SID Update

Turtle Creek Watershed

The purpose of Cycle 2 stressor identification (SID) work is to perform SID in a way that supports Cycle 2 watershed restoration and protection efforts, with an emphasis on meeting local partner needs, protection of biotic integrity, and identifying changes in biotic condition. Cycle 2 SID work will provide sharper focus in adding value to local partner implementation planning efforts. SID staff will seek to strengthen local partnerships and provide scientific analyses and recommendations in a format and timeframe that is most useful to local partners.

Turtle Creek Watershed was identified for Cycle 2 SID work via conversations with local partners and professional judgment from the Minnesota Pollution Control Agency (MPCA) staff. Factors that led to selection included:

- Limited chemistry data in the upper part of the watershed.
- Heavily channelized watershed.
- Turtle Creek Watershed is upstream of the city of Austin, which has a long history of flooding issues.

Goals for Cycle 2 SID work in Turtle Creek Watershed included:

- Summarize current chemical, biological, and physical conditions and identify changes between Cycle 1 (2009) and Cycle 2 (2019).
- Identify stressors and pollutant sources that are currently impacting biological communities and/or threaten future biological condition.
- Identify any “hot spots” or areas contributing a disproportionate amount of a pollutant.
- Identify and prioritize restoration areas.
- Provide value to local planning efforts.

Cycle 1 SID Summary:

- Cycle 1 SID was only conducted on the lower portion of Turtle Creek (AUID -540) and Unnamed Creek (AUID -547); most stream reaches were deferred (not assessed) in Cycle 1 due to channelization.
- Habitat, nitrate, dissolved oxygen (DO), phosphorus, total suspended solids (TSS), and flow alteration were identified as stressors in Cycle 1 on Turtle Creek (AUID -540). Additional biology and chemistry data collected after Cycle 1 resulted in inconclusive Cycle 2 stressor determinations for nitrate, eutrophication, DO, and habitat; TSS and flow alteration were confirmed as stressors in Cycle 2.

- Flow alteration was the only identified stressor in Cycle 1 on Unnamed Creek (AUID -547). No new biology or chemistry data has been collected on Unnamed Creek (AUID -547); therefore, no Cycle 2 SID was conducted.

This SID update document summarizes biological condition and provides monitoring highlights and stressor conclusions for Turtle Creek Watershed.

