Vermillion River Monitoring Network

2024 Monitoring Summary

Vermillion River watershed reflecting life

Prepared for the Vermillion River Watershed Joint Powers Organization
by the Dakota County Soil and Water Conservation District

Monitoring Summary

The Vermillion River Monitoring Network was created to assess water quality and quantity in the Vermillion River Watershed. Monitoring staff with Dakota County Soil and Water Conservation District (DCSWCD) and Scott Soil and Water Conservation District (Scott SWCD) visit eight locations on a biweekly basis from snowmelt (mid-March) through November 1 (Figure 1). Samples were collected during both baseflow and runoff conditions due to a wet spring that continued through July before transitioning to drier fall months. 10 additional runoff monitoring events occurred in 2024, whereas far fewer were collected due to persistent drought conditions in previous years.

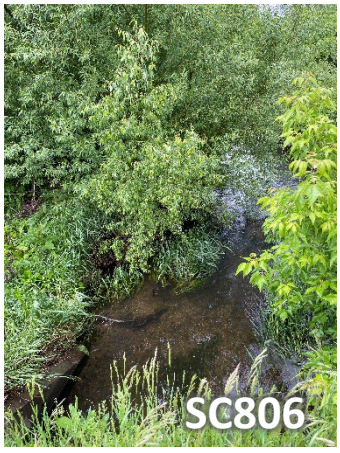
Monitoring activities include sample collection, continuous temperature and water level monitoring, biological monitoring, and equipment maintenance. The data collected though this effort include a combination of chemical, physical, and biological parameters and assessments, enable local agencies such as the Vermillion River Watershed Joint Powers Organization (VRWJPO) to better understand the health of the stream and implement appropriate management strategies throughout the watershed.

Analysis shows that many of the water monitoring parameters are meeting state water quality standards and indicate a generally healthy condition in the Vermillion River and its tributaries.

Chemistry

Nitrate (NO_3; a form of nitrogen) levels were quite low, except at the one station on the South Branch Vermillion River (Figure 2). The South Branch station (SB802) has a significant nitrate load compared to others in the network. High levels of nitrate in drinking water pose a human health risk and are likely related to the soils, artificial drainage, and agricultural land use that is predominant in the South Branch Vermillion River subwatershed. Downstream monitoring locations downstream have elevated nitrate levels in comparison to upstream sites.

The other primary nutrient monitored in the watershed is *phosphorus*, an essential life element for plants. Excess phosphorus can lead to eutrophication and increased algae growth in the river. The median level for all sites is below the state standard during baseflow conditions (Figure 3). Elevated concentrations were recorded during runoff events at all monitoring sites and during snowmelt events at three monitoring sites. Highest variability during baseflow conditions was at VR24 (most upstream site). NC801 and NC808 (North Branch subwatershed outlets), SB802 and VR24 showed most variability during runoff conditions.



Low *dissolved oxygen* concentrations for single event runoff events were common at several sites, with the median below the standard at four of the coldwater sites (Figure 4). All median dissolved oxygen levels met the standard for both 2A and 2B stream sites during baseflow conditions. Historically, NC801 and NC808 have had the lowest recorded levels during baseflow, but SC806 was again lower in 2024. Dissolved oxygen levels during snowmelt conditions were high. Once again, VR24 had the highest variability of all monitoring sites during both baseflow and runoff conditions.

Higher levels of *total suspended solids* (contributing to turbid, cloudy, water) following runoff events were common at several sites (Figure 5). Sample medians were at or below (meeting) the state standard at all stations during baseflow conditions. Individual event exceedances occurred during runoff and snowmelt conditions while sample medians remained at or below the standard during runoff.

Statewide monitoring data has shown that *chloride* concentrations are increasing in Minnesota's surface waters and groundwater. According to the Minnesota Pollution Control Agency (MPCA), a stream, lake, or wetland is considered impaired for chloride if two or more samples exceed 230 mg/L within a three-year period (chronic); or, one sample exceeds 860 mg/L (acute). While currently not a major concern in the watershed, future urbanization may contribute to increased levels, so it is important to gather baseline data now. Monitoring was limited in 2024 with only one sample collected during runoff conditions and one in snowmelt. Chloride levels were below 140 mg/L in both conditions.

Chlorophyll-*a* was added to the VRWJPO monitoring program in 2019 (added to VR24 in 2021, skipped in 2023). It serves as an indirect indicator of nutrient levels in a lake or river (high chlorophyll = high nutrients) and is considered a response variable in the MPCA's water quality impairment assessment strategy based. The 2024 sample medians were below the standard during all monitoring conditions, though individual events exceedances occurred during baseflow conditions (Figure 6).

