SID Update

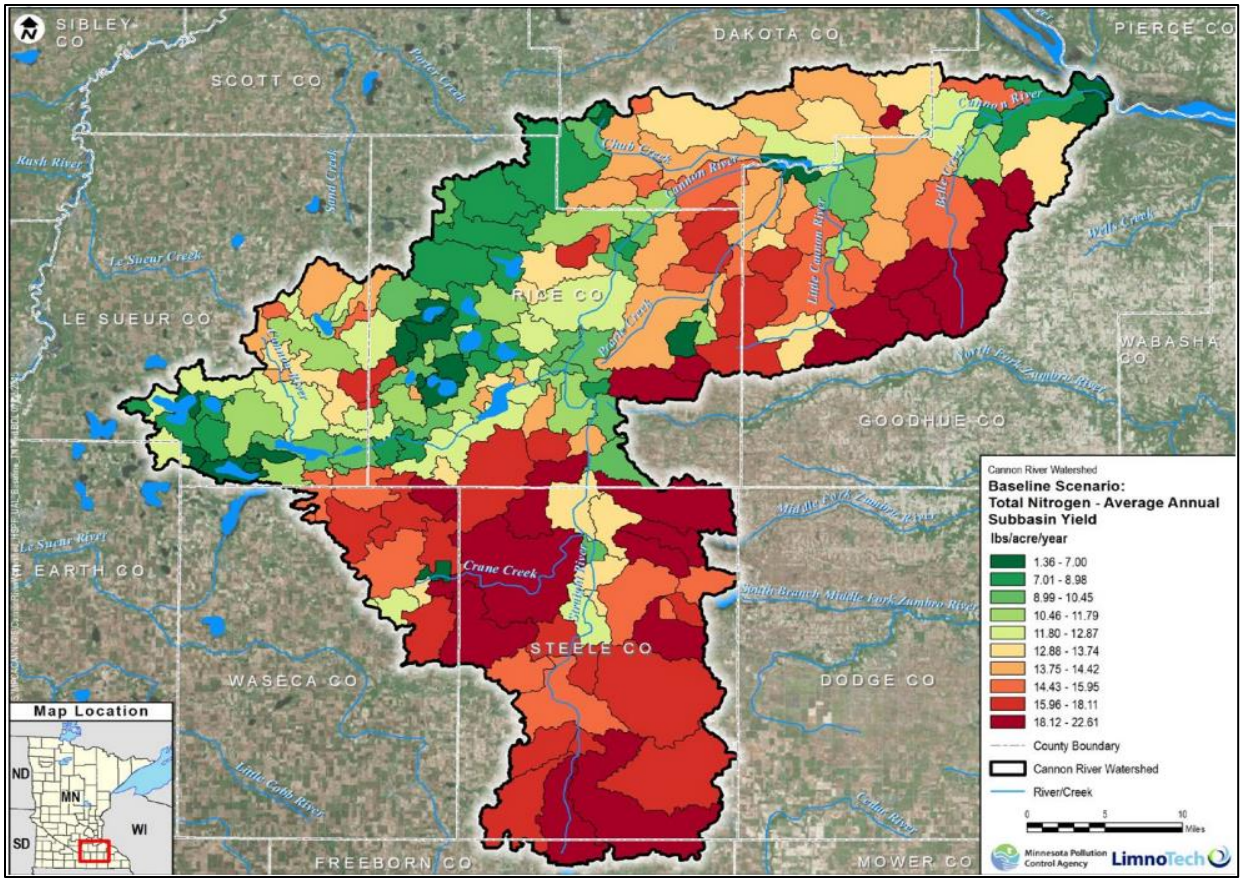
Straight River Watershed Nitrate Summary

February 2024

Background

This document summarizes nitrate sampling conducted in the upper portion of the Straight 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 upper portion of the Straight River Watershed is identified as a priority in the Cannon River Comprehensive Watershed Management Plan (CWMP), and Hydrologic Simulation Program-Fortran (HSPF) modeling results indicate this area has some of the highest total nitrogen loading rates in the entire Cannon River Watershed (Figure 1). This document is designed to complement existing Cannon River Watershed reports and inform watershed planning.

