

Vermillion River Watershed

Stressor ID Update, January 2022

Purpose

Water monitoring is essential to determining whether lakes and streams meet water quality standards designed to ensure that waters are fishable and swimmable. The stressor identification (SID) process looks at specifically why fish and bug communities are suffering. The purpose of Cycle 2 (C2) SID work is to perform SID in a way that supports follow-up watershed restoration and protection strategy (WRAPS) efforts and local water planning and implementation efforts, with an emphasis on meeting local partner needs, protection of biotic integrity, and identifying changes in biotic condition.



The Vermillion River Watershed has many opportunities for recreation such as fishing and canoeing. Identifying impairments and stressors help guide where to implement restoration best management practices and where to protect healthy streams that will help to preserve them for future generations.

What have we learned about stream health and stressors in the Vermillion River Watershed?

The Vermillion River Watershed (Figure 1) faces issues related to dissolved oxygen (DO) and eutrophication in North Creek, Vermillion River Tributary, and Trib. to Rice Lake. Proximity to development, stormwater practices, and low gradient/channelized reaches are issues that contribute to lower DO conditions as well as eutrophic streams in the studied areas. These conditions make it difficult for healthy fish and macroinvertebrate assemblages to thrive.

Habitat, altered hydrology, and connectivity were also significant issues in the watershed. The studied areas show habitat as a stressor in all three reaches, altered hydrology/connectivity in two of the reaches, while suspended solids in at least one. Stream channelization is a major contributor to the poor habitat conditions in North Creek and tributary to Rice Lake. This can lead to excess sedimentation, lack of coarse substrates, and limiting fish habitat features. Fixing these problem areas should be a high priority to see improvement.

Overall, in the Vermillion River Watershed there was a significant change in the Index of Biotic Integrity (IBI) values for fish or macroinvertebrates from the first cycle. Compared to 2008 results, IBI scores for both fish and macroinvertebrates increased substantially in 2018 among the monitoring stations in the Vermillion River Watershed. These results are a hopeful sign that the biological condition of rivers and streams in the watershed is improving.

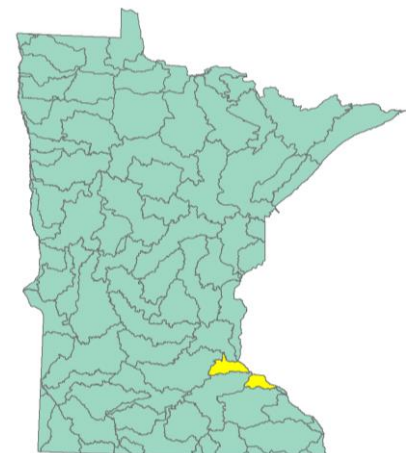


Figure 1. The Mississippi River-Lake Pepin Watershed. The Vermillion River Watershed is the northwestern half.

Water quality conditions did improve since the first intensive watershed monitoring in the Vermillion River Watershed as a result of collaborative efforts of local, state, and federal government entities as well as private landowners and organizations. However, the implementation of new rules and standards since then has resulted in seven total suspended solids (TSS), two DO, and one aluminum impairment.

For additional information on the updated conditions of the watershed, see the [Vermillion River Watershed-Lower Mississippi River Basin: Water Assessment and Trends Update](#). Further reporting addressing SID work in lakes will be provided by the Minnesota Department of Natural Resources.

Part 1: Vermillion River Watershed SID Summary Results

Cycle 1 (C1) and early SID reporting in the Vermillion River Watershed was expansive. Reaches studied include portions of Vermillion River, North Creek, Middle Creek, South Creek, South Branch Vermillion River, and other small tributaries within the watershed.

Cycle 2 Stream Biological Impairment Summary

- Six fish and five macroinvertebrate impairments were added due to revisions to water quality standards, allowing the assessment of channelized streams that were not assessed in 2011 or officially recognizing proposals made in 2011 to change aquatic life class designations (i.e., warm vs cold) of certain stream reaches.
- While many streams in the watershed are impaired for aquatic life, current fish and macroinvertebrate IBI scores suggest that conditions are improving.

Cycle 2 SID: Areas of focus

The Vermillion River Watershed is a small watershed that is part of the larger Mississippi River-Lake Pepin Watershed (HUC-8: 07040001) and the SID process focused on several areas to gain additional information. The following list of streams were studied during the SID process in C2 and are further detailed in this report. These streams were selected based on impairment status, previous SID work, and local stakeholder input. Some streams needed additional information to understand stressor connections, while others needed information on source assessment for prioritization.

