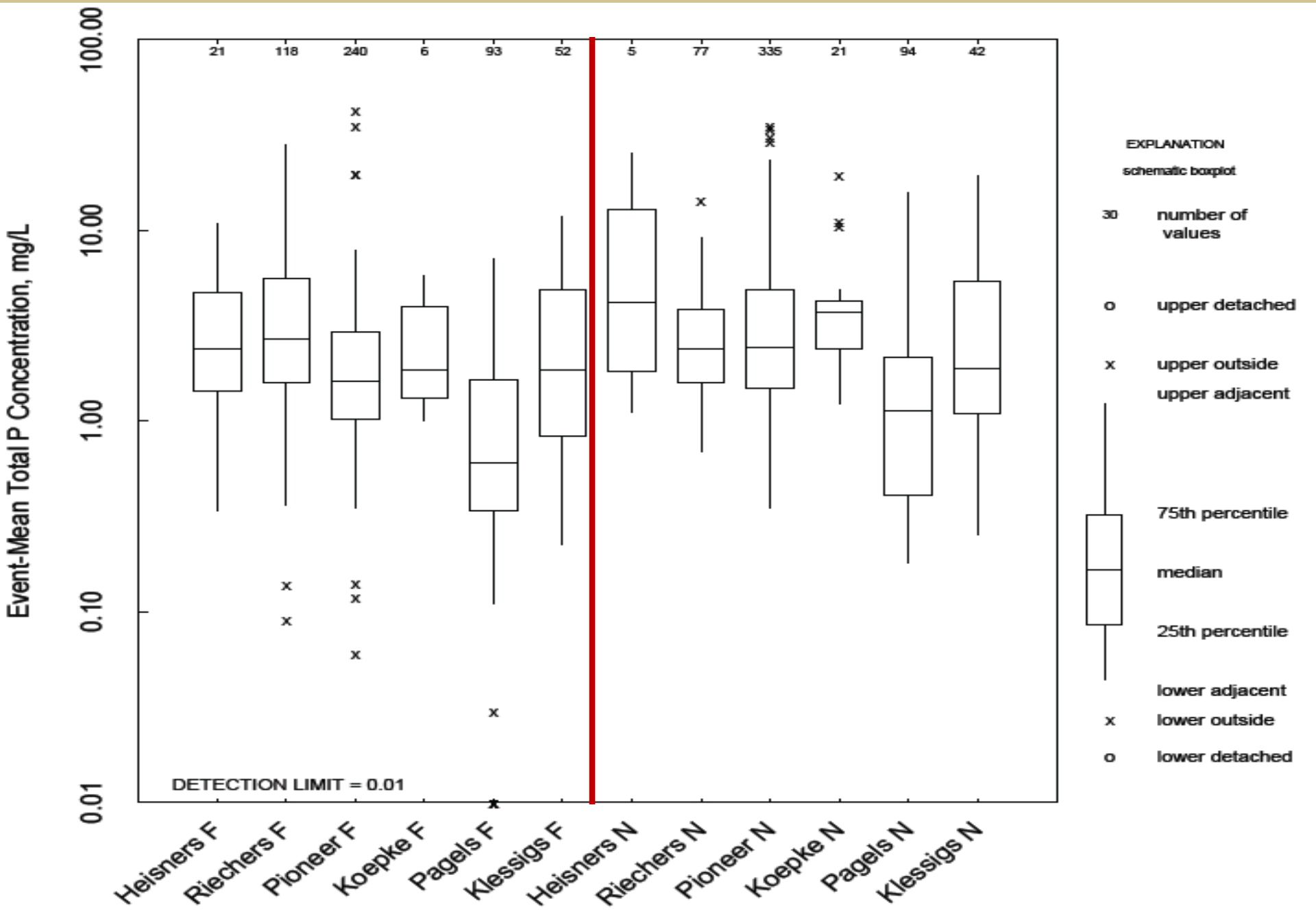


Lessons Learned

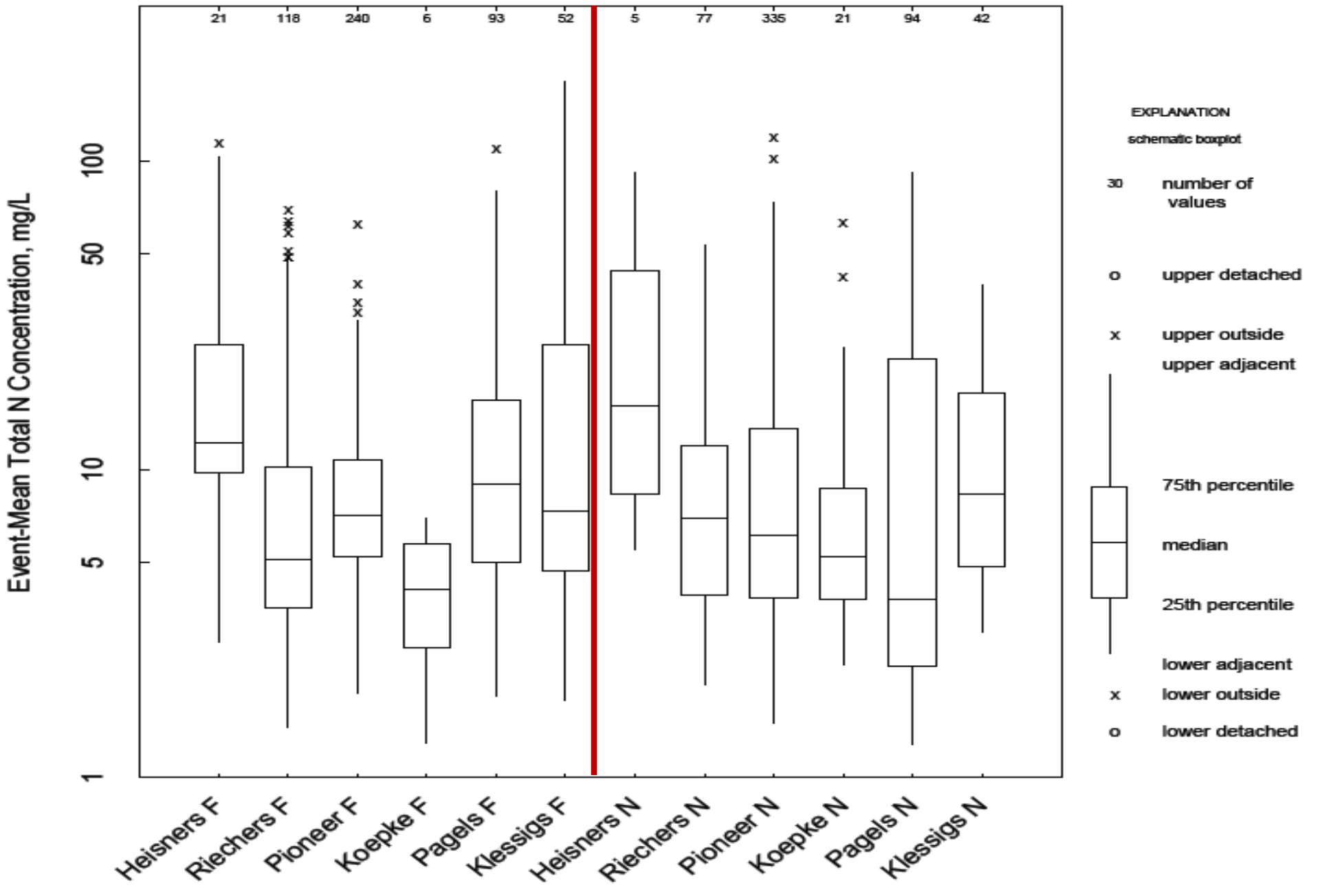
- In addition to the conservation practices and nutrient management plans that were already in place, consideration of:
  - critical runoff periods,
  - field conditions (soil moisture, frozen soil),
  - and the timing of field-management activities (manure applications) in relation to these periods and conditions, could have significantly reduced runoff of nutrients from edges of fields.

In other words: Day-to-day decisions can be very important!