Figure 1: HSPF modeling results for total nitrogen in the Cannon River Watershed; this map was taken from the Cannon River Watershed Restoration and Protection Strategies Report.



Results

Nitrate monitoring as part of the Cycle 2 SID process was conducted in 2020 and 2021 in the upper portion of the Straight River Watershed (Figure 2). Samples were collected at 10 sites, with over 20 samples per site (240 total samples). Nitrate concentrations ranged from 0.2 to 12.9 mg/L (average of 3.9 mg/L), and 11 samples (5%) were greater than 10 mg/L (nitrate drinking water standard) (Figure 3). Station S008-946 had the highest average concentration (4.9 mg/L), while station S009-061 had the lowest average concentration (2.1 mg/L); both stations have similar size drainage areas with slight differences in the amount of cultivated crop acres (91% and 83% respectively), which could help explain the differences in nitrate concentrations (Table 1). Stations S008-949 (Unnamed Ditch), S008-947 (County Ditch 64), S003-013 (Straight River), and S003-012 (Unnamed Creek) are similarly sized headwater stations allowing for comparison and prioritization; station S003-012 had the lowest average nitrate concentration (and percentage of cultivated crops) whereas station S003-013 had the highest average nitrate concentration (and percentage of cultivated crops) (Figure 4). The drainage area for station S003-013 could be considered a top priority area for nitrogen reduction in this part of the watershed. In addition, the drainage area for station S008-946 could be considered a top priority for nitrogen reduction; although it's a smaller drainage area, it had the highest average nitrate concentration of all sites sampled and provides a potential opportunity to document change due to its small size.

In general, nitrate concentrations were moderate to elevated across the upper Straight River Watershed with similar concentrations among stations; concentrations were highest in the spring/early summer and precipitation has significant influence on concentration dynamics from year to year (magnitude, variability, duration of elevated concentrations, etc.). Average concentrations for each station were higher in 2020 compared to 2021; annual precipitation was also higher in 2020 (approximately 37 inches) compared to 2021 (approximately 30 inches; Figure 5). Annual precipitation in 2020 was greater than the 30-year normal (approximately 36 inches) whereas annual precipitation in 2021 was below normal. Cultivated crops dominate the watershed and are the primary source of nitrogen to surface waters; tile drainage is abundant and a primary transport path to surface waters, and most stream channels are altered (Figure 6).

Biological monitoring from Cycle 1 (2011) resulted in one macroinvertebrate impairment in the upper portion of the Straight River Watershed (Figure 2), and nitrate was a stressor in all Straight River Watershed reaches examined during Cycle 1 SID. In general, the macroinvertebrate communities in the upper portion of the Straight River Watershed have elevated numbers of nitrate tolerant individuals, corroborating the observed nitrate concentrations and highlighting the need to reduce nitrogen loading in the watershed (Figure 7). Cycle 2 assessment was not complete at the time of this update, but there were Cycle 2 (2022) fish and macroinvertebrate samples in the upper portion of the Straight River Watershed scoring below the index of biological integrity (IBI) threshold.

Figure 2: Upper Straight River Watershed monitoring stations and Cycle 1 biological impairments.