- North Creek (07040001-670, -671)
- Unnamed Creek/Trib to Rice Lake (07040001-697)
- Unnamed Creek/Middle Creek (07040001-721)

Part 2: Cycle 2 Stressor Identification Stream Reaches

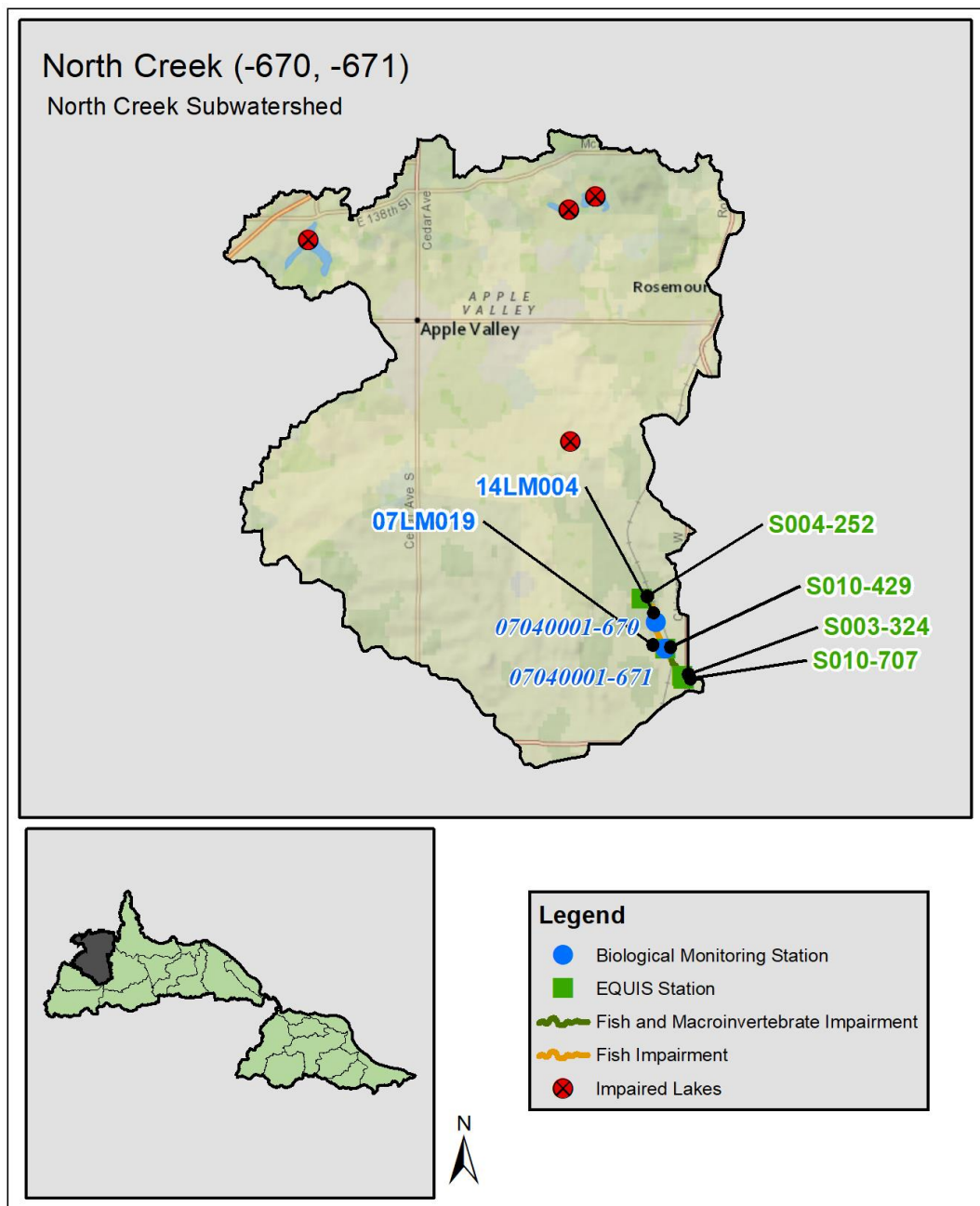
North Creek (07040001-670, -671)

Biological Community Summary

North Creek (-670, -671) is designated as impaired for aquatic life due to the fish community condition in the entire reach, while the macroinvertebrate community is also designated as impaired in the lower