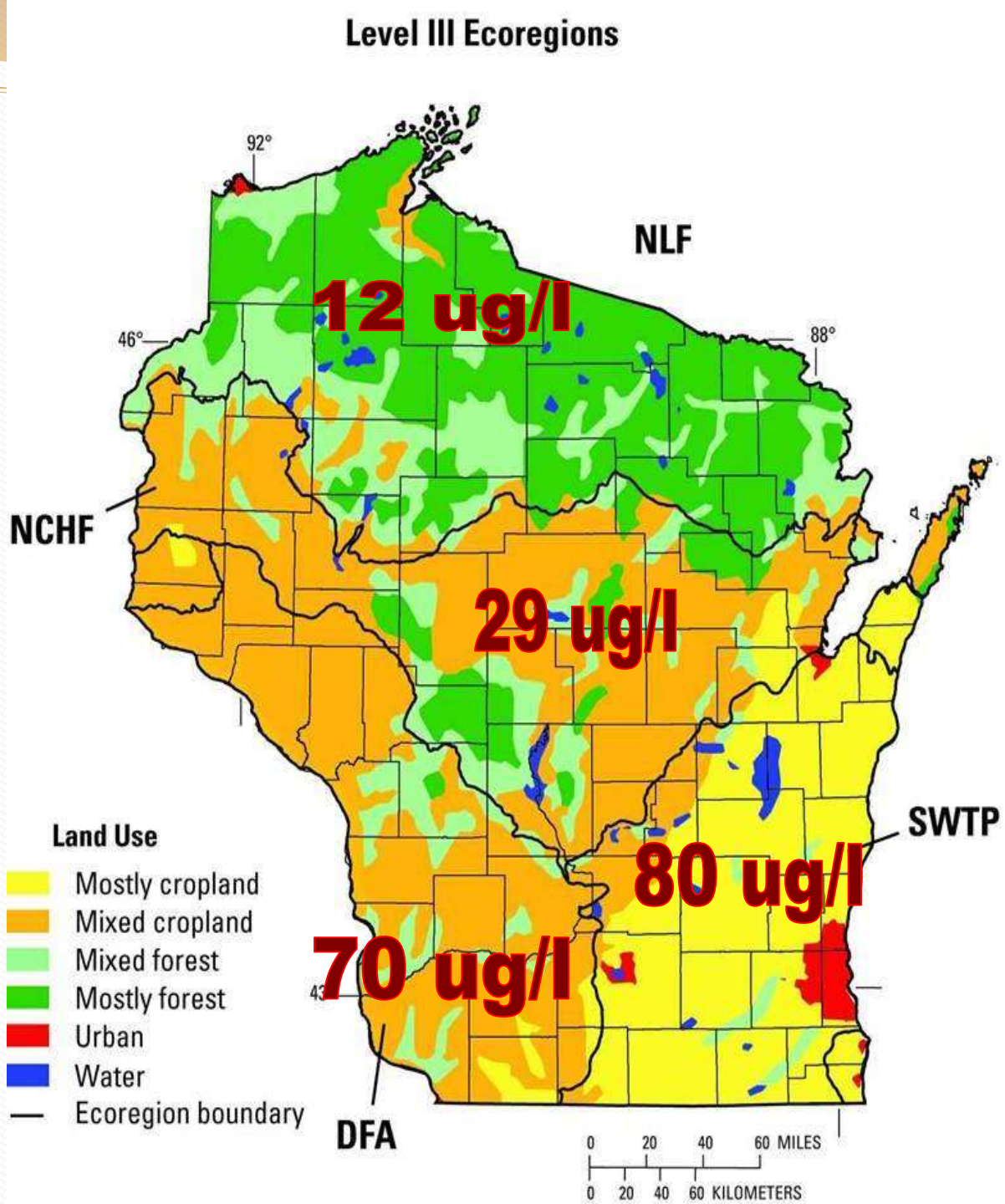
Distribution of event-mean total P concentration 2003 - 08