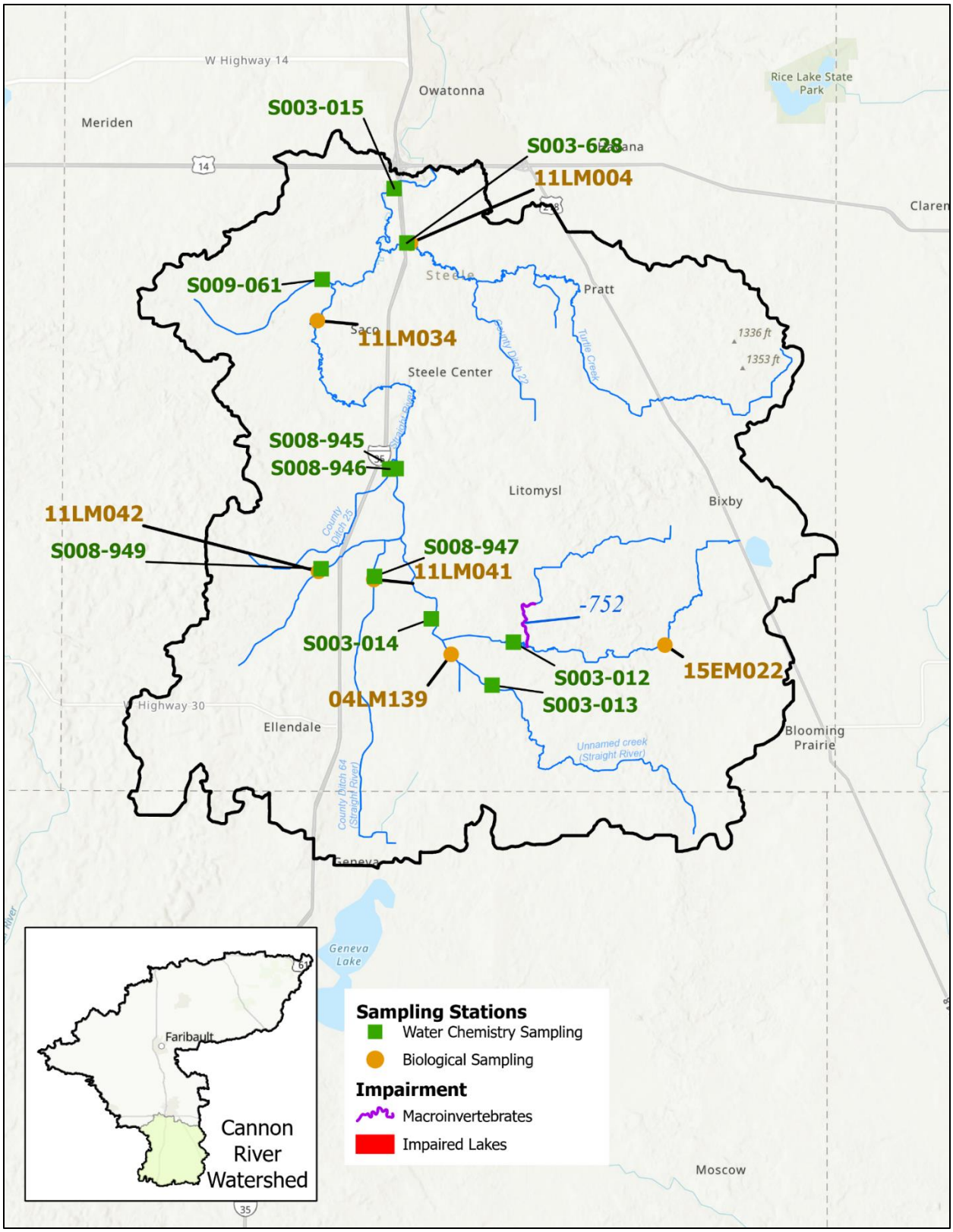


Figure 3: 2020 and 2021 nitrate concentrations and land use in the upper portion of the Straight River Watershed. In general, nitrate concentrations were moderate to elevated with similar concentrations among stations, and cultivated crops dominate the watershed. The red lines represent the nitrate drinking water standard (10 mg/L).

