

# Discovery Farms Minnesota Data Review for Sites in the Red River Valley

Discovery Farms Minnesota is a farmer led water quality research and educational program. The mission of the program is to collect water quality information under real-world conditions to provide credible and practical information that supports better farm management decisions.

There are currently 10 core farm projects in Minnesota. The locations and site information can be found in Figure 1 and Table 1. Two of the sites, Norman County (NO1) and Wilkin County (WI1), are located in the Red River of the North Watershed. While there are surface runoff and tile drainage sites at other locations, only tile drainage is monitored at these two sites. Both NO1 and WI1 are recently installed pattern tile systems with 60-80' spacing, 4' depth, and lift pumps. Data has been collected at NO1 and WI1 from 2013 through 2015.

The data presented in this factsheet are generated from edge-of-field monitoring sites. Water quality monitoring results from edge-of-field monitoring sites are different than stream monitoring data and standards. Therefore, direct comparisons of the two types of data should not be made. Annual data from all Discovery Farms sites in Minnesota is displayed in box plots which display the range of the data collected. The middle line in the box plots represents the 50<sup>th</sup> percentile or median, a number at which half of the values are above and half of the values are below. The colored box represents the 25<sup>th</sup> to 75<sup>th</sup> percentile and the whiskers represent the 10<sup>th</sup> and 90<sup>th</sup> percentiles.

