Discovery Farms Minnesota – N and P, what is happened in Farm Fields?

Jerome Lensing

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AgVise Labs

Jerome.lensing@hotmail.com

Discovery Farms is a farmer led water quality research and educational program, providing credible research, and communicates results

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To show that we can have highly productive farmland and clean water.

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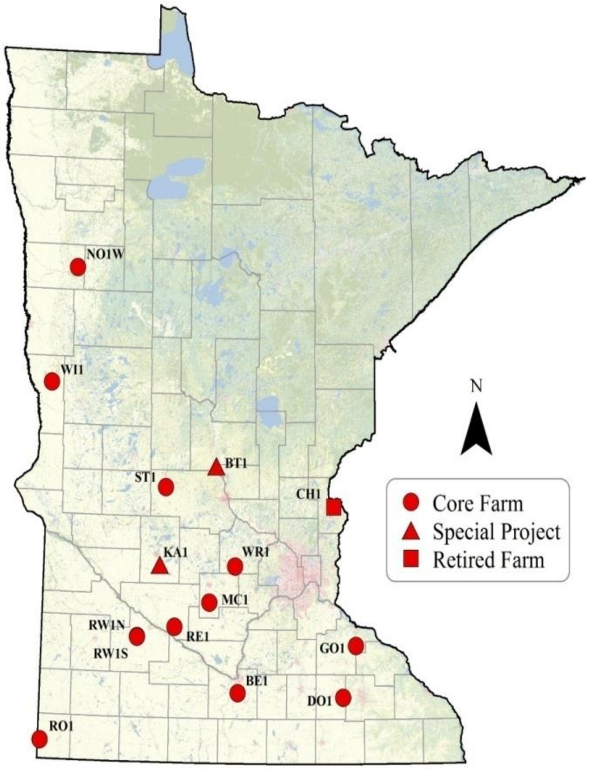
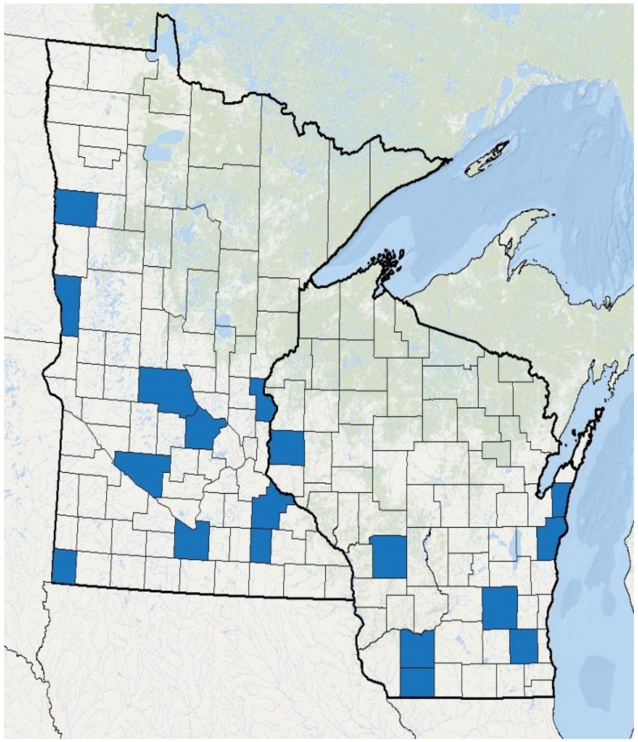
Discovery Farms has one of the largest edge of field datasest with diverse farm systems and locations.





24 Farms
45 Fields
127 Surface Site Years
83 Tile Site Years

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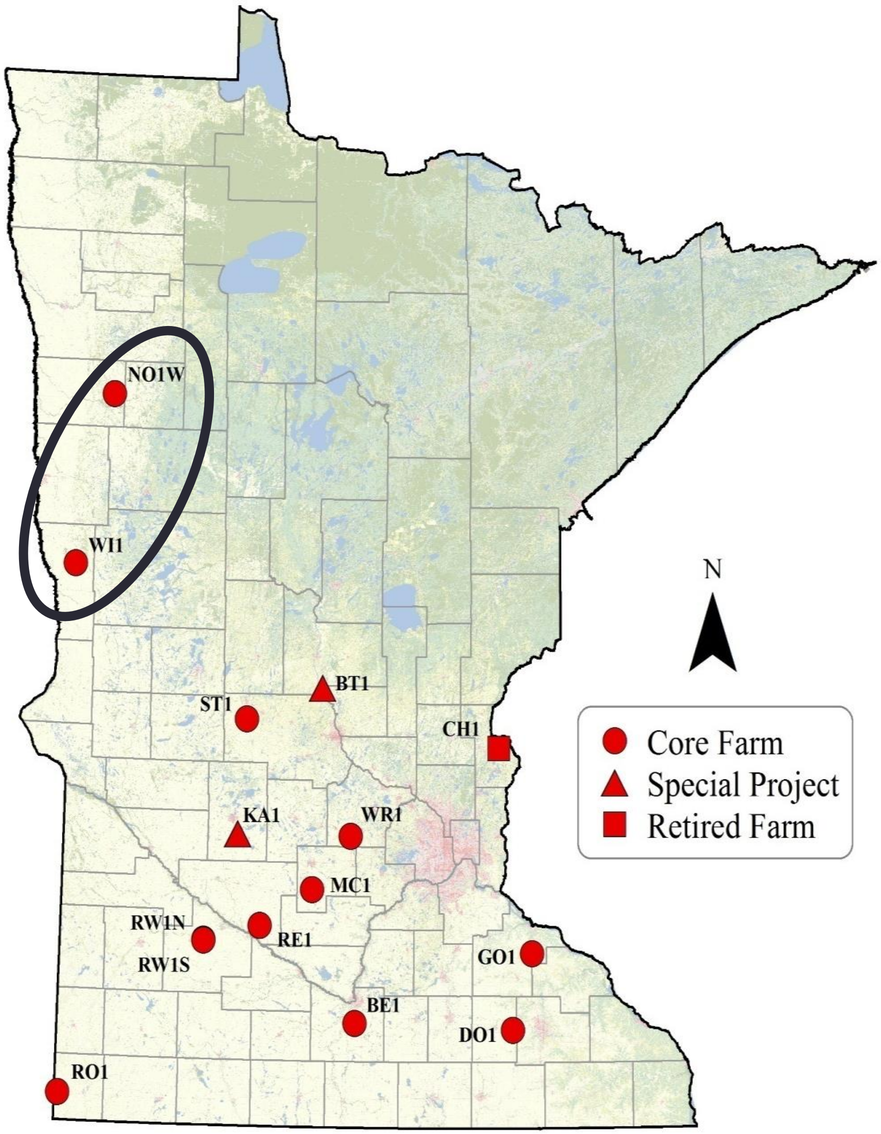
2 sites with lower precipitation



3 sites tile only
3 sites surface only
7 sites surface and tile

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Discovery Farms has a large dataset with diverse farm systems and locations.

- Data collected from 2004-2017
- No tile, pattern and random tile at different spacing and depths
- Drainage areas from 5 to 650 acres
- Field slopes >1% to 9%
- Well drained to poorly drained soils
- Dairy, beef, swine, and grain operations
- Crops range from corn, soybean, alfalfa, sugar beets, wheat and pasture

24 Farms
45 Fields
127 Surface Site Years
83 Tile Site Years

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Discovery Farms Provides Credible Edge-of-Field Research
Typical Installation with both surface and tile

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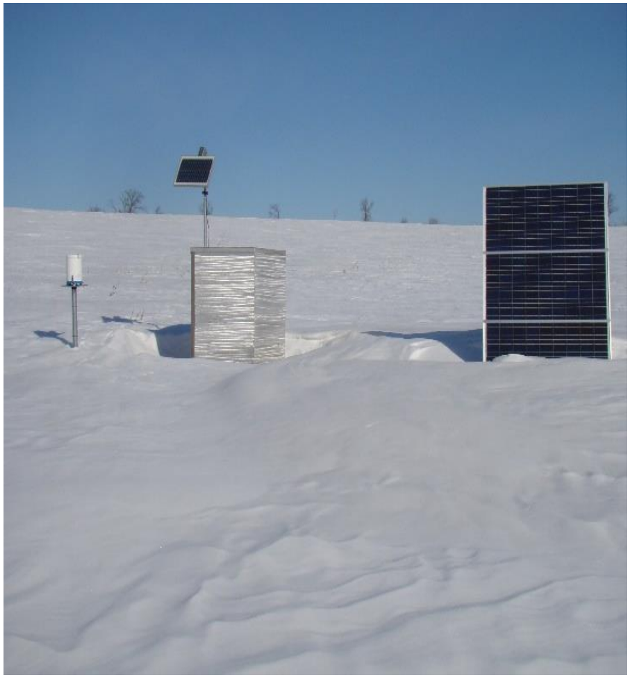
Edge-of-field surface runoff and tile drainage data is collected 365 days a year

Weather • Soil

Flow • Sediment

Nitrogen • Phosphorus



Flow Volume X Concentration (ppm) = Loss (lb/ac)

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Tile drainage is not a new technology but societal values have changed.

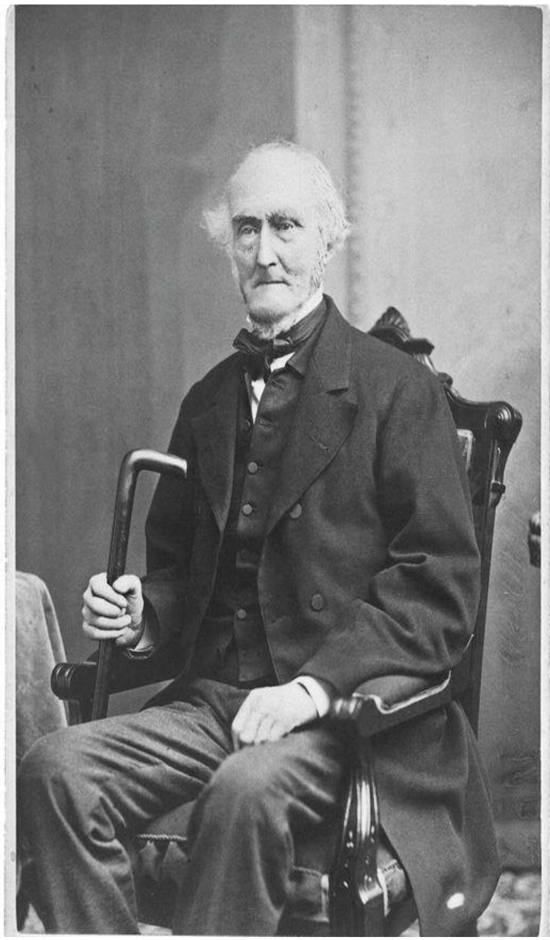
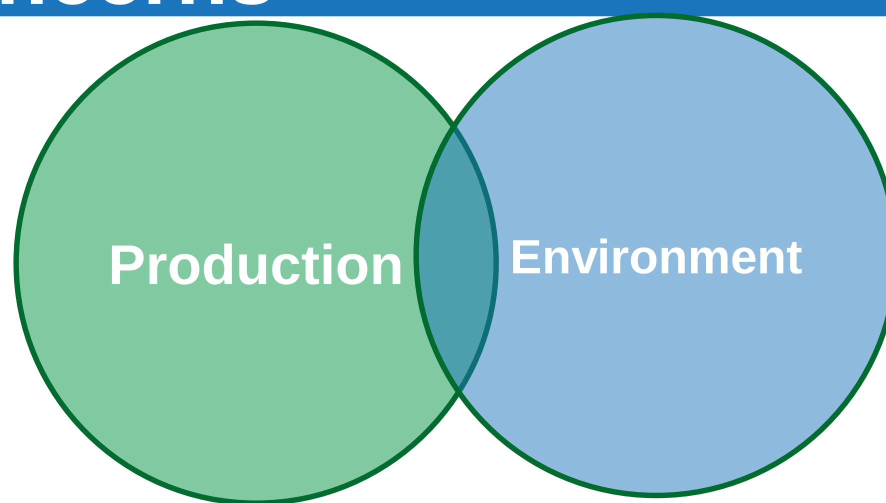


Photo: Geneva Historical Society

A reflection of societal values

1900's – water removal

2000's – balancing production and water quality concerns



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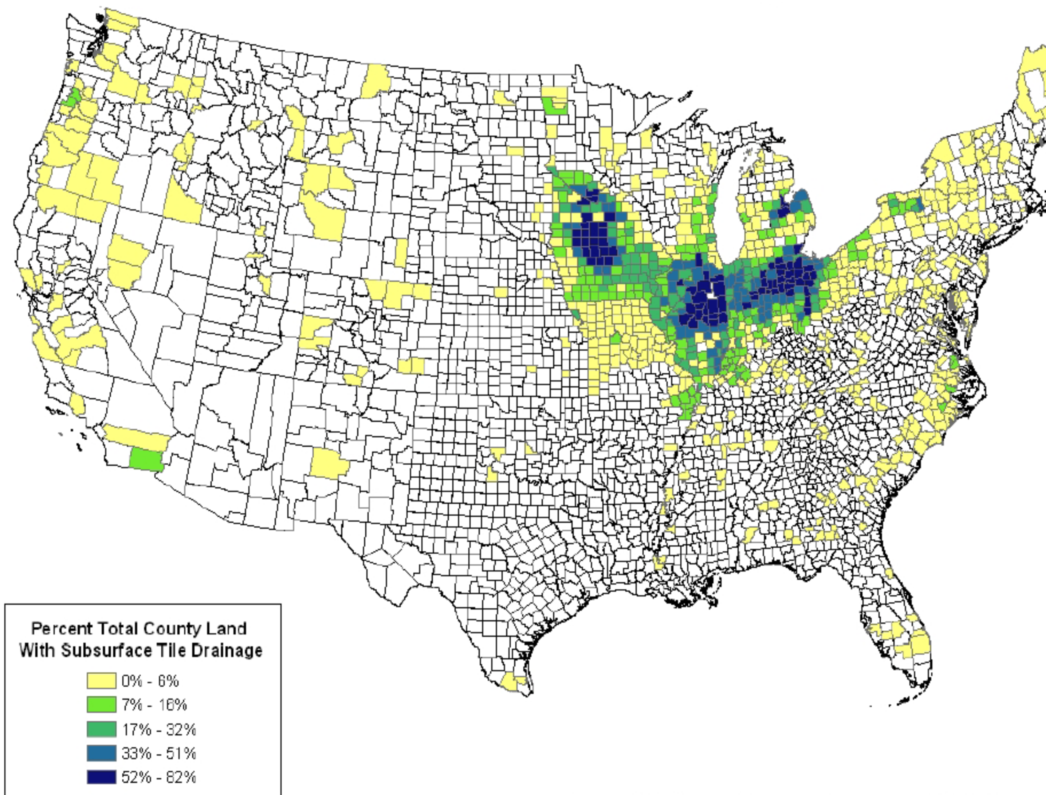
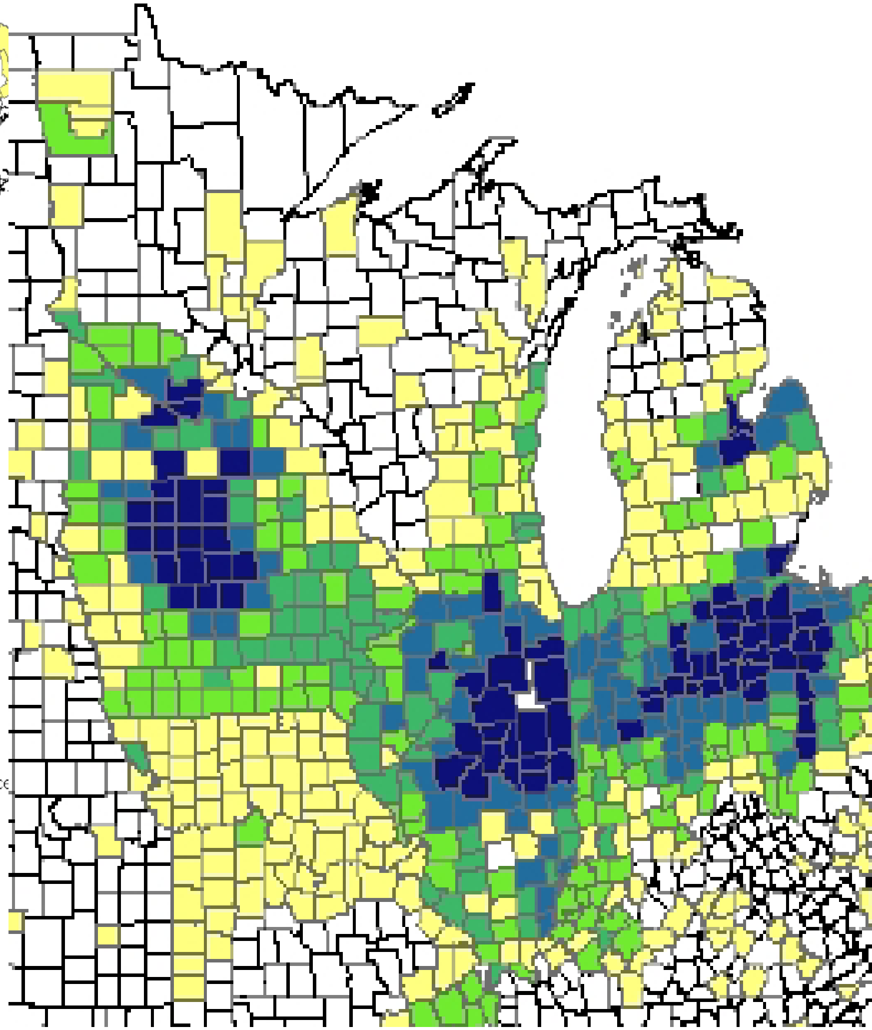
Tile drainage is extensive in parts of WI and Minnesota.