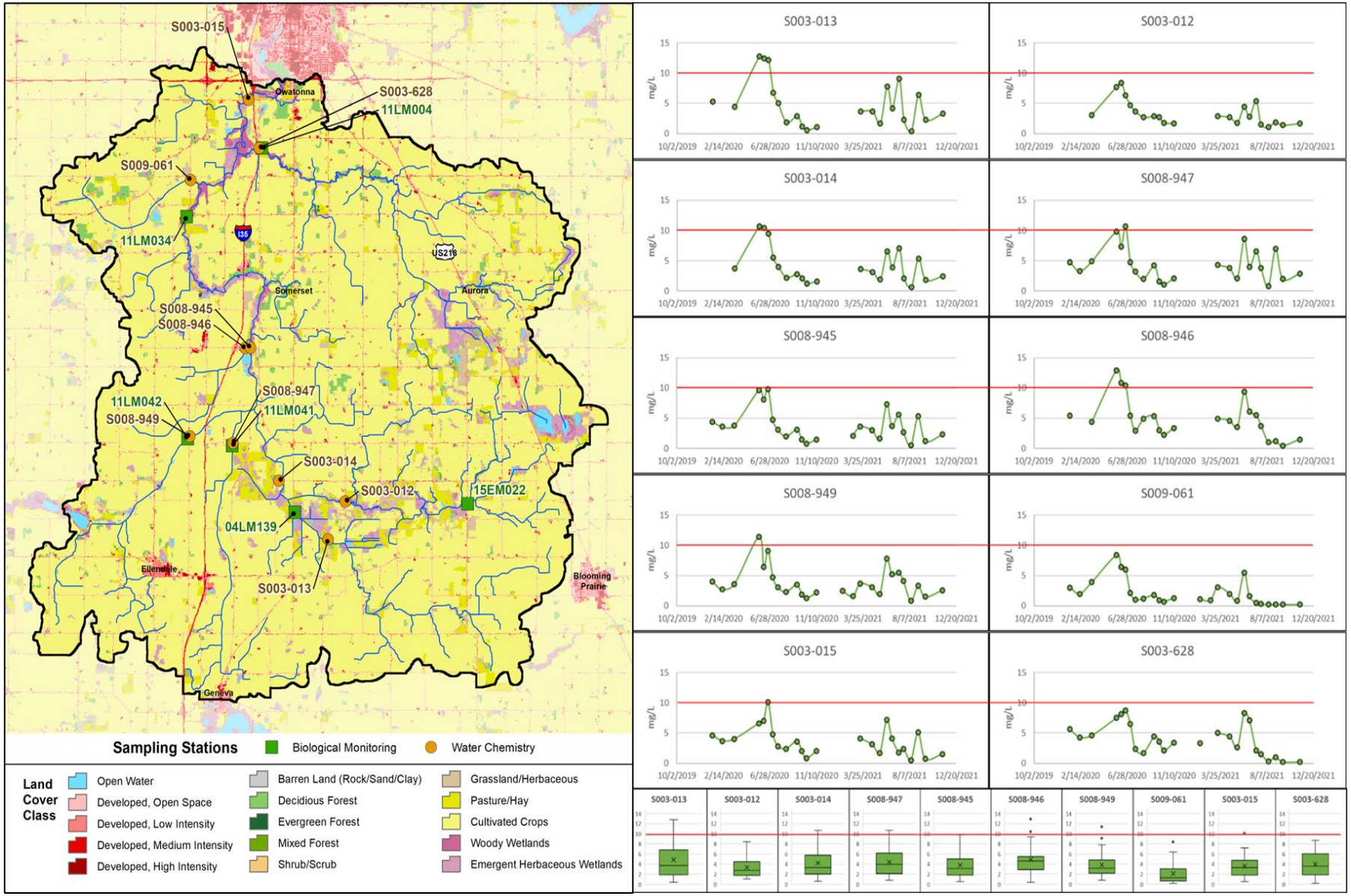