Temperature

The Vermillion River watershed includes stream reaches with both coldwater and warmwater use designations meaning that temperature standards are applied to the middle watershed (coldwater) but are not applicable to reaches in the upper and lower parts of the watershed (warmwater). The coldwater reaches of the Vermillion River and its tributaries are home to a self-sustaining brown trout population, so there is great interest in reducing or maintaining water temperatures suitable for a healthy brown trout fishery.

Continuous temperature data, measured in 15-minute intervals, has been collected annually starting in 2005 for many of the sentinel monitoring stations in the Vermillion River monitoring network. The temperature data for 2024 for NC801 and NC808 (Farmington) shows temperature maximums were measured in the complete mortality range (red; > 25°C) during all summer months with the highest median water temperatures observed in July (Figure 7).

Bacteria Sampling

Some parameters have been measured at undesirable levels. *Escherichia coli (E. coli)* bacteria levels are high in many streams of southeast Minnesota, and the Vermillion River and its tributaries are no exception. Monitoring results in 2024 show numerous low-level exceedances during the season at all the sites in the network. The geometric mean at each site were elevated in comparison to 2022 and continues to show less variability than in 2019 (Figure 8).

E. coli levels at VR24 continue to be higher than samples collected at other monitoring sites within the watershed. The geometric mean for *E. coli* samples at VR24 was 4.5 times greater than the state standard (126 organisms per 100 milliliters). All other sites were 1-2x higher than the standard.

Biological and Habitat Assessments

The MPCA developed biological indices to evaluate the health of the macroinvertebrate community in the Vermillion River. In 2024, seven sites were monitored in various parts of the watershed. The macroinvertebrate index of biological integrity (MIBI) scoring data is not currently available.

Habitat assessments were completed using the MPCA's Minnesota Stream Habitat Assessment protocol to further evaluate and understand the biological integrity of stream reaches. Of the five sites monitored in 2024, three sites had a 'Fair' score and two sites scored 'Good' (Figure 9).

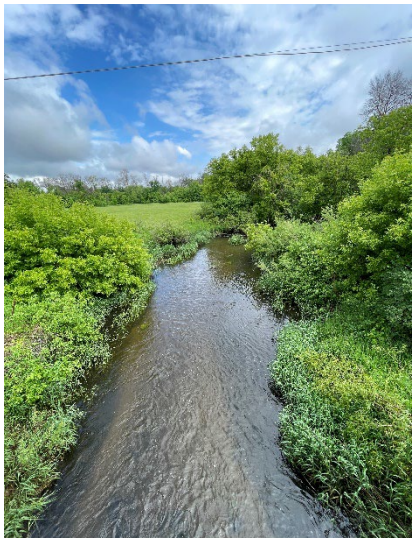
Agency Monitoring

The Minnesota Department of Natural Resources (MNDNR) continues its monitoring effort in response to potential impacts to the quantity of water within the Vermillion River from groundwater withdrawals via appropriations. The MNDNR maintains responsibility for twelve stream gaging stations within the watershed as part of this effort. The VRWJPO contracts MNDNR hydrologists for assistance with maintenance, rating-curve development, and data analysis and compilation at these stations. This information can be accessed at https://www.dnr.state.mn.us/waters/csg/index.html.

The VRWJPO provides cost share for the operation of the U.S. Geological Survey (USGS) Blaine Avenue gaging station, which has the longest continuous record of flow in the watershed. Real-time stage and flow data is available from the USGS station. This information can be accessed at https://waterdata.usgs.gov/mn/nwis/uv?site_no=05345000.

Continuous temperature monitoring was collected at the eight stream gaging stations the DCSWCD, Scott SWCD, and MNDNR operate, as well as at the Metropolitan Council's Watershed Outlet Monitoring Program (WOMP) station in Hastings.

Conclusion



The Vermillion River Monitoring Network is of great value as the watershed can be assessed on its physical, chemical, and biological characteristics. That information is then used to make informed management decisions. Restoring in stream and riparian habitat, reducing nutrients and suspended materials in the stream, and minimizing temperature peaks (along with other possible conservation strategies) will have a cascading positive effect on the overall health of the river.

It is important to consider physical parameters such as temperature, which plays an essential role particularly in cold water streams. Water quantity and flow patterns have a significant impact on aquatic communities, with too much or too little causing stress. An effective management strategy would be one which integrates both the quality and quantity aspects of the Vermillion River.

