# Climate change and the impacts to edge-of-field runoff

There is an ever-increasing focus on climate change and corresponding changes to rainfall and weather patterns. Increasing numbers of extreme rainfall events and warming temperatures have been recently documented in Wisconsin and Minnesota. Farmers experience the changing climate first hand and are finding practices to adapt and help to mitigate climate change. This document reviews some important impacts to edge-of-field runoff that have been analyzed by Discovery Farms® programs in Wisconsin and Minnesota. Over the past 20 years, Discovery Farms has monitored 127 site years of edge-of-field surface runoff, including 2,184 surface runoff events. These runoff events and the corresponding rainfall data were analyzed to answer the following questions:

**How do different size precipitation events influence runoff?**

**How could changing climate characteristics affect runoff and nutrient loss?**

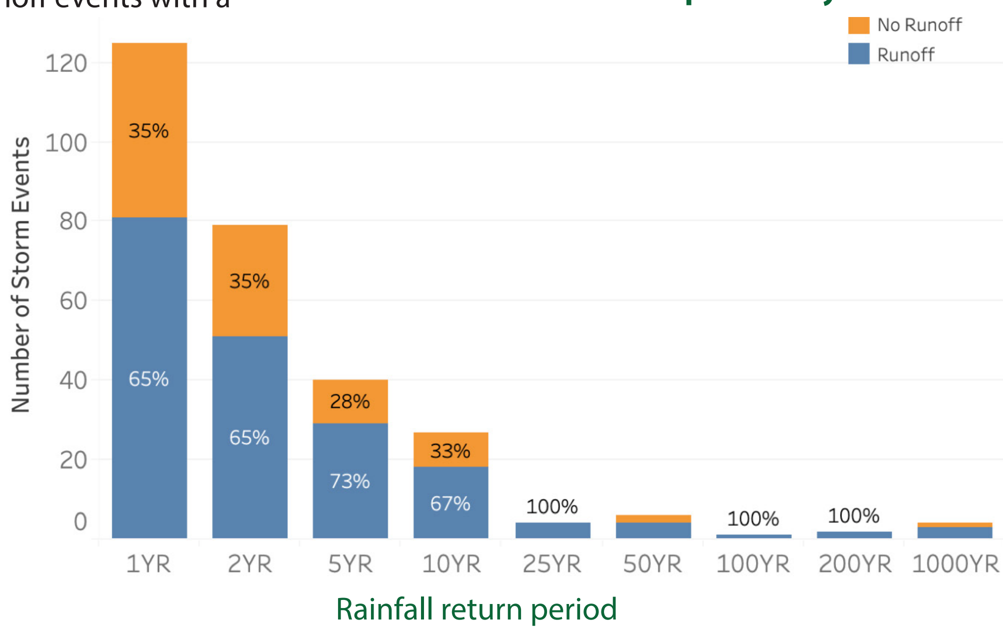
**What adaptation measures could be taken to build resilient farming systems?**

## Overall, 7% of rainfall events result in runoff, but this number increases rapidly as storm size increases.

Rainfall intensity data was compared with long term normals from each location to define rainfall return periods for each rainfall event. A rainfall return period is an estimate of the likelihood of a rainfall event to occur. The probability of a 100-year rainfall event occurring in any given year is 1 out of 100 or 1%. In general, as the return period increases, so does the rainfall or rainfall intensity.

Out of 2,184 total runoff events from 127 site years of data, there were 375 runoff events with a rainfall return period greater than one year. There were 11 runoff events with a rainfall return period of greater than 25 years and four with a rainfall return period estimated to be greater than 1,000 years. As the rainfall return period increased so did the percentage of events that generated runoff. For return periods of 1 to 10 years, 66% of the rainfall events generated runoff. For return periods 25 years and greater, 82% of the rainfall events generated runoff.