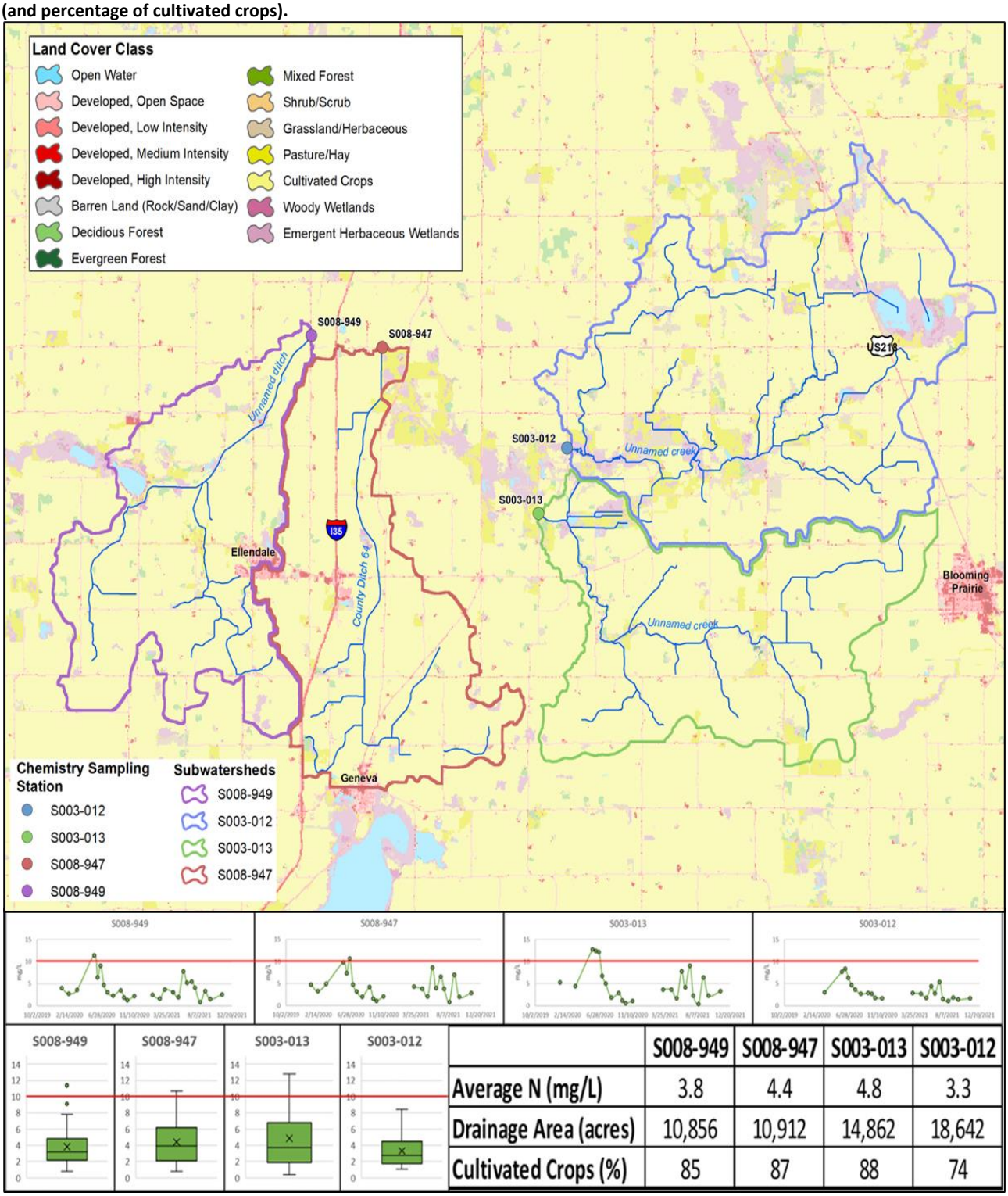