Appendix

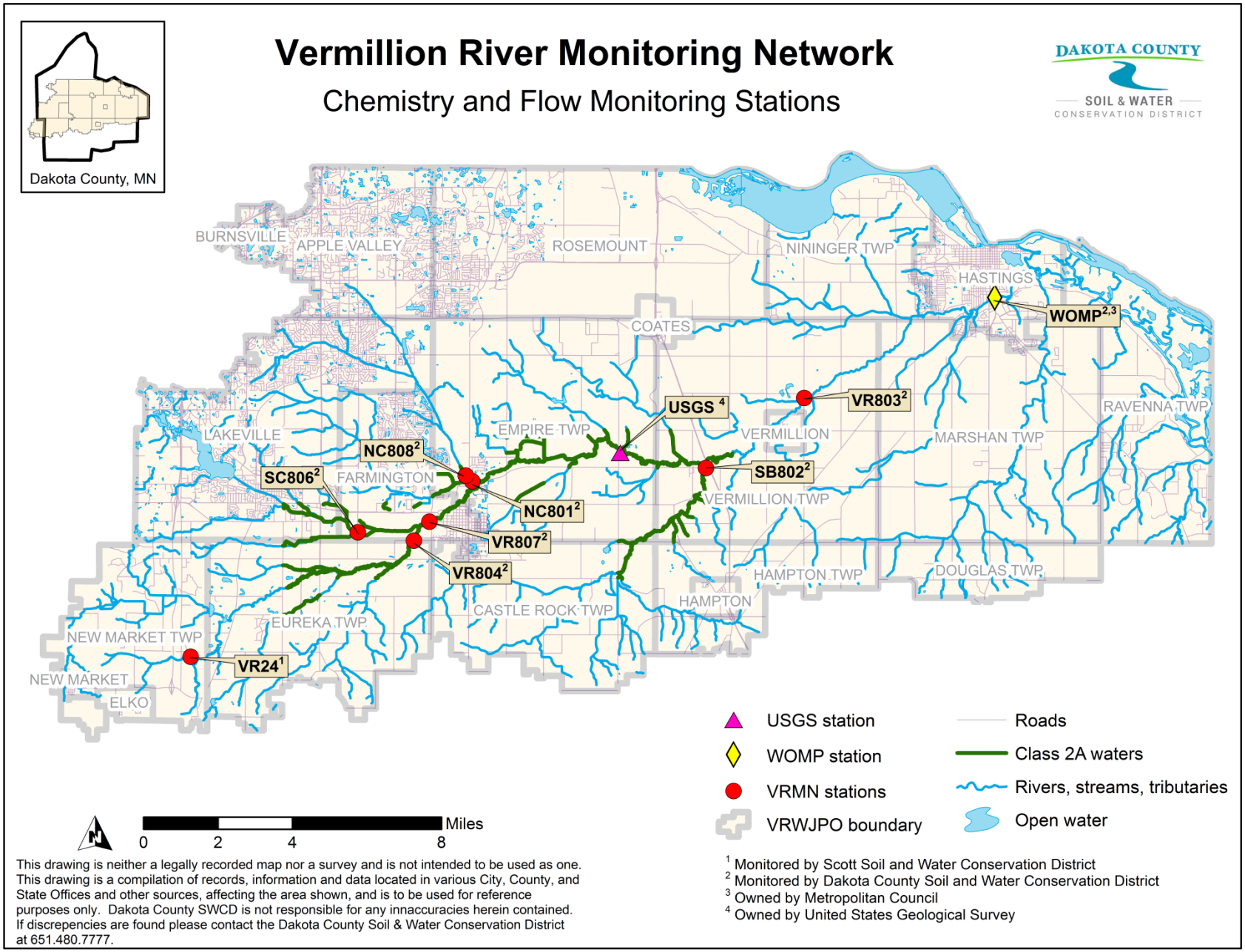


Figure 1. Vermillion River Monitoring Network (VRMN) chemistry and flow monitoring stations.