Sources: 1992 National Resources Inventory and World Resource



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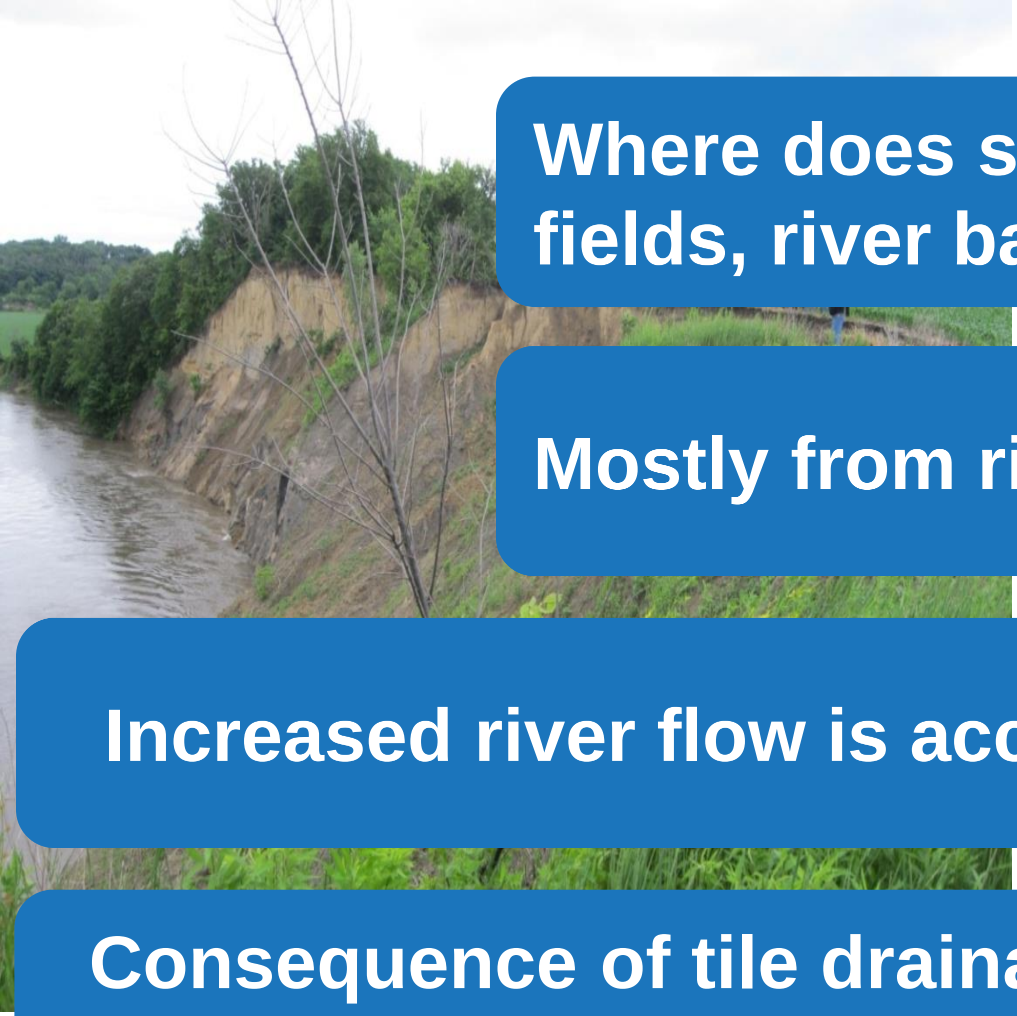
The problem with talking about tile drainage… It can be polarizing and controversial.



Where does sediment come from fields, river banks, or ravines?

Mostly from river banks and ravines

Increased river flow is accelerating bank erosion

Consequence of tile drainage, land use (towns/ag land) or climate change?

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Artificial drainage has benefits and water quality challenges.

Drainage can enhance agricultural production, transportation, and economic development

Drainage can increase risk of sediment and nutrient movement to surface waters

- Chesapeake Bay - Hypoxia
- Gulf of Mexico - Hypoxia
- Lake Erie – City of Toledo
- Des Moines Water Works

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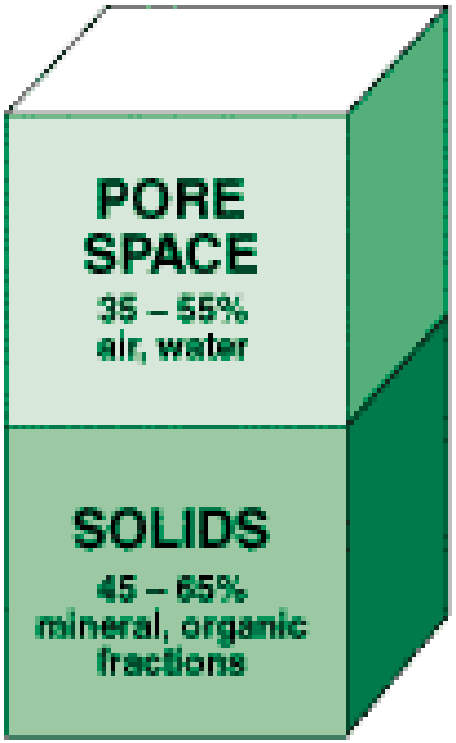
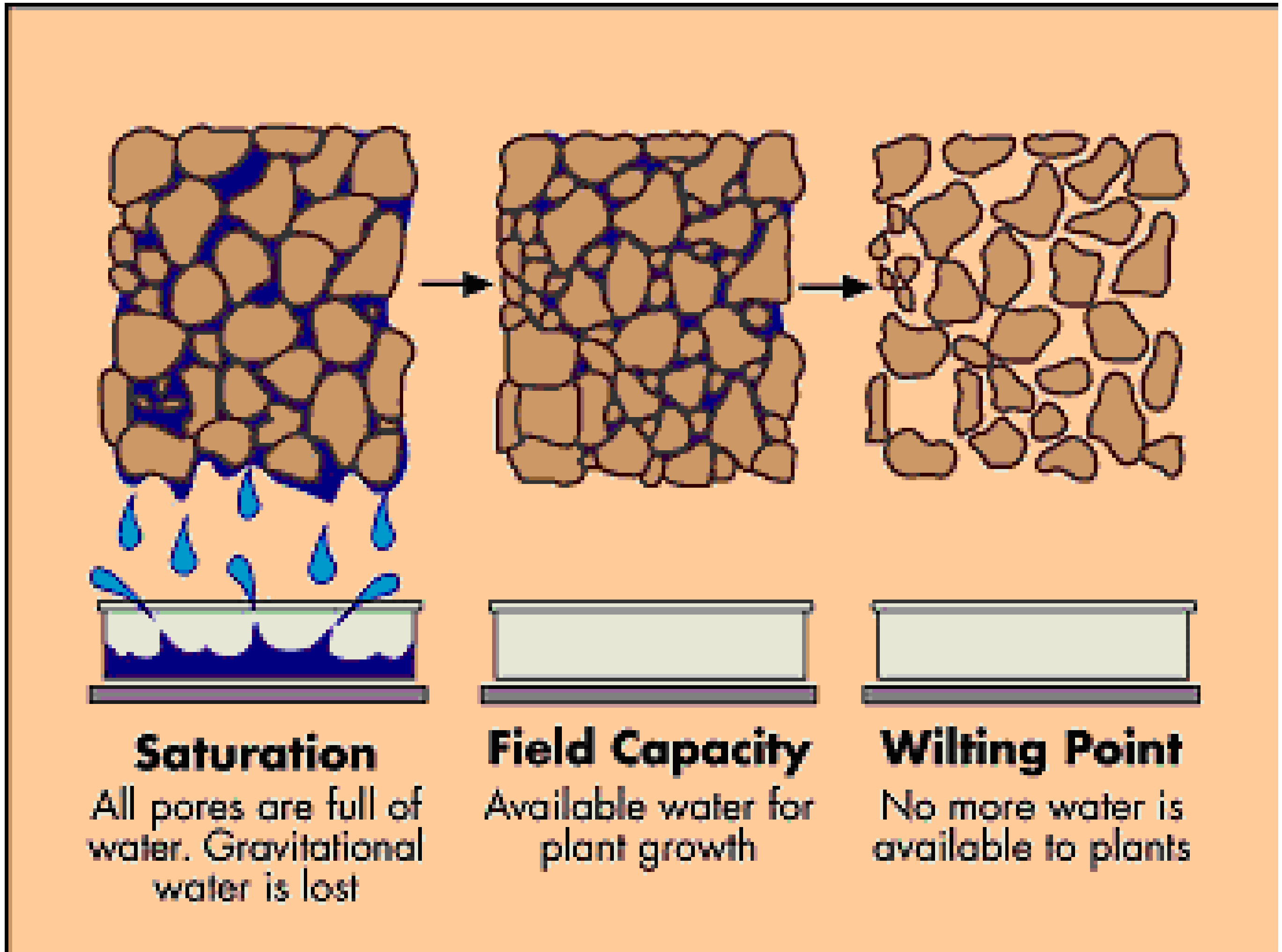
Tile systems drain only a portion of the soil water - gravitational water.





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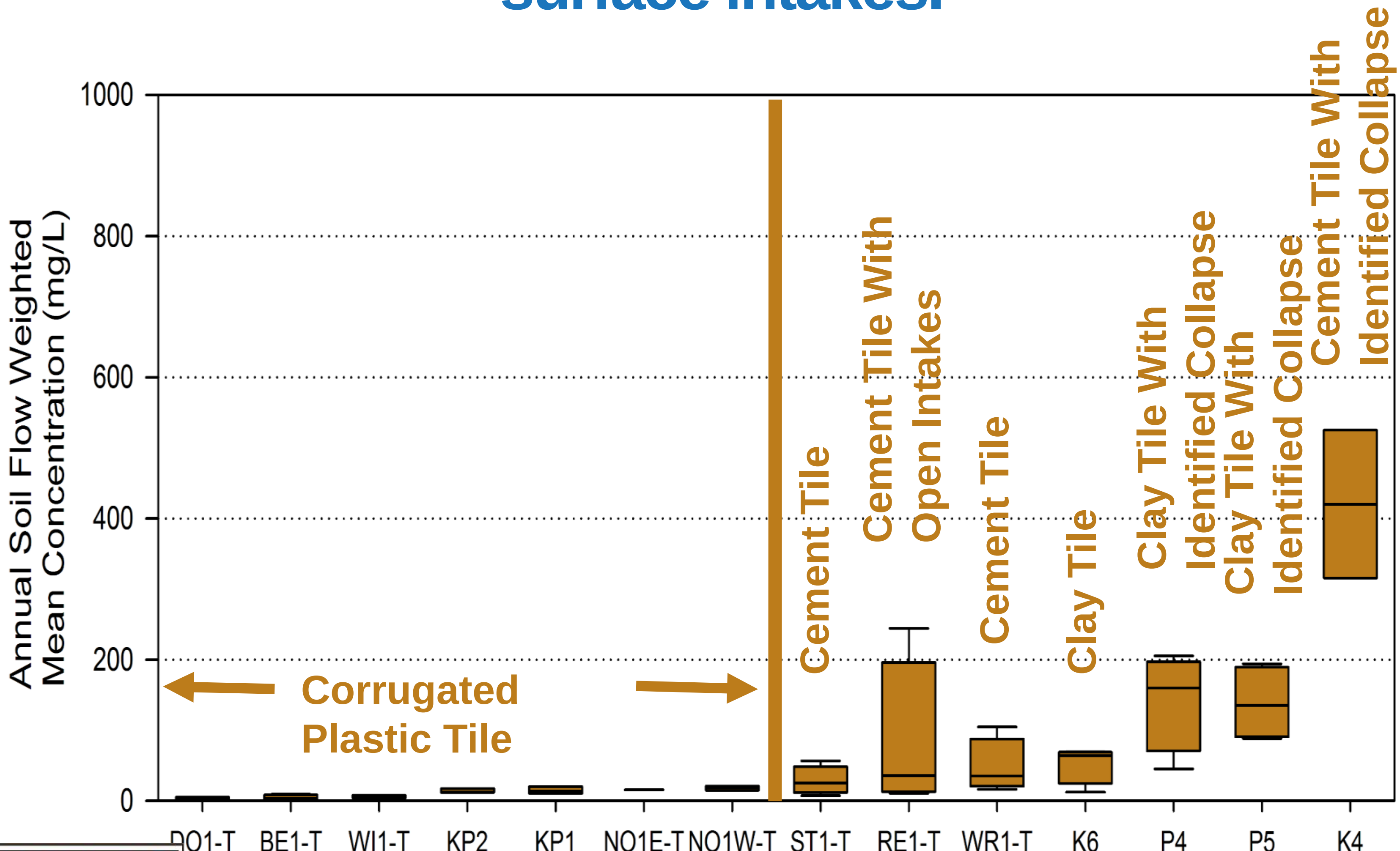
Tile sites that had higher concentrations of sediment had older cement or clay tile systems, tile blowouts, or surface intakes.