Table 1: Average nitrate concentrations (mg/L) and approximate drainage area (acres) and cultivated crops (%) for monitoring stations in the Straight River Watershed.

	S003-013	S003-012	S003-014	S008-947	S008-945	S008-946	S008-949	S009-061	S003-015	S003-628
Average N (mg/L)	4.8	3.3	4.2	4.4	3.8	4.9	3.8	2.1	3.6	4.0
Drainage Area (acres)	14,862	18,642	42,230	10,912	74,634	5,765	10,856	5,386	124,485	28,660
Cultivated Crops (%)	88	74	80	87	82	91	85	83	81	81

Figure 4: Similarly sized headwater stations in the Straight River Watershed; station S003-012 had the lowest average nitrate concentration (and percentage of cultivated crops) whereas station S003-013 had the highest average nitrate concentration (and percentage of cultivated crops).



	S008-949	S008-947	S003-013	S003-012
Average N (mg/L)	3.8	4.4	4.8	3.3
Drainage Area (acres)	10,856	10,912	14,862	18,642
Cultivated Crops (%)	85	87	88	74

Figure 5: 2020 and 2021 monthly precipitation totals (inches) compared to monthly normals (1991-2020); data from Minnesota State Climatology Office website for Owatonna, Minnesota.

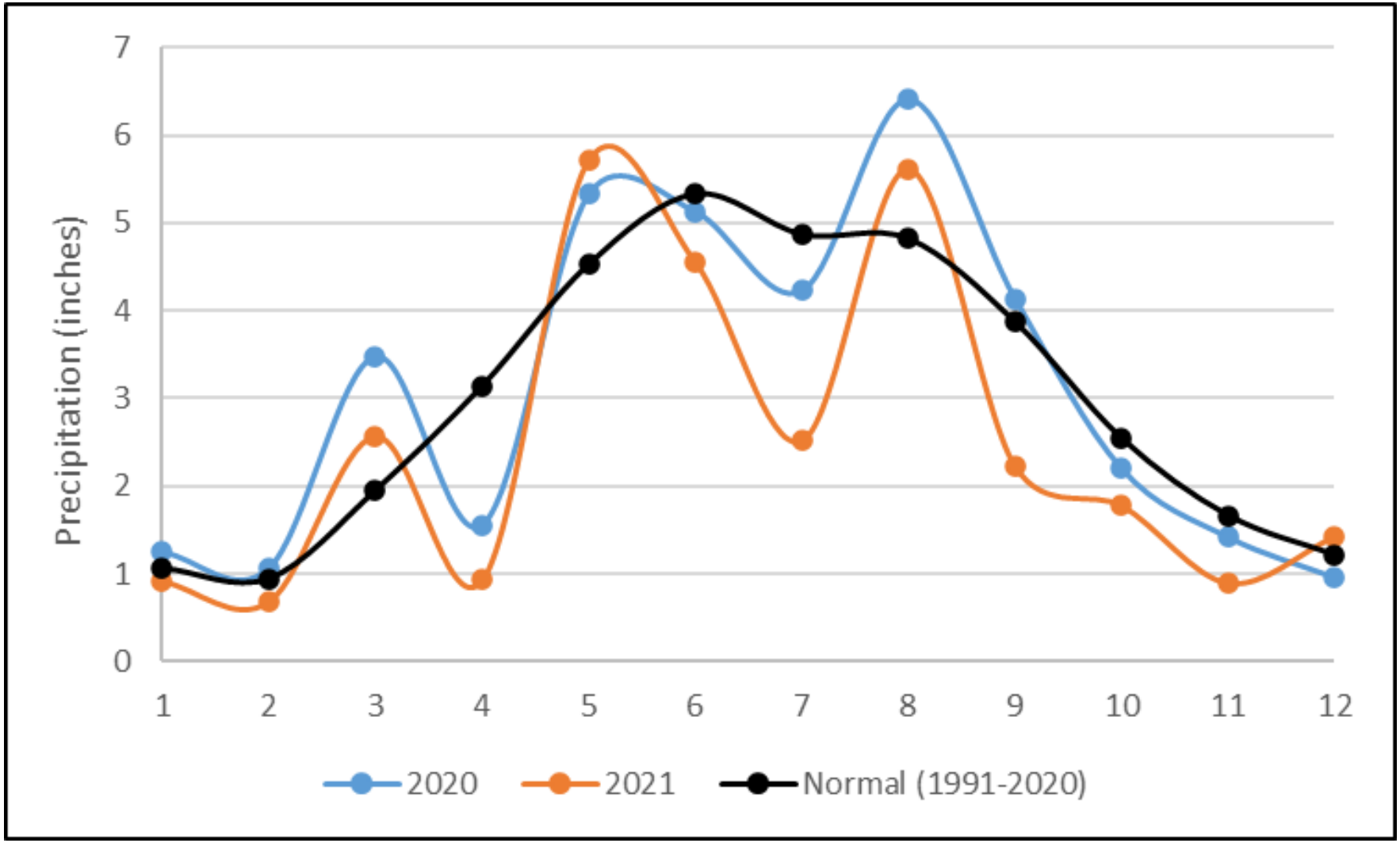


Figure 6: Tile drainage estimates and natural, altered, impounded, and no definable channel watercourses in the upper portion of the Straight River Watershed.