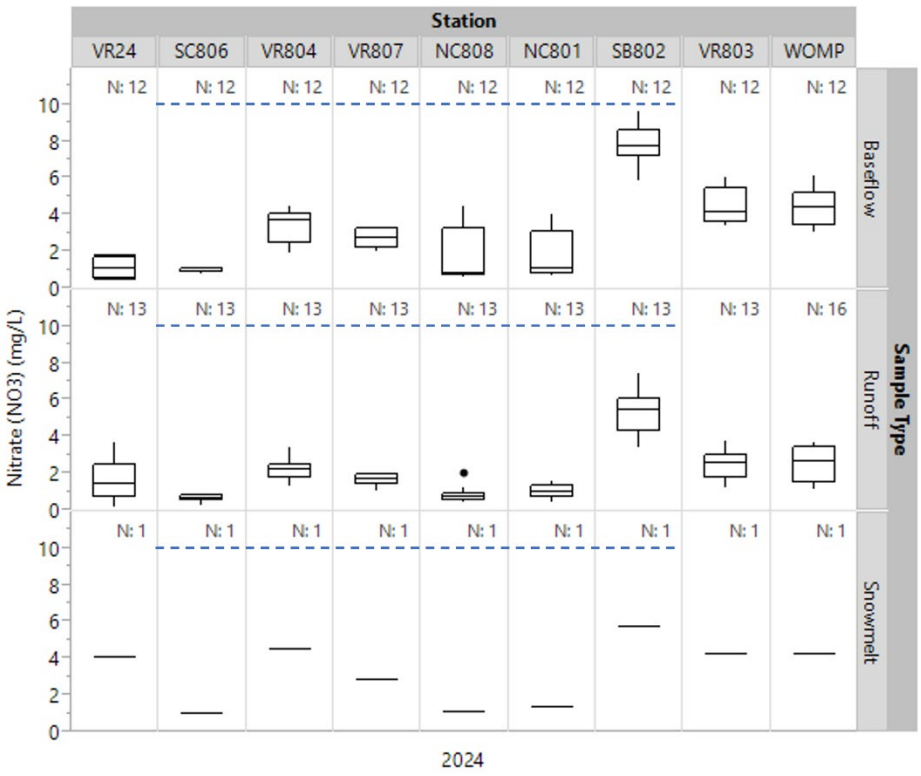


Figure 2. Nitrate nitrogen for each station, categorized by sample type, for 2024. Blue dashed line represents the domestic consumption state standard (≤ 10 mg/L).

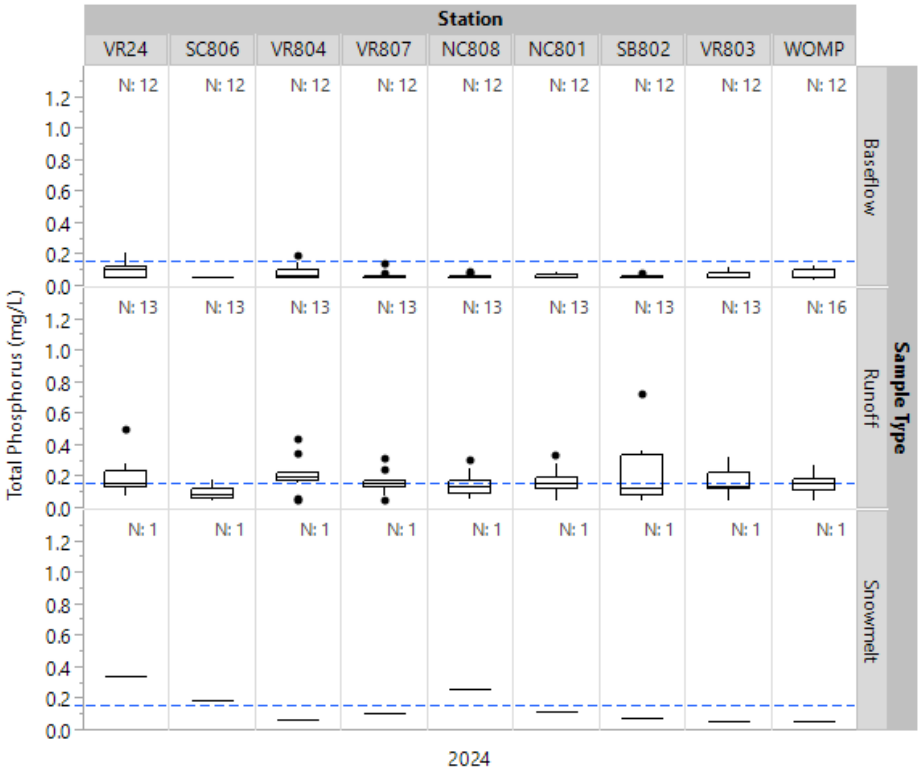


Figure 3. Total phosphorus (TP) for each station, categorized by sample type, for 2024. Blue dashed line represents the state standard for total phosphorus, ≤ 0.15 mg/L.

