May 2022

Watershed

Cedar River Watershed

Cycle 2 Stressor Identification

Nitrate Summary

MINNESOTA POLLUTION CONTROL AGENCY

CLEAN WATER LAND & LEGACY AMENDMENT

Overview

Background

This document summarizes nitrate sampling conducted in the Cedar River Watershed as part of the Cycle 2 Stressor Identification (SID) process. The goal of this effort was to provide value to local partner implementation planning by characterizing current nitrate dynamics and identifying priority areas for nitrogen reduction. Reducing nitrogen loading in the Cedar River Watershed has been identified as a priority in previous studies/documents including the Cedar River Watershed Restoration and Protection Strategy (WRAPS), Cedar-Wapsipinicon Comprehensive Watershed Management Plan (CWMP), and the Cedar River nitrate TMDL.

Nitrate Monitoring

Nitrate monitoring for Cycle 2 SID began in 2018 across the Cedar River Watershed. Results from 2018 and conversations with local partners led to prioritizing the upper portion of the Cedar River Watershed for additional monitoring in 2019 and 2020; this area had the highest nitrate concentrations in 2018. Results from 2019 and 2020 provided valuable information regarding nitrate dynamics and identified priority areas for nitrogen reduction.

Biological Monitoring

Biological monitoring has identified macroinvertebrate (and one fish) impairments in the upper portion of the Cedar River Watershed (Figure 1), and nitrate is a common stressor; nitrate tolerant macroinvertebrates were abundant in both Cycle 1 and Cycle 2.

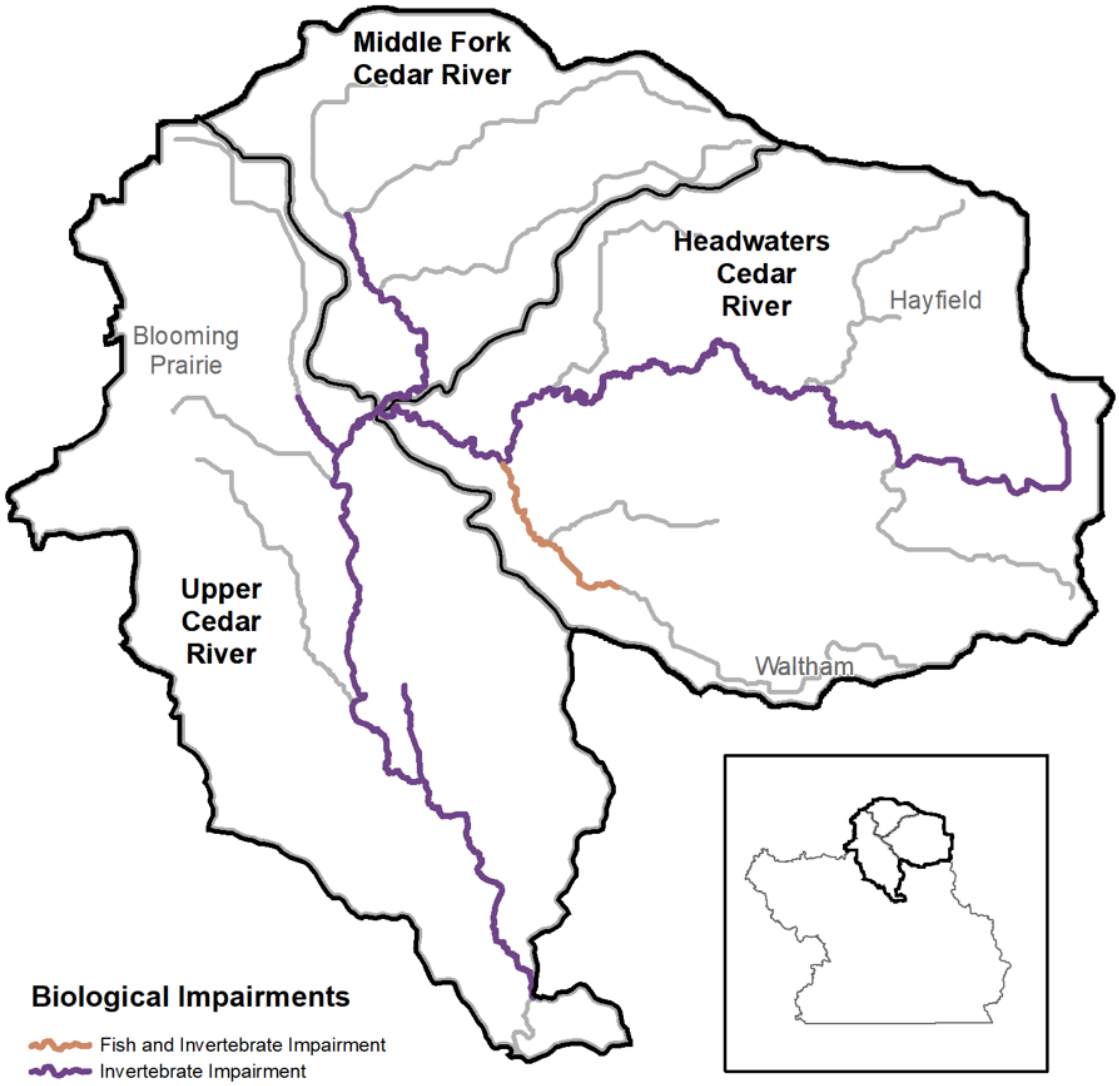

Figure 1: Biological impairments in the upper portion of the Cedar River Watershed.