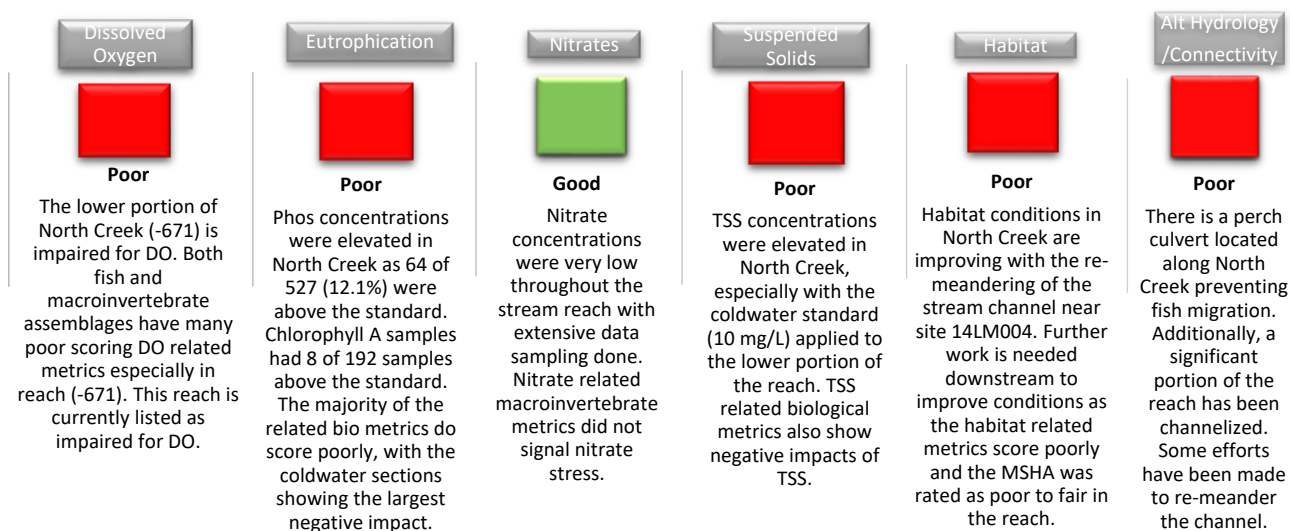
portion of the reach (-671). The upper portion of North Creek is a warmwater reach, while the lower portion is a coldwater reach. Coldwater reaches do have higher water quality standards.

The fish community in North Creek was sampled five times in the upper section (-670) from 2007 through 2018 at biological stations 07LM019 and 14LM004. The Fish IBI (FIBI) score at 07LM019 was 37.8 in 2007. Site 14LM004 had five FIBI scores ranging from 0 to 46.1 from sampling events from 2014 through 2020. The samples in 2018 and 2020 both had less than 25 fish sampled, severely limiting the FIBI score. A re-meandering of the upper portion of North Creek took place in 2008 in an effort to improve the habitat conditions and the FIBI scores.



What stressors are of concern?

SID work was not completed in North Creek during C1 SID. The goal of C2 SID work was to get additional information on DO, eutrophication, nitrates, TSS, and stream transparency. Stressors found in North Creek were DO, eutrophication, suspended solids, habitat, and altered hydrology/connectivity. Nitrate concentrations were low in this reach and are not a stressor at this time.



Summary of stream health in North Creek

Additional water chemistry information throughout North Creek has provided additional focus areas for DO, eutrophication, habitat, and altered hydrology/connectivity stress in North Creek. Prioritization of future work should consider these stressor impacts at various locations in the watershed.

- A DO impairment was identified during the assessment process. DO concentrations tend drop to harmful levels and fluctuate greatly, which negatively impacts aquatic life. The impacts of stormwater runoff (low flow, stagnant water) in North Creek tributaries (Figure 2) and potential runoff from nearby agricultural fields have likely contributed to these conditions. Best management practices to prevent phosphorus from entering the stream system in this section, as well as upstream, are needed.



Figure 2: Eutrophic tributary to North Creek.

- The upstream portion of North Creek is improving in terms of habitat conditions, as a large amount of restoration and the re-meandering of the channel has taken place (Figure 3). This work can take time to show the desired results. Further downstream, the reach is still channelized resulting in lower MPCA Stream Health Assessment (MSHA) scores. Limiting the habitat in this altered section is the surrounding land use (proximity to development and agricultural fields), light stream shading, sand and detritus substrates, severe embeddedness, and fair channel development.
- Altered hydrology/connectivity is a significant issue in North Creek. A field road culvert is perched (Figure 4) and acting as a fish barrier in this reach preventing fish from migrating upstream from the Vermillion River. Proper size and elevation of this culvert would improve FIBI scores upstream as well as improve habitat conditions. Additionally, continued re-meandering of the channelized sections will provide better flow consistency, reduce erosion and sediment issues, while also improve the general habitat conditions.



