# The Sources, Occurrence, and Management of Nitrogen in Wisconsin Groundwater

Groundwater Coordinating Council
November 4, 2011

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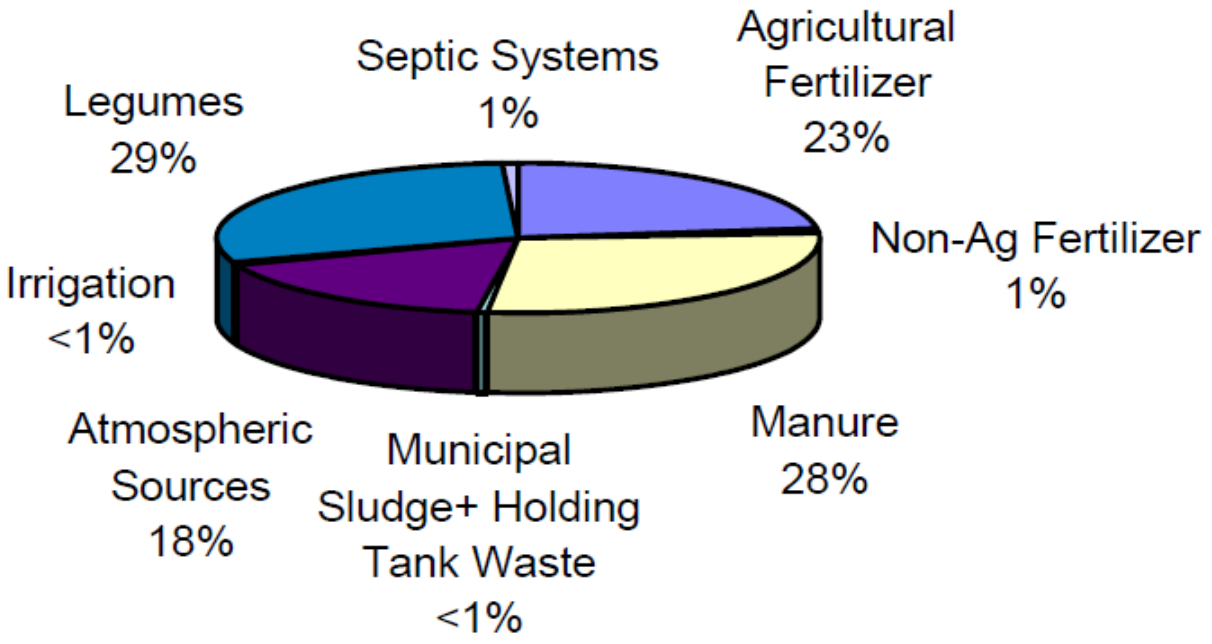
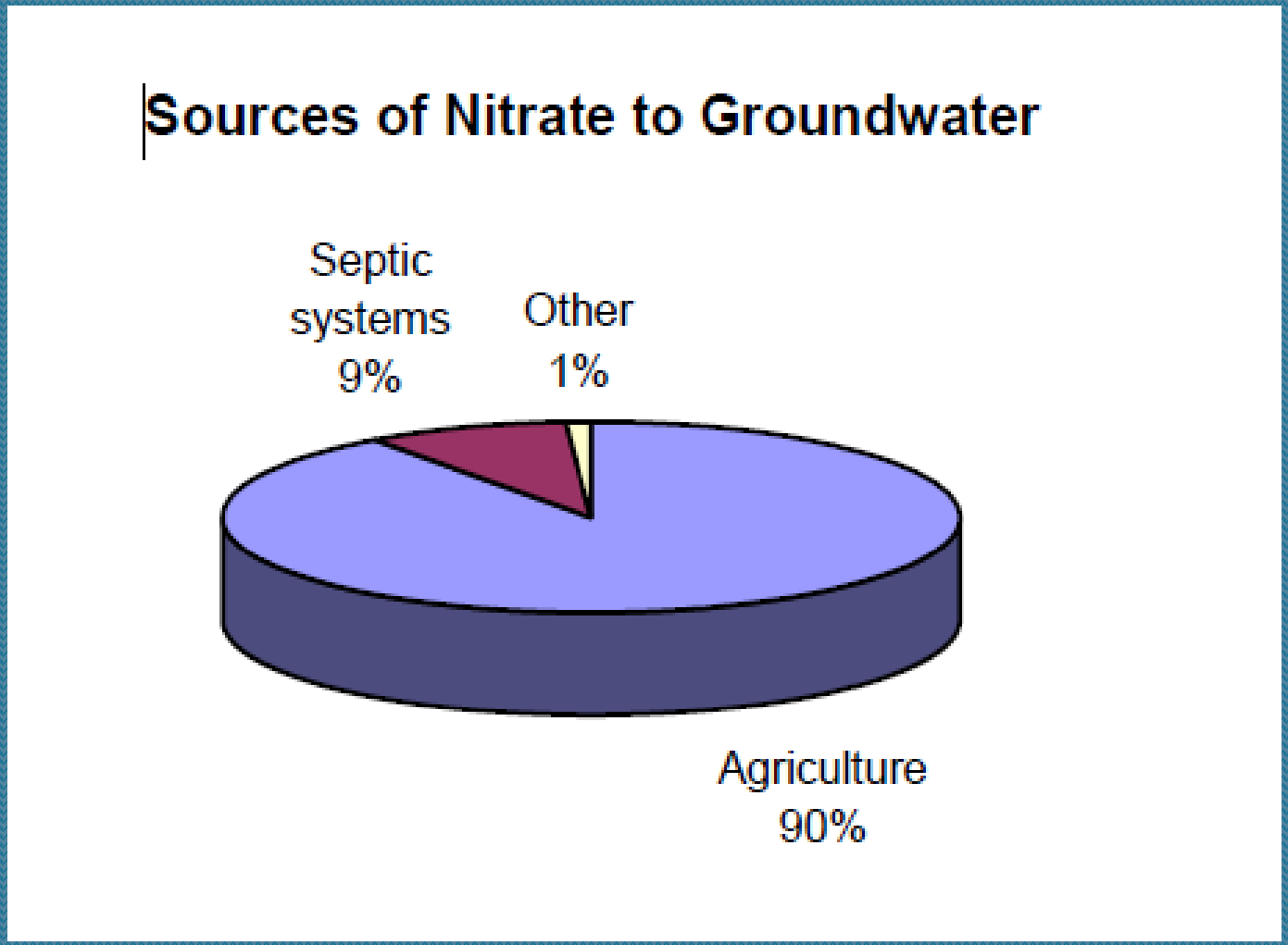
Wisconsin Dept. of Agriculture, Trade and Consumer Protection

# Primary Sources of N to Soils




**Nitrate in Groundwater - A Continuing Issue for Wisconsin Citizens , March 1999**

# Primary Sources of N to Groundwater




Nitrate in Groundwater - A Continuing Issue for Wisconsin Citizens , March 1999

# Primary Nitrate Sources to Groundwater in Rural Landscapes

Kevin Masarik, UWSP
Center for Watershed Science & Education

20 acres

| | | | |
|---|---|---|---|
| 36 lbs | 36 lbs | 36 lbs | 36 lbs |
| 36 lbs | 36 lbs | 36 lbs | 36 lbs |
| 36 lbs | 36 lbs | 36 lbs | 36 lbs |
| 36 lbs | 36 lbs | 36 lbs | 36 lbs |
| 36 lbs | 36 lbs | 36 lbs | 36 lbs |