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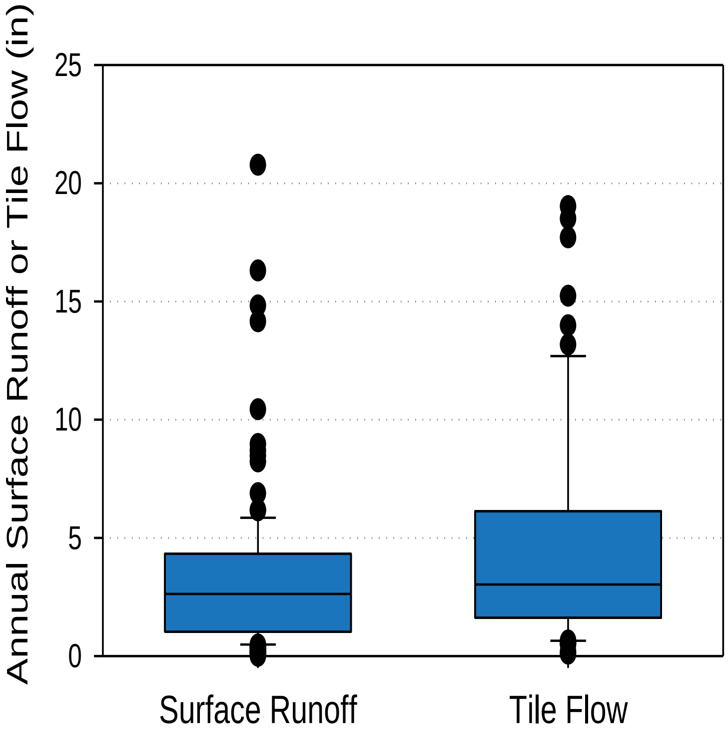
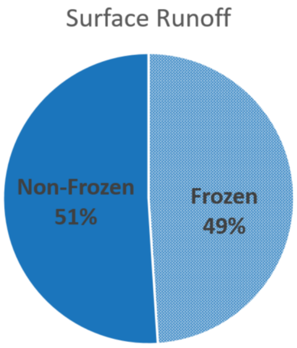
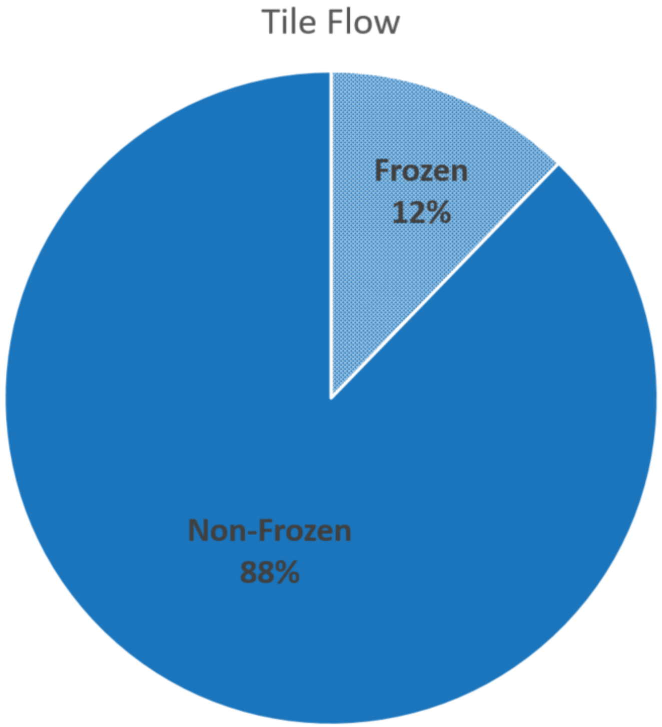
The timing and intensity of surface runoff and tile flow is much different.

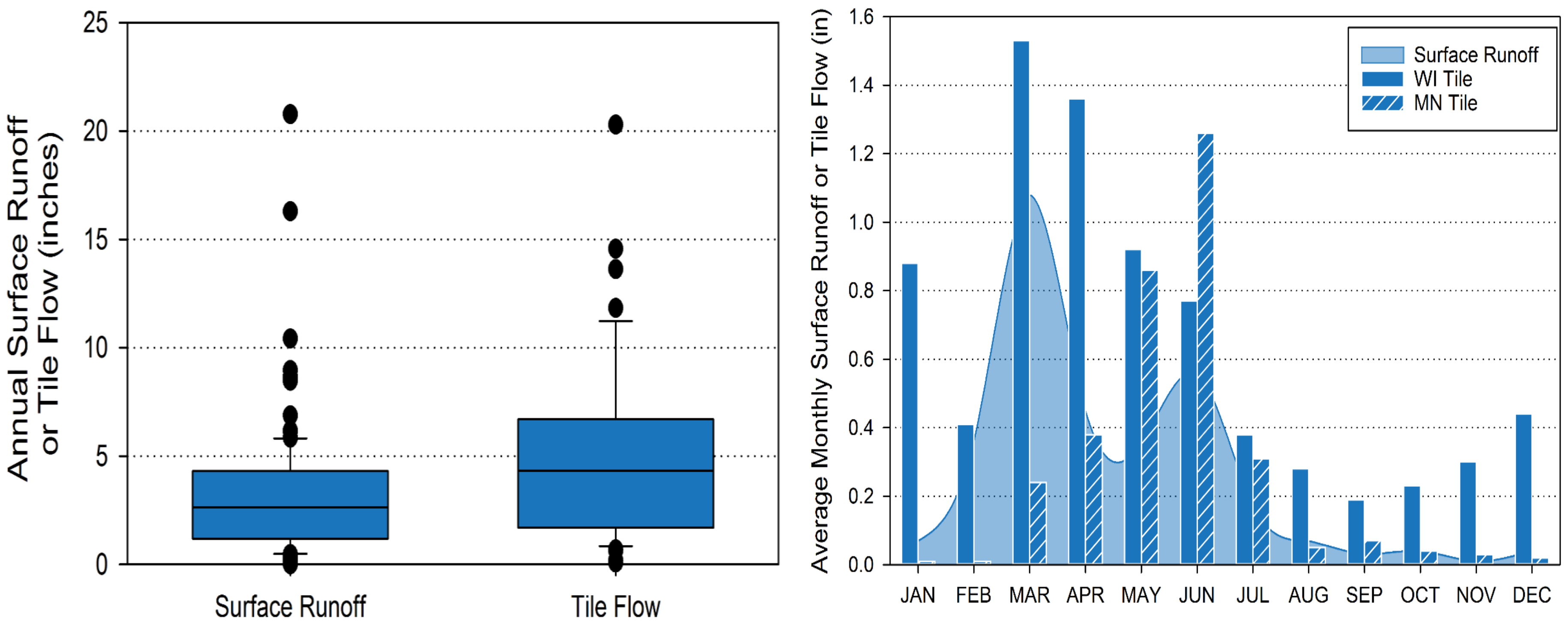






Category	Surface Runoff	Tile Flow
Annual Range (inches)	1.3 to 4.2	1.6 to 6.1
Average annual days of flow	10	195
Average intensity of flow (inches per day of flow)	0.38	0.03

There is typically more tile flow than surface runoff on an annual basis.



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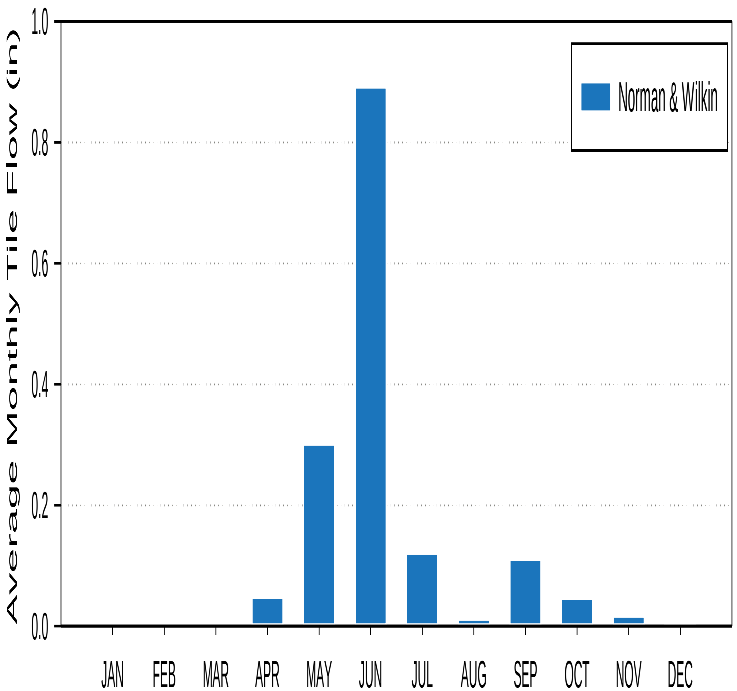
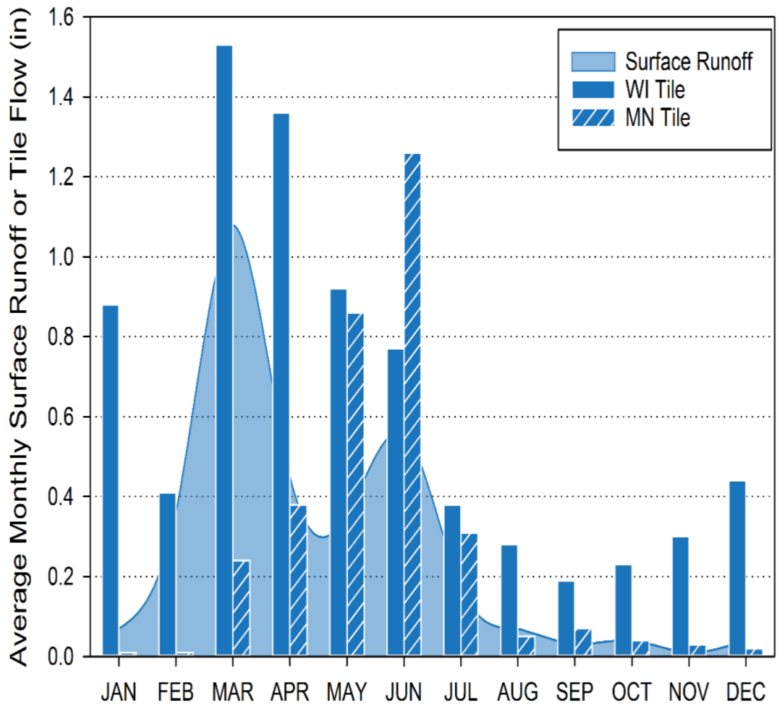
Most of the tile flow occurred in May and June at the Norman and Wilkin County sites.





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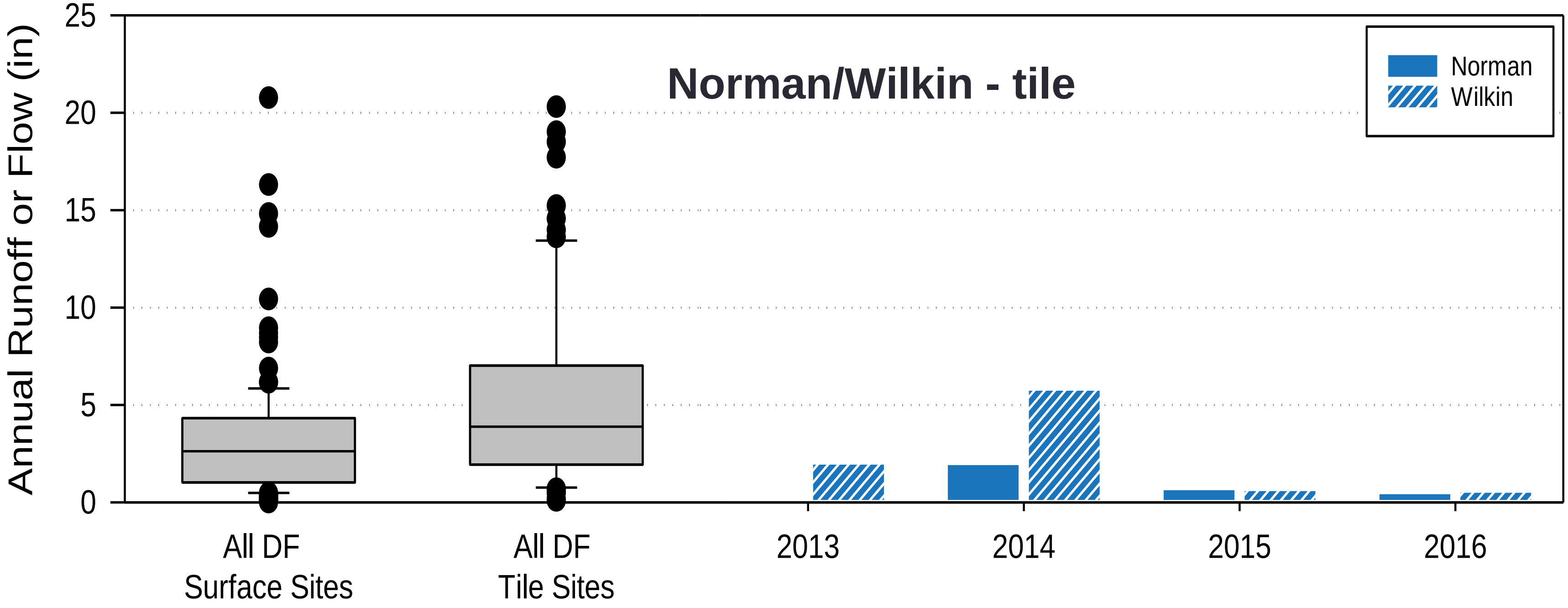
Lower amounts of tile flow on an annual basis, but timing and intensity much different for surface vs tile.



Category	Tile Flow	Surface Runoff
Annual Range (inches)	1.9 to 6.9	1.3 to 4.3
Average annual days of flow	195	10
Average intensity of flow (inches per day of flow)	0.03	0.38

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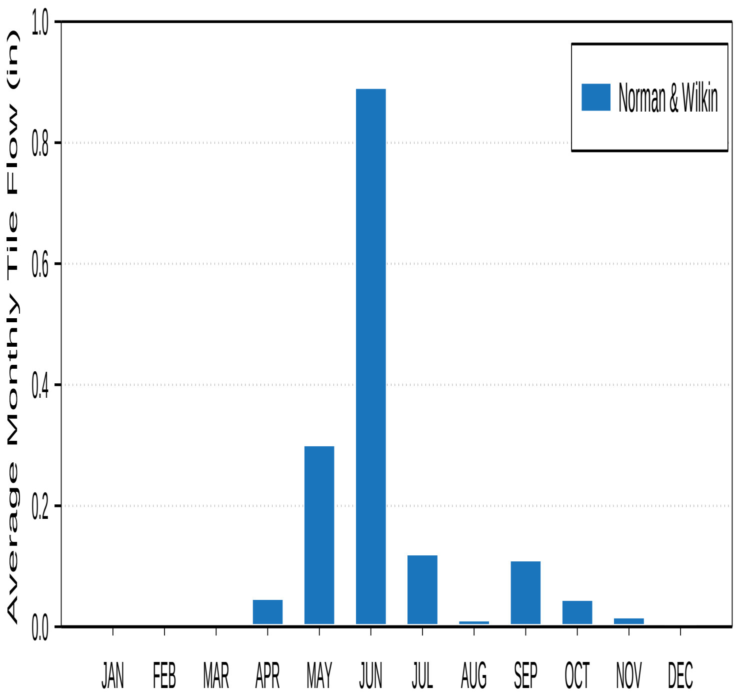
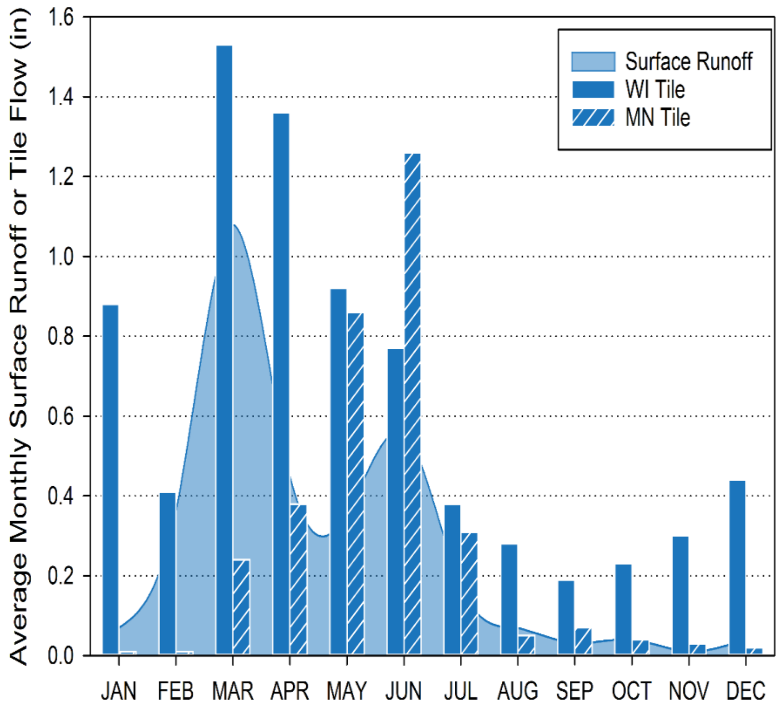
Most of the tile flow occurred in May and June at the Norman and Wilkin County sites.





