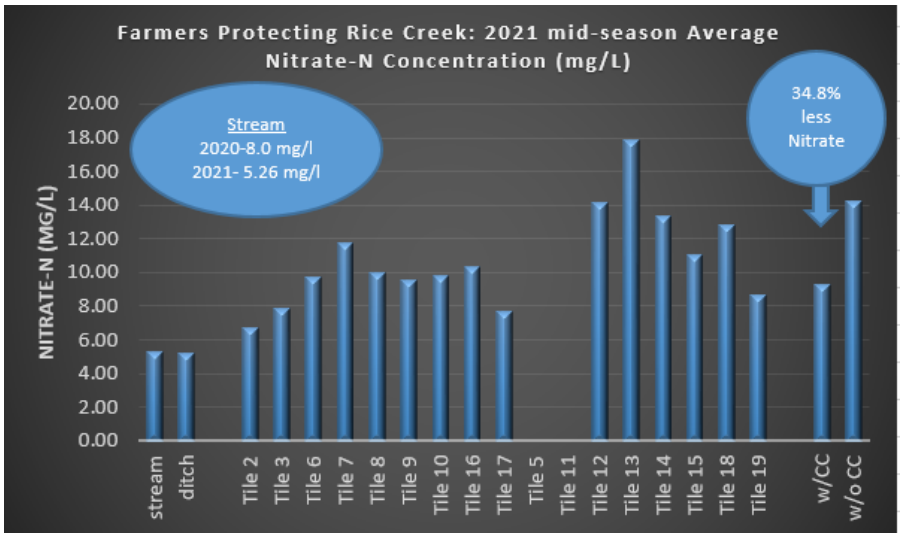
Cover Crops Continue Improving Dundas Trout Stream

By Alan Kraus and Dane McKittrick

2021 marks the third year in a study to measure how cover crops impact water quality in Rice Creek, the only trout stream in Rice County and the most western trout stream in all of Minnesota. The 2021 mid-season results show nitrate concentration levels in 2021 have generally been the lowest levels recorded since the start of the study in 2018. Low rainfall in 2021 may have played a role in this result, but continued lower nitrate concentration in tile drainage from fields with cover crops compared to fields without cover crops supports that land use, in this case planting cover crops, also impacts water quality, even in dry years.

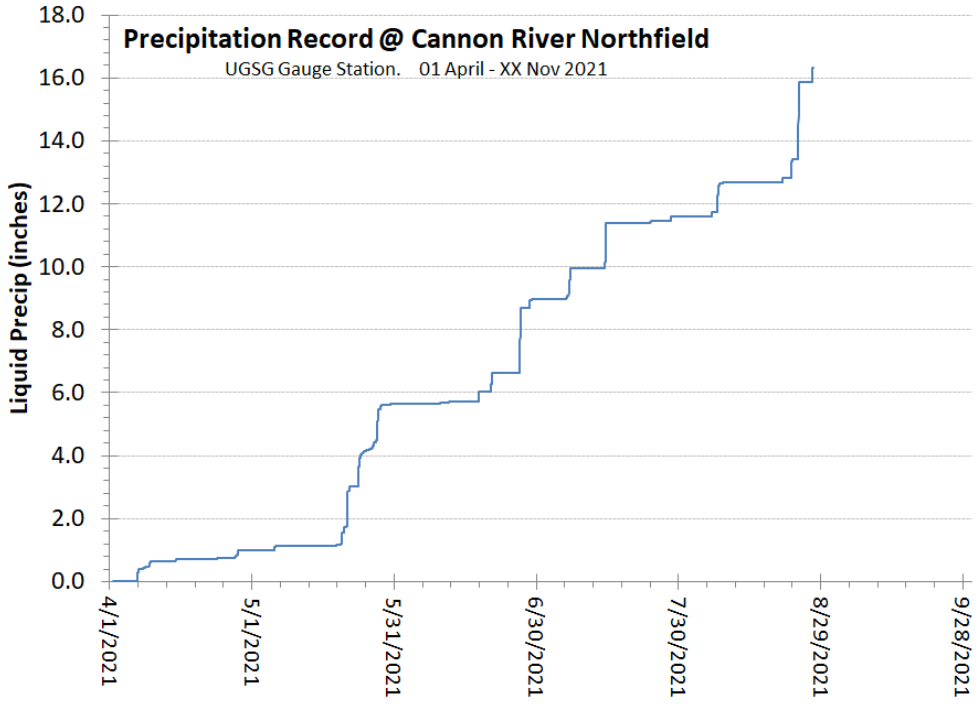
For the past three years, a dozen farmers in the Rice Creek watershed have been planting cover crops on about 1000 acres (30%) of farmland in the 4,100 acre watershed. Clean River Partners, Rice SWCD and St. Olaf College have been comparing nitrate concentration in tile drainage from fields planted with cover crops and fields without cover crops. They have also been testing nitrate concentration in Rice Creek as well as the watershed's main drainage ditch. The stream sampling location, which is downstream from all other sampling locations and therefore considered to be a good representation of all the water entering from upstream, averaged 34% less nitrate concentration by mid-summer 2021 compared to 2020, 42% less than 2019 and 66% less than the 2013 level.