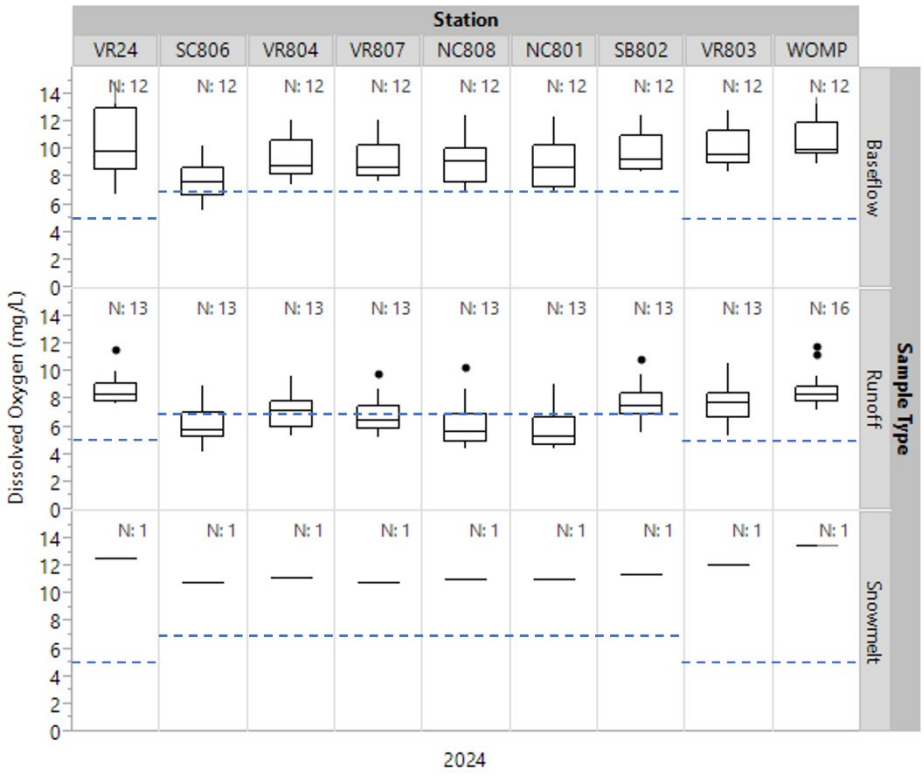


Figure 4. Dissolved oxygen for each station, categorized by sample type, for 2024. Dashed blue lines indicate standards with 7.0 mg/L (2A streams) and 5.0 mg/L (2B streams) as acceptable daily minimums.

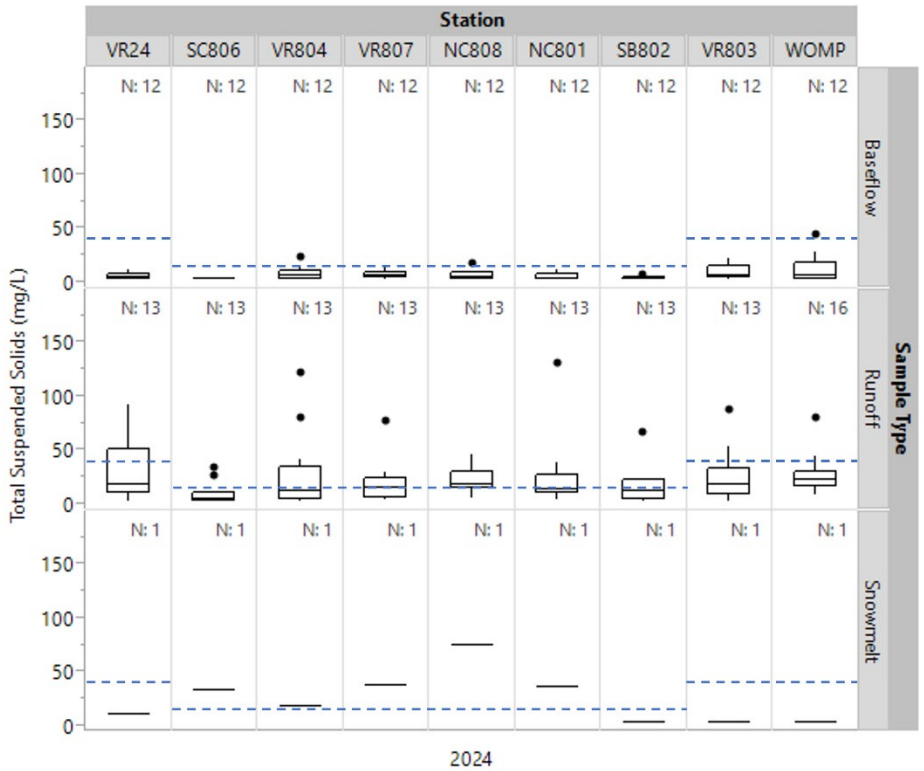


Figure 5. Total suspended solids categorized by sample type for 2024. Blue dashed line represents the state standard for cold 2A (≤ 10 mg/L) and warm 2B (≤ 30 mg/L) waters.