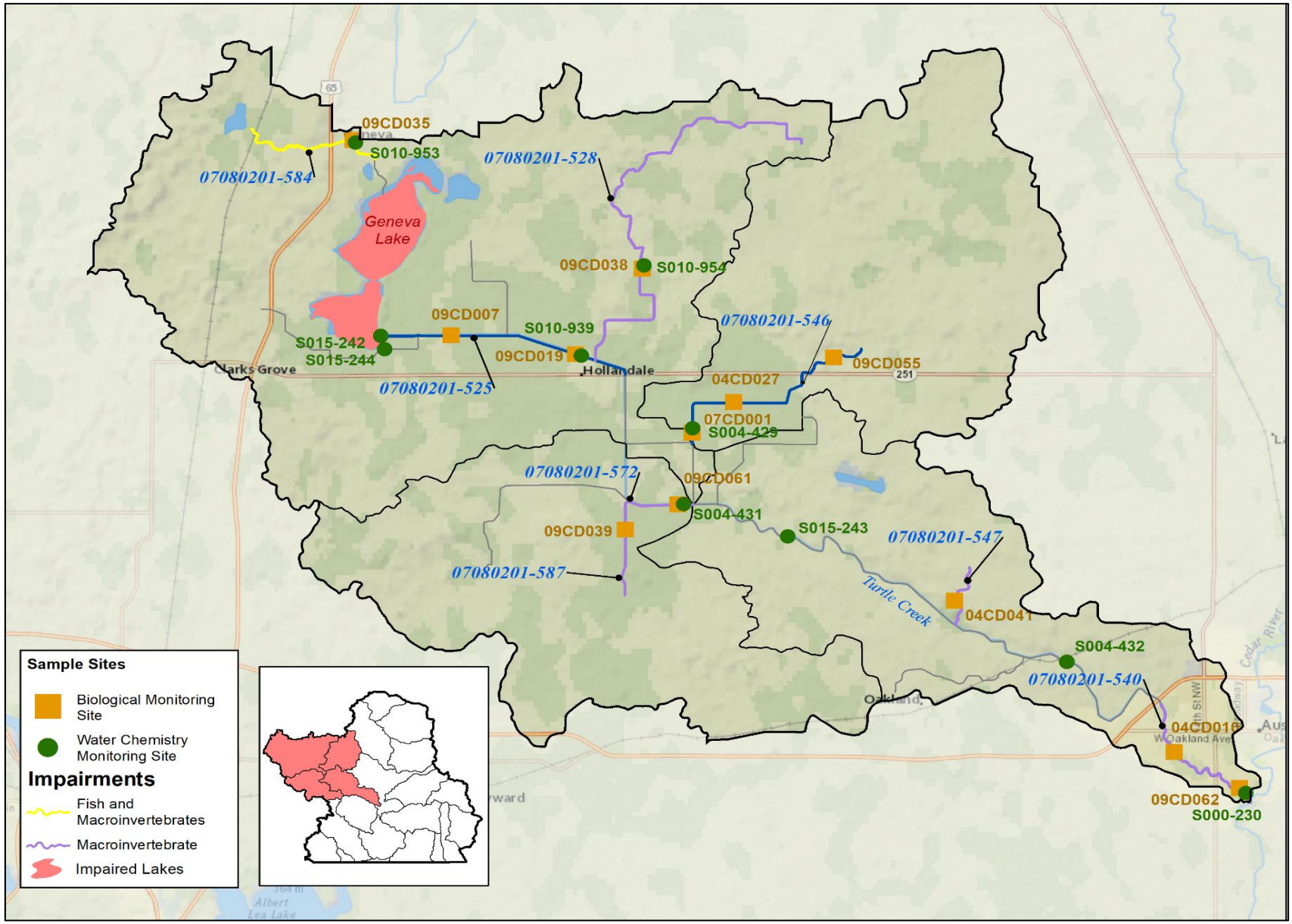
Biological Communities

Fish and macroinvertebrate communities in the Turtle Creek Watershed are impaired and do not meet standards (Table 1, Figure 1). Fish Index of Biological Integrity scores (FIBI) and macroinvertebrate IBI scores (MIBI) were mixed between Cycle 1 and Cycle 2; some scores increased and some decreased. Stations 07CD001 and 09CD061 received Cycle 2 MIBI scores of zero since there was no macroinvertebrate habitat available to sample. Caddisflies, amphipods, and midges were the most abundant macroinvertebrates in Cycle 2; yellow perch, black bullhead, fathead minnow, and green sunfish were some of the most abundant fish species in Cycle 2. Stations 09CD038 (AUID -528), 04CD041 (AUID -547), 09CD061 (AUID -572), and 09CD039 (AUID -587) have macroinvertebrate impairments, and station 09CD035 (AUID -584) has fish and macroinvertebrate impairments. The stream reach including stations 04CD010 and 09CD062 (AUID -540) has a macroinvertebrate impairment, but the Cycle 1 fish listing was removed ("corrected") based on new data from Cycle 2 and re-evaluation of the original listing. In summary, many of the biological communities in the Turtle Creek Watershed are degraded and do not meet goals.

Table 1: Fish and macroinvertebrate IBI scores in Turtle Creek Watershed; only stations that were sampled in Cycle 2 and/or have a biological impairment were included.