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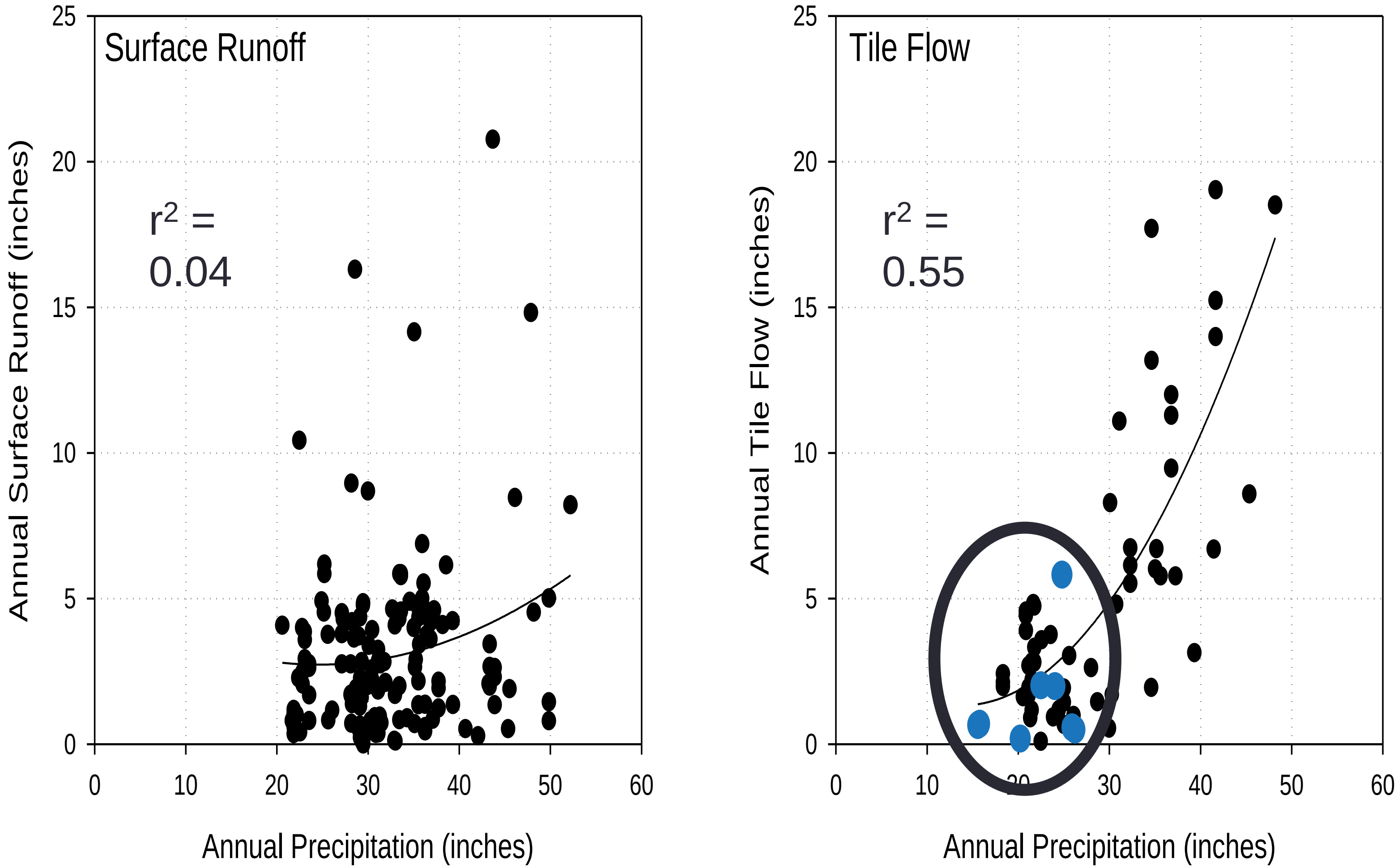
The amount of annual precipitation has a large influence on the amount of tile flow, but not surface runoff.



Timing of precipitation matters for surface runoff.

Site	Date	Precipitation (in)	Intensity (in/hr)	Runoff (in)
ST1	5/18/2012	1.03	1.37	0.17
	7/18/2012	1.03	1.37	0

Intensity of precipitation matters for surface runoff.

Site	Date	Precipitation (in)	Intensity (in/hr)	Runoff (in)
CH1	7/6/2015	2.06	0.17	0.02
	8/22/2015	1.56	0.62	0.34

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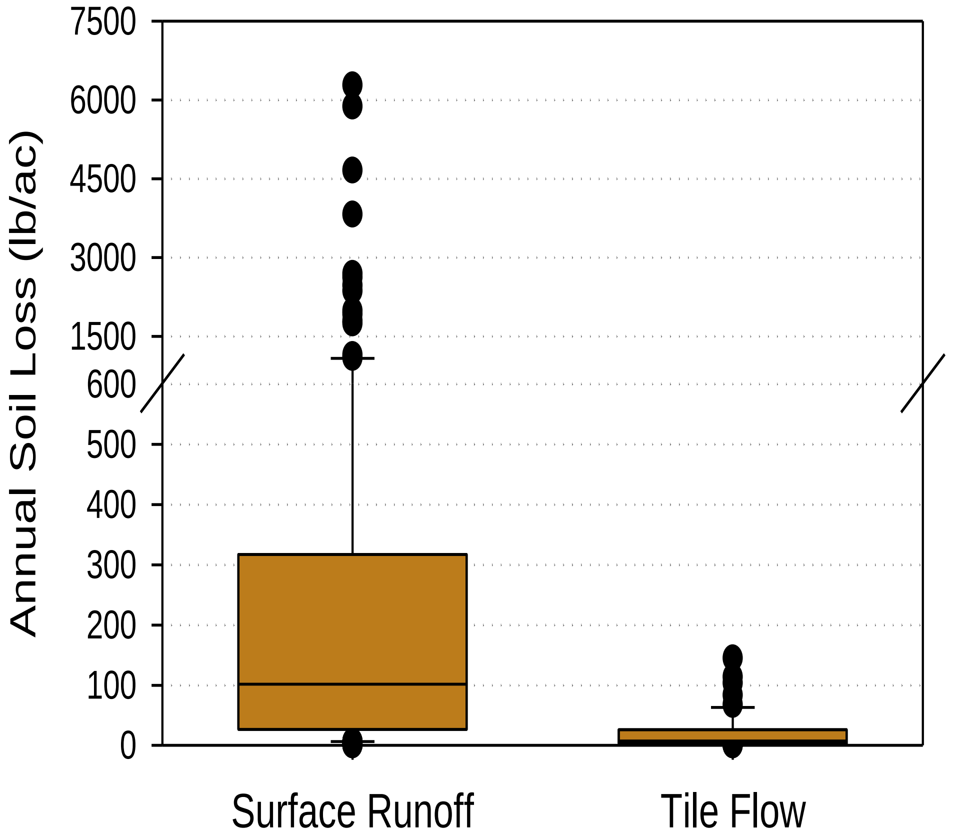
Soil Loss in perspective - a 5 gallon pail will hold a about 45 pounds of soil consider that in pounds/acre that would be similar to spreading that amount over an area of a football field.

Soil loss mostly occurs with surface runoff.



Typical Ranges:
Surface Runoff: 28 to 307 lb/ac
Tile Flow: 3 to 21 lb/ac

Typical Ranges – Buckets:
Surface Runoff: to .6 – 6.8
Tile Flow: .06 to .47

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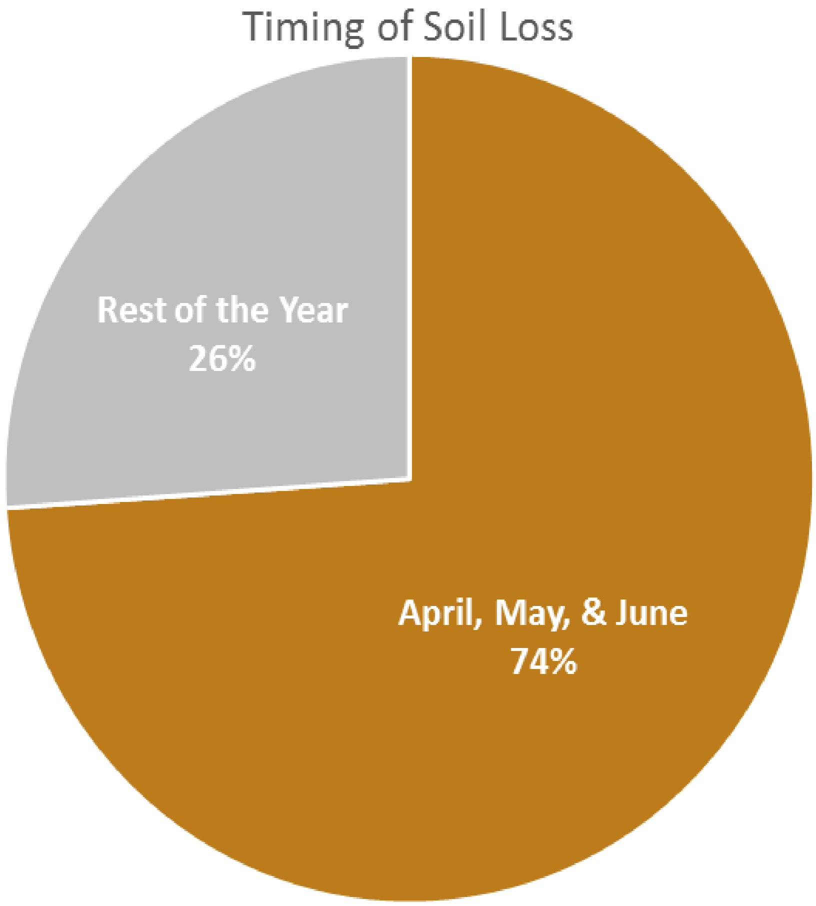
Soil loss mainly occurs in April, May, and June.



April, May, and June: Combination of vulnerable fields and intense storm events.

Reduce soil losses by providing protection during this critical time period.

Level of protection needed is site specific.

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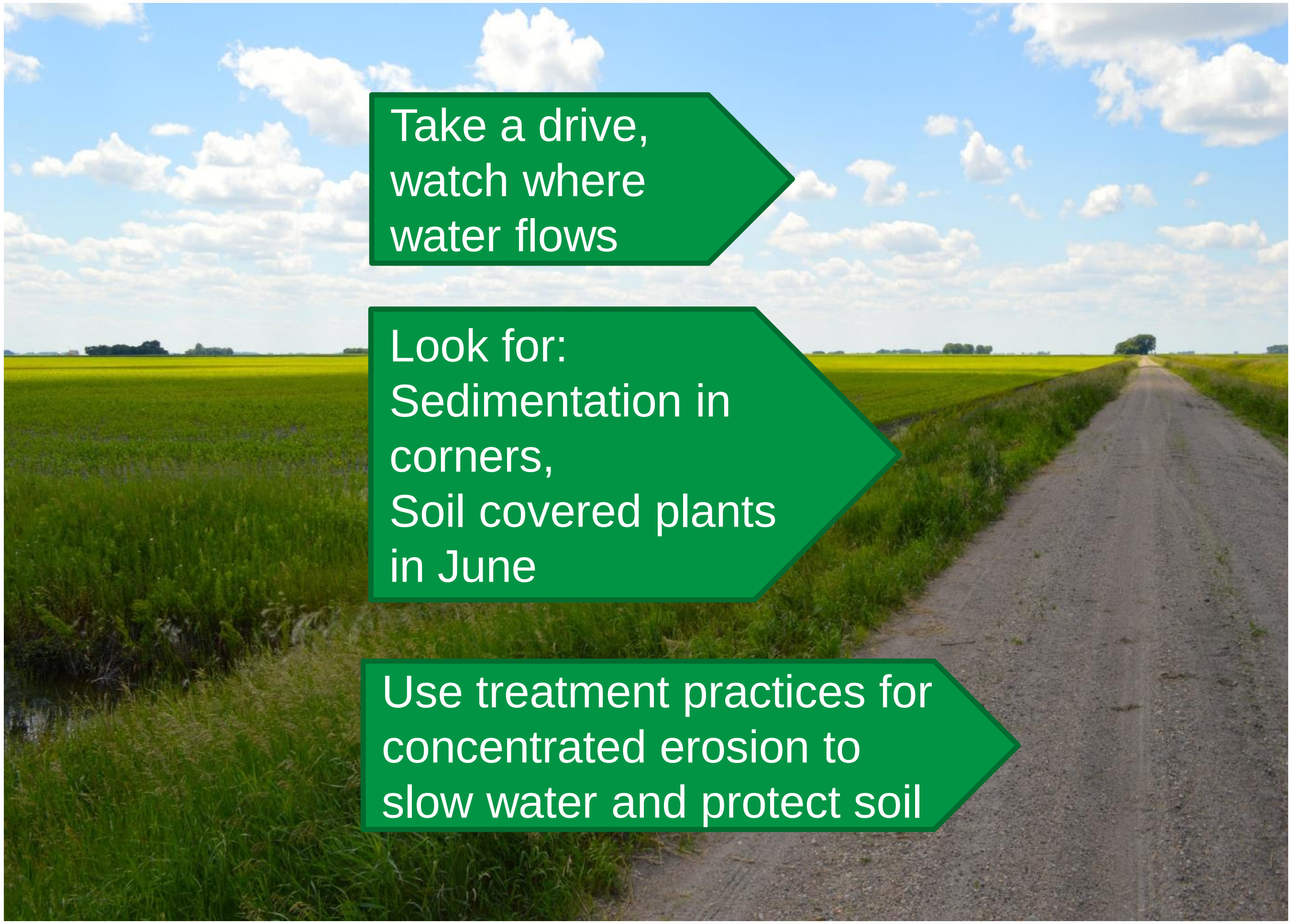
Level of soil protection needed is site specific.

How do we know whether we have enough protection?



Get screened! There is no zero with any land use or ag management practices.