**36 lbs/ac x 20 acres = 720 lbs**

**16 mg/L**

20 acres

20 lbs

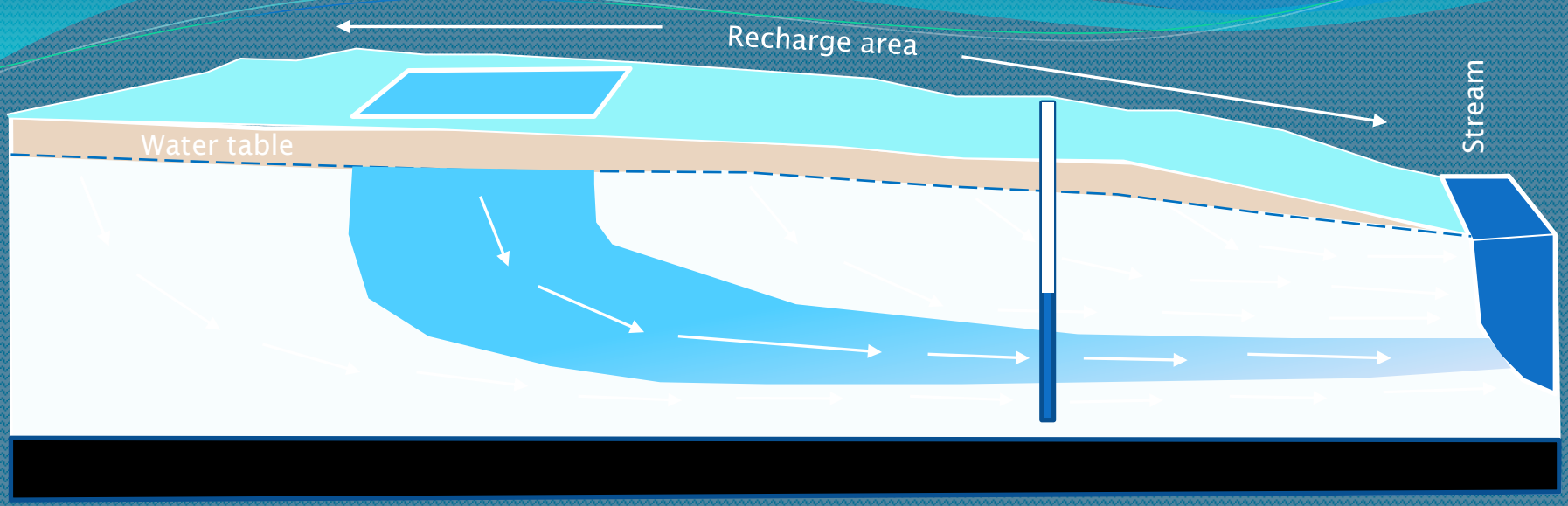
**20 lbs/septic system x 1 septic systems = 20 lbs**

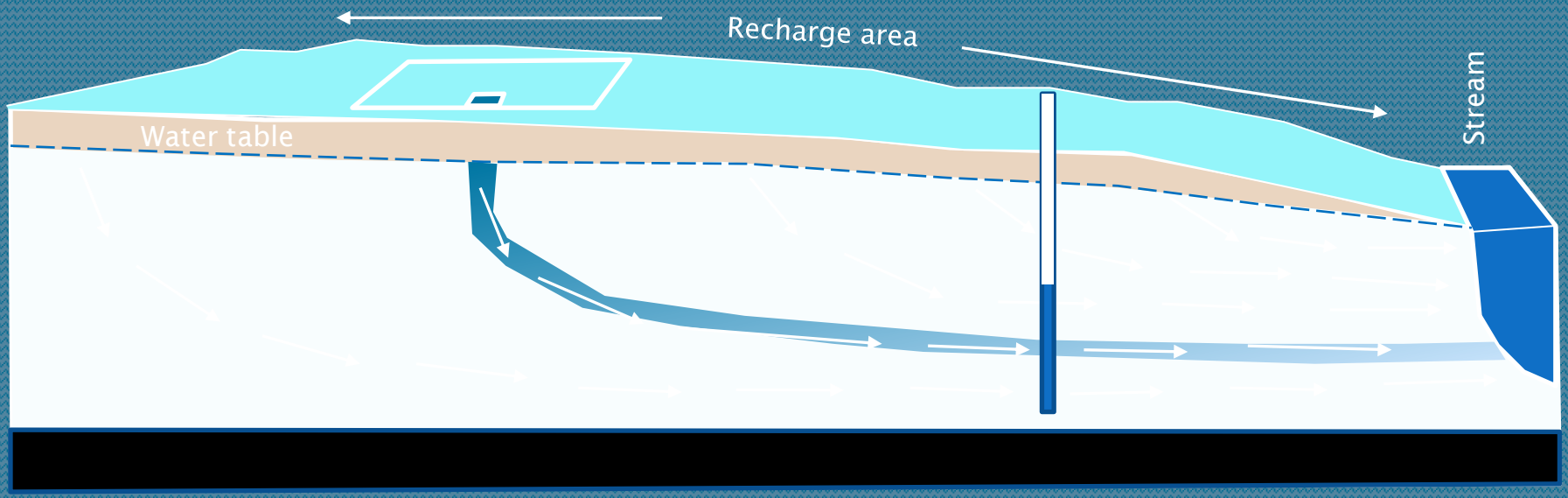
1/36th the impact on water quality

**0.44 mg/L**

*Assuming 10 inches of recharge -*

**36 lbs/ac x 20 acres = 720 lbs**




**20 lbs/septic system**

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# Recharge areas for private wells in concentrated developments