Results

2018

Nitrate sampling began in 2018 as part of the Cycle 2 SID process for the Cedar River Watershed. Sampling was conducted across the watershed to characterize nitrate dynamics and identify priority areas for nitrogen reduction (Figure 2). The results from 2018 and conversations with local partners identified the upper portion of the Cedar River as a priority area for future monitoring and nitrogen reduction due to elevated concentrations; this area had the highest nitrate concentrations across the entire watershed. In addition, modeling data from the Cedar WRAPS and CWMP indicate the upper portion of the Cedar River Watershed has some of the highest nitrogen loading rates in the entire watershed.

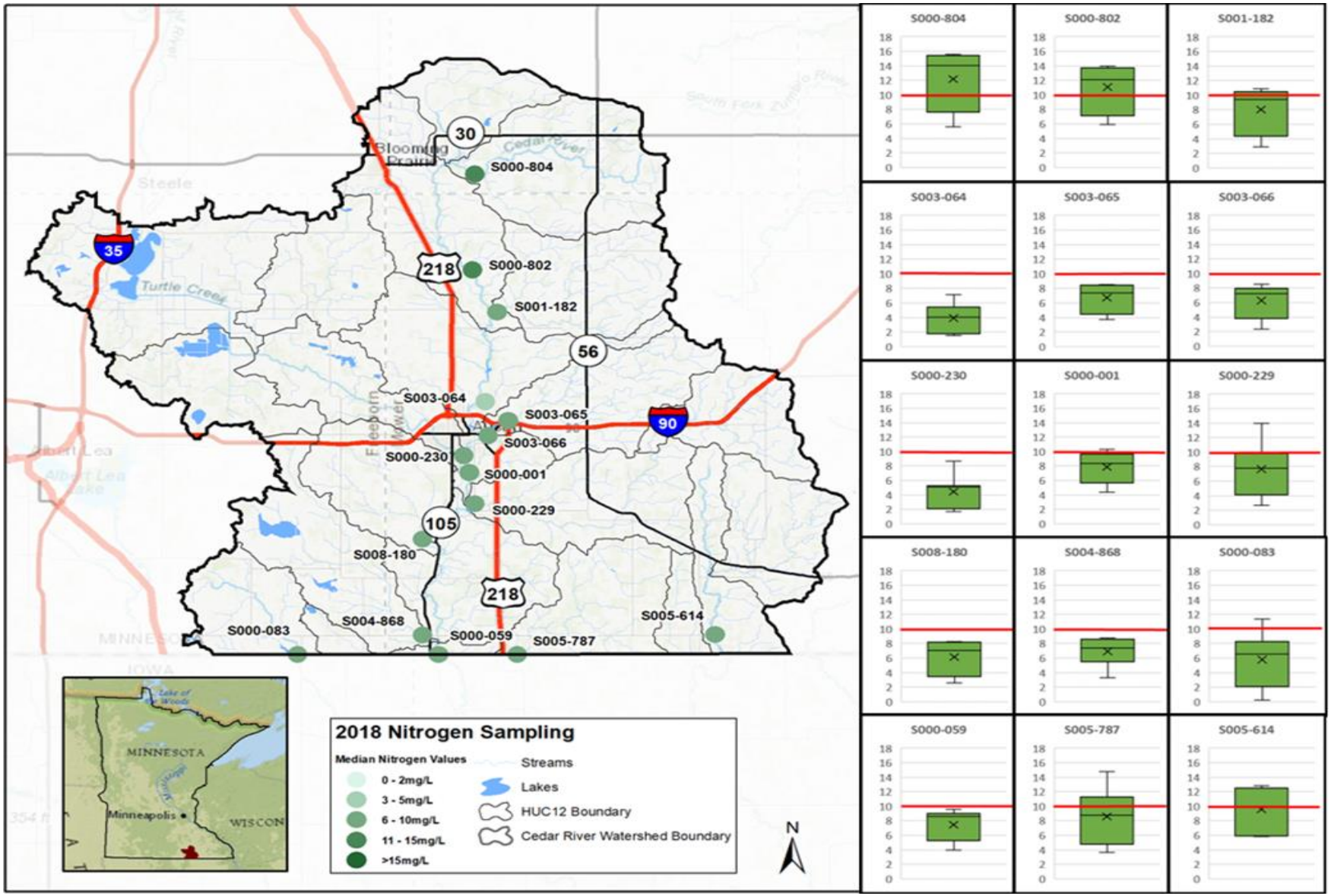

Figure 2: 2018 nitrate concentrations across the Cedar River Watershed. The upper portion of the watershed (stations S000-804 and S000-802) was identified as a priority area for future monitoring and nitrogen reduction. The red lines in the box plots represent the nitrate drinking water standard (10 mg/L).