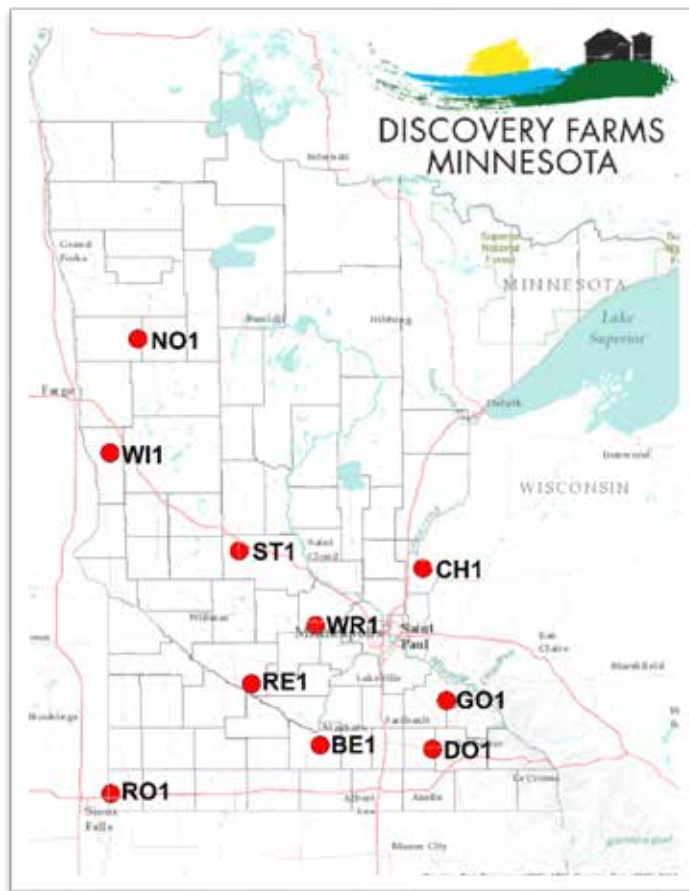


Figure 1: Discovery Farms Minnesota core farm locations

Table 1: Discovery Farms Minnesota location information

Field ID	Farm Enterprise	Start of Project	Monitoring Setup	Soil Texture	Average Slope	Tillage	Manure History
GO1	Swine farrow to wean and beef (corn-alfalfa)	Sep-10	Surface runoff (6.3 acres)	Silt loam (well drained)	6.7 %	Fall chisel, spring field cultivator	Yes
ST1	Dairy (corn-alfalfa)	Mar-11	Surface runoff (28.2 acres) and subsurface tile drainage (24.2 acres)	Loam (poorly drained)	4.1 %	Fall chisel, spring field cultivator	Yes
CH1	Grain (corn-soybean)	Mar-11	Surface runoff (6.1 acres)	Loam (well drained)	3.4 %	No primary tillage	No
BE1	Swine finishing and grain (corn-soybean)	Jun-11	Surface runoff (14.3) and subsurface tile drainage (26.2 acres)	Silty clay loam (poorly drained)	1.4 %	Fall chisel, spring field cultivator	Yes
WR1	Dairy (corn-alfalfa)	Dec-11	Surface runoff and subsurface tile drainage (23.9 acres)	Loam (poorly drained)	4.7 %	Fall chisel, spring field cultivator	Yes
RE1	Grain (corn-soybean/sweet corn-peas)	Dec-11	Subsurface tile drainage (81 acres)	Clay loam (poorly drained)	2.0 %	Fall plow or chisel, spring field cultivator	No
DO1	Swine finishing and grain (corn-soybean)	Oct-12	Surface runoff and subsurface tile drainage (13.9 acres)	Silt loam (poorly drained)	2.9 %	Fall chisel, spring field cultivator	Yes
WI1	Grain (corn-soybean)	Oct-12	Subsurface tile drainage (160 acres)	Very fine sandy loam (poorly drained)	1.1 %	Fall chisel, spring field cultivator	No
NO1	Grain (sugarbeet-corn-dry bean-soybean-wheat)	Oct-12	Subsurface tile drainage (570.8 acres)	Fine sandy loam (poorly drained)	1.0 %	Fall chisel, spring field cultivator	No
RO1	Beef and grain (corn, soybean and alfalfa)	Oct-13	Surface runoff (25.5 acres)	Silt loam (well drained)	4.7 %	Fall disk rip, spring field cultivator	Yes

## Precipitation and Runoff

The amount of precipitation affects the amount of drainage. In general, higher drainage amounts correspond to higher precipitation. Thirty-year normal precipitation amounts range from 36 inches in Southeastern Minnesota to 20 inches in Northwestern Minnesota (Figure 2).

Precipitation at NO1 and WI1 was below normal in 2013, 2014, and 2015 (Table 2). Precipitation was much below normal in 2015 with only about 16 inches of precipitation during the year.

Throughout the Discovery Farms network in Minnesota, the amount of tile drainage and surface runoff was similar on an annual basis (Figure 3). Annual medians for surface runoff and tile drainage were 2.47 and 2.01 inches, respectively. The amount of drainage at NO1 and WI1 tile sites were below the median value for tile drainage sites except for WI1 in 2014.

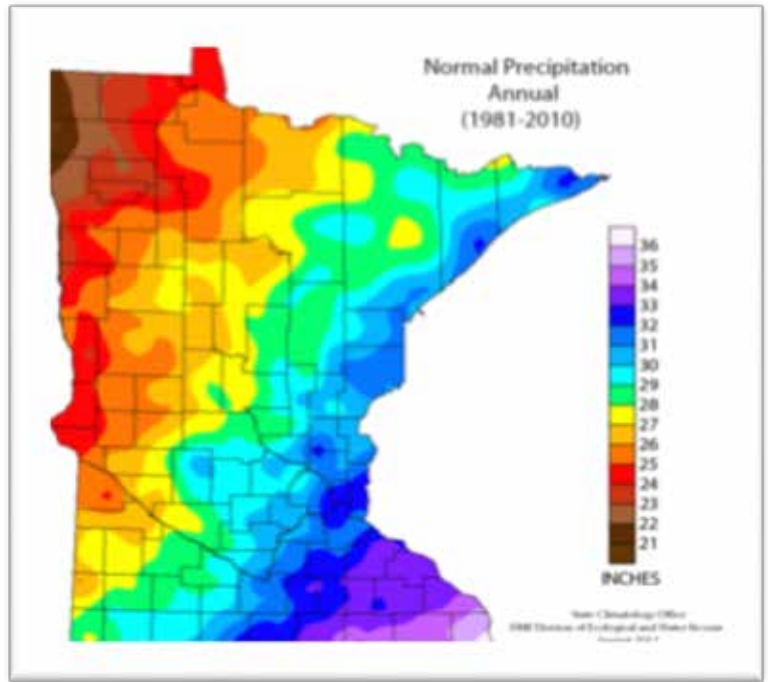


Figure 2: Precipitation normal for Minnesota

Drainage amounts at NO1 and WI1 have been lower than other sites in the Discovery Farms Minnesota network because precipitation amounts have been lower. Sites in Southern Minnesota have higher amounts of drainage due to higher amounts of precipitation. On average, there is about 6-10 inches less precipitation in Northwestern Minnesota compared to Southern Minnesota which leads to lower drainage amounts.