Waterbody	AUID	Biological Stations	Biological Impairment	Class	FIBI	FIBI Threshold	FIBI Year	MIBI	MIBI Threshold	MIBI Year
Turtle Creek	525	09CD007		2Bm	33.4	35.0	2009	28.4	30.0	2009
		09CD019			45.0	35.0	2009	43.3	30.0	2009
					67.9		2019	49.2		2019
					59.1		2019			
Mud Creek	528	09CD038	Macroinvertebrates	2Bm	40.0	33.0	2009	21.8	30.0	2009
Turtle Creek	540	04CD010	Macroinvertebrates	2Bg	44.8	50.0	2004	31.4	43.0	2004
					60.8		2012	57.2		2012
		09CD062			67.4	50.0	2009	34.7	37.0	2009
					64.3		2019	18.8		2019
Deer Creek	546	04CD027		2Bm	25.9	33.0	2004	29.3	30.0	2004
					44.0		2004			
		07CD001			42.4	35.0	2007	47.8	30.0	2009
					38.0		2009	37.4		2009
					35.7		2019	0.0		2019
		09CD055			51.9	33.0	2009	39.7	30.0	2009
Unnamed Creek	547	04CD041	Macroinvertebrates	2Bg	63.6	55.0	2004	35.2	37.0	2004
								34.6		2012
Unnamed Creek	572	09CD061	Macroinvertebrates	2Bm	31.5	15.0	2009	17.6	30.0	2009
					35.2		2019	0.0		2019
County Ditch 8	584	09CD035	Fish, Macroinvertebrates	2Bg	24.8	55.0	2009	40.3	43.0	2009
Judicial Ditch 24	587	09CD039	Macroinvertebrates	2Bm	35.7	15.0	2009	23.6	30.0	2009

Figure 1: Turtle Creek Watershed chemistry and biology monitoring stations and biological impairments.



Monitoring Highlights

Stream Temperature

- Several instantaneous (point) measurements were collected throughout the watershed over the last decade (2011 through 2020), and all were below 30 °C (daily average warmwater standard). Also, stream temperatures during sonde deployments in 2019 were suitable for warmwater biota, but station S010-939 (just downstream of Geneva Lake near Hollandale) did have very brief periods during which temperature exceeded 30 °C.

Nitrate

- Nitrate samples were collected across the watershed at nine stations as part of Cycle 2 SID in 2019, with a goal to sample various flow conditions and establish a range of nitrate concentrations (Figure 2). Concentrations ranged from 0.05 to 10 mg/L (average of 4.2 mg/L), and 0 of the 70 samples were above 10 mg/L. In general, concentrations were highest in the spring, decreased late summer into early fall, eventually returning to "spring-like" concentrations later in the fall. Station S010-954 had the highest concentration (10 mg/L) and average (6.9 mg/L), while concentrations at the outflow of Geneva Lake (S015-242) were always low (< 1 mg/L). The watershed areas upstream of stations S010-954, S004-429, and S004-431 stand out as priority areas for nitrate reduction; concentrations are consistently moderate to elevated and higher than other stations sampled. Average nitrate concentrations at these three stations ranged from 6.0 to 6.9 mg/L, while averages at the remaining stations ranged from 0.3 to 5.2 mg/L (Table 2). These three watersheds also have the highest percentage of cultivated crop acres (84% to 95%) compared to the other watersheds (67% to 84%), which is a potential explanation for the higher nitrate concentrations; differences in nutrient management practices, soils, tile drainage, feedlots, and Geneva Lake are also factors impacting concentrations. In general, nitrate concentrations were moderate to elevated across the Turtle Creek Watershed and nitrate tolerant macroinvertebrates were abundant. Concentrations were very low leaving Geneva Lake (likely due to denitrification and/or plant uptake) and increased gradually moving downstream Turtle Creek, until they eventually decreased slightly from the middle portion to mouth (from station S015-243 to S000-230). Elevated concentrations were documented in the ditches feeding Turtle Creek (Mud Creek (S010-954), Deer Creek (S004-429), and Unnamed Creek (S004-431)).