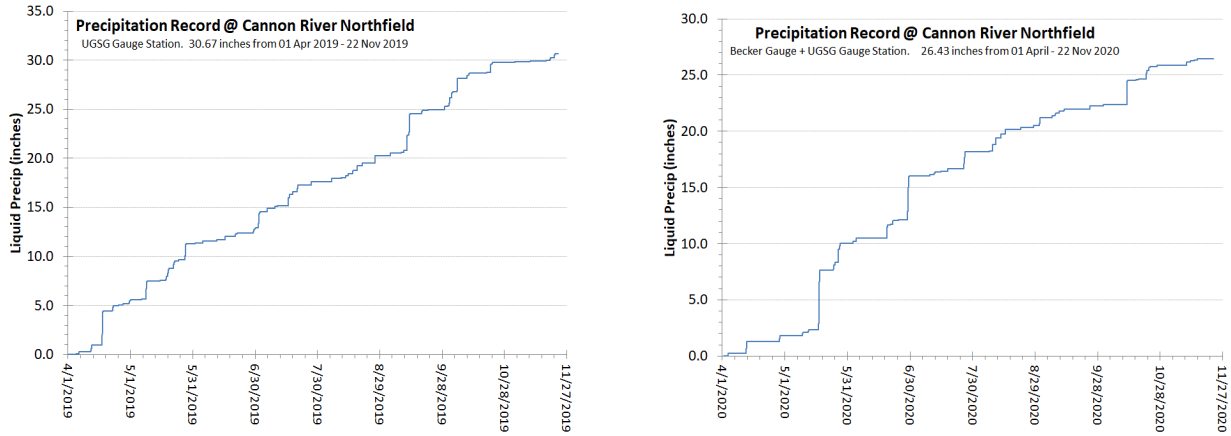
The graph above shows the average nitrate level of all 2021 sampling locations from March 25th through August 10th.

Nitrate concentration levels from tiles draining fields with cover crops and tiles draining non-cover cropped fields also had 34% less nitrate concentration compared to tiles draining fields without cover crops by mid-summer 2021.

Much of Minnesota has experienced extreme drought during most of the 2021 growing season. Precipitation in the Rice Creek watershed was about 4 inches less by mid-August 2021 compared to the same time period in 2019 and 2020. While precipitation levels have increased in the past few weeks and may lead to increases in nitrate, phosphate, and total suspended solids, these possible increases will probably not overshadow the reduction caused by land management practices such as cover crops.



The graph above shows the cumulative precipitation for Northfield MN (representative of precipitation throughout the Rice Creek Watershed) from the start of the 2021 growing season to August 27th.



The cumulative precipitation in 2021 can be compared to the cumulative precipitation in 2019 (left) and 2020 (right). 2021 has seen exceptional drought in much of Minnesota, including the Rice Creek Watershed.