Figure 3: Re-meandering of upper portion of North Creek (-670).



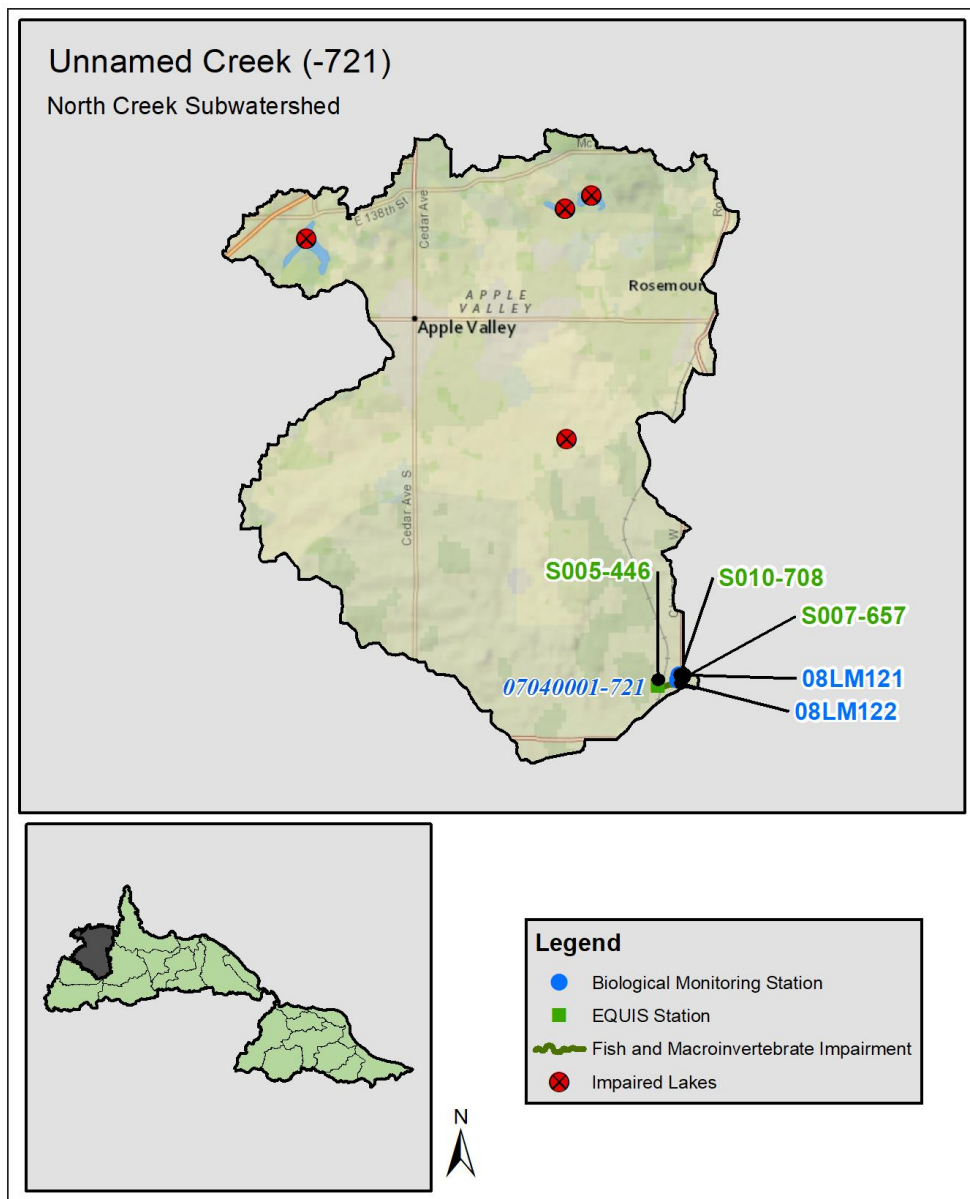
Figure 4: Perched culvert in North Creek preventing fish migration.

The upper portion of North Creek (-670) was re-meandered to eliminate some channelized portions. This restoration work has shown positive results so far as site 14LM004 was resampled for fish in 2020 and had a FIBI score of 46.1.

Unnamed Creek/Middle Creek (07040001-721)

Biological Community Summary

Unnamed Creek/Middle Creek (-721) is a 0.49 mile coldwater reach that is designated as impaired for aquatic life due to the fish and macroinvertebrate community conditions. The FIBI scores were 15.9 in 2008 and 25.3 during 2018 at site 08LM122, which were far below the FIBI class threshold of 50. The macroinvertebrate IBI (MIBI) scores at site 08LM122 were 26 in 2008 and 27 in 2018. These scores were both below their respective class thresholds.