NO_3-N Concentration (ppm)	Interpretation
≤ 5	Native grassland, CRP land, alfalfa, managed pastures
5 – 10	Row crop production on a mineral soil without N fertilizer Row crop production with N applied at 45 lbs./acre below the economically optimum N rate† Row crop production with successful winter crop to "trap" N
10 - 20	Row crop production with N applied at optimum N rate Soybeans
≥ 20	Row crop production where: • N applied exceeds crop need • N applied not synchronized with crop need • Environmental conditions limit crop production and N fertilizer use efficiency • Environmental conditions favor greater than normal mineralization of soil organic matter

Source: Interpreting Nitrate Concentration in Tile Drainage Water, Purdue Extension, Purdue University

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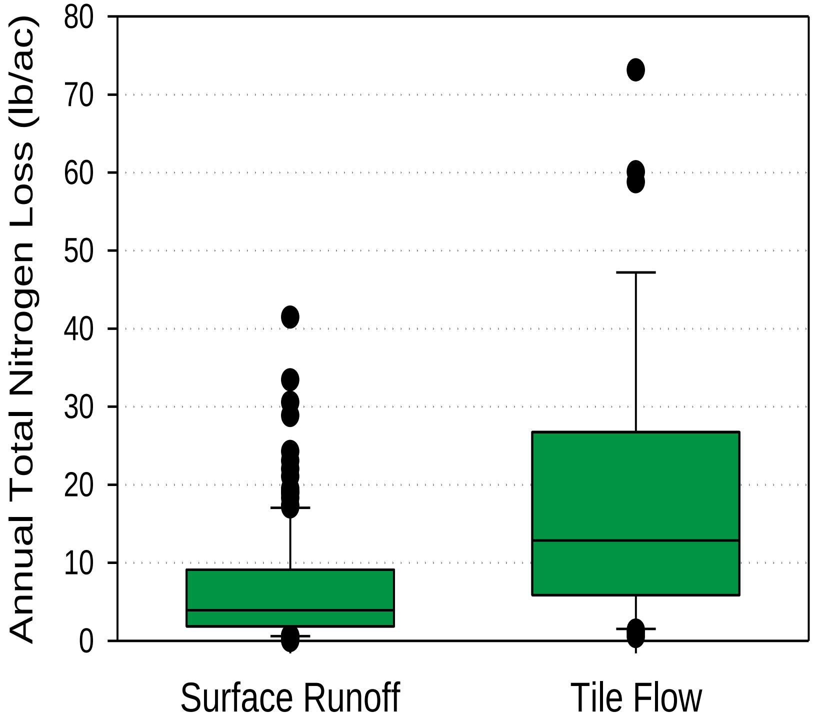
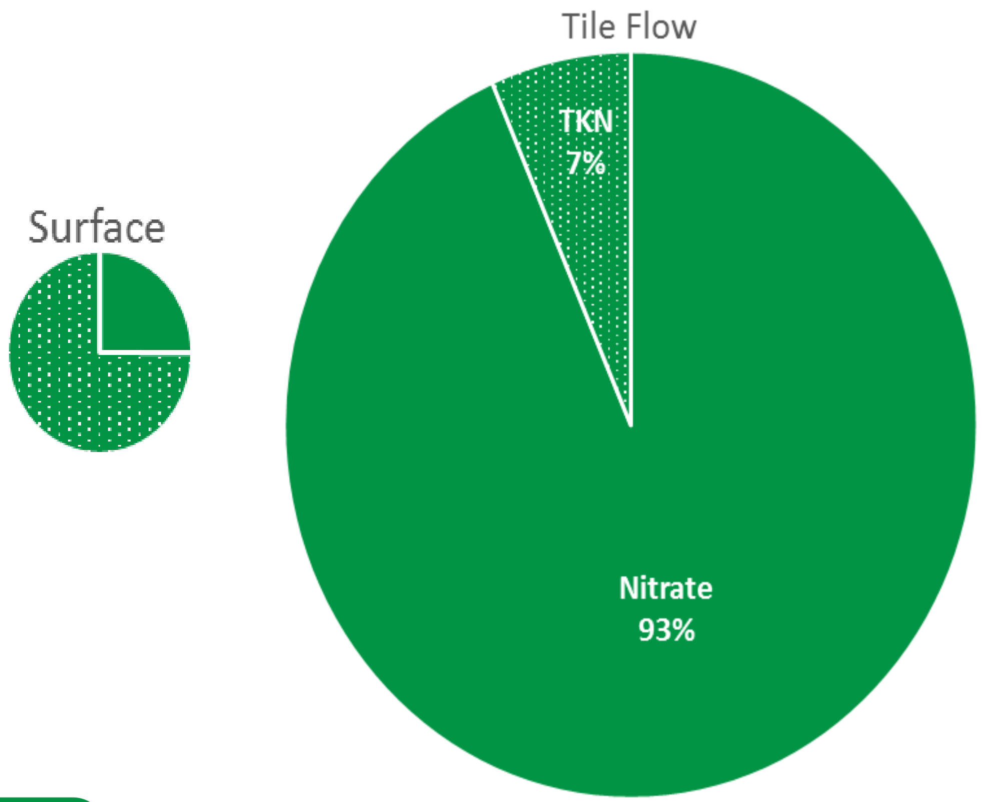
Nitrogen loss mainly occurs with tile flow and nearly all of the nitrogen in tile systems is in the nitrate form.





Typical Ranges:
Surface Runoff: 1.84 to 8.79 lb/ac
Tile Flow: 6.76 to 25.55 lb/ac

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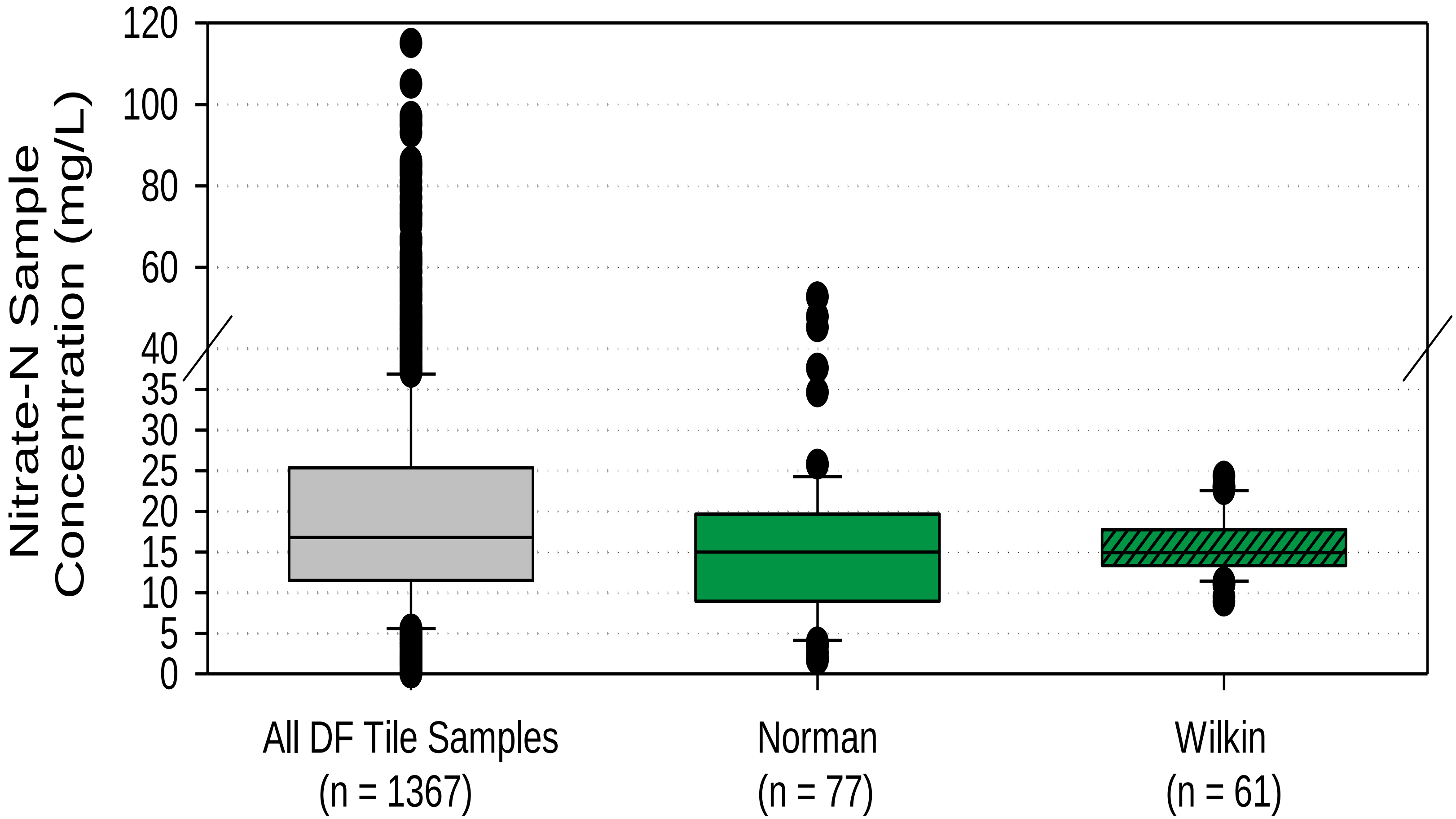
Tile nitrate concentrations in RRV have been similar to other tile monitoring sites. Lower losses are because of decreased tile flow.



Annual Nitrate and Total Nitrogen Loss – Lbs/a
No Manure vs. Manure sites

Surface Nitrate N.:
No Manure: 0.0 to 0.6 #/a
Manure: 0.3 to 1.8 #/a

Surface Total Nitrogen.:
No Manure: 0.4 to 3.5 #/a
Manure: 2.7 to 11.2 #/a

Tile Nitrate N.:
No Manure: 2.1 to 10.6 #/a
Manure: 8.7 to 41.1 #/a

Tile Total Nitrogen:
No Manure: 2.3 to 10.8 #/a
Manure: 13.6 to 44.3 #/a

Annual Nitrate and Total Nitrogen Flow Weighted Mean Concentration – No Manure and Manure sites

Surface Annual TN Flow Weighted Conc.:
No Manure: 2.09 to 6.05 mg/l
Manure: 5.42 to 15.38 mg/l

Tile Annual TN Flow Weighted Conc.:
No Manure: 15.60 to 24.46 mg/l
Manure: 16.06 to 29.47 mg/l

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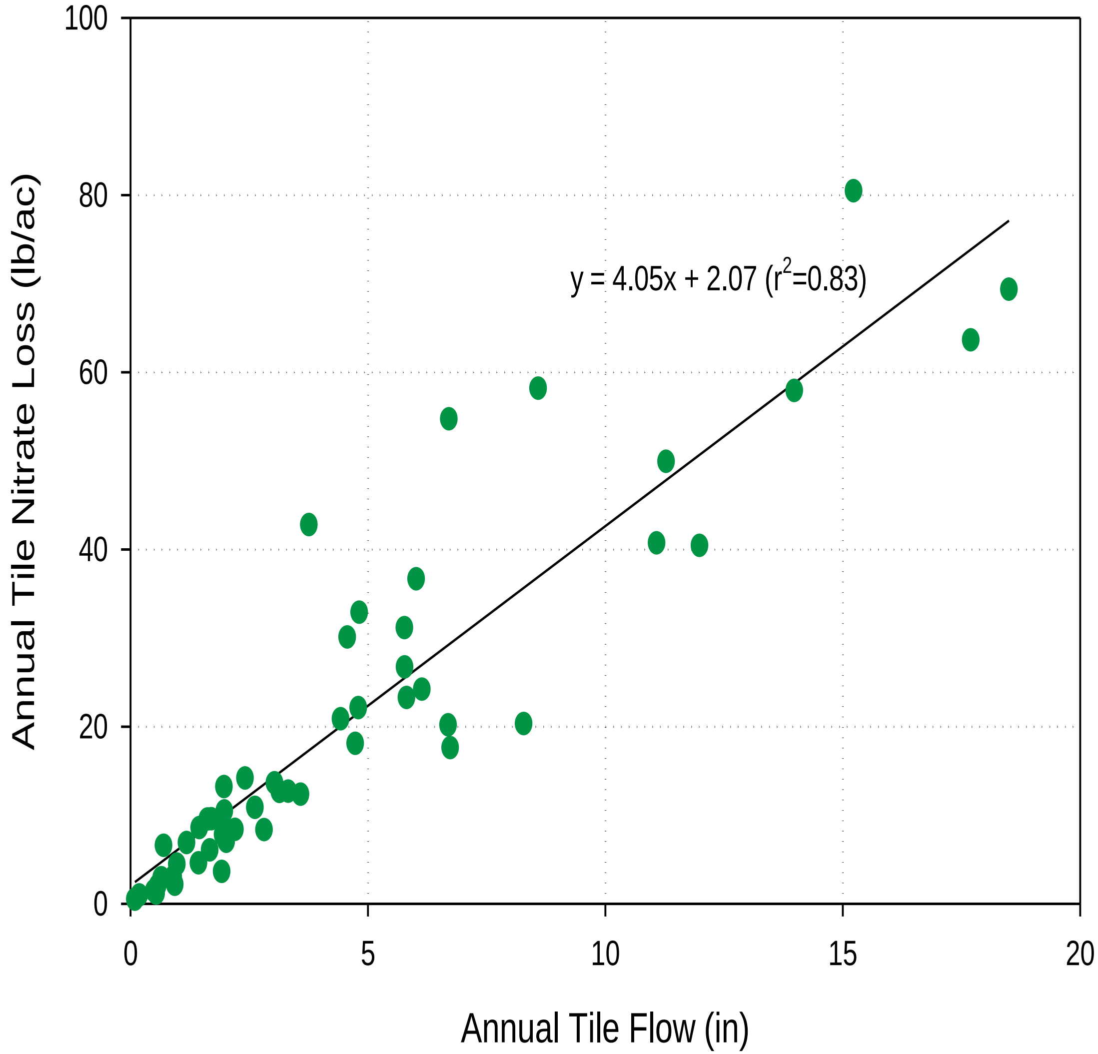
The amount of nitrogen loss in tile systems is dependent on the amount of flow.



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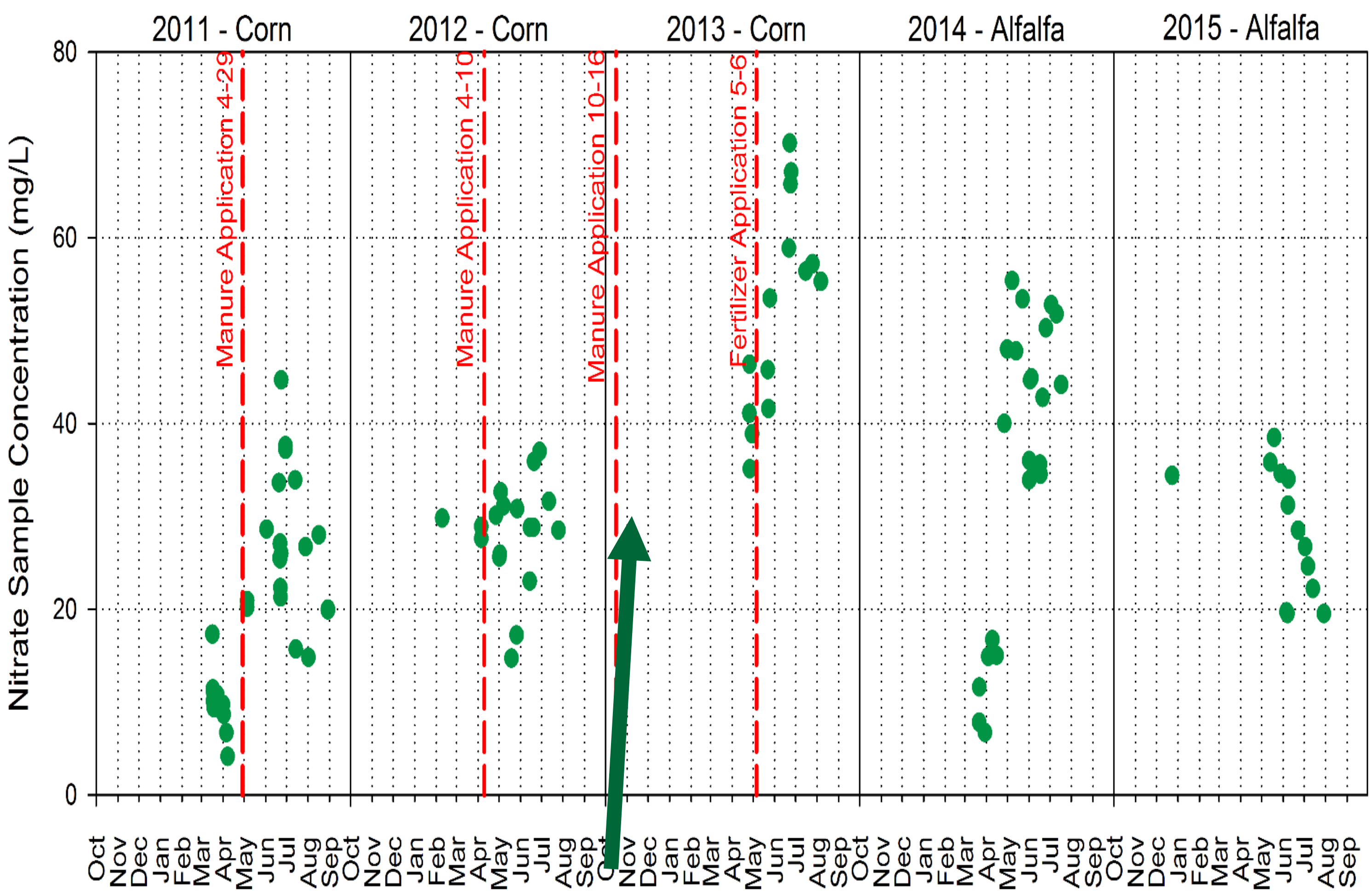
Timing and rate of nitrogen applications influence loss.