**Monitored events separated by storm size**





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USGS science for a changing world

# Runoff is driven by snowmelt and smaller events, but climate changes will influence soil and nutrient loss.

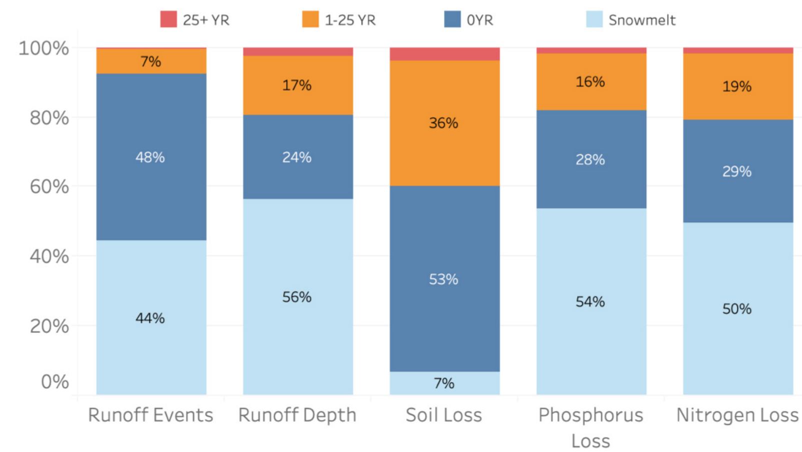
Overall a majority of runoff, soil and nutrient loss was recorded during snowmelt or rainfall events with less than a 1 year return period. **This means these runoff events resulted from common rainfall events or snowmelt.** However, 40% of the soil loss happened with runoff events with a rainfall return period greater than one year. **Extreme rainfall events had more of an impact on soil loss.**

Often a 25-year rainfall event is used as design criterion for conservation practices in agricultural fields. Surface runoff with a rainfall return period of greater than 25 years had very little influence (1 to 2%) on surface runoff losses in this dataset. This could be a result of effective conservation practices designed to withstand larger rainfall events or the relatively few 25-year rainfall events that have been monitored. Only 11 surface runoff events had a rainfall return period greater than 25 years.

In Wisconsin and Minnesota, snowmelt plays a huge factor in runoff. Winter weather pattern changes will have an impact on the snowmelt period including:

- Rain on snow, ice crusting, and soil temperature variability will likely increase the amount of snowmelt because of limited absorption into the soil along with other factors
- Deep snow packs and consistent cold temperatures in the winter will likely decrease runoff

Runoff is driven by snowmelt and common sized events, however soil loss was driven by less common events

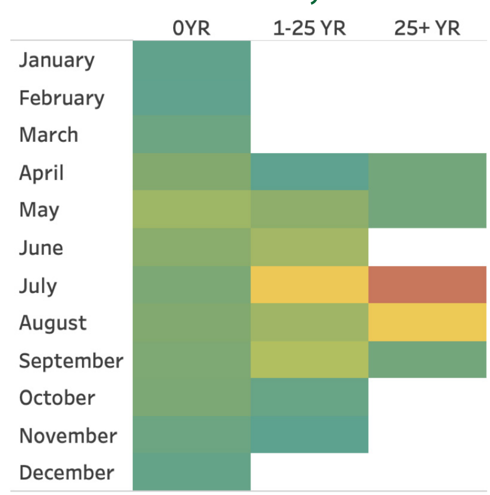



# More of the extreme storms happen in July and August when there is soil cover.

Our dataset has shown most 25+ year storms are happening in July and August. At this time period, crops are established and able to take up water and they also protect the soil from more extreme soil losses. Impacts of extreme rainfall events may increase if this time period is shifted earlier in the year. When we compared an August storm to a May storm when there was no crop established, the differences in losses were dramatic.

Comparing two 1,000 year storms:
May- 5.1 inches of rain, **1.2 inches of runoff**
August- 4.6 inches of rain, **0 inches of runoff**

Storm size broken down by month




# Adaptation measures build resilient farming systems.

Farmers are already implementing practices to help their land be more resilient to unpredictable weather such as...

Establishing cover in the fall that will carryover into winter and spring providing protection during heavy runoff time periods.

Decreasing soil disturbance that maintains residue on the surface is a way to provide some protection before plants are established.

Diverse crop rotations that opens up new windows for manure applications during the summer.