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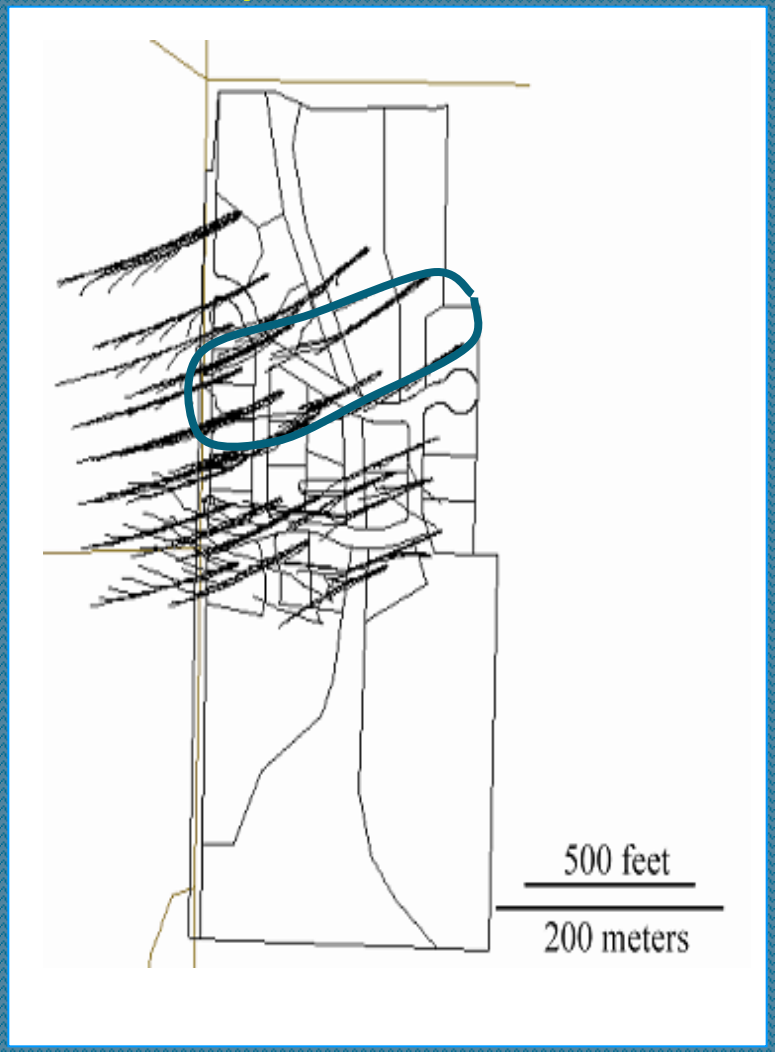
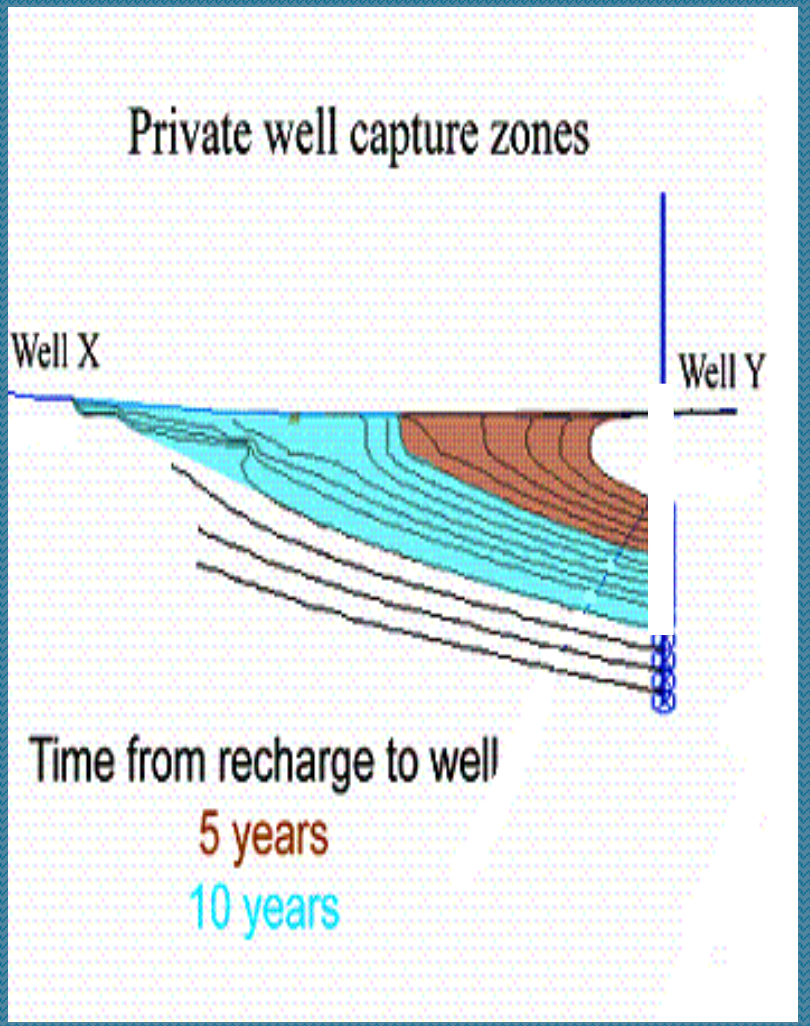
Center for Watershed Science & Education




*Ten - year capture zones*



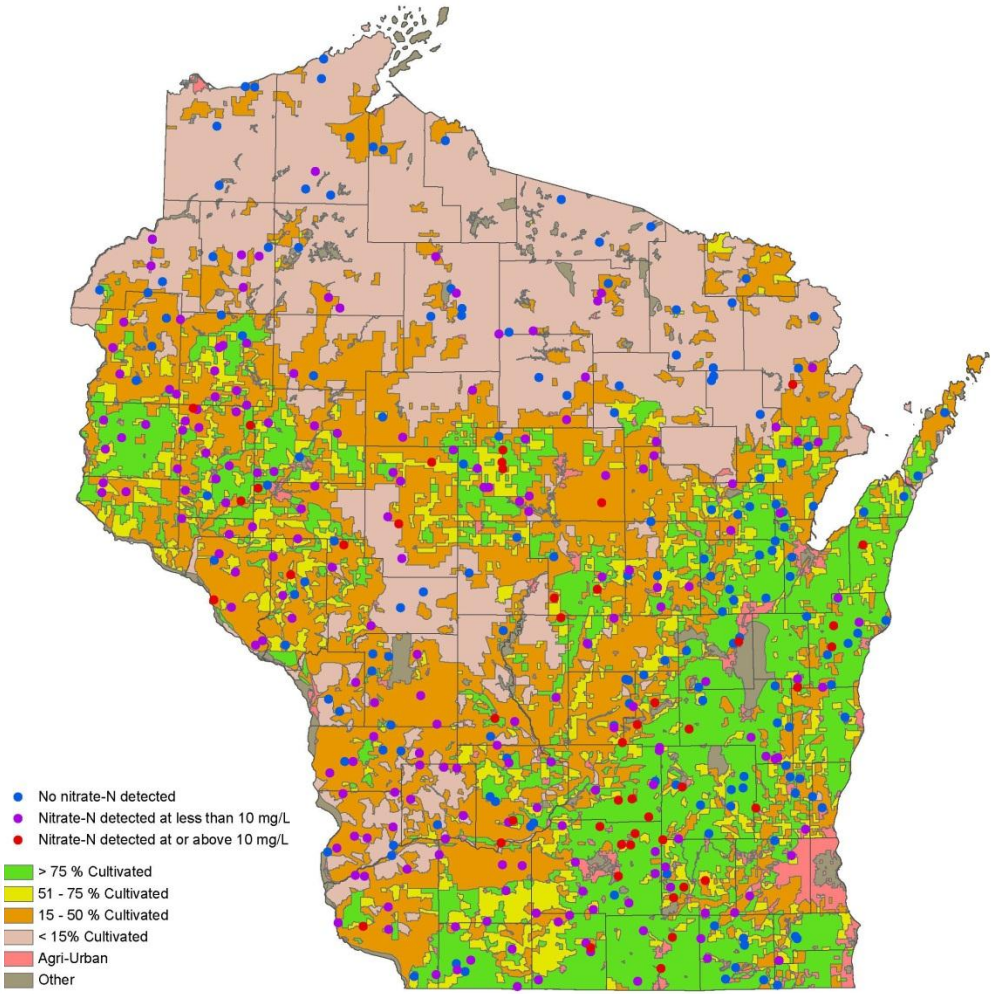

Courtesy of Madeline Gotkowitz, WGNHS

# *Private well testing shows relationship between landuse & Nitrate*

- No Nitrate-N detected
- Nitrate-N detected < 10 mg/l
- Nitrate-N detected > 10 mg/l