What stressors are of concern?

SID work was not completed in Unnamed Creek/Middle Creek (Figure 5) during C1 SID. The goal of C2 SID work was to get additional water chemistry information on DO, eutrophication, nitrates, and stream transparency. Stressors found in this reach were DO and habitat. More information is needed to determine if eutrophication and suspended solids are stressors to the impaired biological communities, while nitrates and altered hydrology/connectivity were both ruled out as stressors.

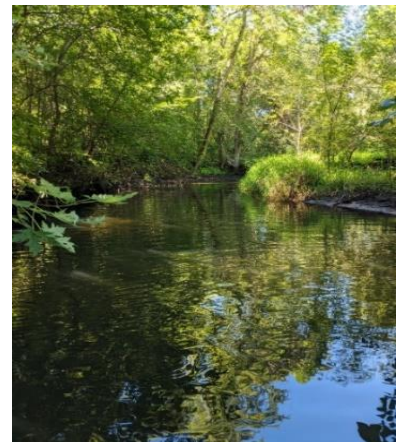
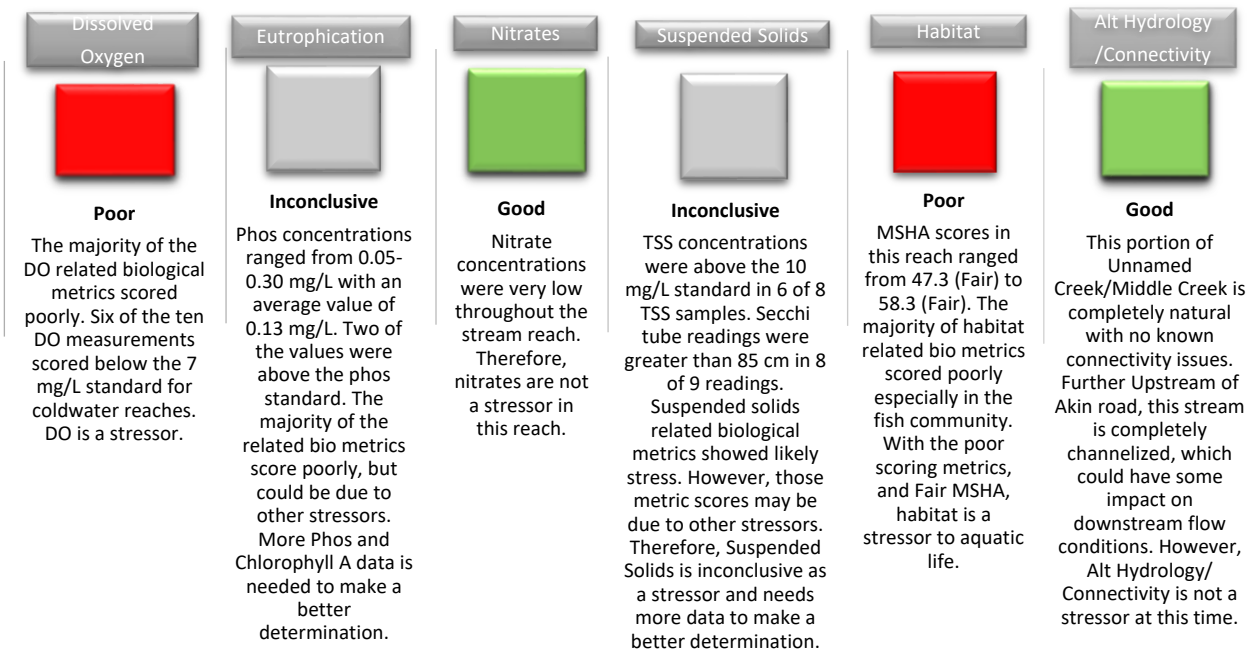


Figure 5: Unnamed Creek/Middle Creek at sampling site S007-657.