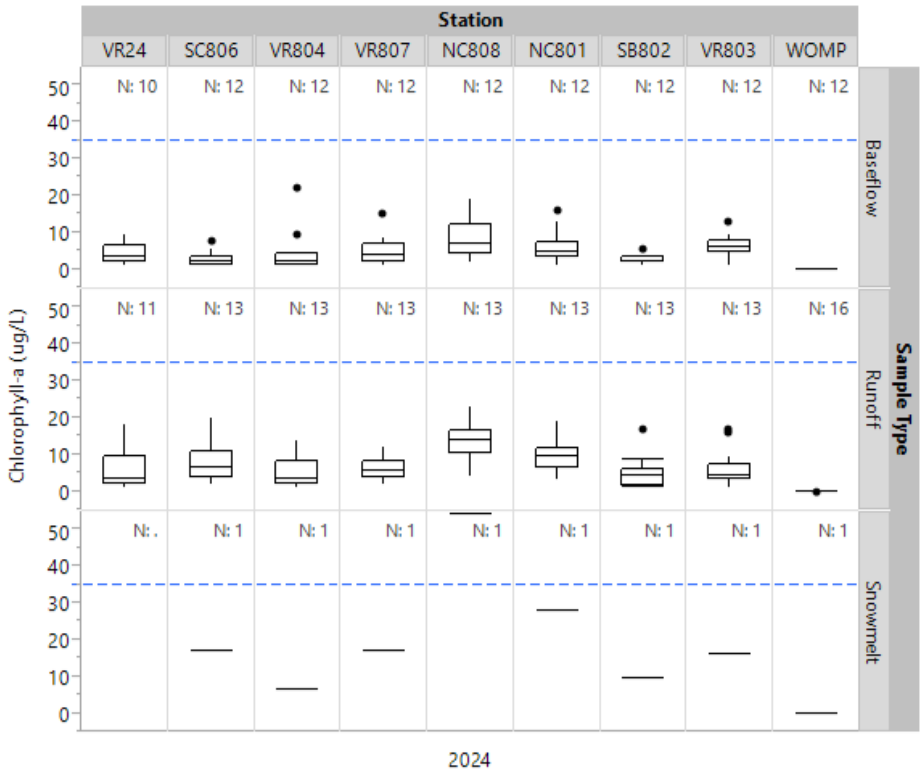


Figure 6. Chlorophyll-a, categorized by sample type, for 2024. Blue dashed line represents the state standard of ≤ 35 mg/L.