- >75% cultivated
- 51-75% cultivated
- 15-50% cultivated
- <15% cultivated

Nitrate-Nitrogen Results from the 2007 Survey

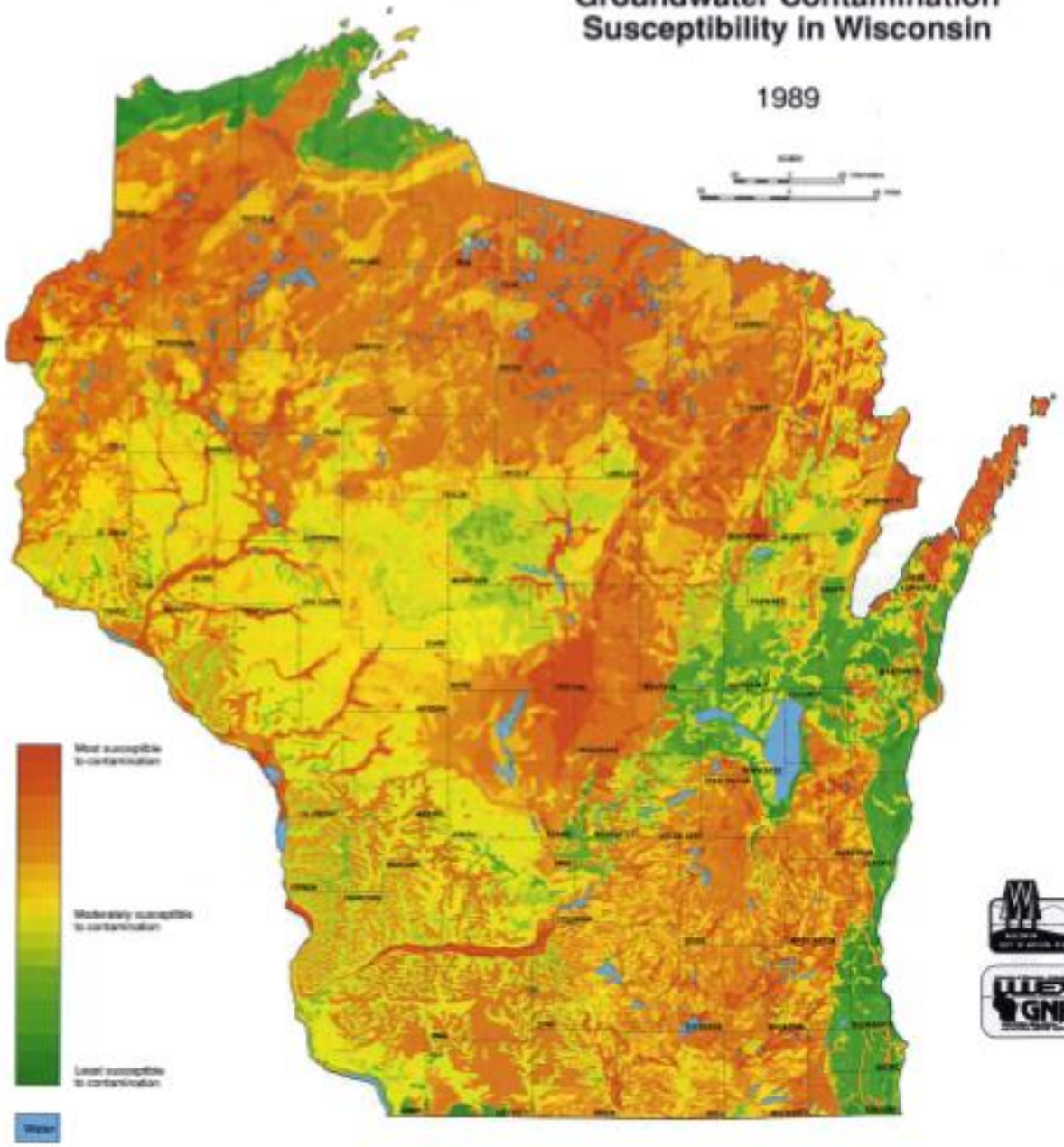


# *Percentage of Wells with Detectable Nitrate-N >10 mg/l by Surrounding Area Cultivated*

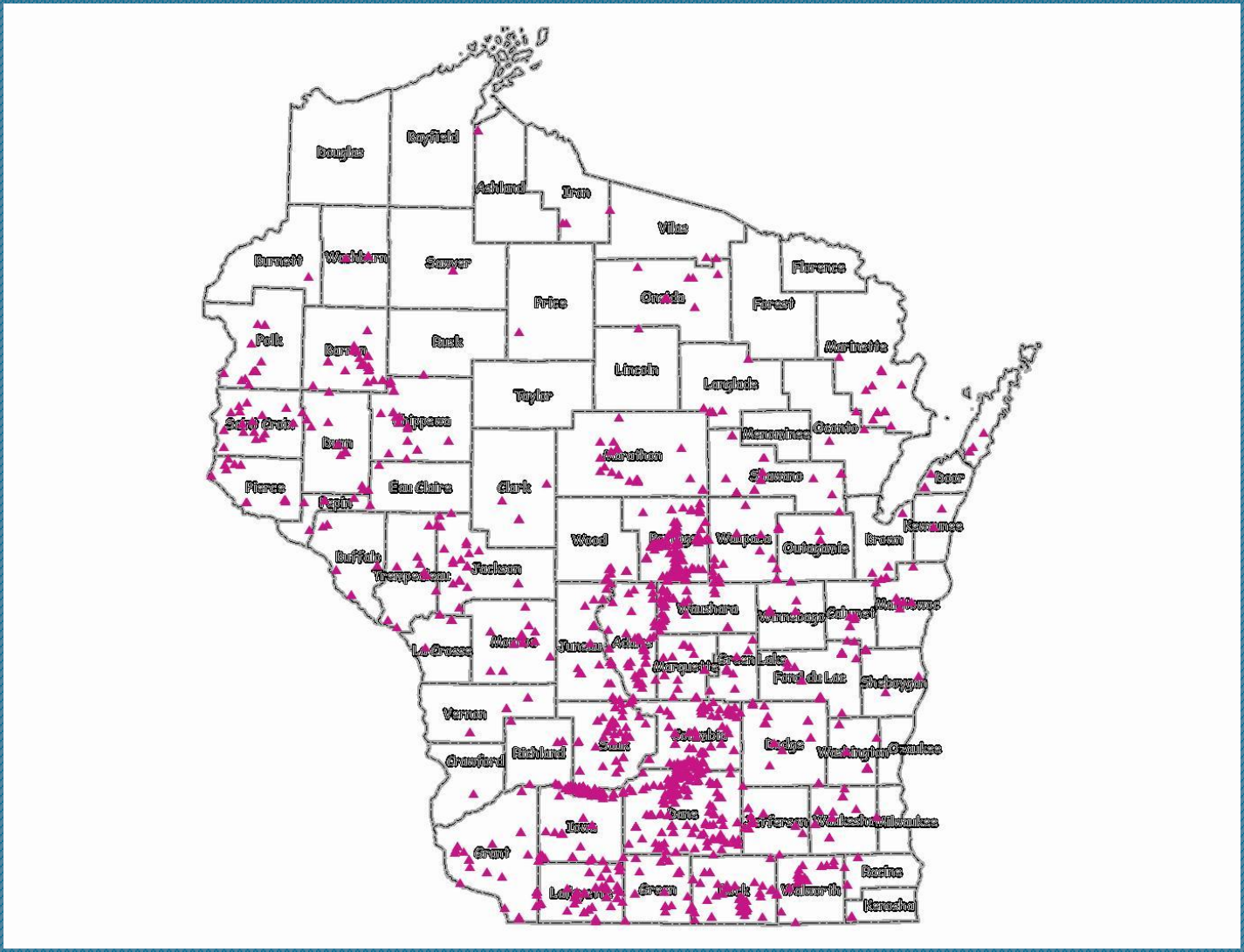
| % of Surrounding Area Cultivated | % of Wells w/detectable Nitrate-N >10 mg/l |
|---|---|
| > 75% cultivated | 21.0 |
| 51-75% cultivated | 10.0 |
| 15-50% cultivated | 8.6 |
| <15% cultivated | 1.7 |