Table 2: Precipitation details for NO1 and WI1

Site	Year	Precipitation	30 YR Normal
NO1	2013	20.22	24.73
	2014	24.03	
	2015	15.76	
WI1	2013	22.49	25.20
	2014	24.79	
	2015	15.55	

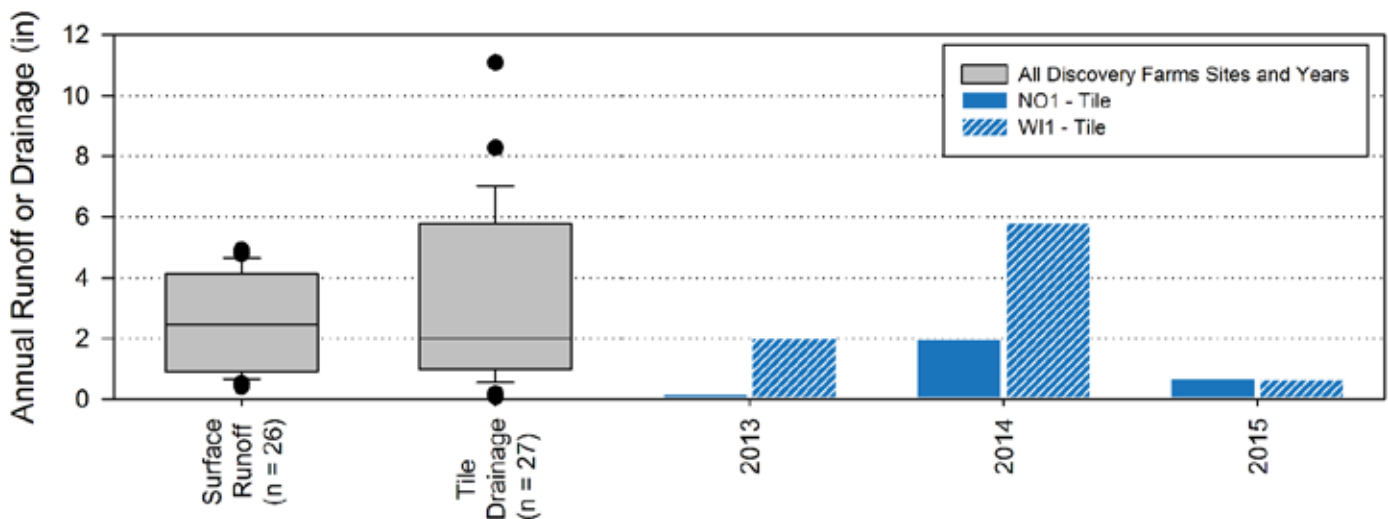


Figure 3: Annual surface runoff or tile drainage at all Discovery Farms locations and 2013-2015 at NO1 and WI1

## Soil and Phosphorus Loss

Soil and phosphorus loss are mostly transported by surface runoff across the Discovery Farms monitoring network in Minnesota (Figures 4 & 5). Annual soil loss medians for surface runoff and tile drainage were 208 and 7 lb/ac, respectively. Annual phosphorus loss medians for surface runoff and tile drainage were 0.8 and 0.1 lb/ac, respectively. The amounts of soil and phosphorus transported by tile drainage systems in Minnesota is relatively low.

The amount of soil and phosphorus loss at NO1 and WI1 tile sites were below the median values for tile drainage sites (Figures 4 & 5). Modern design of the tile systems at NO1 and WI1, including plastic corrugated pipe and no surface intakes, limit the amount of soil that moves into the tile system. Low soil test P values, both fields below 10 ppm, limit the amount of phosphorus available to move into the tile system.