Oct 16, 2012:
Soil Temperature 50 degrees F

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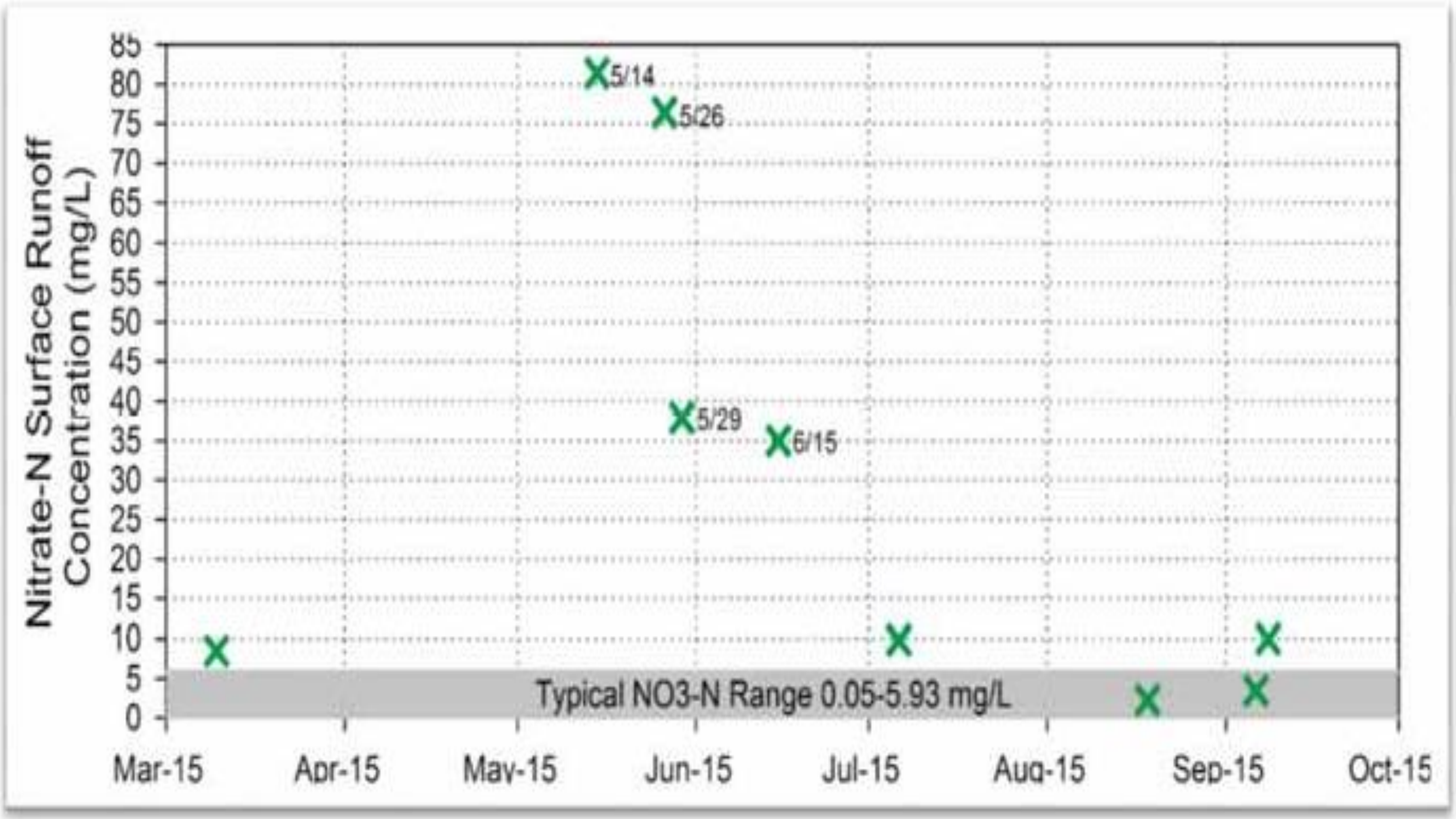
Nitrate-nitrogen concentrations in surface runoff at one Discovery Farm location in 2015



Urea had been broadcast to the soil surface of harvested soybean stubble in late November of 2014 after the soil temperature had dropped below 50°F.
No fall incorporation of the urea.

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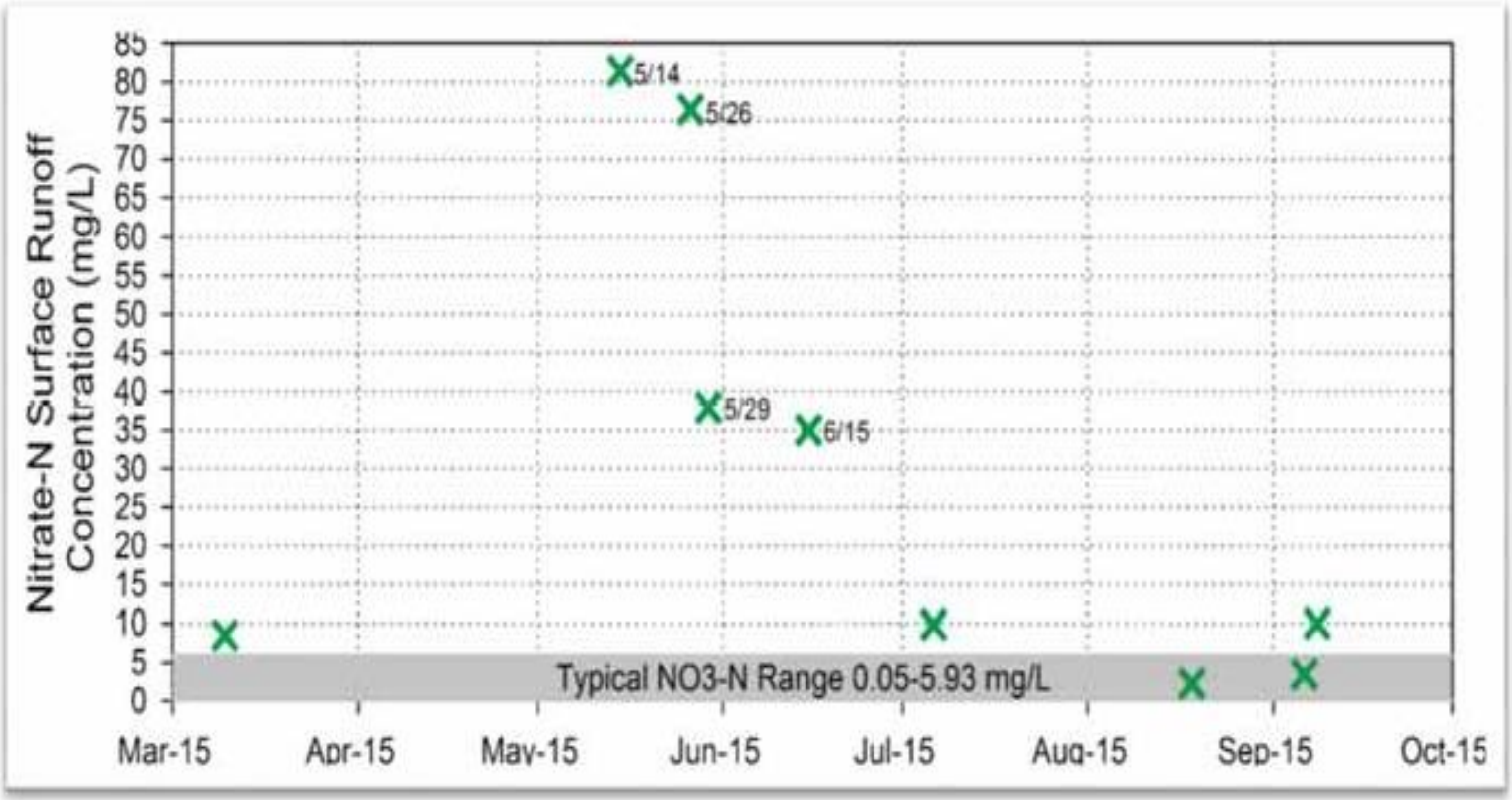
Nitrate-nitrogen concentrations in surface runoff at one Discovery Farm location in 2015



Shallow incorporation resulted in the nitrate-nitrogen produced from the breakdown of urea remaining close to the soil surface. Surface runoff caused by spring rains in May and June then carried a portion of the nitrogen away, resulting in potential economic loss for the farmer and potential environmental concerns.

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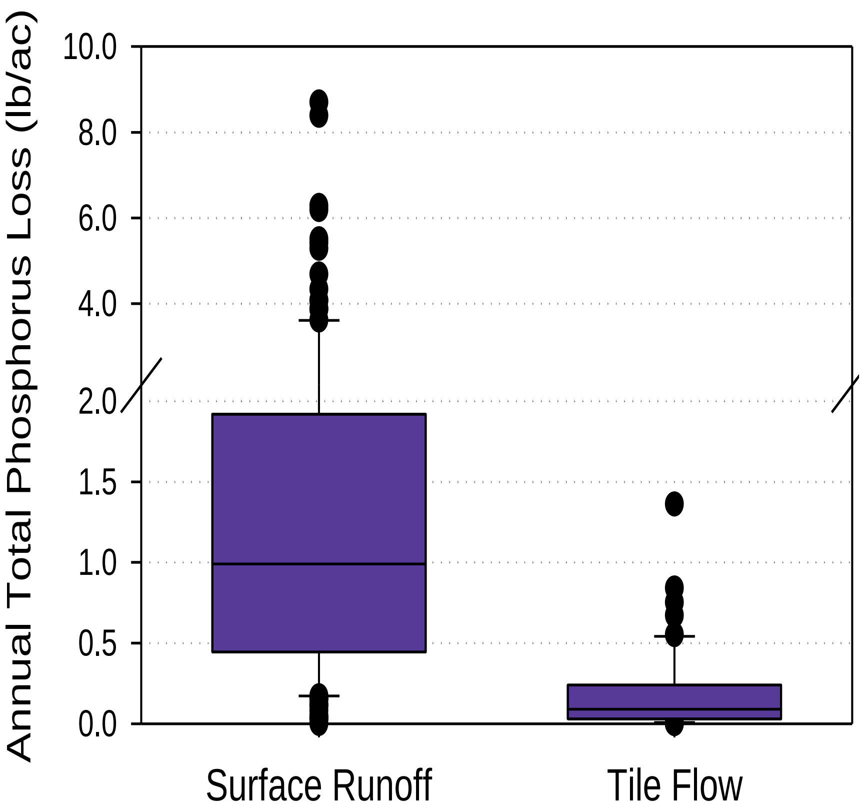
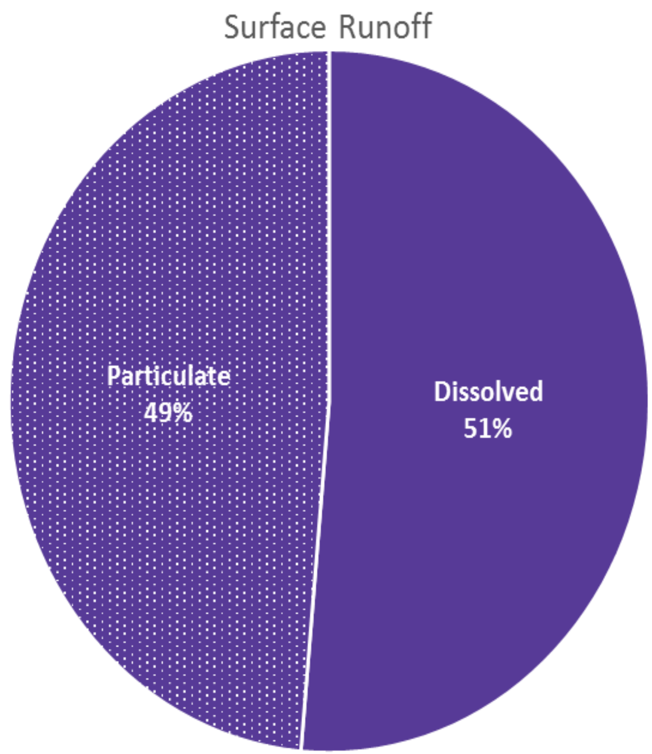
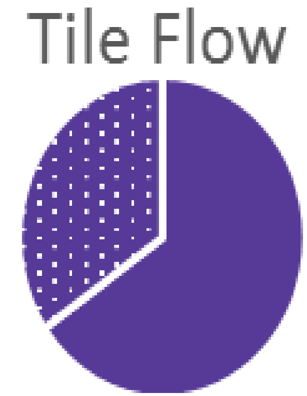
Phosphorus loss mainly occurs with surface runoff, but a few tile sites have had elevated losses.







Typical Ranges:
Surface Runoff: 0.45 to 1.89 lb/ac
Tile Flow: 0.03 to 0.24 lb/ac

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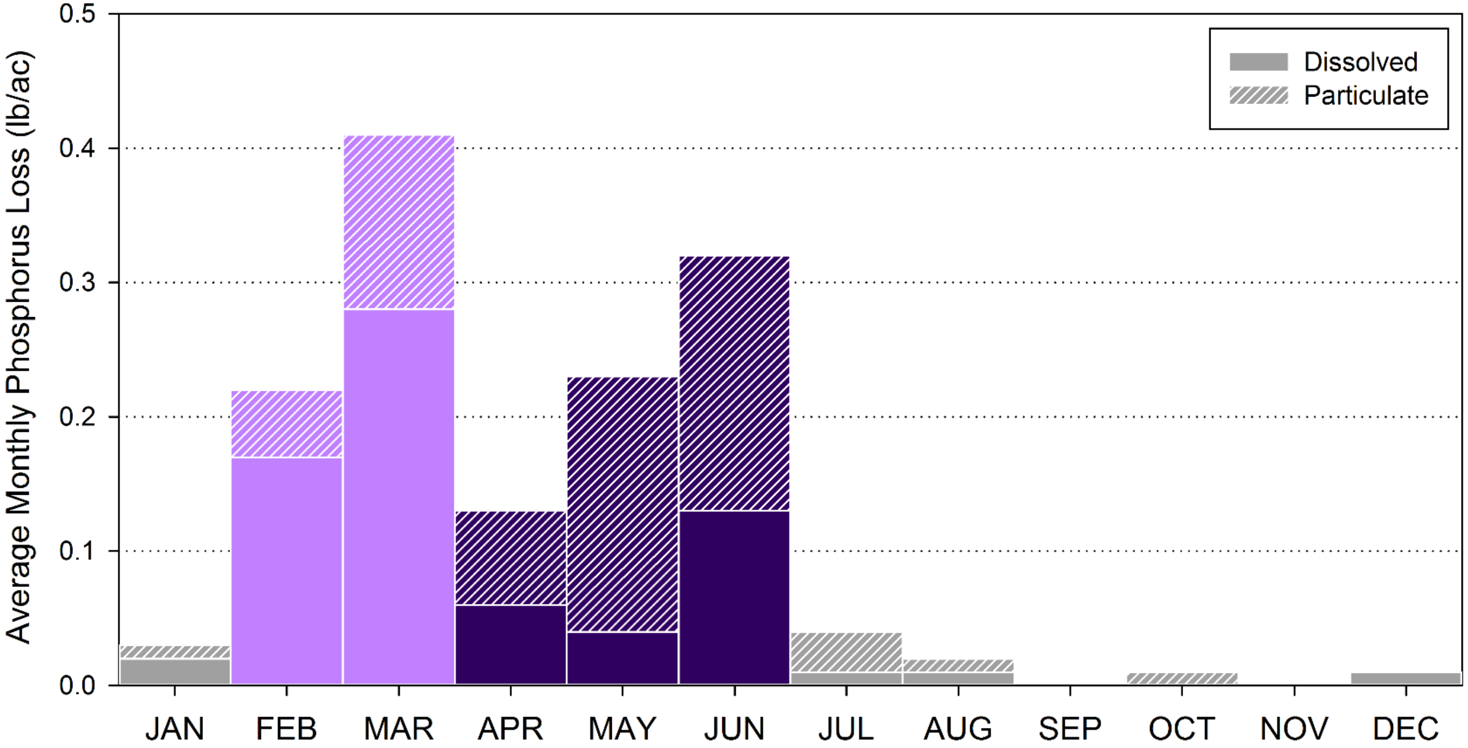
There are Two Time Periods for P Loss – Snowmelt and Spring Runoff