# Groundwater Contamination Susceptibility in Wisconsin

1989

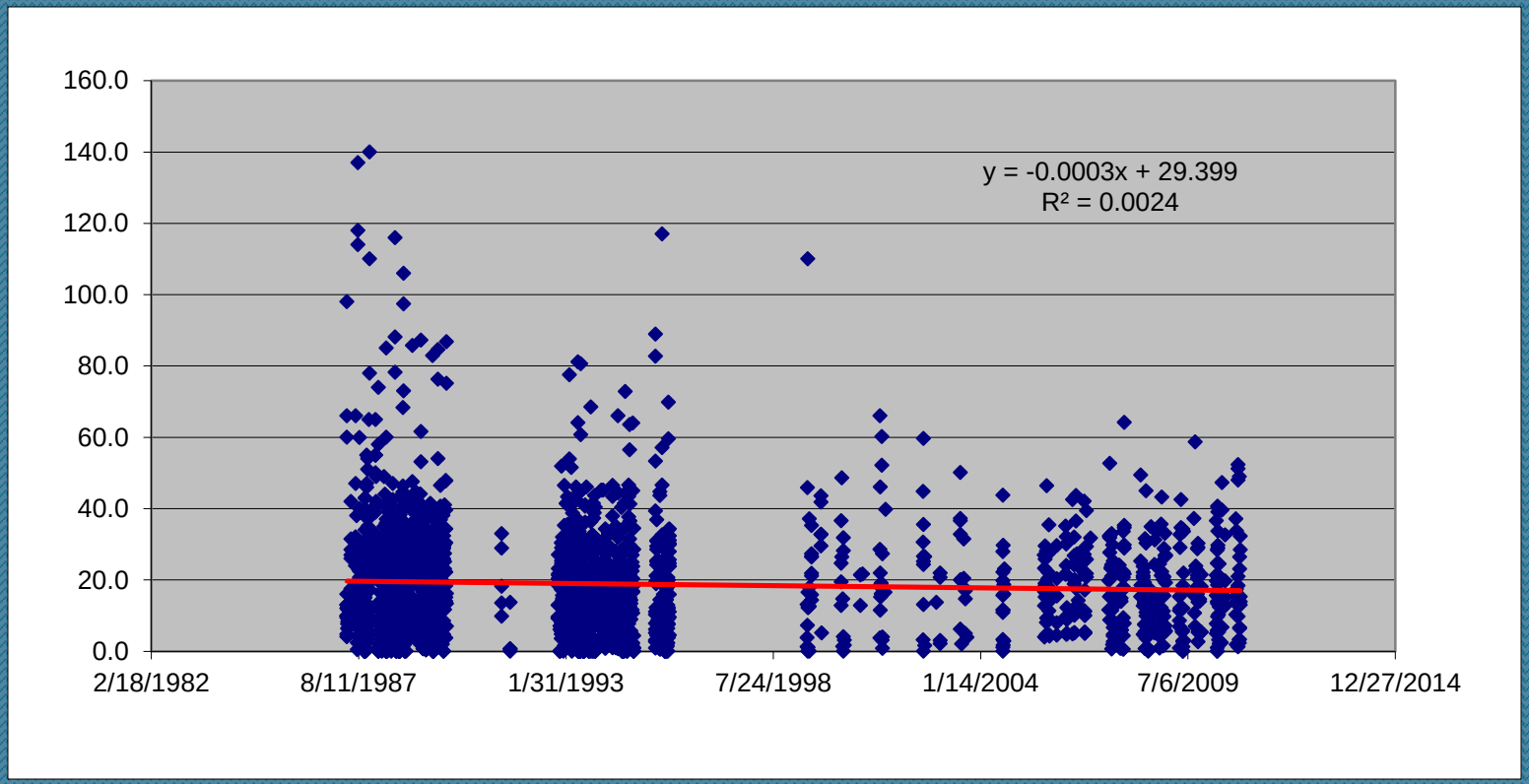


# Statewide Nitrate results > 20 mg/L – Private Wells DATCP & GRN Results (1988 to present)



# Nitrate Trends in DATCP Monitoring Wells – Irrigated Sands

- Average N concentrations essentially constant since 1987
- Very high N concentrations have declined
- Compliance rates w/NM standard not known at these sites



# Can N Loading be controlled?

## Nutrient Management

- Managing the *amount, source, placement,and timing* of nutrient applications
- UW Soil tests and recommendations:
  - Crop need – nutrient credits = fertilizer to apply
  - Soil sample every 4 yrs according to UW A2100
  - Analyzed by DATCP certified lab
- Account for **all** N-P-K inputs over the entire crop rotation
- Account for landscape vulnerabilities
- Update 590 NM plan annually
- Only qualified planners may prepare NMPs:
  - CCA's, CPAg, SSSA, CPCC, farmer planners

# Nutrient Application Restriction Maps

www.manureadvisorysystem.wi.gov

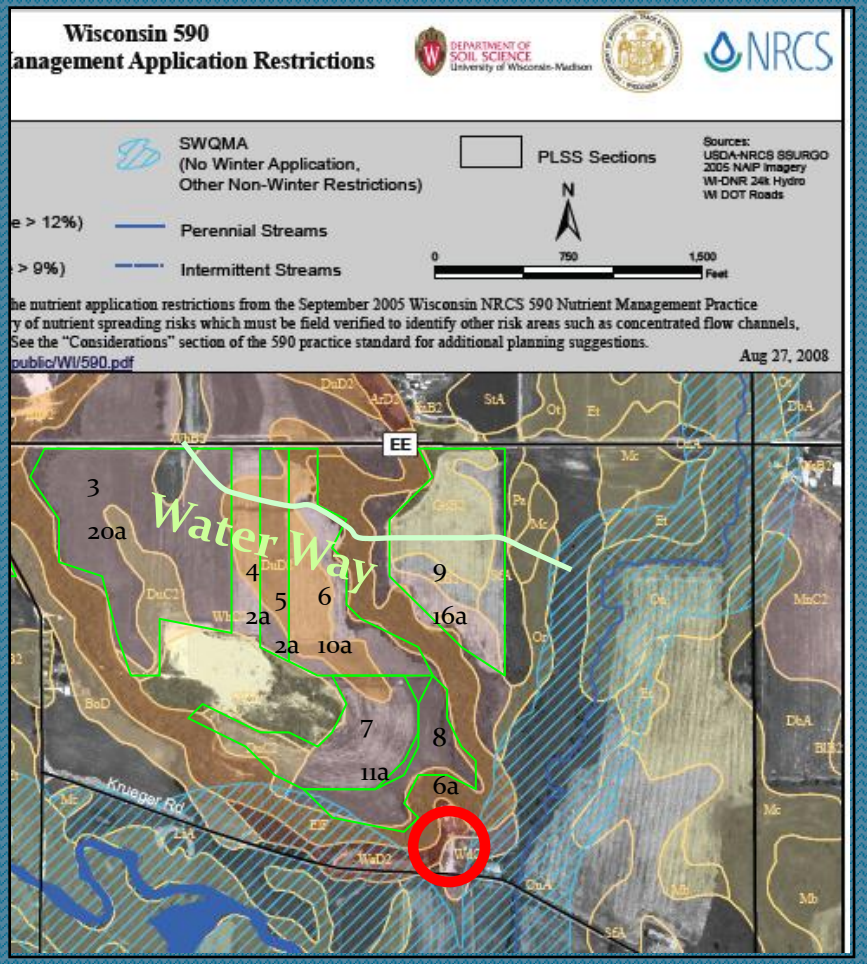
Maps show:

O 200' setback from wells, sinkholes, fractured bedrock at the surface - nutrient applications must be incorporated within 72 hours

**Blue** No winter apps 300' from perennial streams, 1,000' from lake and ponds. Other non-winter application restrictions required

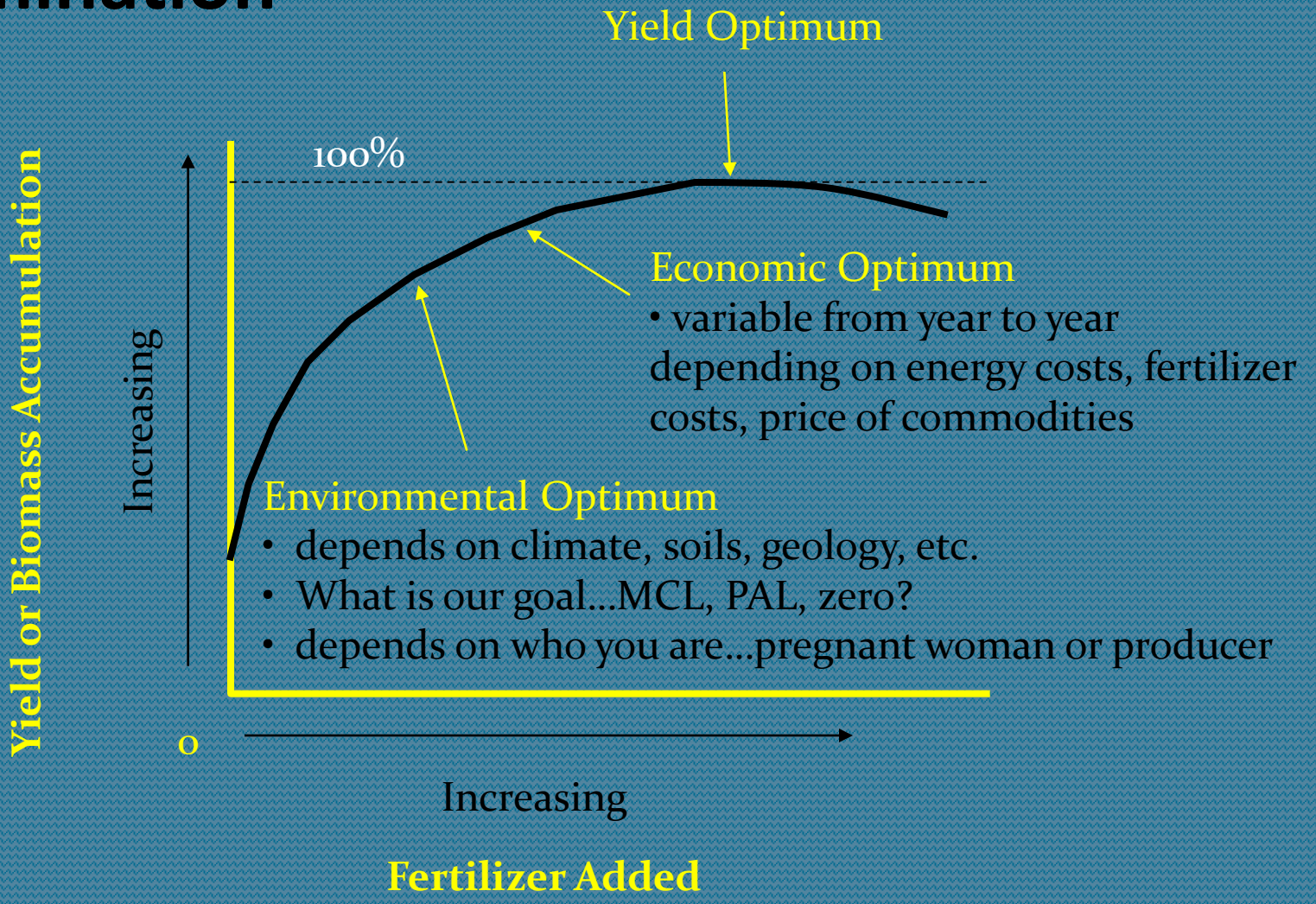
**Red** No winter applications

**Pink** and **clear** can have winter manure apps if contoured or if slopes are 9% or less. Winter manure apps can not exceed 7,000 gals/acre or P removal of the crop




**Yellow** No fall fertilizer N. Fall manure apps limited; best to spring apply.

# Nutrient Management to mitigate nitrate contamination

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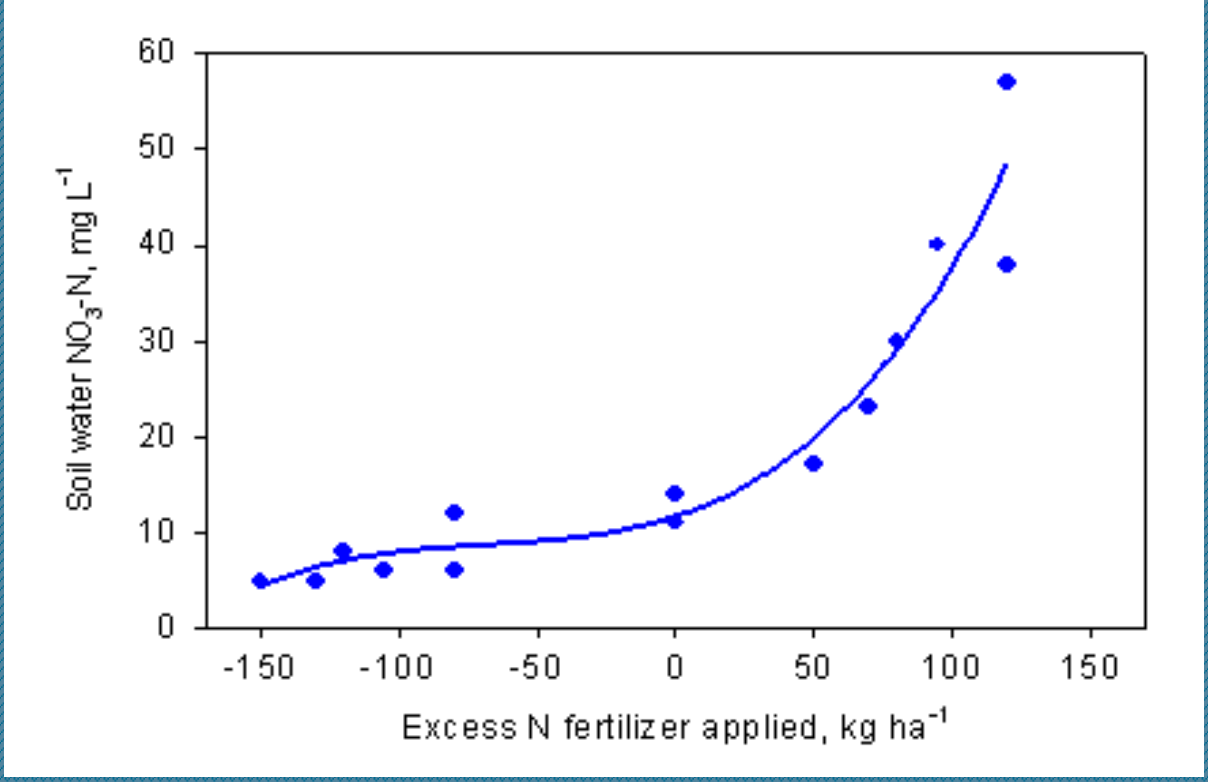
# Nitrogen management practices