2019

Eight stations were sampled in 2019 in the upper portion of the Cedar River Watershed. In general, nitrate concentrations were elevated across this part of the watershed for a majority of the year. Concentrations declined late summer, but then increased again after a September rain event and remained elevated the rest of the year. Precipitation events in artificially drained systems often move nitrate downward into tile lines, resulting in increased loading to streams/ditches. Stations S007-067 and S003-069 behaved differently than the other stations as they displayed lower magnitude and variability; differences in soils and/or nutrient management practices (e.g. source, timing, and rate of nitrogen application) are potential explanations. Annual precipitation for 2019 (~48 inches) was well above normal (~34 inches); precipitation was above normal for every month except August (Figure 3).

Nitrate concentrations at stations S010-957 and S006-870 were consistently higher than the rest (Figure 4). These stations had the highest maximum, median, and average concentrations. Drainage areas for all stations were delineated and calculated to provide context in regards to overall nitrogen load. Station S010-957 has the smallest drainage area (~4,000 acres) and station S006-870 has the second largest (~12,600 acres). Both drainage areas are rich with nitrogen and are priorities for reduction. Station S006-870 has the second highest concentrations and drainage area (indicating a large load as well), and although station S010-957 has the smallest drainage area it has the highest concentrations and this small area provides a unique opportunity to document change. Stations S006-870 and S010-957 are dominated by cultivated crops and large feedlots, both of which driving elevated nitrate concentrations (Figure 5).

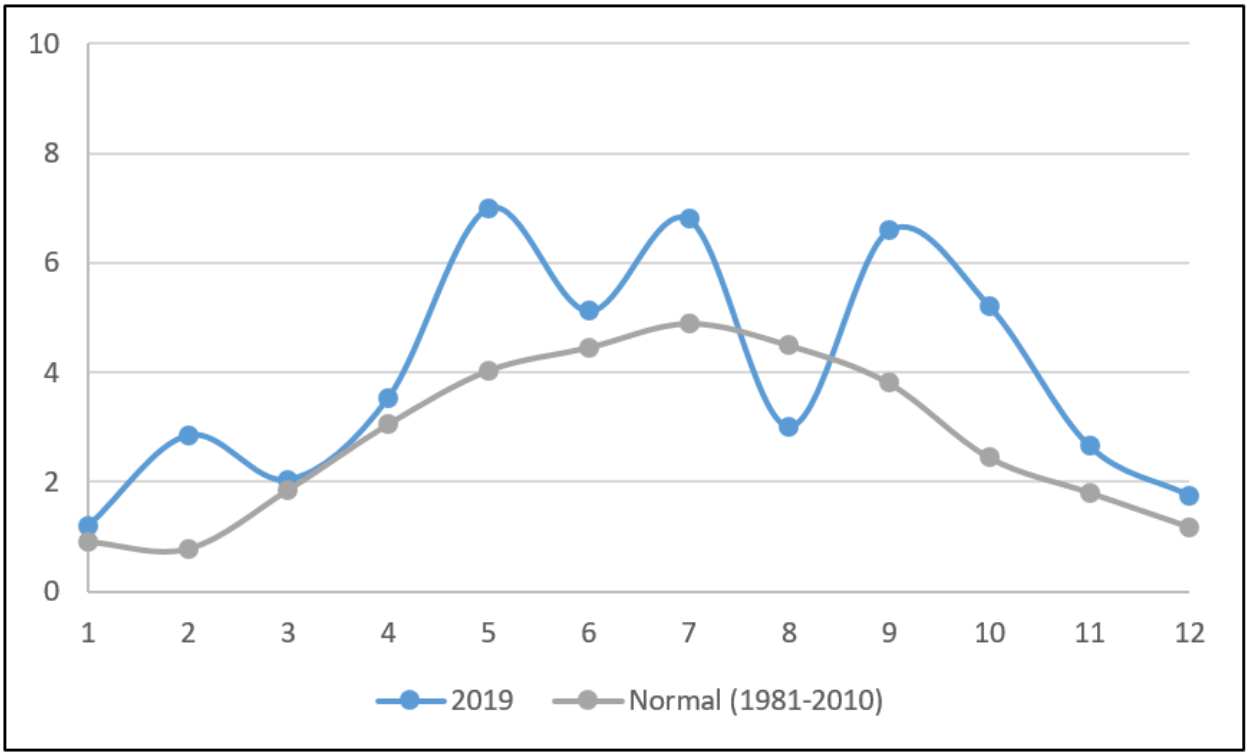

Figure 3: 2019 monthly precipitation totals (inches) compared to monthly normals (1981-2010); data from Minnesota State Climatology Office website for Blooming Prairie, Minnesota.