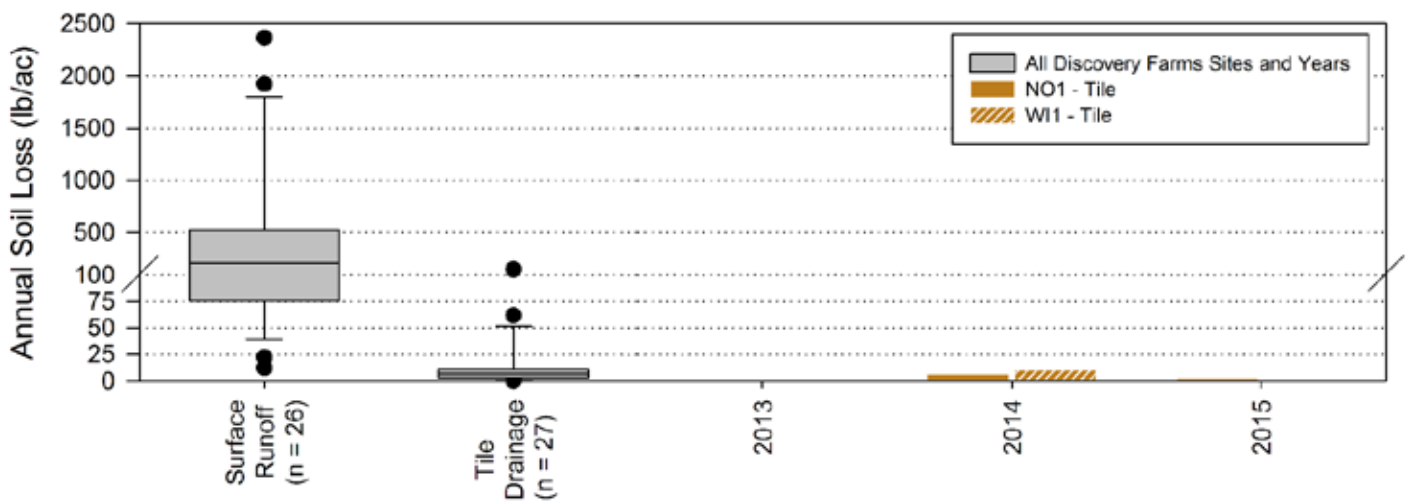


Figure 4: Annual soil loss at all Discovery Farms locations and 2013-2015 at NO1 and WI1

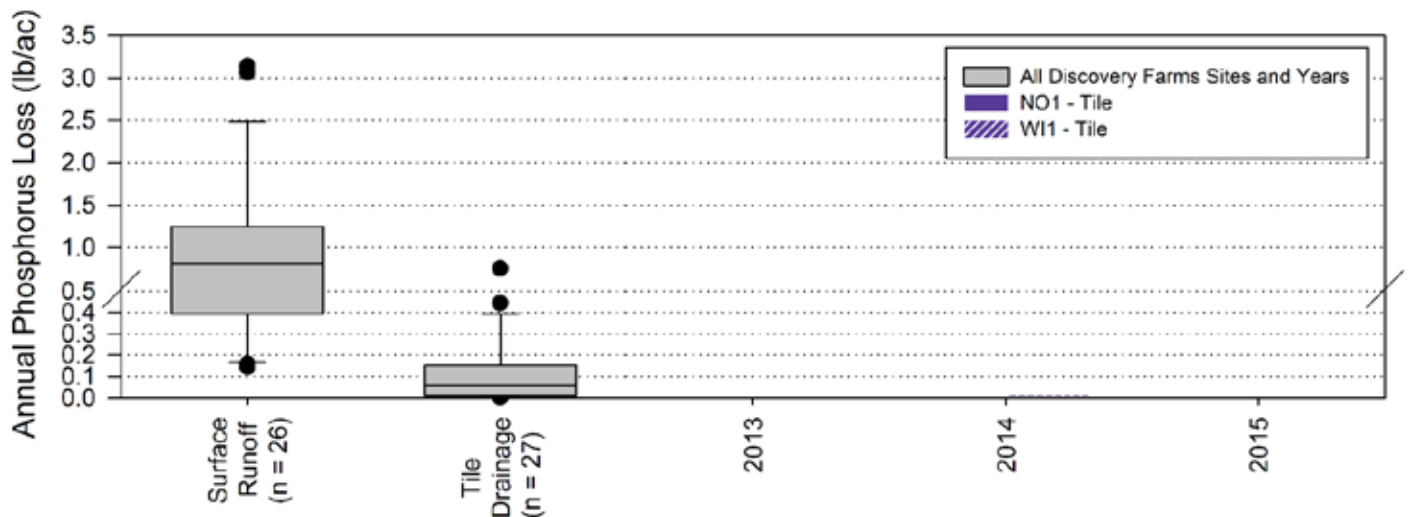


Figure 5: Annual phosphorus loss at all Discovery Farms locations and 2013-2015 at NO1 and WI1

## Nitrogen Loss

Nitrogen loss is mostly transported by tile drainage across the Discovery Farms monitoring network in Minnesota (Figure 6). Annual nitrogen loss medians for surface runoff and tile drainage were 3.9 and 11.4 lb/ac, respectively. The amount of nitrogen transported by surface runoff in Minnesota is relatively low.

The amount of nitrogen loss at NO1 and WI1 tile sites were below the median value for tile drainage sites except for WI1 in 2014 (Figure 6). Nitrogen losses typically follow the amount of drainage, meaning that more drainage usually equals more nitrogen loss. The low nitrogen losses at NO1 and WI1 compared to other Discovery Farms sites in Minnesota are mostly a consequence of lower drainage amounts.