Although some of the nitrate reduction seen so far this year could be attributed to reduced rainfall, cover cropping has played a significant role. Tile drainage comparisons from 2019 to 2020, a period of more typical rainfall, support this finding. During that period, tiles that drained fields with cover crops averaged 28% less nitrate concentration compared to fields without cover crops. The mid-summer 2021 result is 34% less for fields with cover crops. These findings suggest that the watershed health benefits of using cover crops increases with the number of years that the practice is in use.

Furthermore, with the exception of tiles 2, 7, and 14 (and the partial exception of tile 3 that had both corn and soy growing within its watershed in 2019), the corn-soybean crop rotation within the overall study area was the same in 2021 as it was in 2019. This is important to consider because corn and soybeans uptake nutrients at different rates and will likely lead to different levels of nitrate concentration in the drainage water. Again, while low rainfall in 2021 likely reduced the total amount of nitrate discharging from tile drainage, the results in 2021 show that even with the same crops growing on the same land as in 2019, average nitrate concentration in the stream was 42.8% lower in 2021 compared to 2019. This finding further supports that cover crop history plays an important role in nutrient runoff reduction

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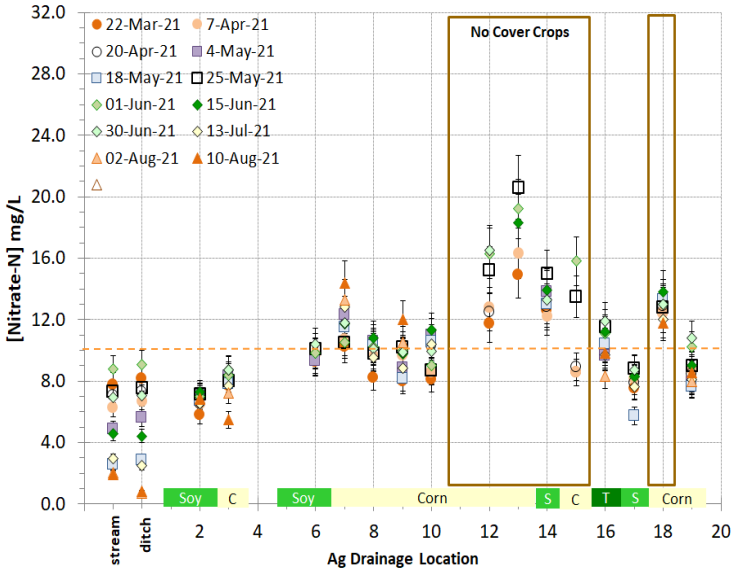
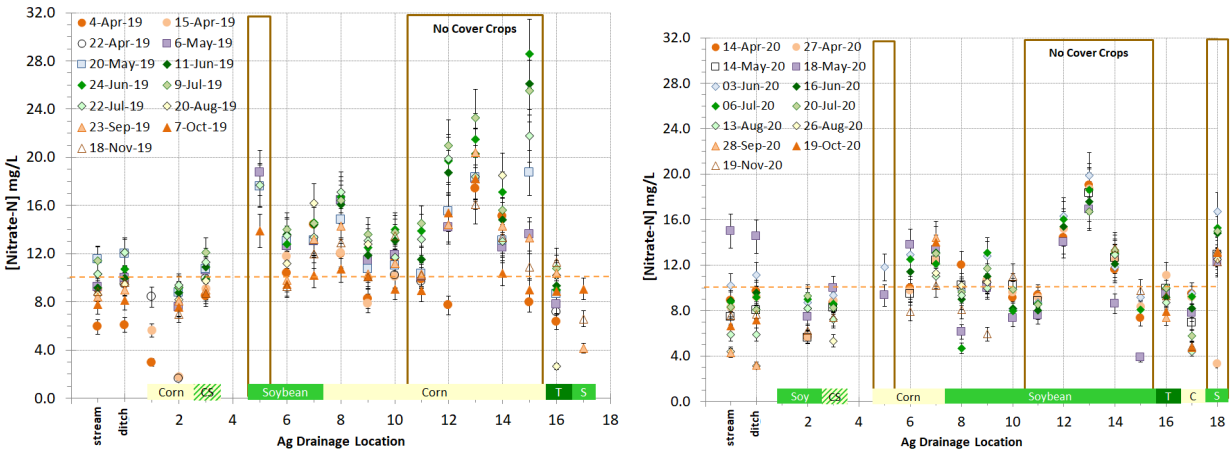
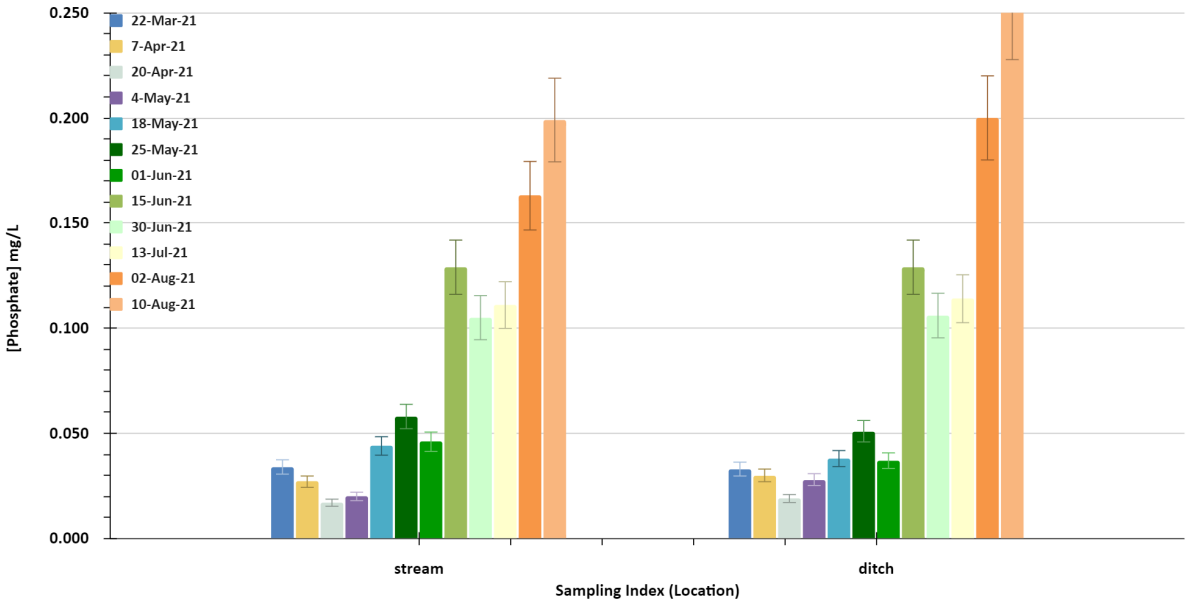