Feb/Mar: 44%
Apr/May/Jun: 48%

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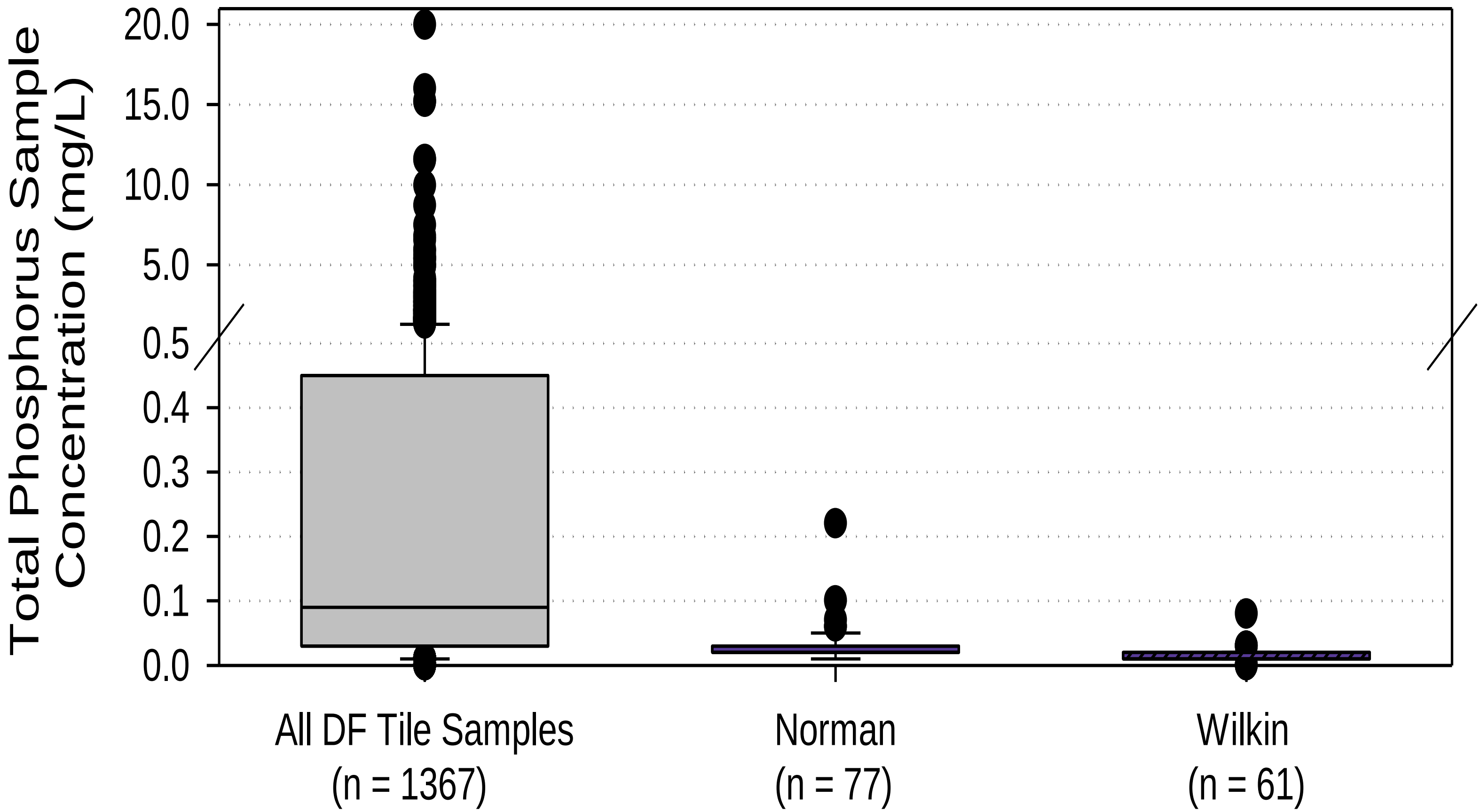
Tile phosphorus concentrations in the RRV have been much lower than other tile monitoring sites. Lower losses are because of decreased concentrations and tile flow.



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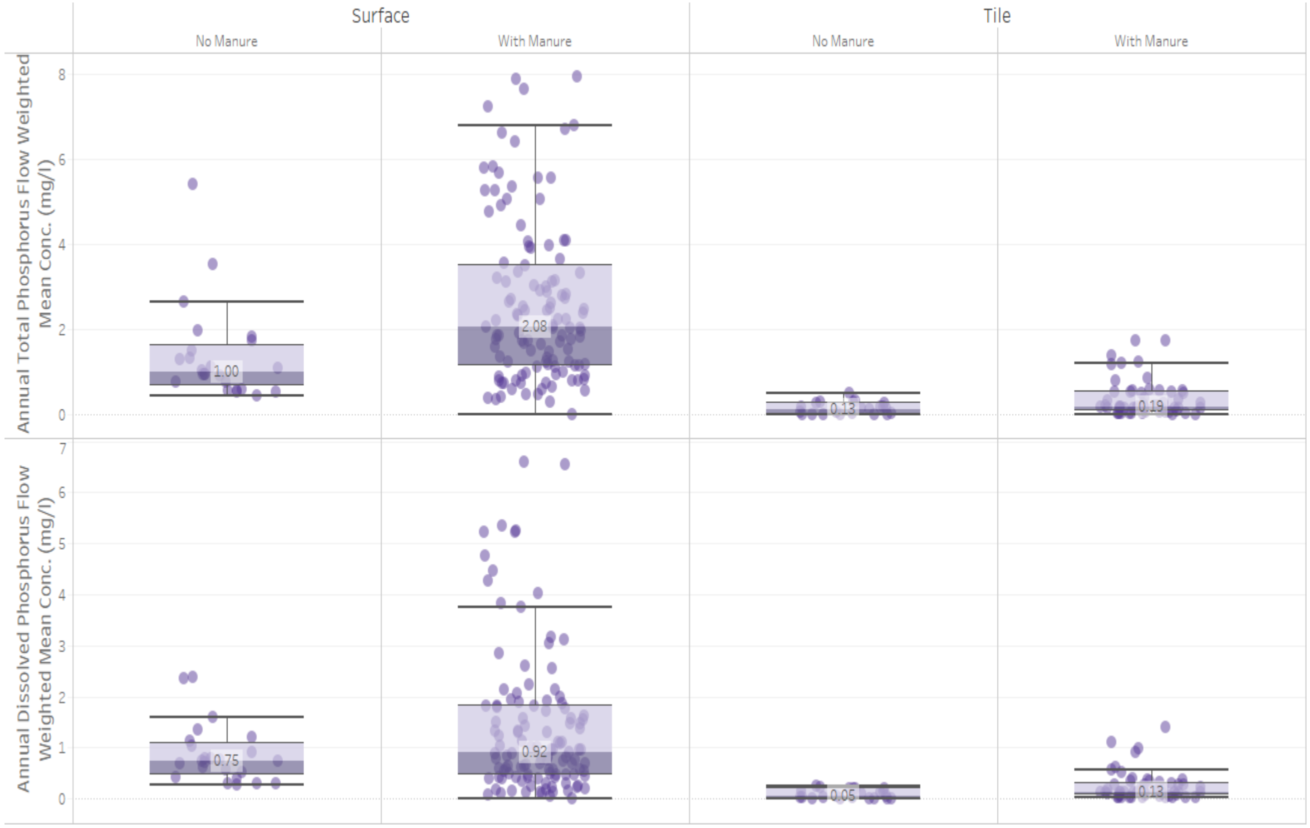
Annual Soluble and Total Phosphorus Flow Weighted Mean Concentration – No Manure and Manure sites



Surface Annual TP Flow Weighted Conc.:
No Manure: 0.69 to 1.62 mg/l
Manure: 1.17 to 3.52mg/l

Tile Annual TP Flow Weighted Conc.:
No Manure: 0.02 to 0.28 mg/l
Manure: 0.09 to 0.54 mg/l

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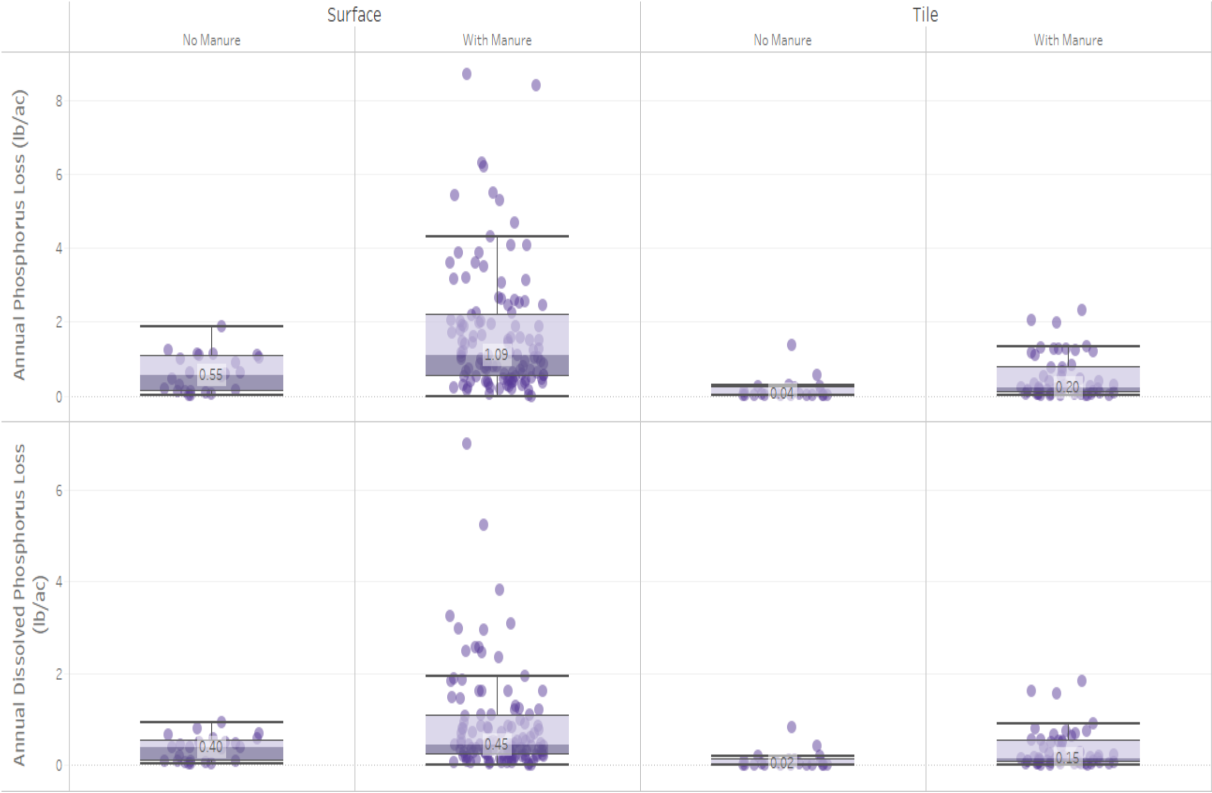
Annual Dissolved and Total Phosphorus Loss – Lbs/a – No Manure vs. Manure sites



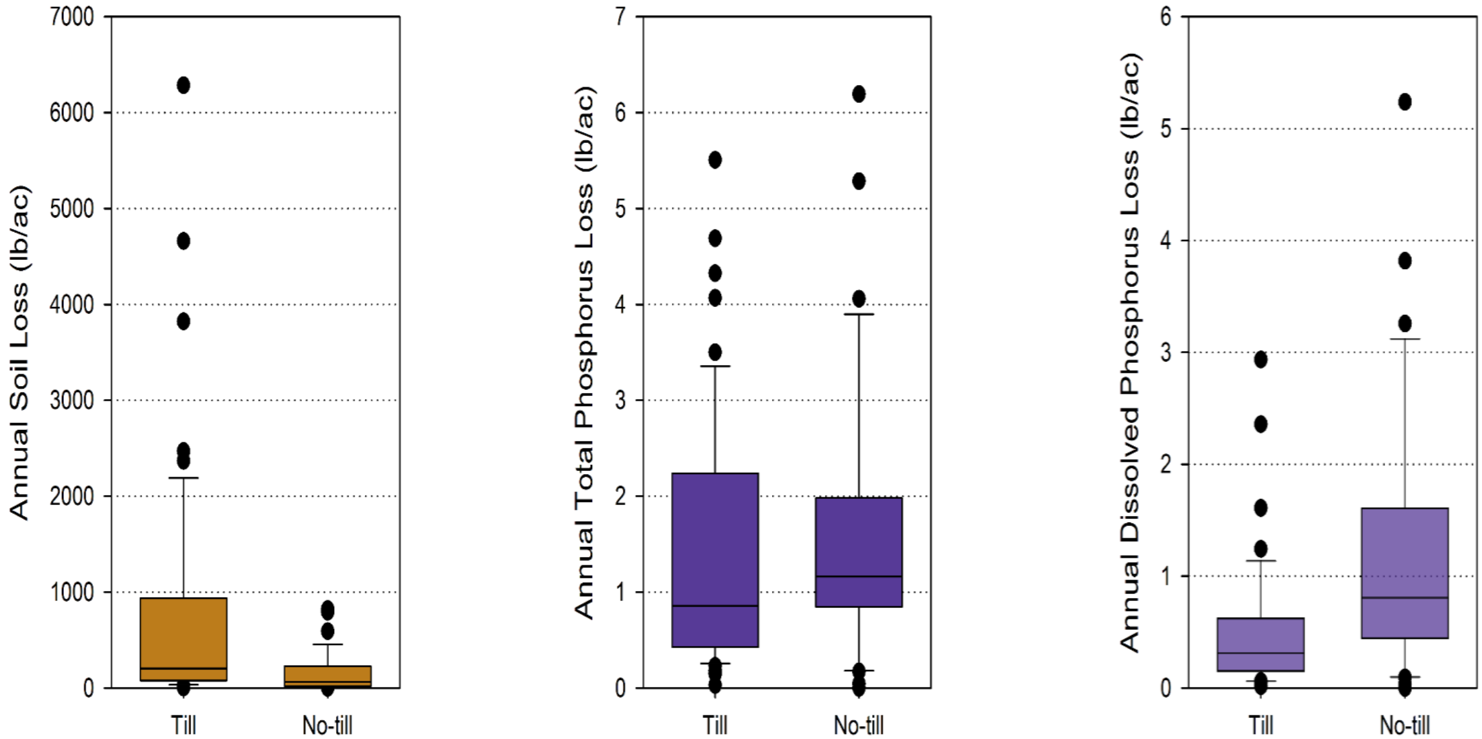
Surface Dissolved P.:
No Manure: 0.09 to 0.53 #/a
Manure: 0.23 to 1.06 #/a

Surface Total P.:
No Manure: 0.12 to 1.05 #/a
Manure: 0.52 to 2.18 #/a

Tile Dissolved P.:
No Manure: 0.00 to 0.12 #/a
Manure: 0.05 to 0.51 #/a

Tile Total P.:
No Manure: 0.01 to 0.21 #/a
Manure: 0.07 to 0.76 #/a

Controlling soil losses is JUST the first step to managing phosphorus loss.