Summary of stream health in Unnamed Creek/Middle Creek

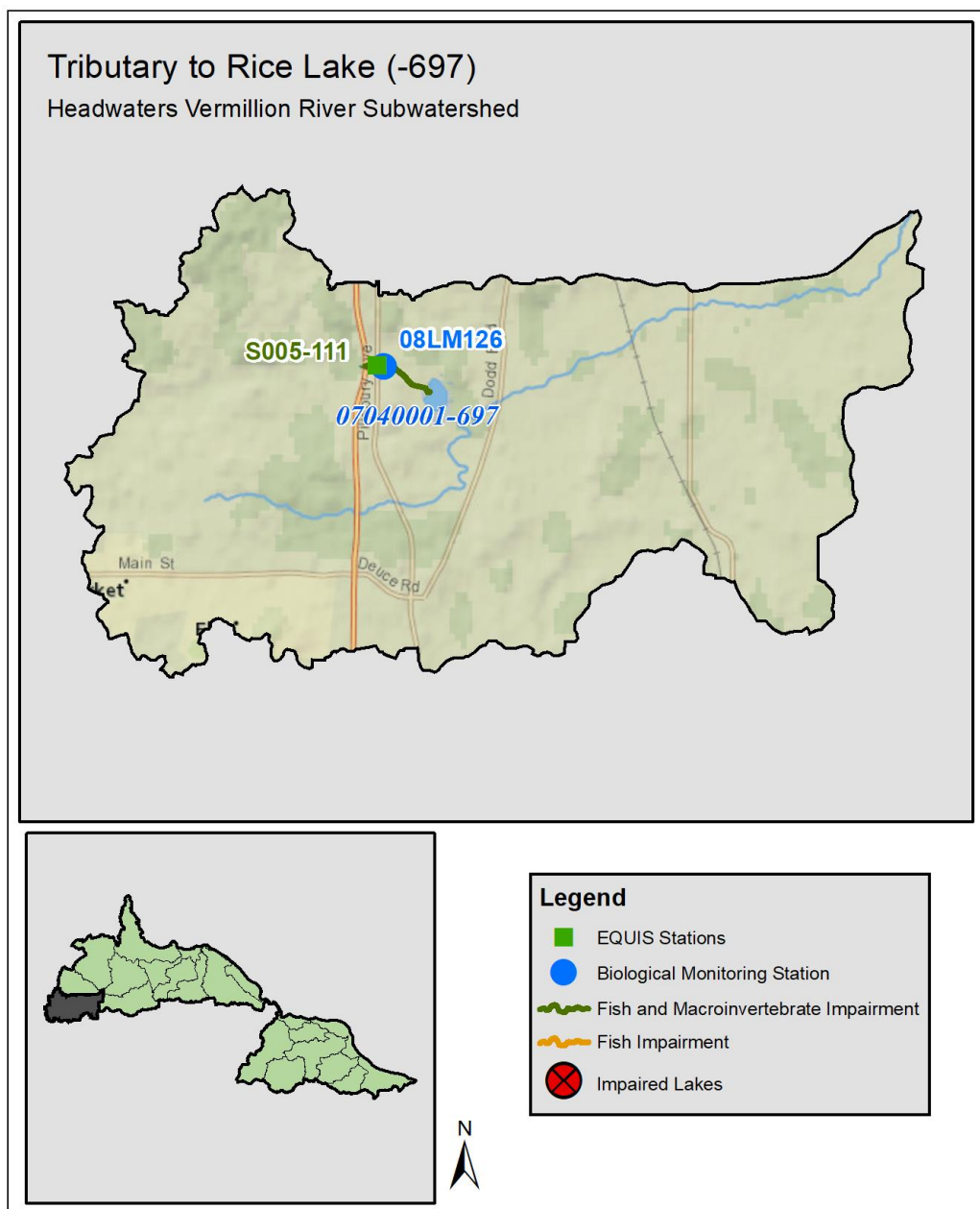
Additional biological and water chemistry information throughout Unnamed Creek/Middle Creek provided additional focus areas for DO, eutrophication, and habitat stressors. Suspended solids may be a potential stressor in the future. Prioritization of future work should consider these stressor impacts at various locations in the watershed.

- Low DO and eutrophication were issues in Unnamed Creek/Middle Creek. The proximity to row crop agriculture in the upstream portion of this reach, could be a source of the elevated phosphorus concentrations, which can lead to eutrophic conditions as well as lower DO values. Another potential source of the elevated phosphorus are the proximity of wetland areas in the upstream portion of the reach.
- Habitat conditions were considered to be fair in Unnamed Creek/Middle Creek. Limiting the habitat at site 08LM122 was the park and row crop surrounding land use, heavy bank erosion, presence of sand and silt substrates in some of the reach, moderate to severe embeddedness, sparse fish cover, and moderate channel stability. Habitat improvement projects could help further develop and provide more diversity to the biotic communities in this reach.
- Suspended Solids in Unnamed Creek/Middle Creek could potentially be an issue as well. The related biological metrics do score poorly, but that could be due to other major stressors like habitat. There is a large swing in transparency and TSS concentrations immediately following rainfall events.

