Core Farm
Year in Review – 2012

Discovery Farms Minnesota (DFM) 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 and provide credible and practical information to support better farm management decisions. There are currently 11 Discovery Farm sites located in Minnesota (Figure 1 and Table 1).

This factsheet summarizes data collected at Core Farms in water year (WY) 2012 (October 2011 through September 2012). Data from GO1, ST1, CH1, BE1, BE2, WR1, and RE1 are included as these sites were operational for all of this time period. Surface runoff sediment and nutrient data from BE2 are not included in this report because a frozen sample line prevented collection of water samples during the month of February. Data from KA1 are not included because this is a special project and will be summarized in a separate report.

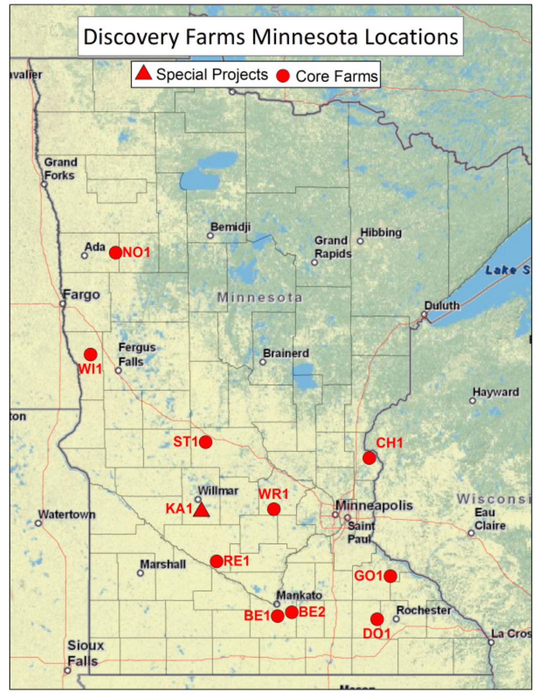

Figure 1: Discovery Farm Minnesota Locations.

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 or standards and therefore, direct comparisons of the two types of data should not be made. It is also important to note and remember that the information presented is only from one year of data collection. Past research has shown that runoff losses can vary greatly from year to year. Final conclusions should not be made from this information, but rather these data should be used as a point of context for information gained in future years.

Table 1: Description of Discovery Farms Minnesota Projects.

Farm ID	Farm Enterprise	Start of Project	Monitoring Setup	Monitored Area	2012 Crop in Monitored Area
KA1 (Special Project)	Turkey, Grain (corn-soybean)	Aug-07	Surface runoff and subsurface tile drainage	3 fields and bioreactor	corn and soybean
GO1	Swine farrow to wean, Beef cow-calf	Sep-10	Surface runoff	6.3 acres	alfalfa
ST1	Dairy – conventional	Mar-11	Surface runoff and subsurface tile drainage	28.2 and 24.2acres	corn
CH1	Grain (corn-soybean; modified no-till)	Mar-11	Surface runoff	6.1 acres	soybean
BE1	Swine finishing, Grain (corn-soybean)	Jun-11	Surface runoff and subsurface tile drainage	14.3 and 26.2 acres	soybean
BE2	Grain (corn-soybean)	Jul-11	Surface runoff and subsurface tile drainage	14.2 acres	corn
WR1	Dairy - conventional	Dec-11	Surface runoff and subsurface tile drainage	23.9 acres	corn
RE1	Grain (corn-soybean/sweet corn-peas)	Dec-11	Combined Surface and subsurface tile drainage	81 acres	sweet corn and soybean
DO1	Swine finishing, Grain (corn-soybean)	Oct-12	Surface runoff and subsurface tile drainage	14 acres	soybean
WI1	Grain (corn-soybean)	Oct-12	Subsurface only	160 acres	corn
NO1	Grain (sugarbeet-corn-dry bean-soybean-wheat)	Oct-12	Surface runoff and subsurface tile drainage	2 fields - 570 and 85 acres	sugarbeet and wheat

Average edge-of-field farm losses with maximums and minimums are presented in this report. The purpose of this report is to give a range of precipitation and runoff losses observed throughout the DFM monitoring network in WY2012. Precipitation and runoff data are presented as inches of water. Runoff is calculated by taking the total volume of runoff water (either surface runoff or subsurface tile drainage) and dividing by the monitored area. Presenting runoff data in inches allows comparison with precipitation, which is also in inches, and comparison between monitored sites with different contributing areas. Sediment, phosphorus, and nitrogen yield data are presented as lb/ac, this allows for comparison among monitored sites with different contributing areas. Weather conditions, landscape characteristics, and farm management practices vary significantly from farm to farm and affect runoff losses. For more information, including concentration data, and discussion on farm specific runoff data in WY2012 please view the 2012 Water Year Monitoring Report and farm specific data reviews on the resources page at www.discoveryfarmsmn.org.