The graph above shows nitrate levels for all sampling locations at each sampling date in 2021 from the start of the growing season to August 10th. The dominant crops in the areas that each tile line drains are shown on the bottom axis. The dashed orange line indicates the safe level of nitrate in drinking water set by the Safe Drinking Water Act (SDWA).

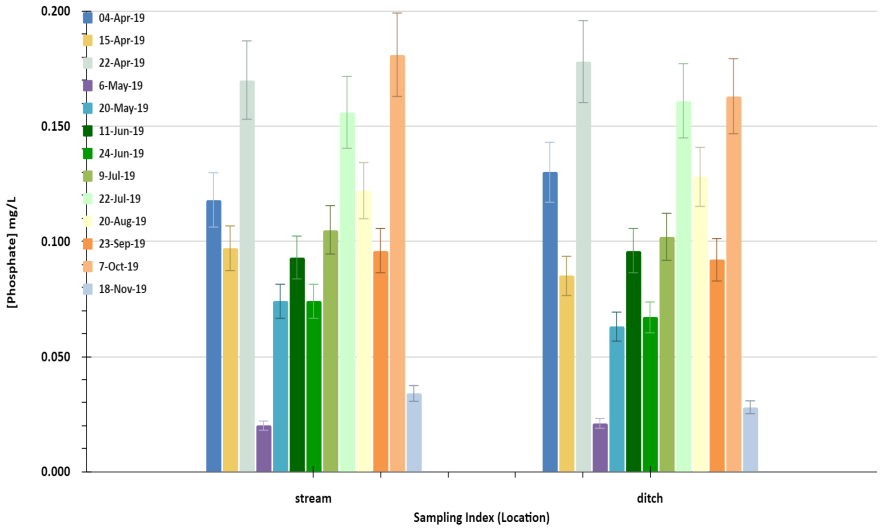


The graphs above show nitrate levels for all sampling locations at each sampling date in the 2019 (left) and 2020 (right) sampling season. The dominant crops in the areas that each tile line drains are shown on the bottom axis. The dashed orange line indicates the safe level of nitrate in drinking water set by the Safe Drinking Water Act (SDWA).