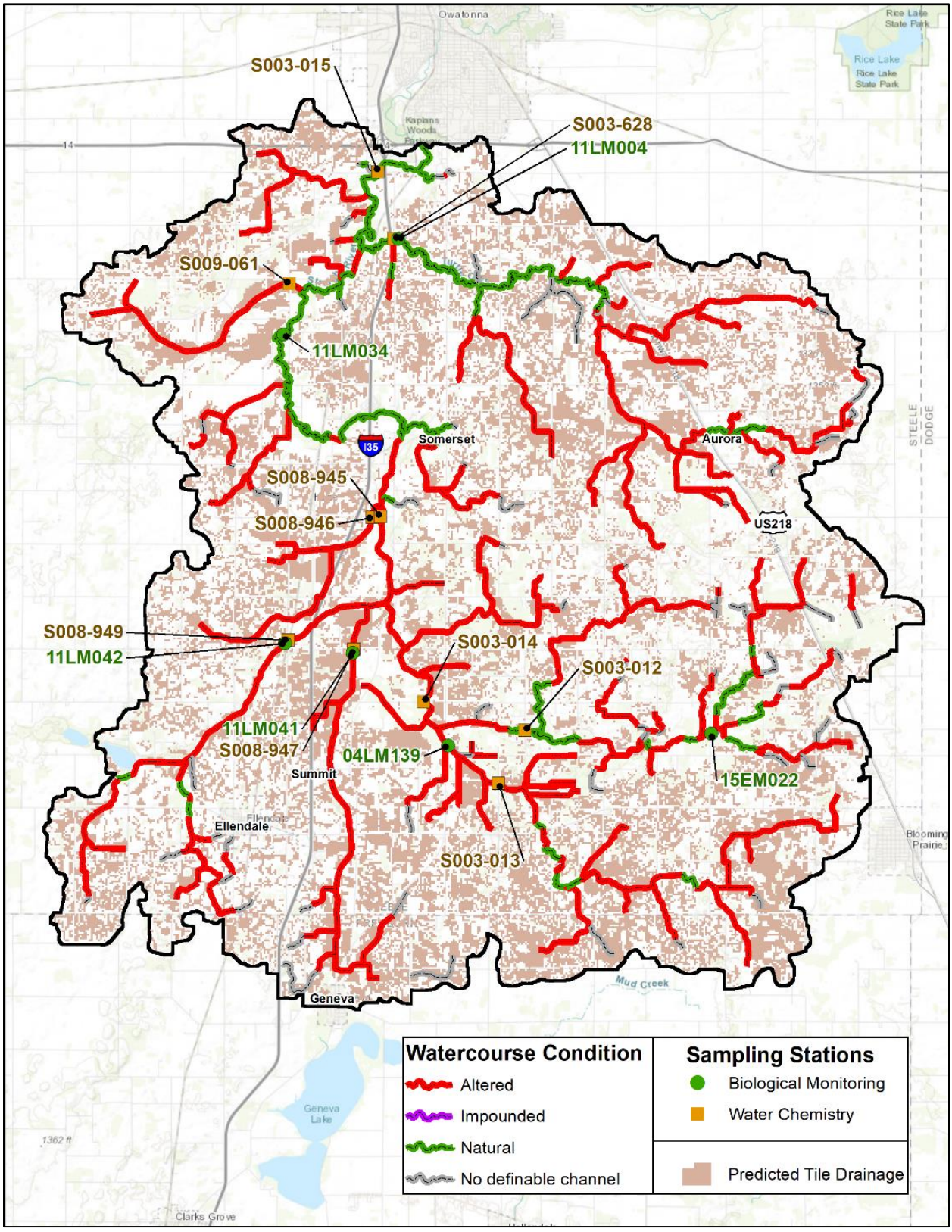
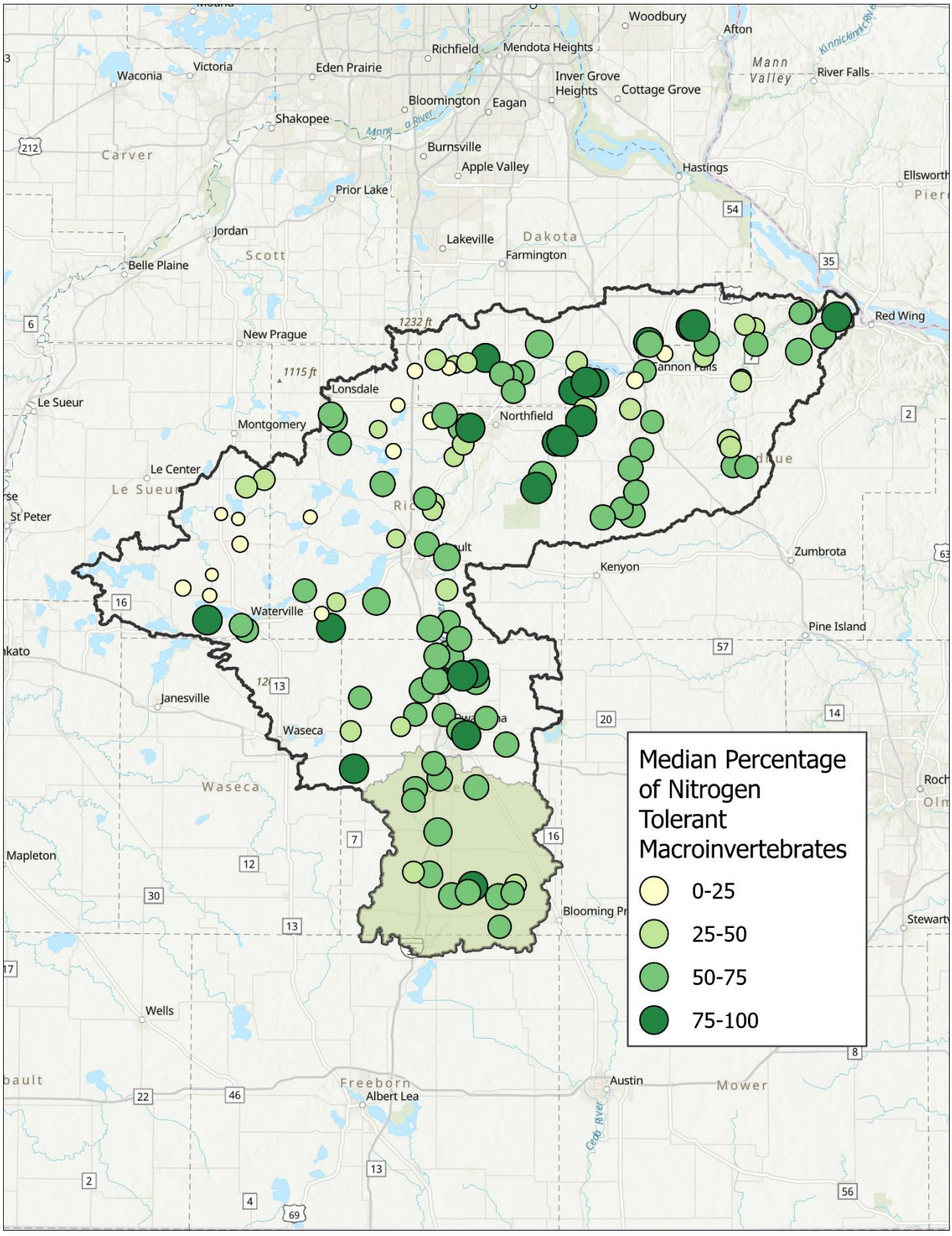