Long term edge-of-field surface runoff data from the Wisconsin Discovery Farms Program are summarized in: *Precipitation-Runoff Relations and Water Quality Characteristics at Edge-of-Field Stations, Discovery Farms and Pioneer Farm, Wisconsin, 2003/08*, which is available online at http://pubs.usgs.gov/sir/2011/5008/. The results provided in the Wisconsin Discovery Farms summary can be used as a reference for the surface runoff data presented in this report.

PRECIPITATION

Average annual precipitation for DFM locations in WY2012 was 6.31 inches below normal, with a range of 10.15 inches below normal to 3.72 inches above normal (Figure 2). Average monthly precipitation was below normal in October and November, near normal from December to April, much above normal in May, and much below normal from June to September (Figure 2). High precipitation totals, an average of 3.96 inches above normal, were observed in May. At one DFM location, May precipitation was 8.21 inches above normal.

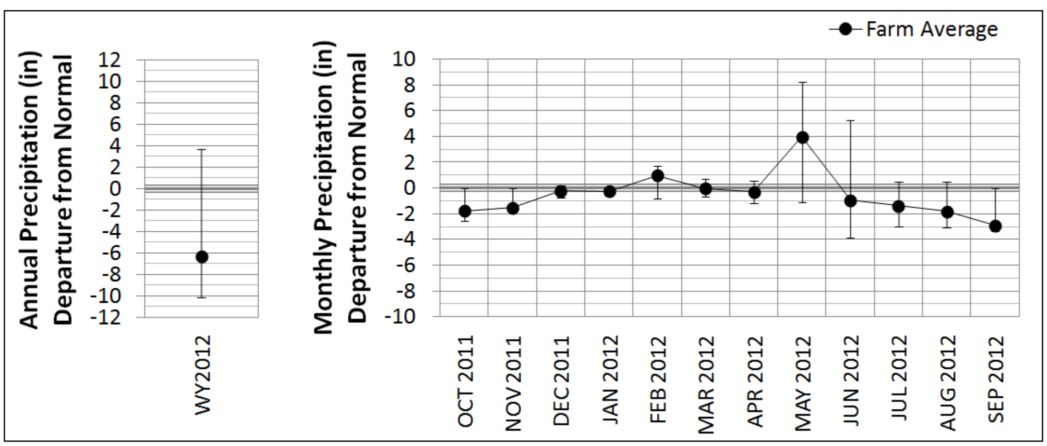

Figure 2: Annual and Monthly Precipitation Departure from Normal (data points represent averages from seven DFM locations and error bars represent maximum and minimum values).

RUNOFF

Surface Runoff

Average surface runoff at DFM locations in WY2012 was 1.79 inches with a range from 0.42 to 4.90 inches (Figure 3). Only 26% of the surface runoff was observed during frozen ground conditions due to the limited snowfall during the winter months. Most of the annual surface runoff (71%) was observed in May and June (Figure 3).

Long term edge-of-field Wisconsin Discovery Farms sites had an average of 2.55 inches of surface runoff on an annual basis, which was about 8% of the total annual precipitation. In Wisconsin, 54% of the total surface runoff occurred during frozen ground conditions and 46% during non-frozen ground conditions.

Subsurface Tile Drainage

Average subsurface tile drainage in WY2012 was 2.58 inches with a range from 0.90 to 4.82 inches (Figure 3). Only 10% of the subsurface tile drainage was observed during frozen ground conditions. Most of the annual subsurface tile drainage (75%) was also observed in May and June (Figure 3).