Till median: 205 lb/ac
No-till median: 65 lb/ac
Rank sum p value: 0.001

Till median: 0.9 lb/ac
No-till median: 1.2 lb/ac
Rank sum p value: 0.294

Till median: 0.3 lb/ac
No-till median: 0.8 lb/ac
Rank sum p value: <0.001

Till Count: 53; No-till Count: 37

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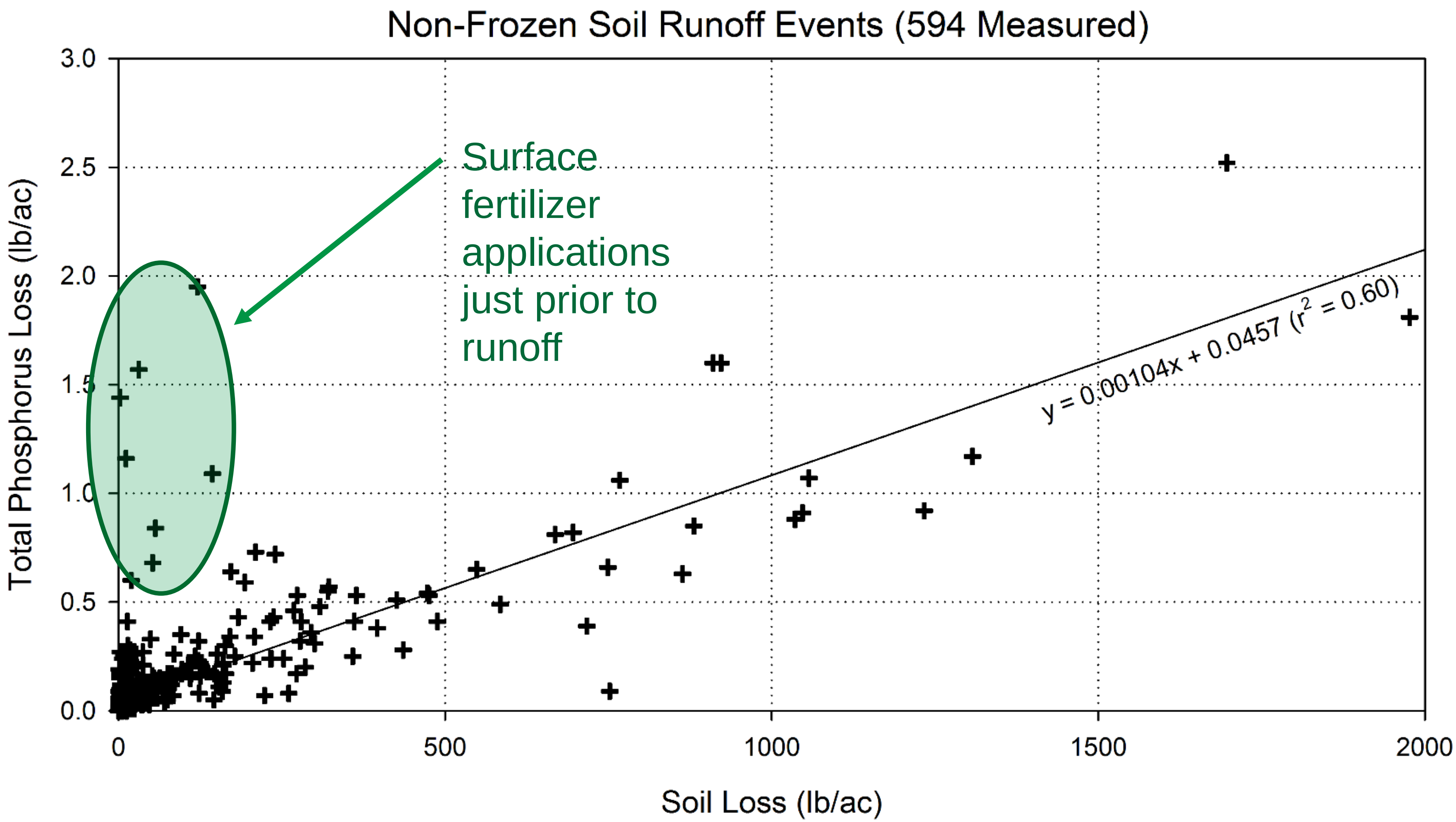
During the Growing Season Phosphorus Loss is Driven by Soil Loss



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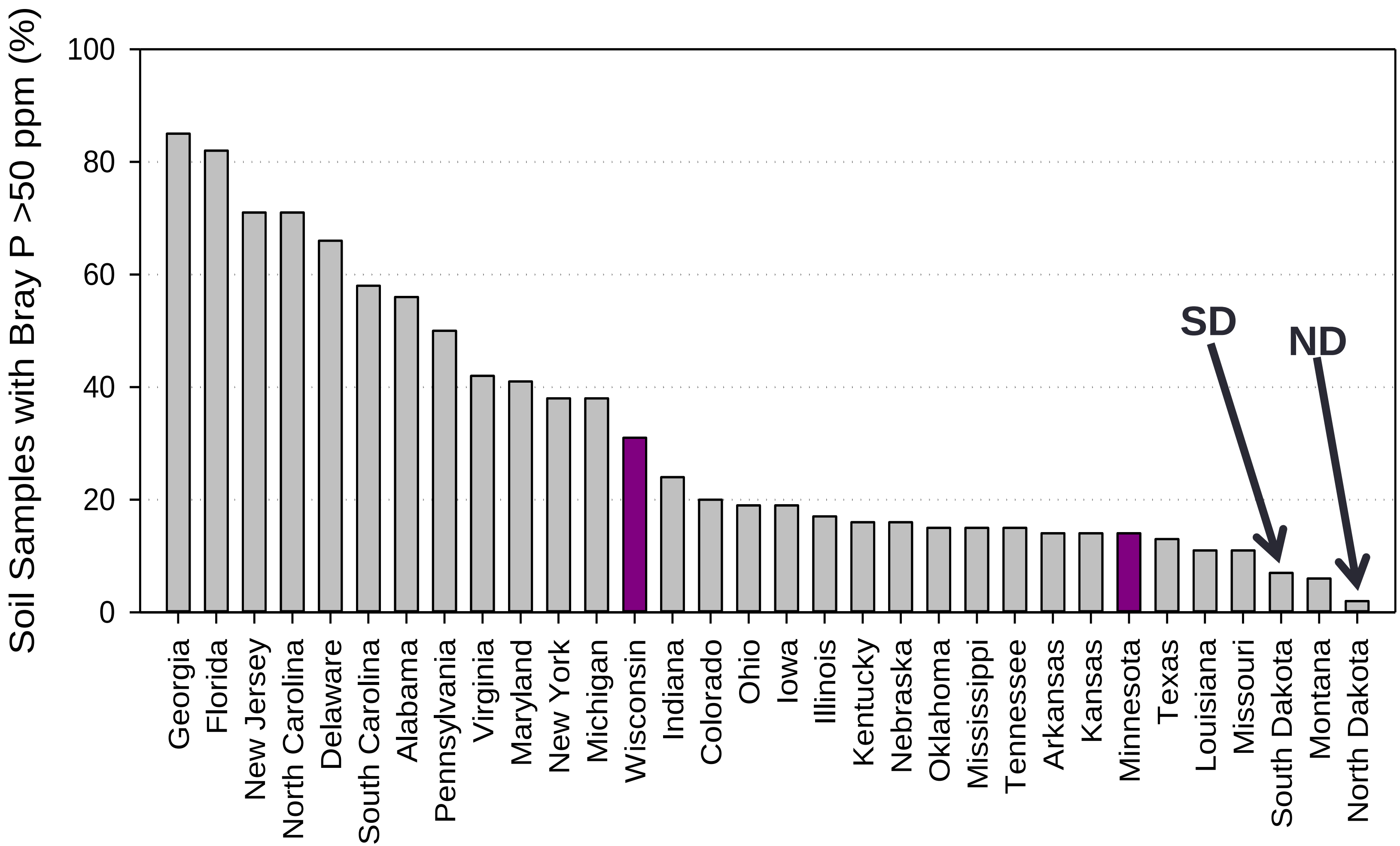
High soil test P levels in MN, ND, SD are not typical.



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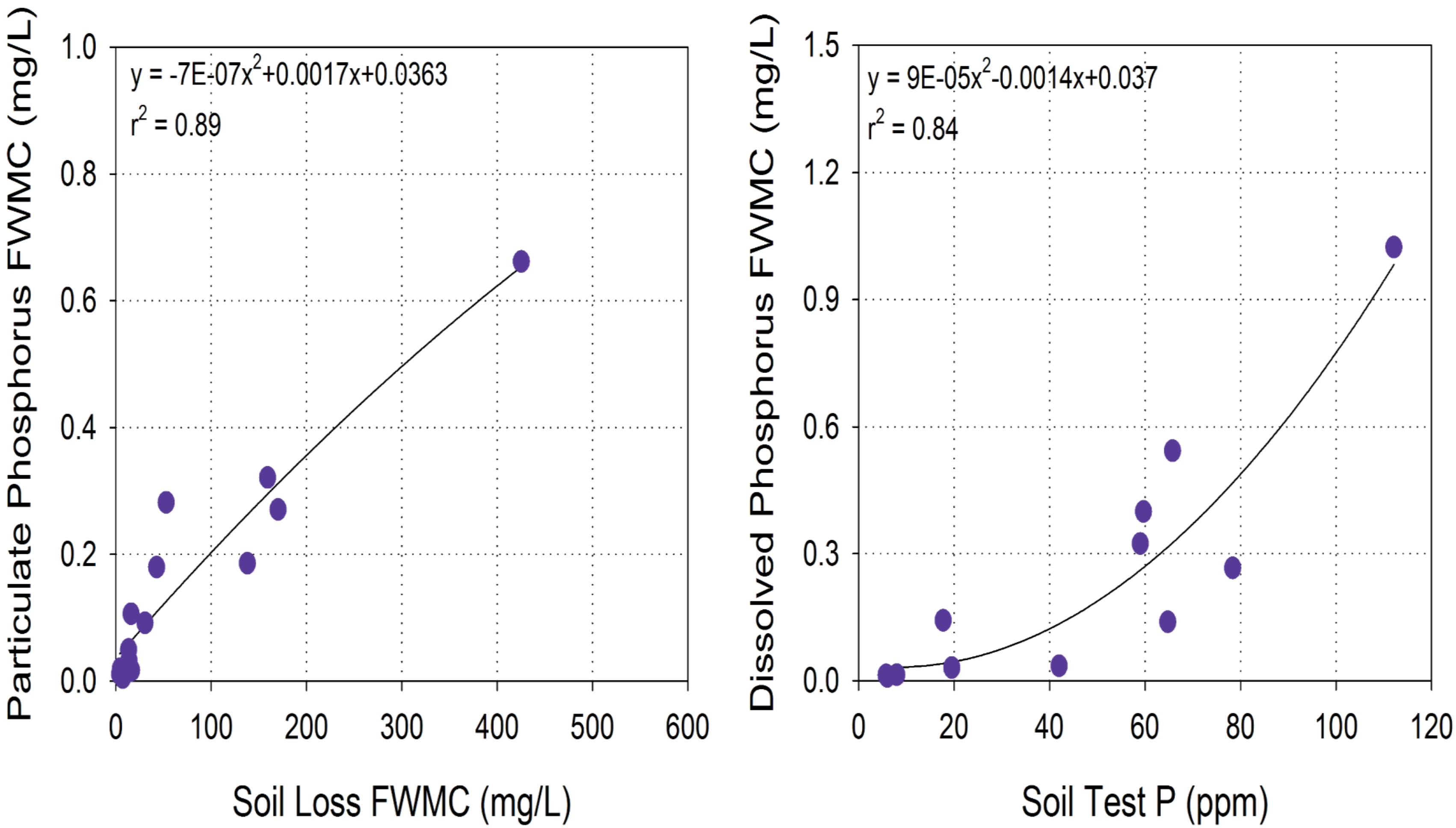
Phosphorus loss in tile systems is influenced by sediment concentrations and soil test phosphorus levels.



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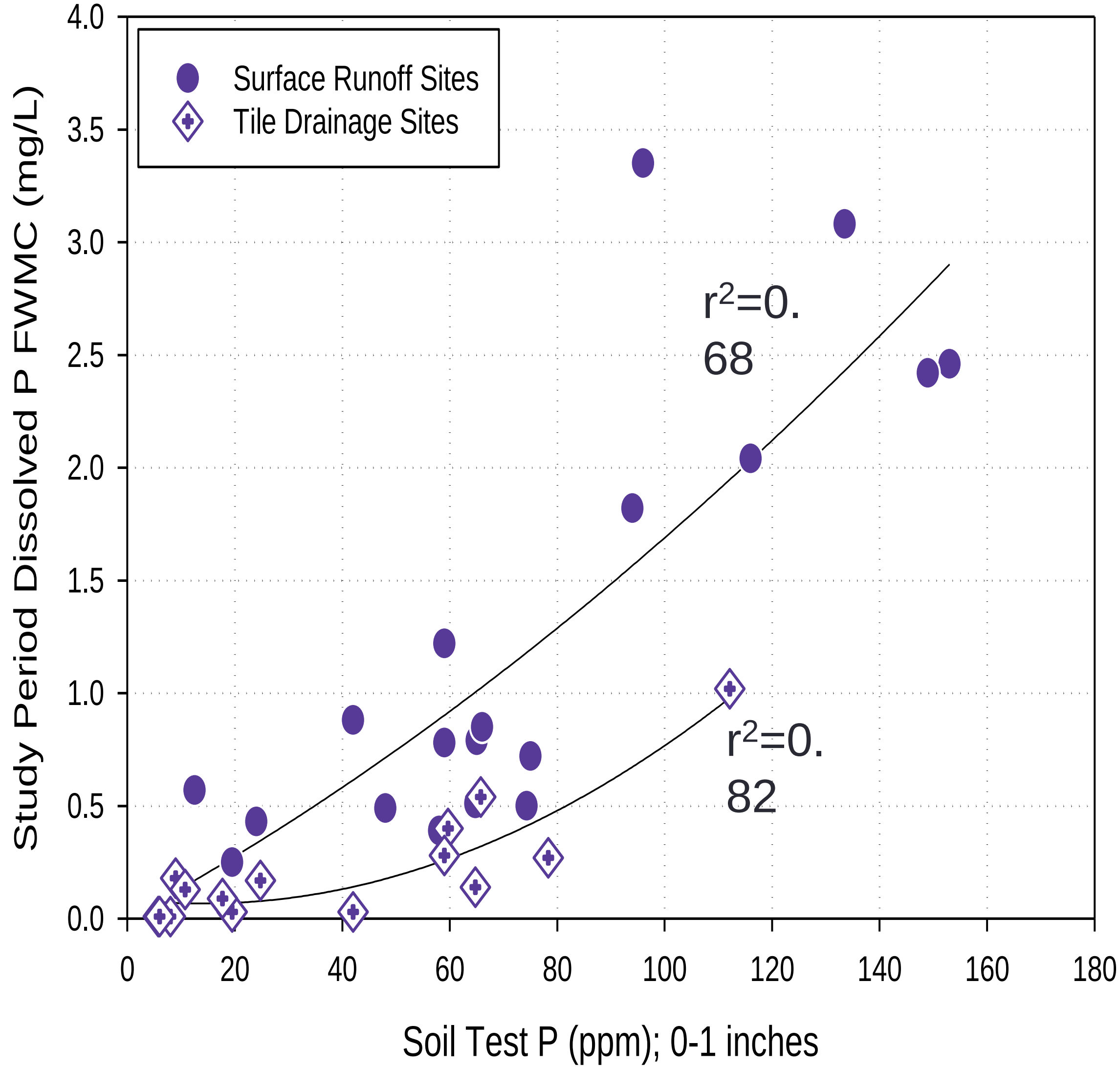
Managing soil test phosphorus levels and stratification is just as important.



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We have been collecting edge-of-field water quality data in MN and WI for 10-20 years, what do we know?

Losses are different than expectations

Every farm and every management system has an area where environmental impact could be improved

There are no silver bullet solutions

What changes have been made since the start of the program by cooperators

Increased manure testing and timing and rates of manure applications

Changes in tillage practices and amount of tillage

Removal of intakes or installation of equipment that reduces the amount of sediment into intakes

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Keys to reduce risk of soil and nutrient losses.

Control soil loss by using appropriate level of soil protection and update and maintain tile systems.

Consider timing and placement of application and check soil test phosphorus levels to reduce dissolved phosphorus.

Consider timing and rate of application to reduce nitrogen loss and know your tile nitrate levels.

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CEUs in Nutrient Management and Soil and Water will be available for Certified Crop Advisors

Nitrogen Conference
4 SW, 4.5 NM, .5 PM

Nutrient Conference
1 PM, 2 SW, 6 MN.

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Jerome.lensing@hotmail.com

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Thank you!
Have a very profitable 2018