

Field Runoff



Field to Stream Partnership

The Root River Field to Stream Partnership is a multi-organizational effort to evaluate agricultural practices and water quality at multiple scales and landscape settings. The strategic selection of these study watersheds allows the findings to be applied to similar areas across southeastern Minnesota.

Phase I

Determine the range of sediment and nutrient losses associated with runoff from representative farming systems in southeastern Minnesota. Results from four fields, collected over a twelve-year study period from 2010-2021 (46 site years) are summarized.

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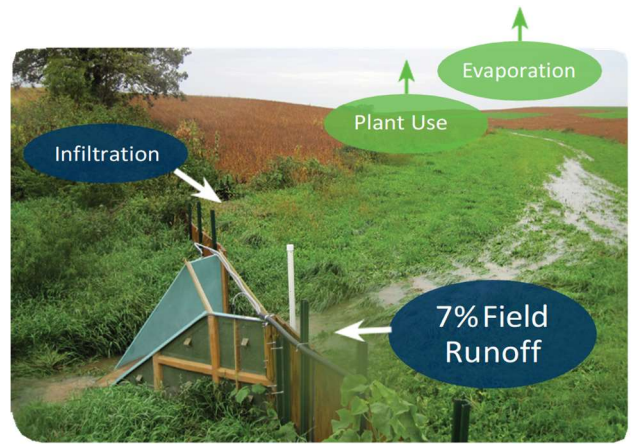


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How Much Runoff?

On average, 36 inches of precipitation were received annually.

On average, 7% of this total was measured as **surface runoff** with a range of less than 1% in a dry year and up to 26% during a very wet year.



- On average, **22 runoff events** occurred per year with each event lasting about **nine hours**. Typically, over 50% of the annual nutrient and sediment losses occurred during only one or two of those events.
- On average, 48% of the annual runoff volume occurred when the soil was **frozen** with a wide range of 0% to 100%.

High Risk Periods

- Sediment and nutrient losses in surface runoff peak at varying times of the year. Understanding these risk periods is key to reducing loss.
- Dissolved phosphorus and nitrate losses in surface runoff were highest in March and often occurred when the ground was frozen. Incorporation of fertilizer and manure and proper management of soil test phosphorus levels help reduce these losses.
- 25% of the runoff in May and June produced 75% of the sediment and over 50% of the annual nutrient loss. Reduced tillage, grassed waterways, water/sediment basins and perennials are key practices to reduce loss.

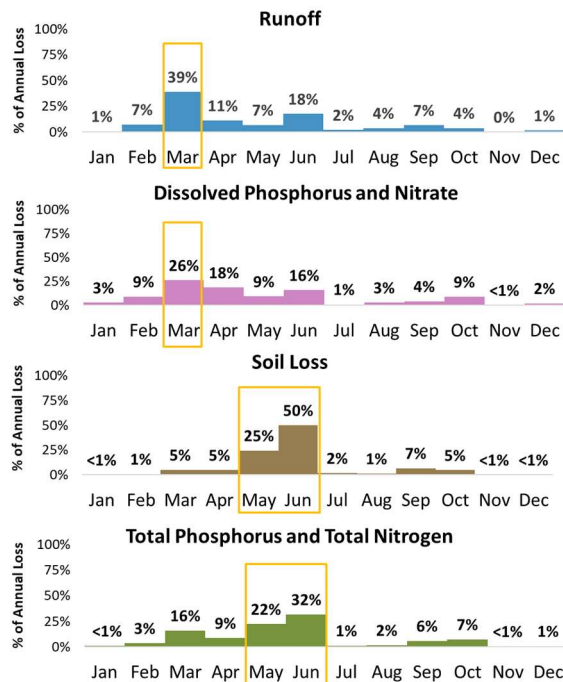


Figure 1. Timing of surface runoff, sediment, and nutrient loss. 12-Year Average, 46 site years, 2010-2021.

Precipitation & Runoff

- **Precipitation** averaged 2% below the region's 1991-2020 normal of 37 inches and included a mix of dry, normal, and wet conditions. (2011-driest study year, 2018-wettest study year)
- **Field runoff** averaged 2.8 inches (7% of annual precipitation) with 48% occurring during frozen soil conditions.
- **Runoff Events:** Field surface runoff has been observed in every month with an average of 22 runoff events each year last about nine hours. Runoff did not occur every time it rained.

Sediment Loss

- **Average sediment loss:** 1,238 lb/ac (0.6 tons/ac)
Range: <1 to 8,969 lb/ac.
- **Sustainable soil loss:** <1,000 lb/ac/year. If erosion is visible, losses likely exceed this rate. Two fields exceeded this level 17% of the time while at two other fields this rate was exceeded 42-50% of the time.
- **May and June** accounted for 74% of the annual loss. During this critical time, fields were prepared for planting, but not at full canopy.

Total Phosphorus Loss

- **Average total phosphorus (TP) loss:** 1.8 lb/ac.
Range: <0.1 to 10.0 lb/ac 55% of this loss occurred in May and June. Typically, less than 10% is lost through subsurface drainage tile.
- **Dissolved Phosphorus (not attached to sediment):**
Accounted for 18% of TP loss in surface runoff.
- **Phosphorus and sediment connection:**
For every 1,000 lb/ac. of sediment loss, about 1.5 lb/ac of TP is lost. Good soil conservation can reduce these losses to less than 1.0 lb/ac.

Total Nitrogen Loss

- **Total Nitrogen (TN)** includes ammonia, nitrate and organic forms.
- **Surface runoff loss:** Average of 9 lb/ac with a range of <1 to 37 lb/ac. For every 1,000 lb/ac of soil loss, there was 7 lb/ac of TN loss. TN transported in surface runoff can be controlled through soil conservation practices.
- **Sub-surface loss** (1 tile site): Average of 35 lb/ac with a range of 7 to 64 lb/ac. Most nitrogen (80% or more) from ag fields is lost through sub-surface leaching and is detected as nitrate-nitrogen in tile drainage, springs, streams/streams, and groundwater.
- **Reducing nitrate leaching losses is challenging, but it is a very important task.** Fine-tuning nitrogen rates, split applying nitrogen, crediting legumes and manure, growing perennials, and using cover crops are important practices.

12-Year Average Annual Losses

46 site years, 2010-2021

SURFACE RUNOFF

2.8 inches

7% of the annual precipitation

Range <1 to 11.3 inches

SOIL

1,238 lb/ac

Range <1 to 8,969 lb/ac

TOTAL PHOSPHORUS

1.8 lb/ac

Range <0.1 to 10.0 lb/ac

TOTAL NITROGEN

9 lb/ac surface

Range <1 to 37 lb/ac

35 lb/ac sub-surface*

Range 7 to 64 lb/ac

**1 edge-of-field drain tile site in Mower County*



Root River Field to Stream Partnership



Minnesota Department of Agriculture
Minnesota Agricultural Water Resource Center
The Nature Conservancy

Mower SWCD
Fillmore SWCD
Root River SWCD