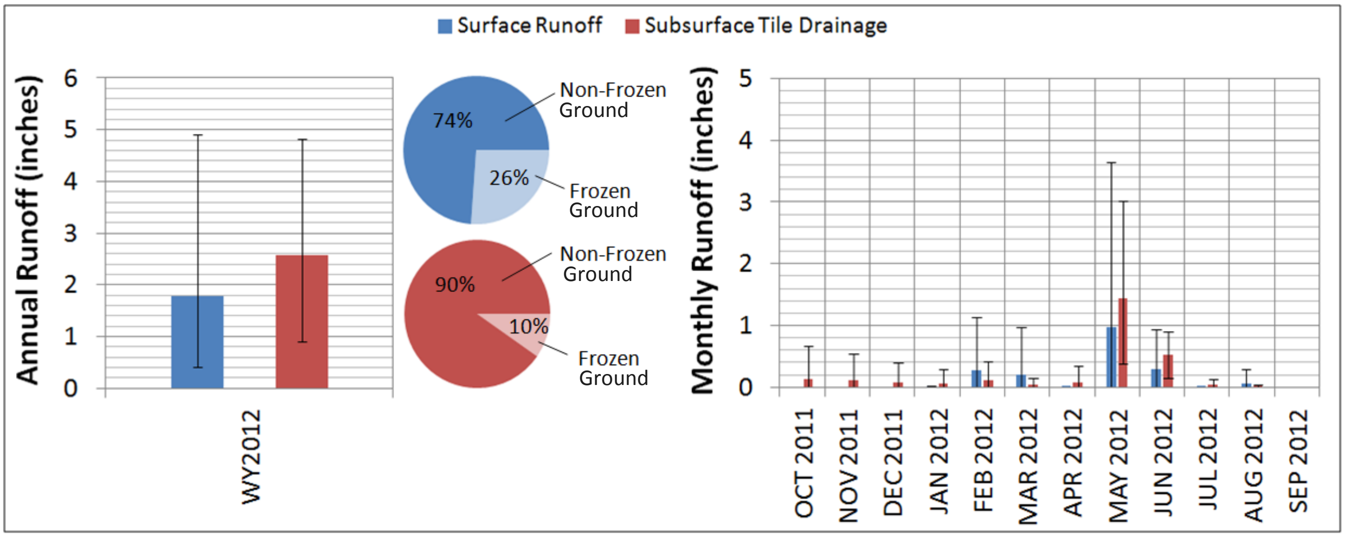

Figure 3: Annual and Monthly Runoff (data points represent averages from six surface runoff and five subsurface tile drainage monitoring stations and error bars represent maximum and minimum values).

Surface Runoff vs. Subsurface Tile Drainage

In WY2012, an average of 4.37 inches of water left the monitored DFM fields. Subsurface tile drainage contributed 59% of the total runoff compared to 41% for surface runoff. While surface runoff was extremely variable and "flashy" throughout the year with an average of only 6.0 cumulative days of flow, subsurface tile drainage, with an average of 122.7 cumulative days of flow, was much more constant and had a larger baseflow component (Table 2). About 6% and 11% of the annual precipitation left the monitored fields as surface runoff or subsurface tile drainage, respectively (Table 2).

Table 2: Annual Runoff Average Cumulative Flow Duration and Percentage of Precipitation (data represent averages from six surface runoff and five subsurface tile drainage monitoring stations).

WY2012 Averages	Cumulative Flow Duration (days)	Runoff as a Percentage of Precipitation (%)
Surface Runoff	6.0	6%
Subsurface Tile Drainage	122.7	11%

SEDIMENT

Total suspended solids (TSS) are solids in water that can be trapped by a filter – both organic and inorganic (i.e. the mineral fraction). Volatile solids are those that will burn off at 550°C or lower. Volatile solids represent the organic fraction of animal or plant origin. The TSS data in this report represent both the volatile and mineral solids fractions.

Surface Runoff

Average surface runoff TSS yield at DFM locations in WY2012 was 651 lb/ac with a range from 22 to 2367 lb/ac (Figure 4). Greater than 99% of the surface runoff TSS yield was observed during non-frozen ground conditions. Almost 99% of the annual surface runoff TSS yield was observed in May and June (Figure 4). Long term edge-of-field Wisconsin Discovery Farms surface runoff sites had an average of 667 lb/ac of sediment loss on an annual basis.