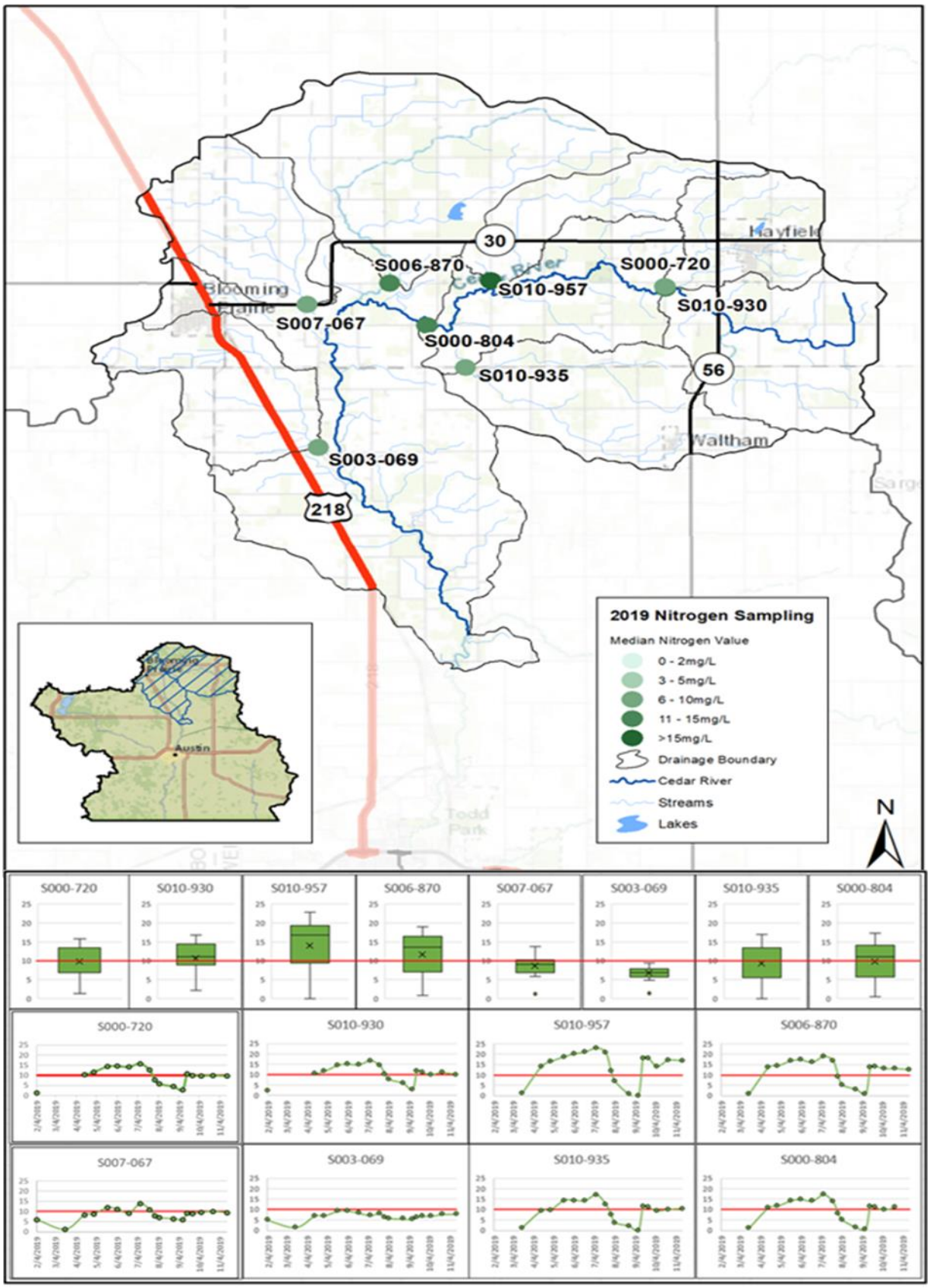

Figure 4: 2019 nitrate concentrations across the upper portion of the Cedar River Watershed; concentrations at stations S010-957 and S006-870 were consistently higher than the other stations. The red lines represent the nitrate drinking water standard (10 mg/L).