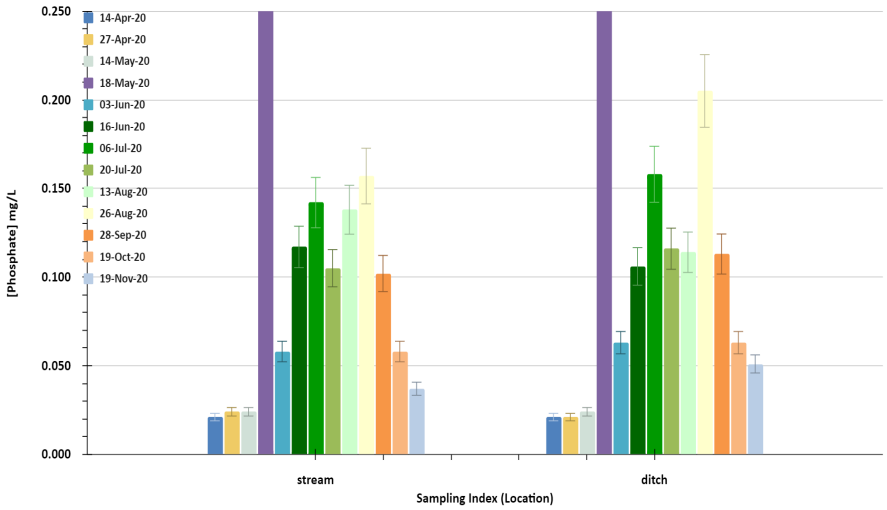
Regarding the stream and ditch total phosphorus concentration, the most significant reduction during 2021 compared to previous years occurred during the start of the season. This is likely due to the drought that was most prominent during this portion of the year. When precipitation increased later in the season, total phosphorus levels were similar to levels observed in previous years. These findings support a strong correlation between periods of high rainfall with elevated phosphate levels. This suggests that land management has less of an impact on total phosphorus concentration in tile drainage than precipitation. Additional data should be collected to provide greater insight on how phosphate in tile drainage and land use are connected.



The graph above shows phosphate levels of the stream and ditch sampling site from the start of the sampling season to August 10th in 2021.