Subsurface Tile Drainage

Average subsurface tile drainage TSS yield at DFM locations in WY2012 was 47 lb/ac with a range from 8 to 109 lb/ac (Figure 4). Approximately 92% of the subsurface tile drainage TSS yield was observed during non-frozen ground conditions. Almost 90% of the annual subsurface tile drainage TSS yield was observed in May and June (Figure 4).

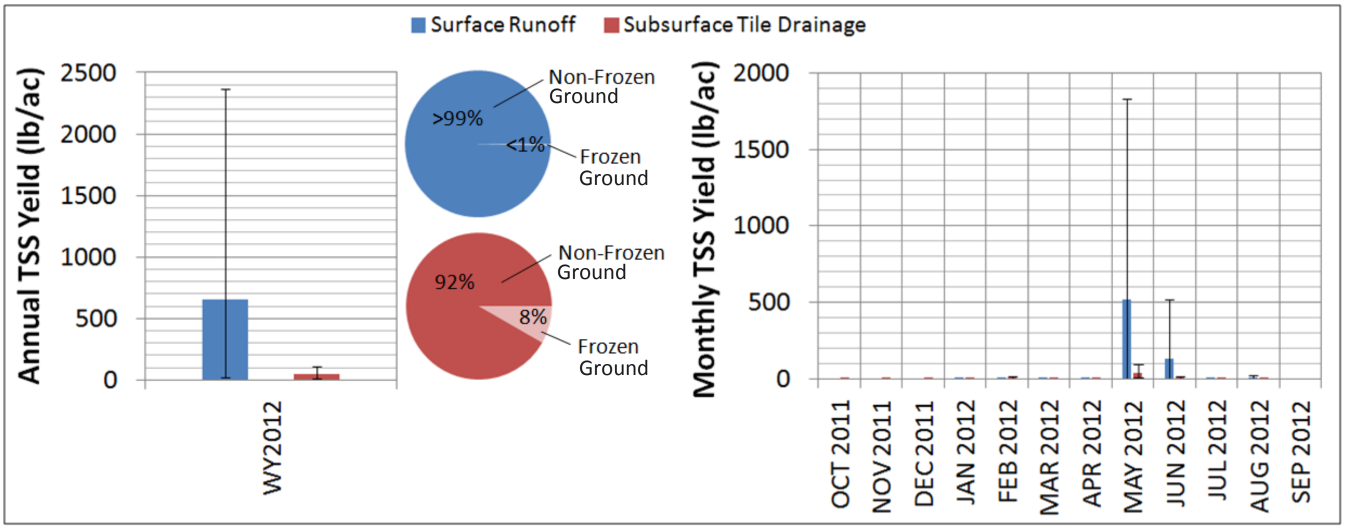

Figure 4: Annual and Monthly TSS Yield (data points represent averages from five surface runoff and five subsurface tile drainage monitoring stations and error bars represent maximum and minimum values).

Surface Runoff vs. Subsurface Tile Drainage

In WY2012, an average of 698 lb/ac total TSS yield (surface runoff + subsurface tile drainage) left the monitored DFM fields. Most (93%) of the TSS yield was observed in surface runoff.

PHOSPHORUS

Total phosphorus (TP) refers to the combined total of two different forms of phosphorus: (1) the particulate form which is bound to soil particles and (2) the dissolved form which is not. Particulate phosphorus is usually considered to be the dominant form of phosphorus transported in runoff from agricultural areas when associated with soil loss. Dissolved phosphorus levels can be significant contributors to total phosphorus losses from agricultural fields when soil test phosphorus levels are high or when surface runoff contains phosphorus from decaying plants and crop residue.

Surface Runoff

Average surface runoff TP yield at DFM locations in WY2012 was 1.2 lb/ac with a range from 0.1 to 3.1 lb/ac (Figure 5). Seventy-six percent of the surface runoff TP was in the particulate form and 24% was in the dissolved form. Almost 86% of the annual surface runoff TP yield was observed in May and June (Figure 5). Long term edge-of-field Wisconsin Discovery Farms surface runoff sites had an average of 2.0 lbs/acre of phosphorus loss on an annual basis, with approximately 51% of the total phosphorus loss in the dissolved form and 49% in the particulate form.

Subsurface Tile Drainage

Average subsurface tile drainage TP yield at DFM locations in WY2012 was 0.1 lb/ac with a range from 0.0 to 0.2 lb/ac (Figure 5). Approximately 61% of the subsurface tile drainage TP yield was in the particulate form. About 82% of the annual subsurface tile drainage TP yield was observed in May and June (Figure 5).