Unnamed Creek/Trib to Rice Lake (07040001-697)

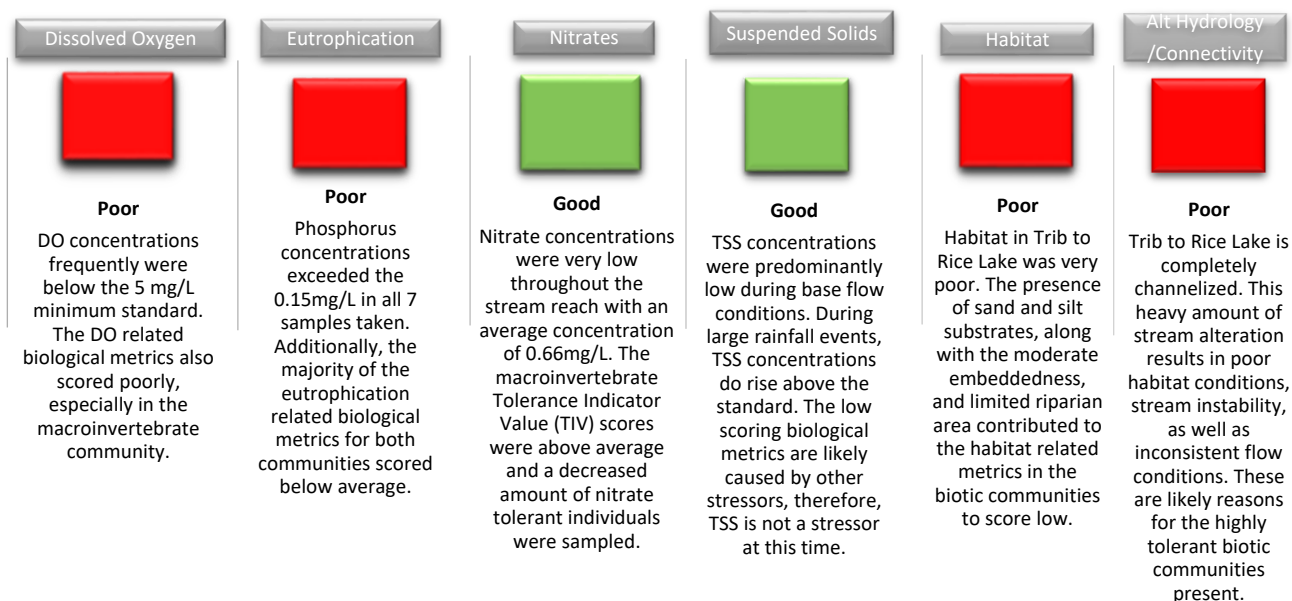
Biological Community Summary

Trib to Rice Lake (-697) is a 0.89 mile reach that is impaired for aquatic life use due to the low-scoring fish and macroinvertebrate assemblage scores. The lone biological monitoring site, 08LM126, located near CSAH-46, 3.5 miles SW of Lakeville had MIBI scores of 18 and 5, which are far below the class threshold of 30 leading to the impairment designation. The FBI in this reach was 35.7 in 2018. This is above the low gradient, modified use threshold of 15. However, the biological condition gradient of this stream was very poor indicating severe degradation and the fish community consisted of mainly tolerant black bullheads. Further monitoring of this community above the FBI could result in a de-listing of the impaired fish community.



What stressors are of concern?

SID work was not completed in Trib to Rice Lake during C1 SID. The goal of C2 SID work was to gather and analyze the biological and chemical data to determine the likely cause of stress to the impaired fish and macroinvertebrate communities. DO, eutrophication, habitat, and altered hydrology/connectivity were the identified stressors, while nitrates and suspended solids are not considered stressors to aquatic life at this time.



Summary of stream health in Trib to Rice Lake

Overall, Trib to Rice Lake (-697) is in poor health. The analysis of biological and water chemistry information throughout Trib to Rice Lake has provided additional focus areas for addressing eutrophication, DO, suspended solids, and habitat issues.

- The channelization of the entire stream reach likely contributes to the other stressors as well. The channelization and the low gradient nature of the reach allows for minimal flow causing an excess of silt and detritus to accumulate on the stream bed. This excess sediment covers potential coarse substrates and specialized habitats that intolerant species need to survive.
- Habitat conditions were very poor in Trib to Rice Lake. Across three visits, the MSHA (habitat) had an average score of 24. Limiting the habitat in this reach were the sand and silt substrates, the lack of coarse substrates, limited stream shading, no riffles, poor sinuosity and channel development as well as limited channel depth variability. Habitat improvement projects could help further develop and provide more diversity to the biotic communities in this reach.