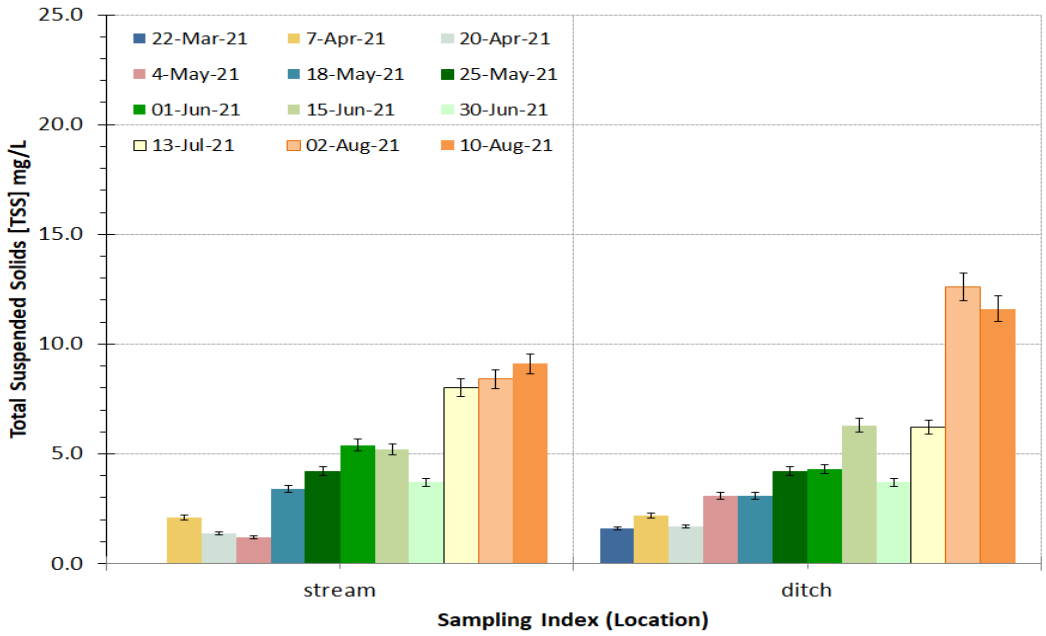


The graph above shows phosphate levels of the stream and ditch sampling site from the 2019 sampling season.

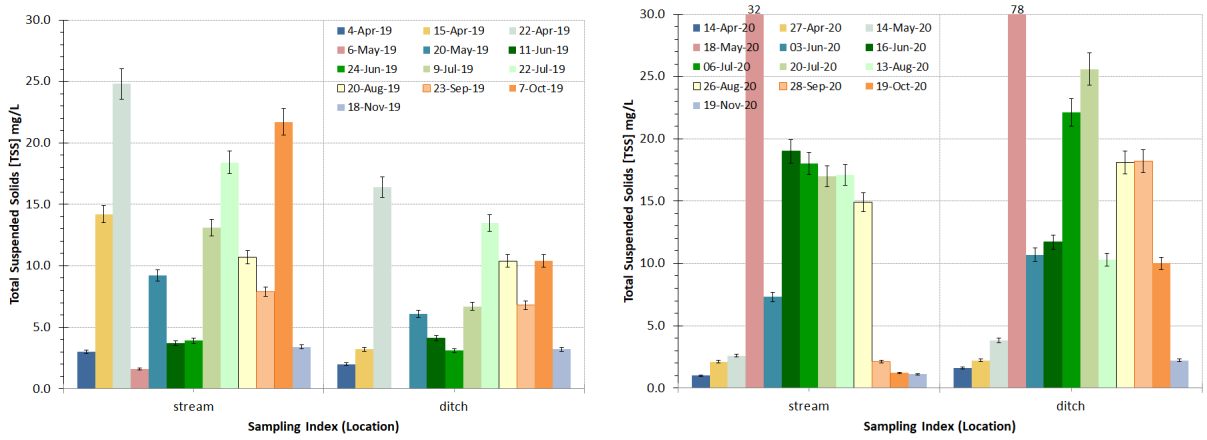


The graph above shows phosphate levels of the stream and ditch sampling site from the 2020 sampling season.

The total suspended solids (TSS) in the stream and ditch have been the lowest average recorded in the study. Also, over the entire study period TSS levels are highly variable. Similar to total phosphorus concentrations over the period, TSS appears to be linked to precipitation, with higher periods of precipitation being connected to high TSS levels. A return to more normal precipitation later in 2021 may lead to higher TSS levels.



The graph above shows total suspended solid (TSS) levels recorded from the start of the 2021 sampling season until August 10th at the stream and ditch sampling locations.



The graph above shows total suspended solid (TSS) levels recorded from the 2019 (left) and 2020 (right) sampling seasons at the stream and ditch sampling locations.

The results of this study are evidence that planting cover crops reduces nitrate discharge in tile drainages, and when planted on a significant portion of the watershed, cover crops can improve water quality in streams. Thank you to the collaborating farmers and landowners in the Rice Creek watershed. They contributed about 40% of the cover crop cost and their leadership has provided real world, farm level results that are critical to understanding how agricultural practices can benefit water quality. We would also like to thank Dr. Paul Jackson at St. Olaf College for help with data analysis and graph construction. Other important partners include Fishers and Farmers Partnership, Rice SWCD, Minnesota DNR, Minnesota Pollution Control and Compeer Financial. Bridgewater Township joined this list in 2021 to continue this project through 2024.