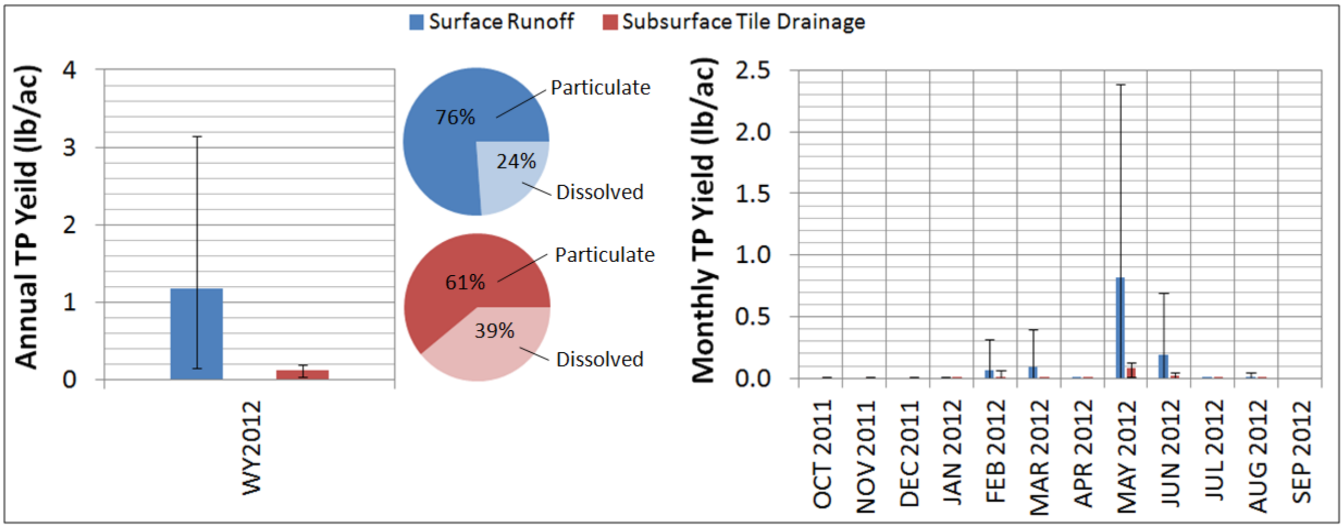

Figure 5: Annual and Monthly Phosphorus Yield (data points represent averages from five surface runoff and five subsurface tile drainage monitoring stations and error bars represent maximum and minimum values).

Surface Runoff vs. Subsurface Tile Drainage

In WY2012, an average of 1.3 lb/ac total TP yield (surface runoff + subsurface tile drainage) left the monitored DFM fields. Most (92%) of the TP yield was observed in surface runoff. Subsurface tile drainage had a higher dissolved phosphorous fraction than surface runoff.

NITROGEN

Total nitrogen (TN) refers to the combined total of nitrate nitrogen, ammonia nitrogen, and organic nitrogen. Organic nitrogen can be attached to soil particles, found in manure, or be associated with plants and plant residue. Nitrate can be associated with manure, fertilizer, atmospheric, and soil-available nitrogen because it is a stable breakdown product of biological processes. Ammonia nitrogen can be linked to manure, fertilizer, soil, and atmospheric nitrogen.

Surface Runoff

Average surface runoff TN yield at DFM locations in WY2012 was 6.8 lb/ac with a range from 1.1 to 17.1 lb/ac (Figure 6). Eighty-eight percent of the surface runoff TN was in the organic nitrogen form, with 8% in the nitrate form and 5% in the ammonia form. About 88% of the annual surface runoff TN yield was observed in May and June (Figure 6). Long term edge-of-field Wisconsin Discovery Farms surface runoff sites had an average of 7.2 lbs/acre of nitrogen loss on an annual basis, with approximately 25% of the total nitrogen loss in the nitrate nitrogen form, 21% in the ammonium nitrogen form, and 54% in the organic nitrogen form.

Subsurface Tile Drainage

Average subsurface tile drainage TN yield at DFM locations in WY2012 was 16.1 lb/ac with a range from 3.4 to 36.9 lb/ac (Figure 6). Eighty-eight percent of the subsurface tile drainage TN was in the nitrate nitrogen form, with 11% in the organic nitrogen form and <1% in the ammonia form. About 71% of the annual surface runoff TN yield was observed in May and June (Figure 6).