  Nitrate concentrations across the watershed over the last decade (2011 through 2020) ranged from 0.05 to 28.2 mg/L (average of 7.3 mg/L, 712 samples); 168 samples (24%) were above 10 mg/L. The lower portion of Turtle Creek (station S004-432) was sampled routinely over this time period, with concentrations decreasing in recent years (Figure 3). The highest concentrations occurred in 2013, which was a wet year following a drought year in 2012; drought years can result in an abundance of un-utilized nitrogen in the soil profile, which is available to leach in subsequent years. Nitrate concentrations decreased following 2013 as they returned to more "normal" concentrations.

TP/ Eutrophication

- Total phosphorus (TP) samples were collected across the watershed at 9 stations as part of Cycle 2 SID in 2019, with a goal to sample various flow conditions and establish a range of TP concentrations (Figure 2). Concentrations ranged from 0.036 to 0.496 mg/L (average of

0.153 mg/L), and 27 (39%) of the 70 samples exceeded the river eutrophication standard for the South Region (0.15 mg/L). Each station had at least 1 exceedance, and exceedances occurred during low flow and elevated flow conditions. Low concentrations have been documented, but in general TP concentrations are moderate to elevated across the watershed. Geneva Lake outflow concentrations were typically below the standard, but the lake is impaired for nutrients and a likely contributor to low DO conditions documented downstream.

TP concentrations across the watershed over the last decade (2011 through 2020) ranged from 0.024 to 3.16 mg/L (average of 0.216 mg/L, 674 samples); 332 samples (49%) were greater than 0.15 mg/L. In addition to elevated TP concentrations, low DO and elevated DO flux, chlorophyll-*a*, and BOD have also been documented in the watershed. Chlorophyll-*a* concentrations ranged from 1 to 35.8 µg/L (10 samples, average of 12.2 µg/L), and BOD concentrations ranged from 1.4 to 4.6 mg/L (8 samples, average of 2.7 mg/L). One chlorophyll-*a* sample (35.8 µg/L) exceeded the standard (35 µg/L), and two BOD samples (4.5 mg/L and 4.6 mg/L) exceeded the standard (3 mg/L); all exceedances occurred in the summer of 2019 just downstream of Geneva Lake near Hollandale (S010-939). Sonde deployments in 2019 resulted in 2 out of the 4 stations (S010-939 and S004-431) having brief exceedances of the daily DO flux standard (4.5 mg/L).

DO

- Several instantaneous (point) DO measurements were collected throughout the watershed over the last decade (2011 through 2020), and 7 (2%) were below 5 mg/L (warmwater DO standard). This dataset also includes very high DO (max of 24.9 mg/L), which is often associated with eutrophic conditions (via photosynthesis). In addition, field work in late summer 2021 identified low DO in County Ditch 8 (1.9 mg/L and 3.8 mg/L) and Mud Creek (0.5 mg/L and 4.2 mg/L). Sonde deployments in 2019 also documented low DO (minimum of 1.3 mg/L) at station S010-939 (just downstream of Geneva Lake near Hollandale); DO concentrations got below the standard 9 out of the 21 days of deployment. Sondes were deployed late June through mid-July of 2019 at 4 stations in the Turtle Creek Watershed; station S010-939 was the only station where low DO (<5 mg/L) was documented. In general, low DO tolerant fish and macroinvertebrates were common across the Turtle Creek Watershed.