Improved prediction of crop N needs and timing of N applications can reduce nitrate leaching losses

(but not to zero nor always to 10 mg/L).

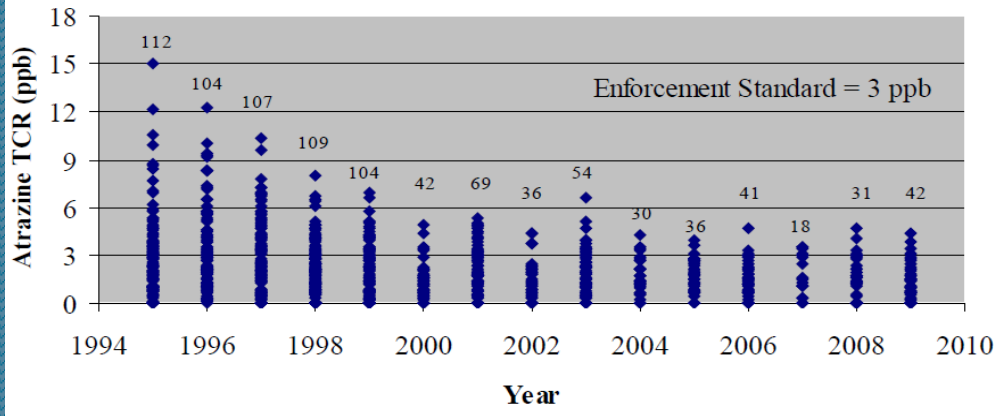



*(Andraski, Bundy, Brye; 2000 J. Environ Qual. 29:1095-1103).*

# Nitrate in Private Wells in Atrazine Prohibition Areas

"From "15 Years of DATCP Exceedence Well Survey"

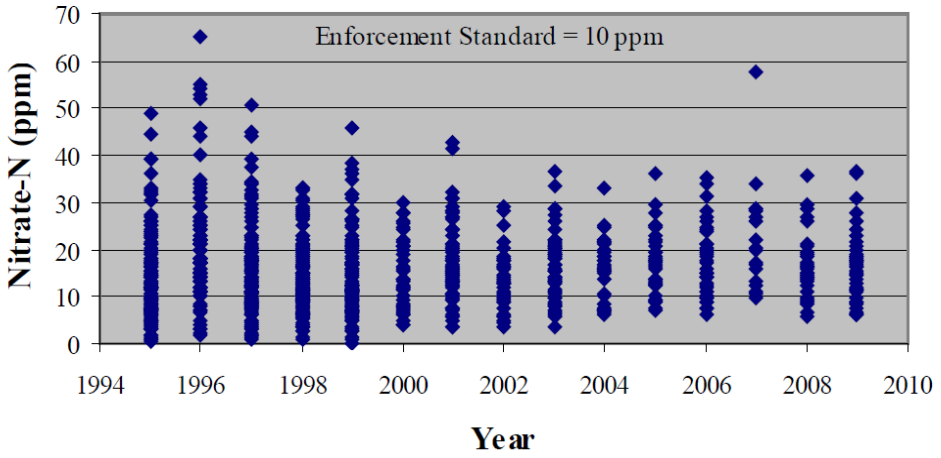
**Figure 2. Distribution of Atrazine TCR Results and Number of Samples in the EX Survey, by Year**




Average atrazine concentrations decline over time with high degree of management

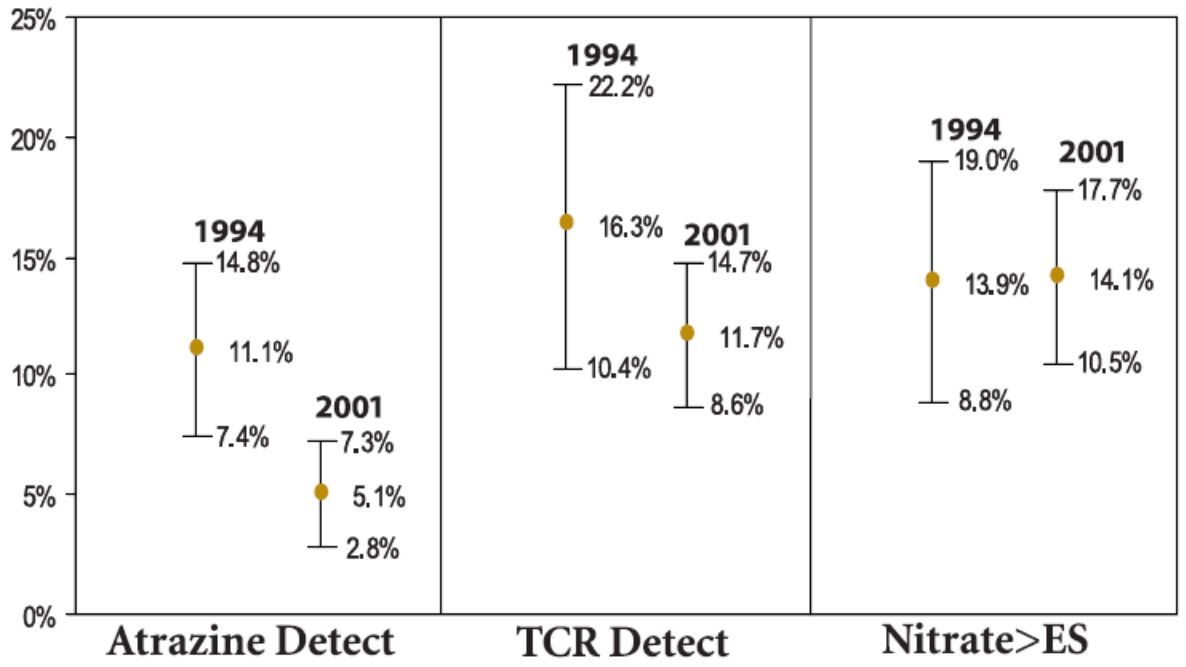
Average nitrate levels slightly increase over time with low degree of management