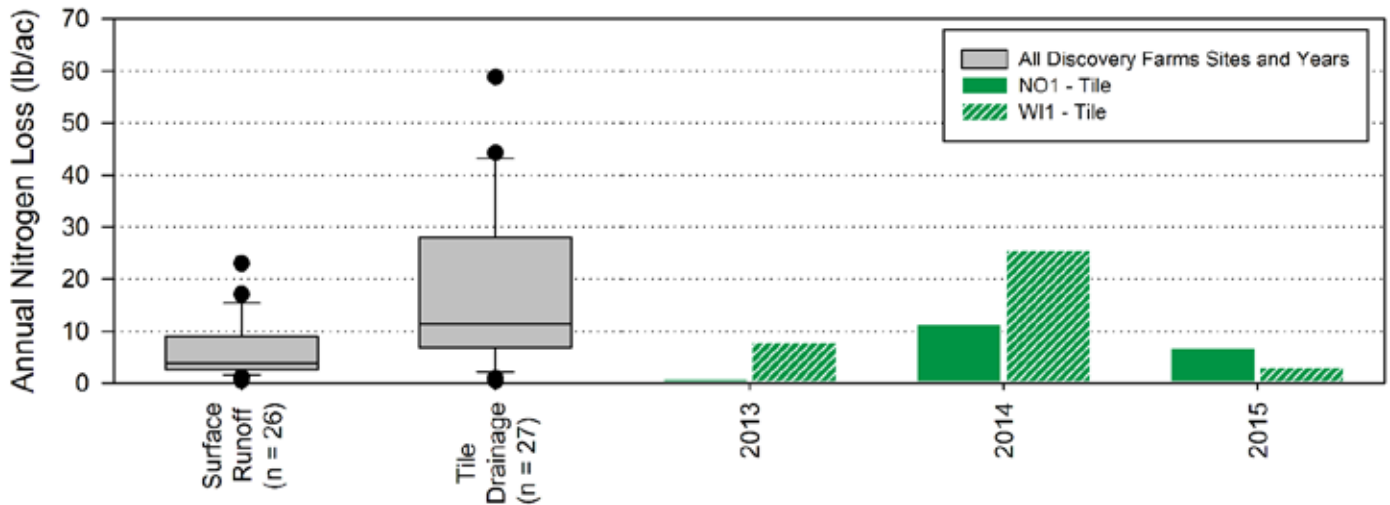


Figure 6: Annual nitrogen loss at all Discovery Farms locations and 2013-2015 at NO1 and WI1

Over 90% of the nitrogen loss in tile systems is in the nitrate nitrogen form. Analyzing nitrate nitrogen concentrations in the tile systems gives insight into the field's nitrogen management practices. Median nitrate nitrogen sample concentration for all Discovery Farms Minnesota tile sites, NO1, and WI1 were 19.2, 17.4, and 14.9 mg/L, respectively (Figure 7). Lower concentration values were observed for the NO1 and WI1 sites, indicating that both have good nitrogen management practices. These lower concentrations along with lower drainage amounts lead to lower nitrogen losses.

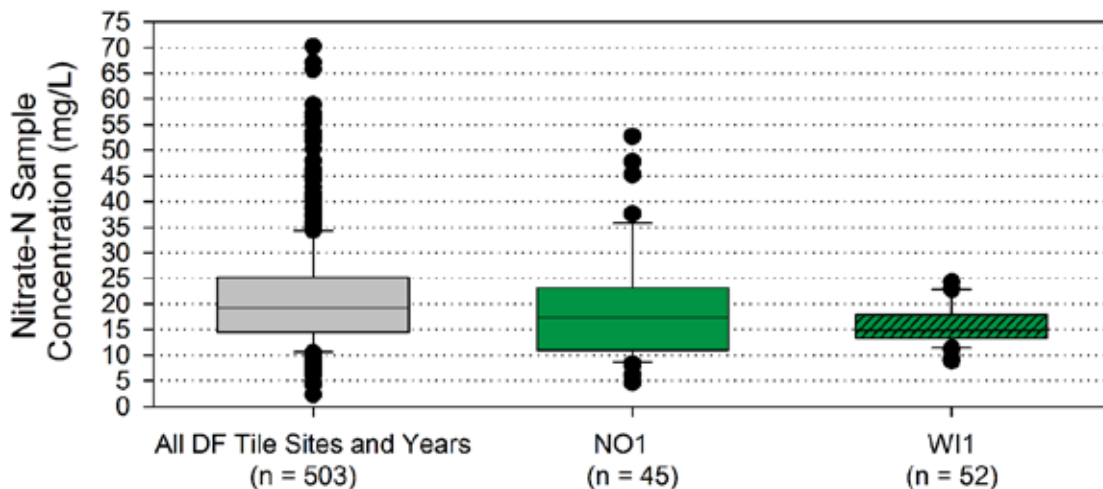


Figure 7: Nitrate nitrogen sample concentration at all Discovery Farms locations, NO1, and WI1