TSS

- Total suspended solids (TSS) samples were collected across the watershed at 9 stations as part of Cycle 2 SID in 2019, with a goal to sample various flow conditions and establish a range of TSS concentrations (Figure 2). Concentrations ranged from 4.4 to 200 mg/L (average of 41.8 mg/L), and 12 (17%) of the 71 samples exceeded the warmwater TSS standard (65 mg/L). All stations except S010-953 and S015-242 had at least 1 exceedance; exceedances occurred during both low flow and elevated flow conditions. In general, TSS concentrations were low entering and leaving Geneva Lake (S010-953 and S015-242). After leaving the lake, concentrations increased in the upper portion of Turtle Creek (S010-939 and S015-243) but then decreased in the lower portion (S000-230). Concentrations in the Turtle Creek tributaries (S015-244, S010-954, S004-429, and S004-431) were generally low (below the standard). TSS concentrations increased significantly near Hollandale (S010-939), highlighting the need for sediment reduction upstream; the Cedar WRAPS and CWMP also identify this area as having some of the highest sediment loading rates in the entire Cedar

River Watershed (Figure 4). Also, most of main stem Turtle Creek is impaired for TSS/ turbidity and TSS tolerant fish and macroinvertebrates were common across the watershed.

TSS concentrations across the watershed over the last decade (2011 through 2020) ranged from 2 to 1,000 mg/L (average of 49.7 mg/L, 709 samples); 121 samples (17%) were greater than 65 mg/L.

Habitat

- The MPCA Stream Habitat Assessment (MSHA) scores throughout the watershed range from 15.5 ("poor") to 77.1 ("good"), with most falling in the "poor" range. Channelization is common in the Turtle Creek Watershed, and often associated with poor habitat quality and limited availability; fine substrates typically dominate channel beds reducing the amount of coarse substrate available. Habitat examples from biological monitoring in 2019 can be seen in Figure 5; stations 07CD001 and 09CD061 received Cycle 2 MIBI scores of zero because there was no macroinvertebrate habitat available to sample. Also, most macroinvertebrate and fish metrics are indicative of habitat stress; many stations have elevated burrowers and legless individuals, reduced clingers, limited riffle species, and an abundance of tolerant species.

Fish Passage

- There were no obvious fish barriers identified on County Ditch 8 during a survey in August 2021; County Ditch 8 was the only stream reach evaluated for fish passage as it's the only AUID with a fish impairment. However, low flows and a culvert with a small perch (780th Avenue) were observed; it's possible that both could impact fish passage during certain years/time periods.

Flow Alteration

- The Turtle Creek Watershed is dominated by ditch systems. Channelization is often associated with poor habitat, an abundance of fine substrate, excess nutrients and productivity (Figure 6), altered DO regimes (low DO and high DO flux), and minimal flow time periods. Tile drainage is also common in these landscapes and typically a large source of the nitrogen load.

Figure 2: 2019 TSS (brown box plots), TP (purple box plots), and nitrate (green box plots) concentrations (mg/L) in Turtle Creek Watershed. The red lines represent the TSS standard (65 mg/L), river eutrophication standard for the South Region (0.15 mg/L), and nitrate drinking water standard (10 mg/L).