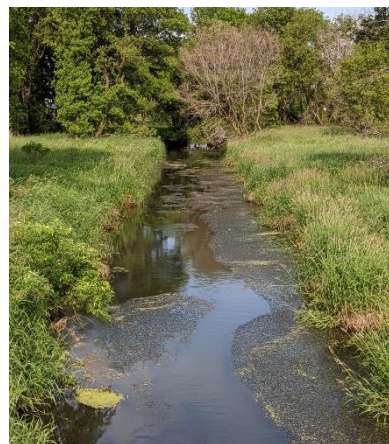


Figure 6: Eutrophic conditions in Trib to Rice Lake.

- DO and eutrophication (Figure 6) were also found to be stressors in this reach. High amounts of phosphorus in addition to the slow moving, low gradient nature of the stream are significant contributors to these issues.

Part 3: Conclusion and Recommendations

Summary of Stressors

The stressors for the biological impairments in the Vermillion River Watershed are listed in Table 1. The most common stressors in the watershed during C2 SID were DO (3) and Habitat (3). Flow Alteration/Connectivity (2) and Eutrophication were also significant issues, while Suspended Solids (1) is also an issue to be improved upon in the watershed. Nitrates were ruled out as a stressor in these reaches.

Table 1: Stressor determinations for the Vermillion River Watershed during Cycle 2 SID (2020) as well as previous SID work (2004-2011) completed in the watershed.

		Stressors	Dissolved Oxygen	Eutrophication	Nitrate	Suspended Solids	Habitat	Flow Alteration /Connectivity
Stream Name	AUID	Aquatic Life Impairment						
Cycle 2 SID (2020)								
North Creek	07040001-670, -671	Fish, Macroinvertebrates	●	●	---	●	●	●
Unnamed Creek/Middle Creek	07040001-721	Fish, Macroinvertebrates	●	○	---	○	●	---
Unnamed Creek/Trib to Rice Lake	07040001-697	Fish, Macroinvertebrates	●	●	---	---	●	●
Previous SID (2004-2011)								
Vermillion River	07040001-507	Fish, Macroinvertebrates	○	---	---	●	●	○
Vermillion River	07040001-517	Fish, Macroinvertebrates	●	---	---	●	●	○
Unnamed Creek	07040001-527	Fish, Macroinvertebrates*	●	---	---	●	●	○
Unnamed Creek (Vermillion River Trib.)	07040001-667	Fish	○	---	---	●	○	○
Unnamed Creek (Vermillion River Trib.)	07040001-668	Fish, Macroinvertebrates	○	---	---	●	●	○
Unnamed Creek (Vermillion River Trib.)	07040001-671	Fish, Macroinvertebrates*	●	---	---	●	●	○
Vermillion River	07040001-692	Fish	○	---	---	●	●	○
Vermillion River, South Branch	07040001-707	Fish, Macroinvertebrates*	○	---	○	●	●	○

● = stressor; ○ = inconclusive stressor; --- = not an identified stressor

* New C2 impairment

Recommendations and Additional Monitoring

In the Vermillion River Watershed, the most common stressors identified were DO, eutrophication, and habitat. These stressors are largely tied to land use activities in the watershed, as well as human-caused alterations to the stream channel and flow regime. Additionally, the low gradient and wetland-like areas are also contributing to these stressors by their inability to move water through the systems allowing sedimentation, poor habitat, low DO and eutrophic conditions. Table 2 contains recommendations of possible solutions to these stressors.

Table 2. Recommended prioritization of restoration activities relative to the stressors contributing to the biological impairment in the Vermillion River Watershed.

Stressor	Priority	Comment
Habitat	High	Re-establish quality riparian corridor to increase stream stability, and stream shading. Protecting streambanks, reduce erosion and overall stream sedimentation, as well as potentially re-meandering channelized stream sections, especially in North Creek.
DO and Eutrophication	High	Utilize a variety of nutrient reducing BMPs targeting headwater reaches and tributaries. Decreasing the nutrient load in these reaches will help raise and stabilize dissolved oxygen conditions in the impaired reaches.
Flow Alteration/Connectivity	High	Evaluate and remove/replace culverts that are perched and impeding fish movement, primarily the field road culvert in North Creek.
Suspended Solids	Medium	Focus on reducing sediment input from riparian corridor and immediate stream channel (stream banks).

For more information

The WRAPS development including necessary TMDL's follow the completion of the SID process. For more information about this watershed, go to

<https://www.pca.state.mn.us/water/watersheds/mississippi-river-lake-pepin>.

Details and specific monitoring information related to the SID analysis of this report is available, see contact person below.

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