Figure 7: Median percentage of nitrogen tolerant macroinvertebrates across biological monitoring stations in the Cannon River Watershed; nitrogen tolerant macroinvertebrates are abundant throughout most of the study area (upper Straight River Watershed, highlighted in light green). Figure includes data from Cycle 1 and Cycle 2.



Summary

- Overall, nitrate concentrations were moderate to elevated and similar among stations monitored in the upper portion of the Straight River Watershed; nitrate tolerant macroinvertebrates were also abundant.
- The entire area (upper portion of Straight River Watershed) is a priority for reducing nitrogen loading as elevated nitrate concentrations have been documented and it's one of the highest nitrogen contributing areas in the entire Cannon River Watershed (Figure 1 and Figure 3). Within this area, drainage areas for stations S008-946 and S003-013 could be considered top priorities; these stations had the highest nitrate averages (and percentage of cultivated crops) (Table 1). Station S008-946 has a smaller drainage area, thus providing a potential opportunity to document change.
- Cultivated crops dominate the watershed and are the primary source of nitrogen to surface waters; tile drainage is abundant and a primary transport path to surface waters (Figure 6).
- Results from this nitrate summary document are designed to complement existing reports and provide data at a smaller scale to aid with prioritization and maximizing limited implementation resources. See the Cannon River Watershed Restoration and Protection Strategies (WRAPS) Report and Cannon River CWMP for more information regarding priority areas, specific implementation recommendations, and nitrogen source information.

For more information

For more information, go to https://www.pca.state.mn.us/watershed-information/cannon-river.

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CLEAN WATER LAND & LEGACY AMENDMENT

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