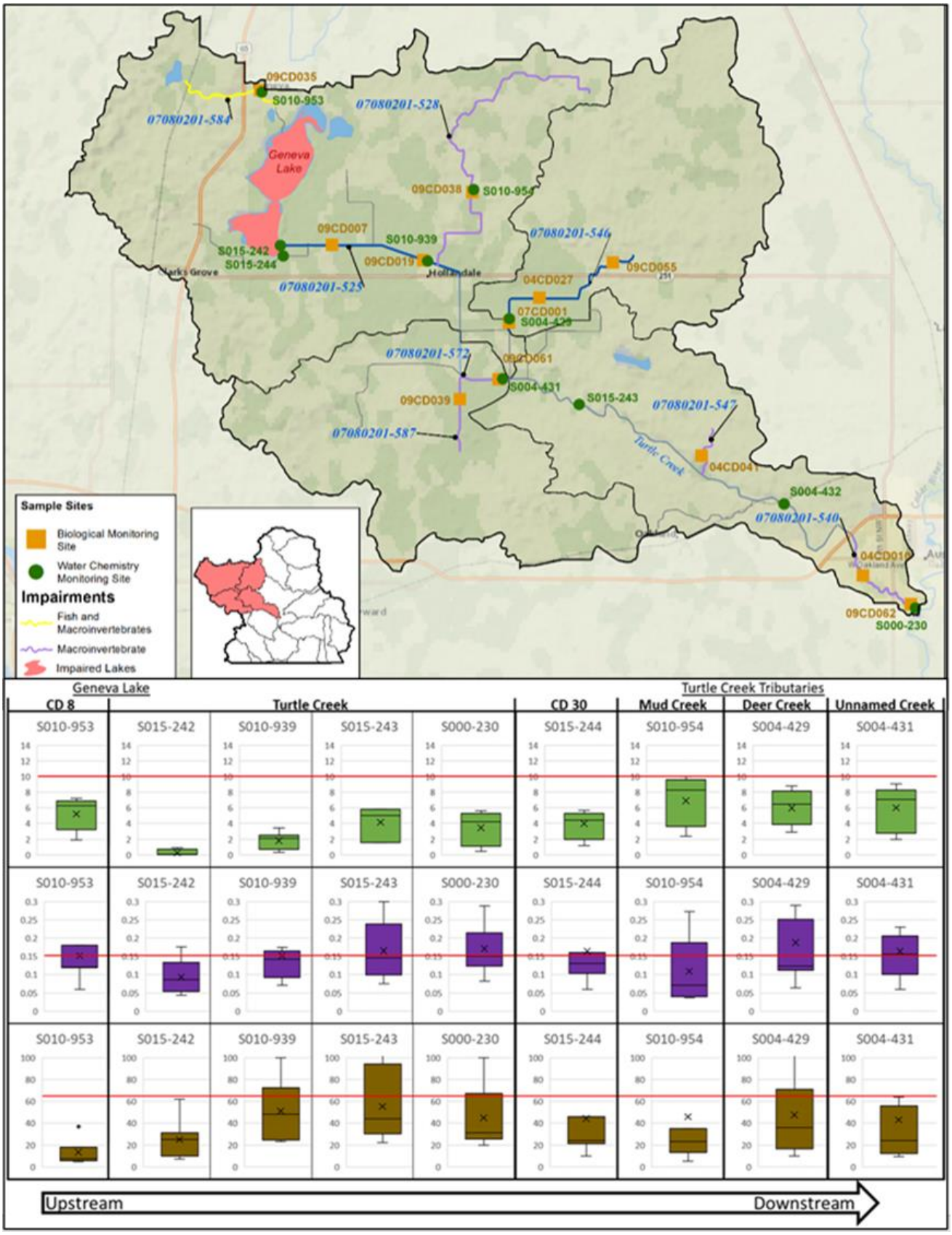


Table 2: Average nitrate concentrations (mg/L) and approximate drainage area (acres) and cultivated crops (%) for monitoring stations in Turtle Creek Watershed.

	S010-953	S015-242	S015-244	S010-939	S010-954	S004-429	S004-431	S015-243	S000-230
Average N (mg/L)	5.2	0.3	4.0	1.8	6.9	6.0	6.0	4.2	3.4
Drainage Area (acres)	6,254	13,571	6,913	30,105	6,184	19,771	18,714	85,038	98,074
Cultivated Crops (%)	84	67	82	78	95	84	89	83	80

Figure 3: Nitrate concentrations (mg/L) at station S004-432 over the last decade (2011 through 2020). The highest concentrations occurred in 2013, which was a wet year following a drought year in 2012; drought years can result in an abundance of unutilized nitrogen in the soil profile, which is available to leach in subsequent years. Nitrate concentrations decreased following 2013 as they returned to more "normal" concentrations. The red lines represent the nitrate drinking water standard (10 mg/L).