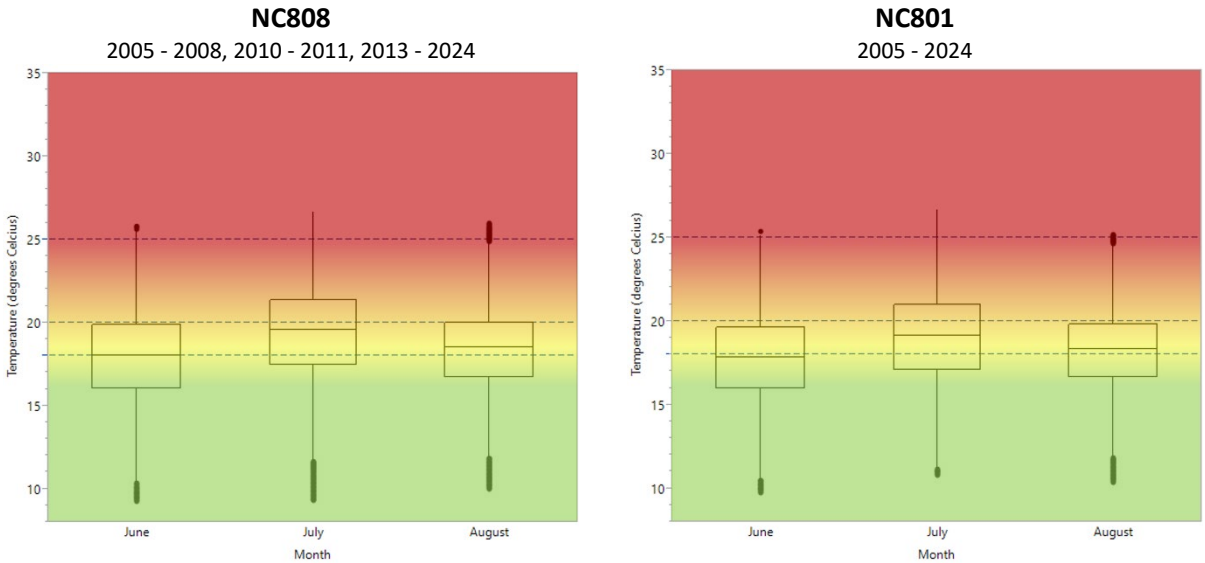


Figure 7. Continuous temperature data for NC808 and NC801 (coldwater stream sites) during the summer months from 2005-2024 (when available). Temperature ranges apply to adult Brown Trout. Optimal <18°C, tolerance 18-20°C, resistance 20-22°C, and complete mortality at 25°C (Coutant (1975), Gardner & Leetham (1914), Bell (2006))