**Figure 5. Nitrate-N Results by Year in the EX Survey**



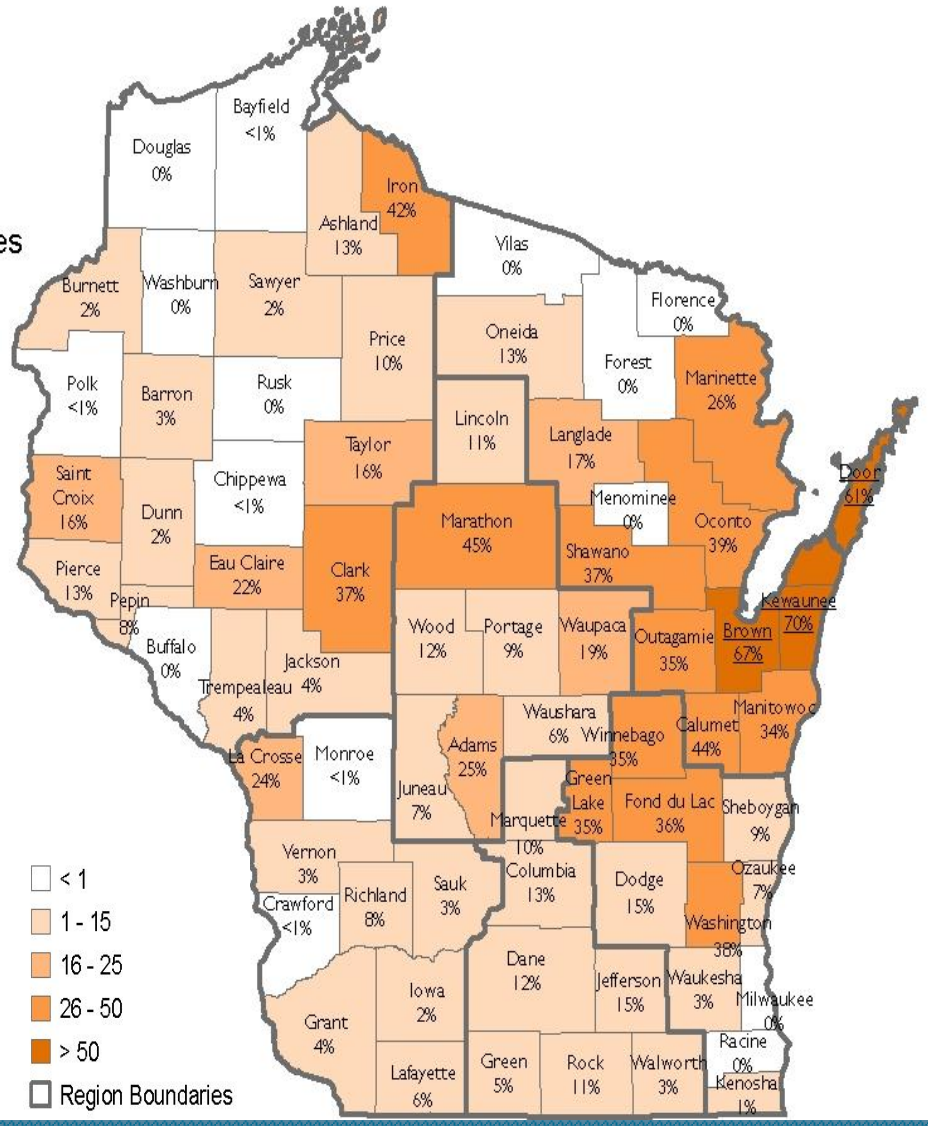
# Private well survey – 2001
# Does management matter?

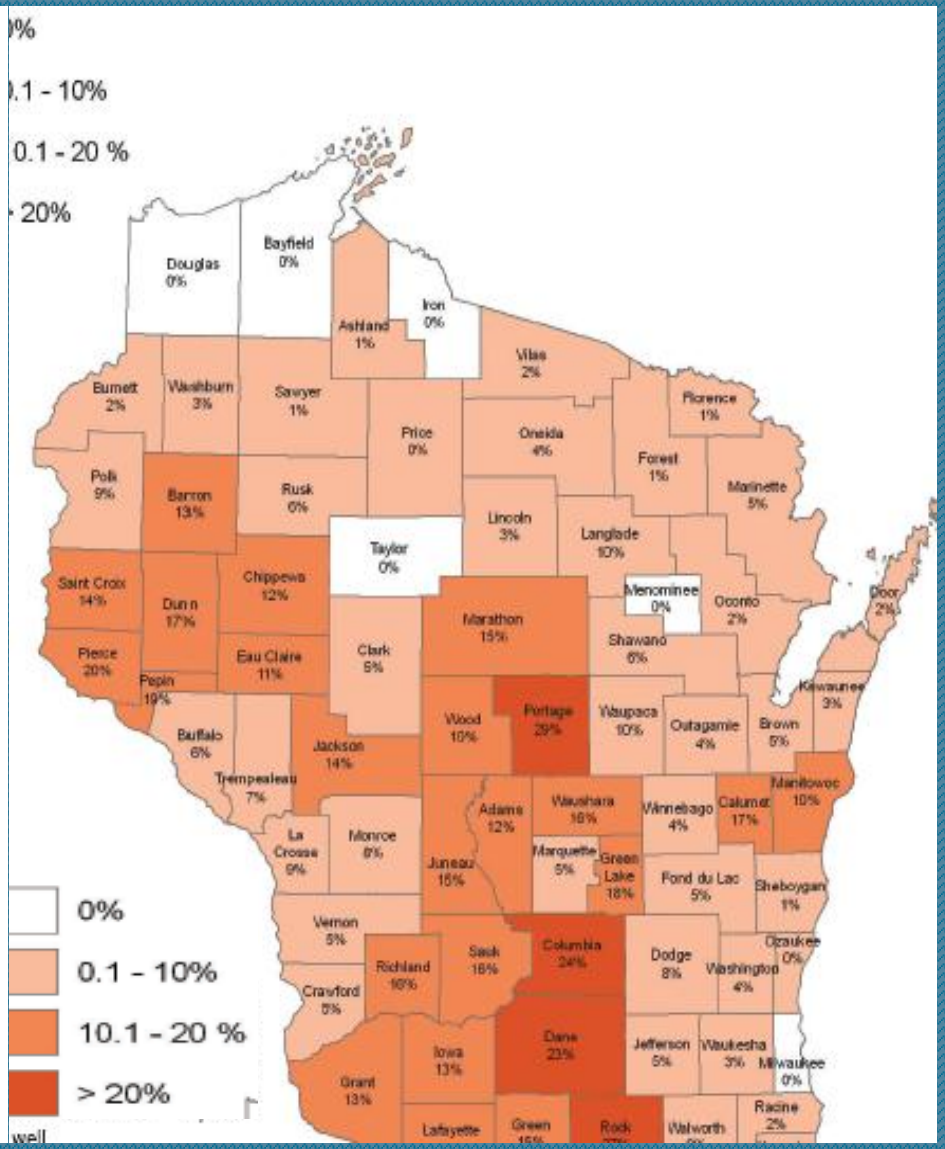
Comparison of proportion estimates and 95% Confidence Intervals for 1994 and 2001




Atrazine use rates & other practices required by rule, compliance is high
Nitrogen use strategy (NM) similar to atrazine management, compliance is low

# % crop acres under NM plan (1.8 million ac. reported in 2011)




# % of Drinking Wells Exceeding 10 mg/L Nitrate-N