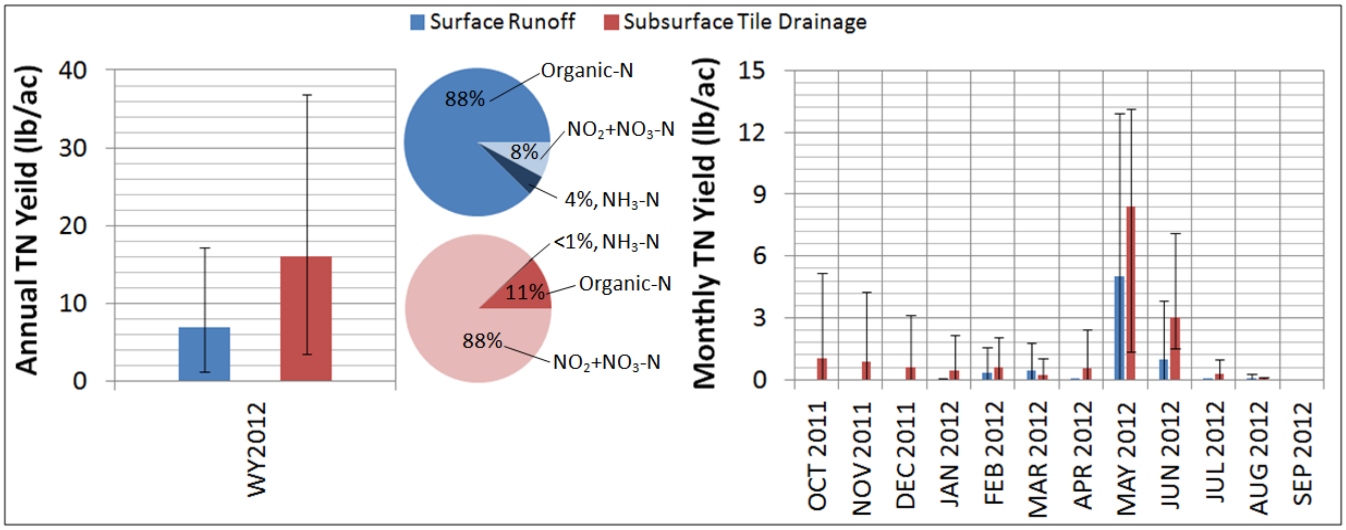

Figure 6: Annual and Monthly Nitrogen Yield (data points represent averages from five surface runoff and five subsurface tile drainage monitoring stations and error bars represent maximum and minimum values).

<u>Surface Runoff vs. Subsurface Tile Drainage</u>

In WY2012, an average of 22.9 lb/ac total TN yield (surface runoff + subsurface tile drainage) left the monitored DFM fields. Most (70%) of the TN yield was observed in subsurface tile drainage. Organic nitrogen was the dominant form of nitrogen in surface runoff while nitrate nitrogen was the dominant form in subsurface tile drainage.

CONCLUSION

Data from WY2011 documented the importance of snowmelt and single storm runoff events, while data from WY2012 documented the importance of the timing of precipitation. Overall WY2012 was a very dry year; however, high precipitation amounts in the months of May and June had a major affect on annual sediment and nutrient losses at some sites. In May and June, the crop canopy is usually not established on many fields which leaves the soil vulnerable to raindrop impact and detachment. High precipitation totals during this critical time period can lead to higher sediment and nutrient losses. Discovery Farms research has shown that several factors are important for reducing risk of nutrient and sediment loss throughout the year, including:

- *Harvesting Precipitation Water*. Any management in and around agricultural fields that encourages infiltration of precipitation very close to where it falls. Often this includes a network of conservation practices coupled with highly efficient crop and soil management. Usually, a lower volume of runoff equals lower sediment and nutrient loss.
- *Avoid Nutrient Application Prior to Anticipated Runoff*. Whether it is manure or commercial fertilizer, applying nutrients shortly preceding a runoff event has the greatest risk for increased nutrient losses. Every runoff event can't be predicted, but using the forecast to understand when snow may be melting, rain on snow/frozen ground could occur, or a large rain event is looming helps to make the best management decisions.

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