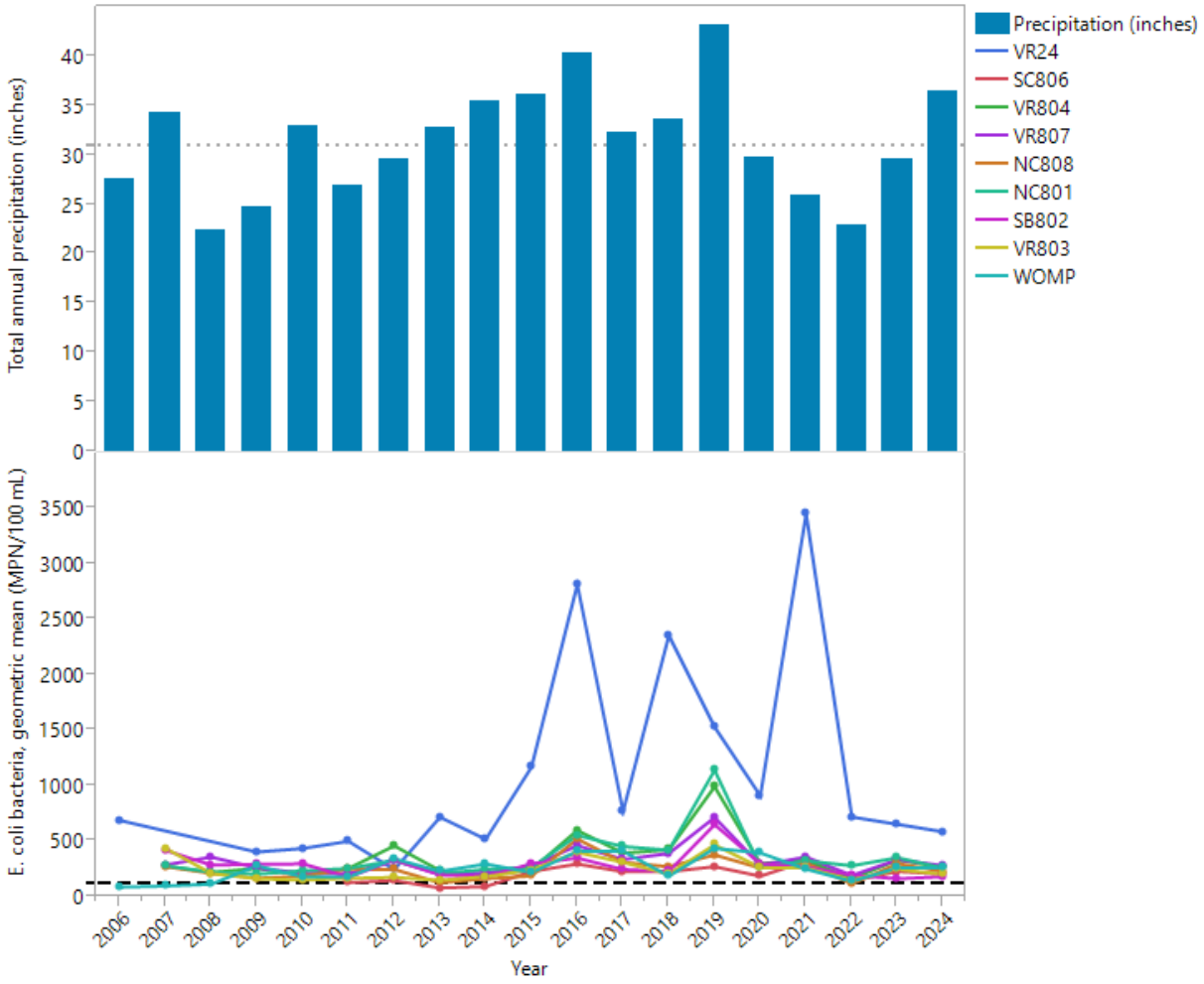


Figure 8. Annual geometric mean of *Escherichia coli* (*E. coli*) bacteria for all stations by year. MPN stands for most probable number of organisms. Black dashed line indicates the 30-day geometric mean standard (for data collected April through October) of ≤126 MPN/100 mL. Bars represent total annual precipitation for each year. Gray dotted line indicates the 30 year (1994-2023) total annual average precipitation at the Minneapolis – St. Paul airport weather station of 30.9 inches.

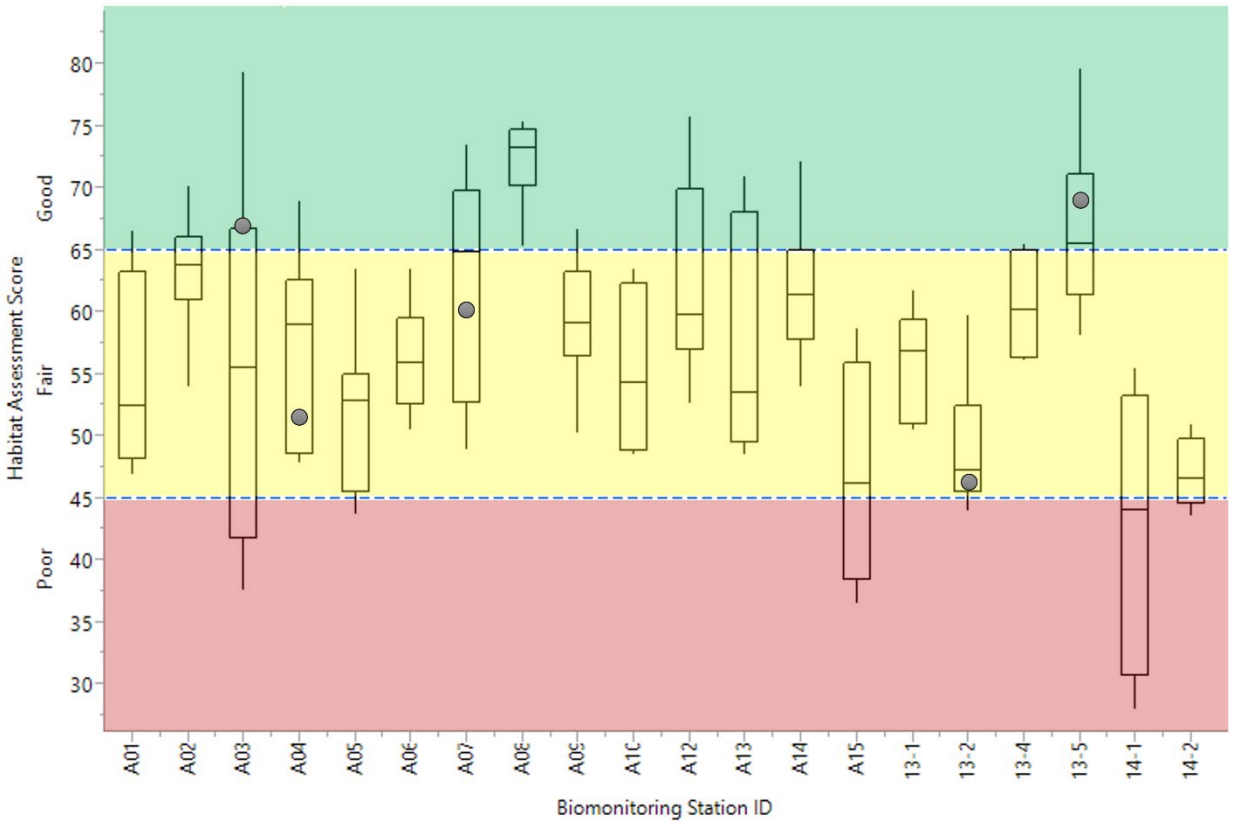


Figure 9. Habitat assessment scores for 2024 biomonitoring stations. Habitat scores for 2024 are indicated by grey circle. Dashed blue lines indicate limits for Good (≥66), Fair (45-65), and Poor (≤44) categories. Number of samples collected from 2009-2024 is shown in parenthesis.