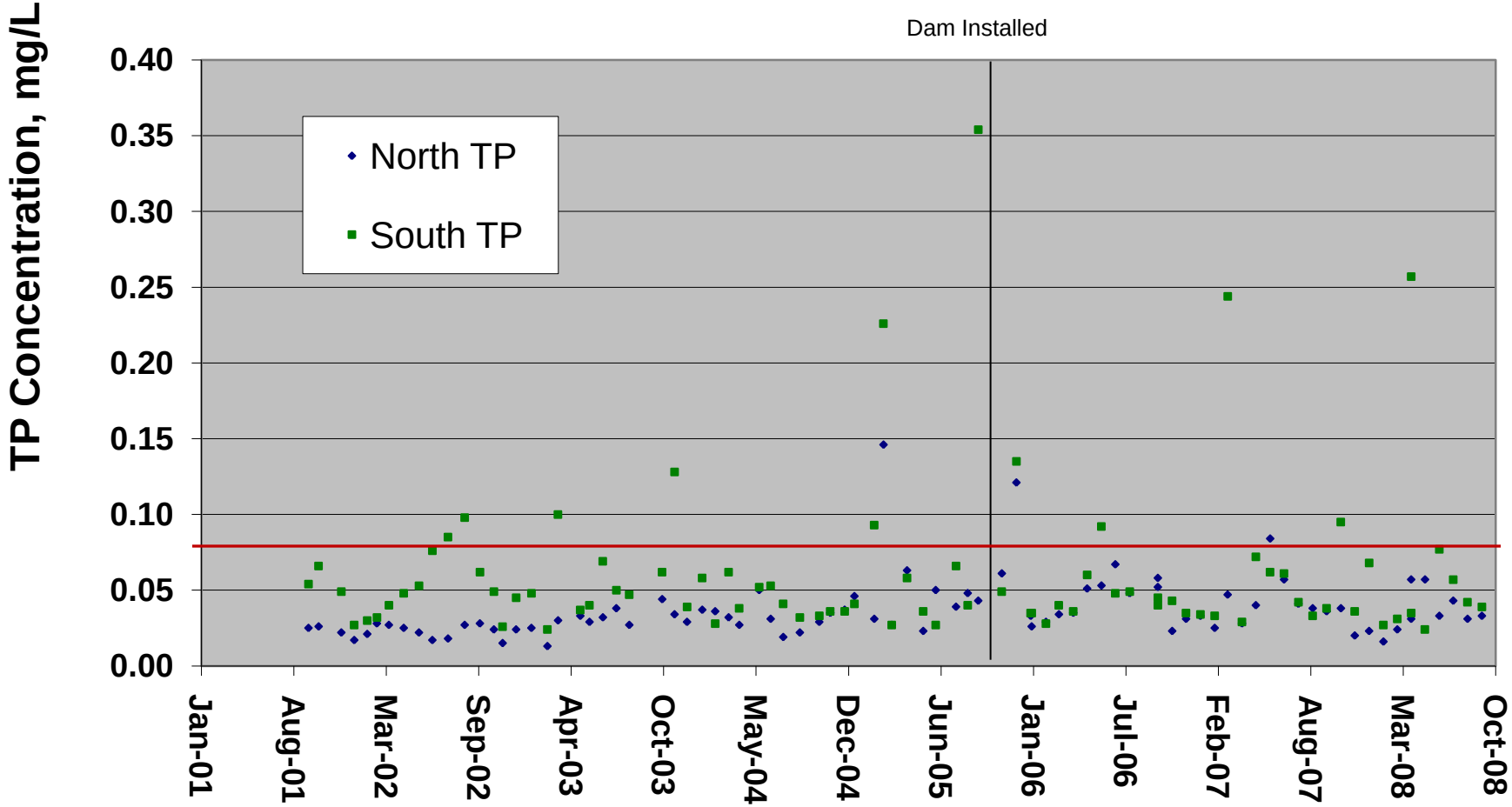
Distribution of event-mean total N concentration 2003 - 08



EPA guidance for phosphorus loss in streams in Wisconsin.



Bragger Base Flow Samples
Total P, WY02 - WY08



Next Steps

- Moving into studies that evaluated more than losses from agricultural fields
- Looking at losses from fields to surface water
- Looking at losses from cities and non-ag land
- Looking at impacts on entire watershed

Questions?

Thank you!

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