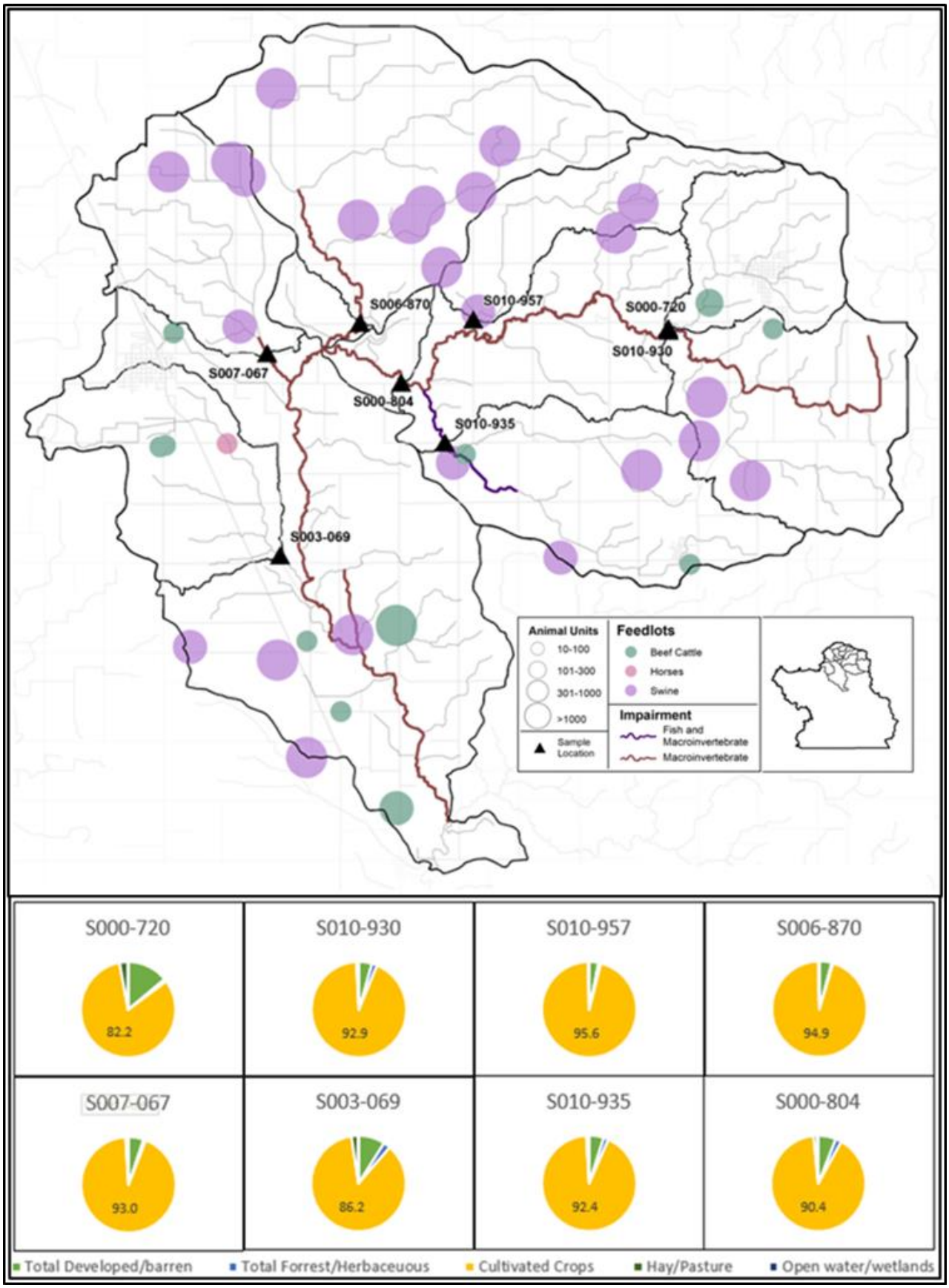

Figure 5: Cultivated crop acres (%) and feedlot information for the upper portion of the Cedar River Watershed. The number displayed in each pie chart represents the percent of cultivated crops for each station.

2020

The upper Cedar River Watershed was sampled again for nitrate in 2020, with three new stations (S016-277, S016-278, and S016-279) added in the S006-870 watershed to aid with prioritization (Figure 6). Similar results were observed in 2020; nitrate concentrations were elevated across the watershed with a decline mid-summer followed by an increase late fall. The decline in concentrations occurred earlier in 2020 than it did in 2019 as rainfall was significantly lower in 2020; this also resulted in lower nitrate averages across most stations. Annual precipitation for 2020 (~33 inches) was just below normal (~34 inches) (Figure 7). Once again S010-957 and S006-870 had the highest concentrations (when compared to the original eight sites), and stations S007-067 and S003-069 had lower concentrations and variability. The new stations in the S006-870 watershed had elevated concentrations with S016-277 having the highest concentration across all stations. Station S016-277 was consistently higher than S016-278, and S016-278 was consistently higher than S016-279. Based on this information and the fact that their drainage areas are similar in size, the drainage area for S016-277 is a top priority within the larger S006-870 drainage area.

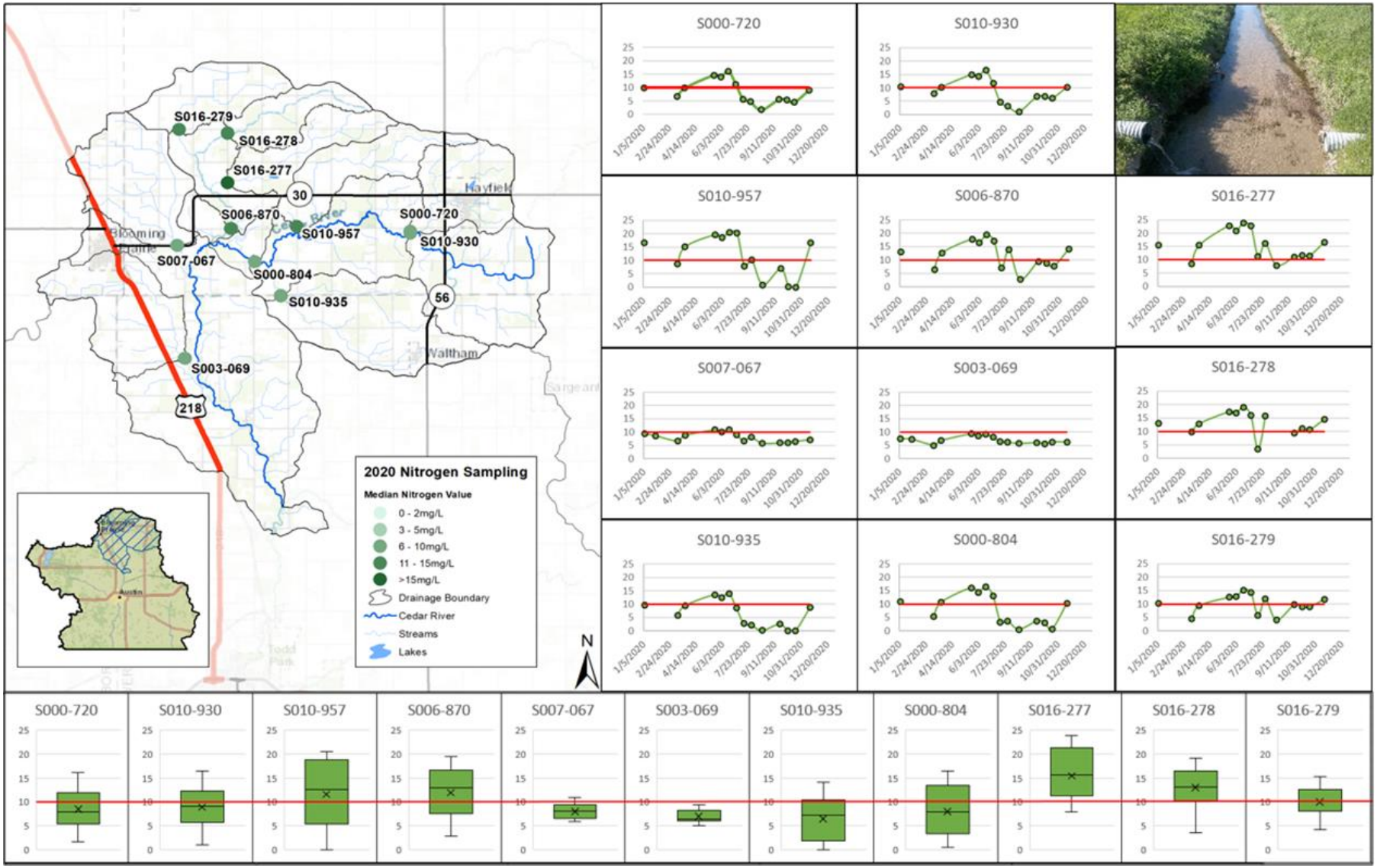

Figure 6: 2020 nitrate concentrations across the upper portion of the Cedar River Watershed. Three additional stations (S016-277, S016-278, and S016-279) were added in 2020 to help prioritization within the S006-870 drainage area. The red lines represent the nitrate drinking water standard (10 mg/L).

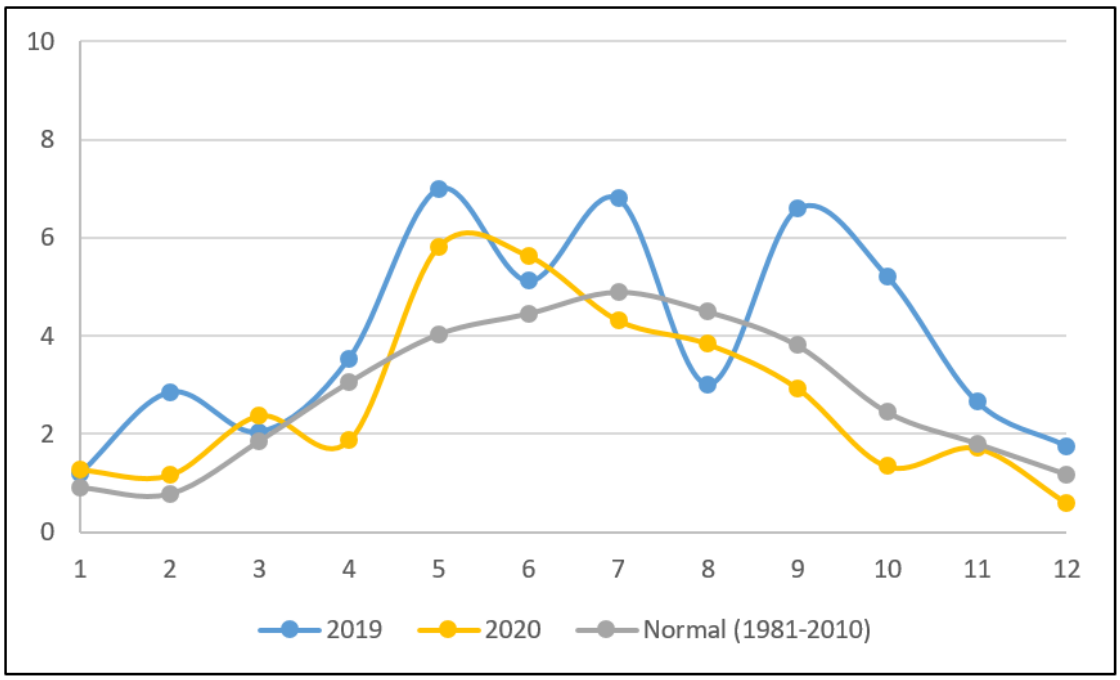

Figure 7: 2019 and 2020 monthly precipitation totals (inches) compared to monthly normals (1981-2010); data from Minnesota State Climatology Office website for Blooming Prairie, Minnesota.

Conclusion

The upper portion of the Cedar River Watershed has elevated nitrate concentrations that are negatively impacting local stream biota and contributing to downstream impairments (IA, Gulf hypoxia). Reducing nitrogen loading is an important goal in the watershed and prioritization is necessary to maximize limited resources. The upper portion of the Cedar River Watershed has some of the highest nitrate + nitrite loading rates (lbs/ac) in Minnesota, and some of the highest total nitrogen loading rates (lbs/ac/yr) within the Cedar River Watershed (Figure 8).

Based on nitrate data collected in Cycle 2 SID, the upper portion of the Cedar River Watershed was identified as high priority for nitrogen reduction as this area had the highest concentrations across the watershed (Figure 9). Within the upper portion of the Cedar River, drainage areas for stations S006-870 and S010-957 were identified as high priority as their nitrate concentrations were consistently higher than the other stations. Similarly, within the S006-870 drainage area, station S016-277 was identified as high priority as concentrations were consistently higher than other areas within the S006-870 watershed. The cultivated crop acres and feedlots/manure application are main sources of nitrogen, with tile drainage a primary transport path to surface waters. A more detailed examination of the agronomic variables and practices in these watersheds would provide more insight into the elevated concentrations and help with implementation planning.

In general, the Cedar WRAPS Report identifies headwater areas (including the upper portion of the Cedar River) as “first priority” for implementation efforts and the Cedar CWMP identifies most of this area as a “level 2” or “level 3” priority. Results from this nitrate summary document are designed to complement existing reports and provide prioritization data at a smaller scale. See the Cedar River WRAPS and CWMP for more information regarding priority areas, specific implementation recommendations, and nitrogen source information.

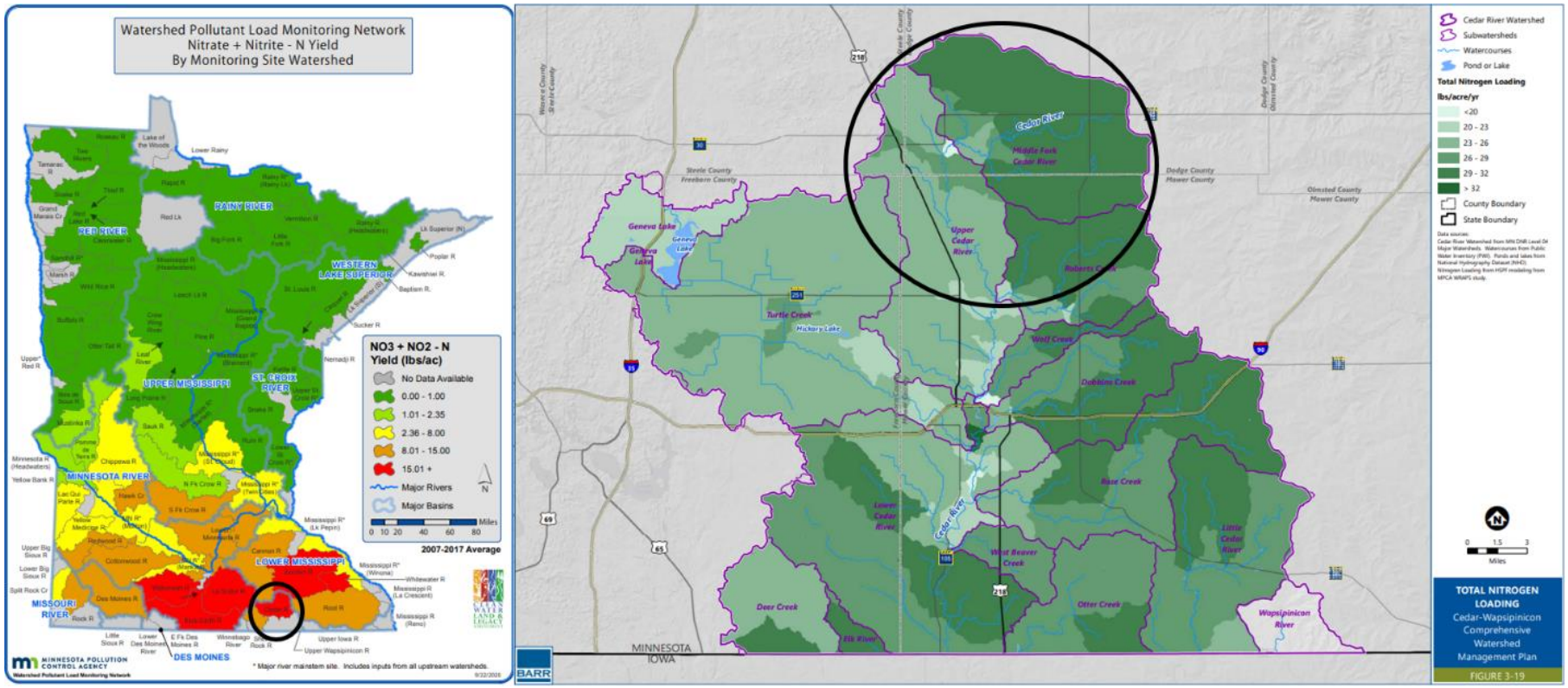

Figure 8: The upper portion of the Cedar River Watershed has some of the highest nitrate + nitrite loading rates (lbs/ac) in Minnesota (left), and some of the highest total nitrogen loading rates (lbs/ac/yr) within the Cedar River Watershed (right). The statewide loading map is a product of the MPCA Watershed Pollutant Load Monitoring Network (WPLMN), and the Cedar River Watershed loading map was derived from Hydrologic Simulation Program-Fortran (HSPF) modeling data and was taken from the Cedar CWMP; much of the upper portion has estimated loading rates of 29 to 32 lbs/ac/yr. Black circles were added to highlight the area of interest.

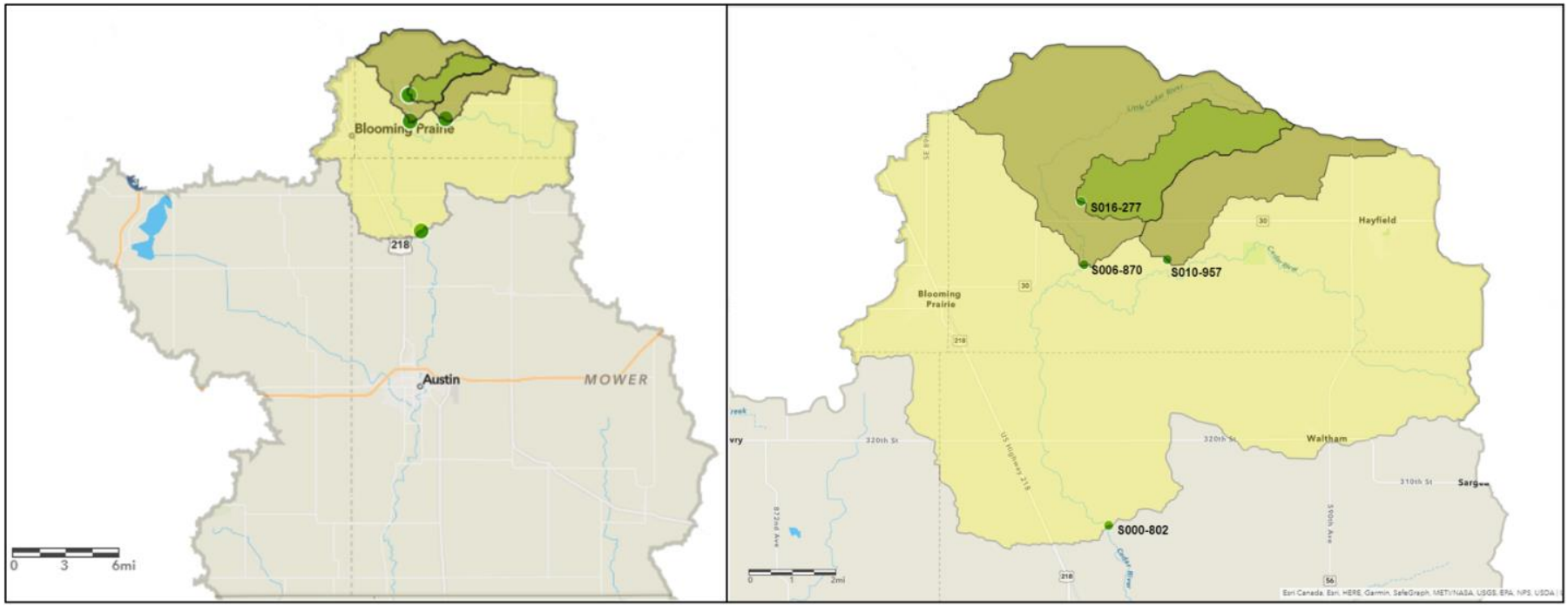

Figure 9: The upper portion of the Cedar River Watershed (left) is a priority area for nitrogen reduction; this area had the highest nitrate concentrations during watershed-wide sampling in 2018. Within the upper portion of Cedar River Watershed, the drainage area for stations S006-870 and S010-957 (right) is a priority for nitrogen reduction as concentrations were consistently higher than other stations. Within the S006-870 drainage area, station S016-277 was identified as high priority as concentrations were consistently higher than other areas within the S006-870 drainage.

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For more information

For more information, go to https://www.pca.state.mn.us/water/watersheds/cedar-river.

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