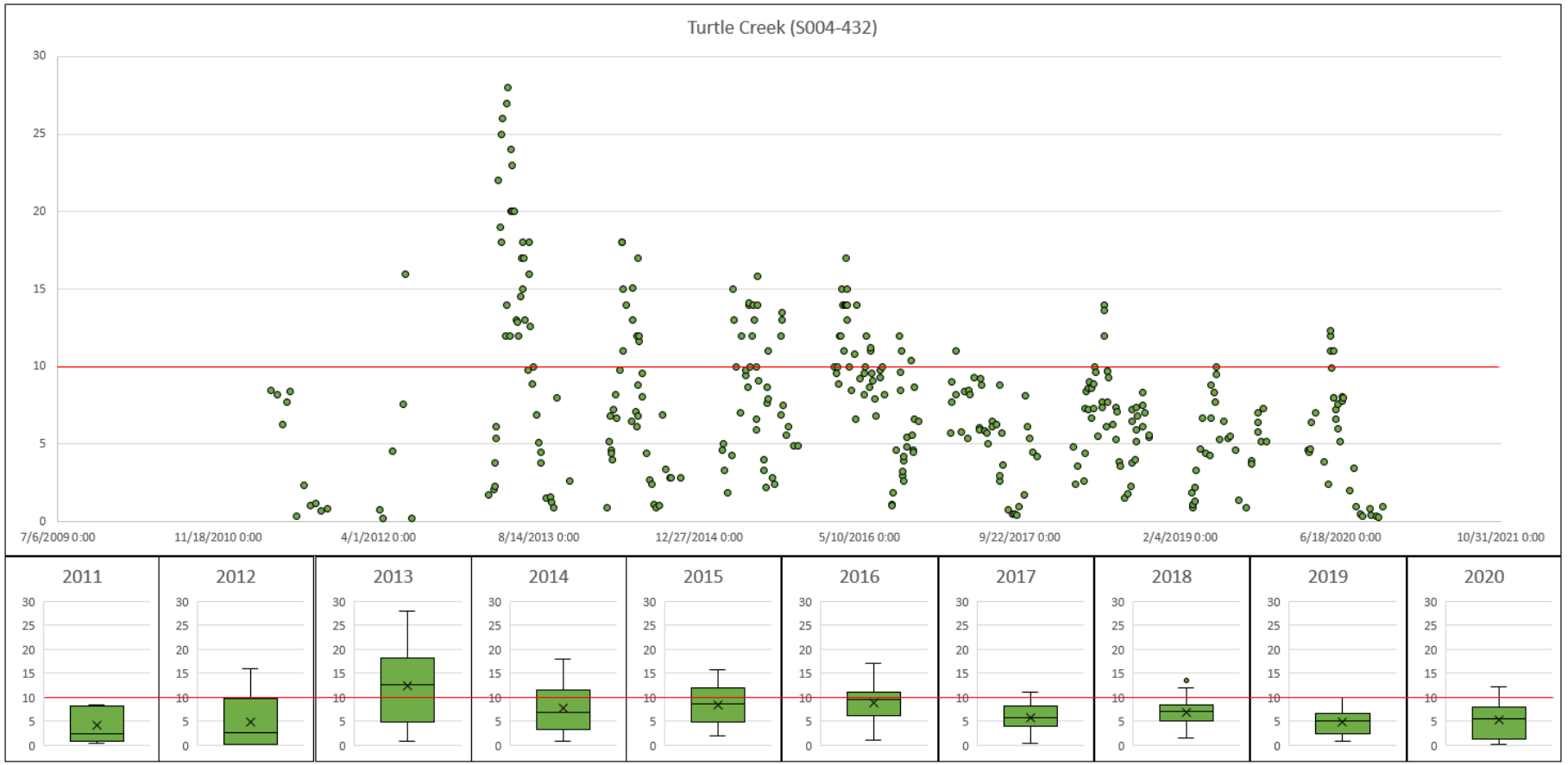


Figure 4: Sediment loading figures taken from the Cedar WRAPS (left) and CWMP (right). The red circles weren't part of the original figures, but were added to highlight the upper portion of Turtle Creek as one of the highest sediment loading areas in the entire Cedar River Watershed.

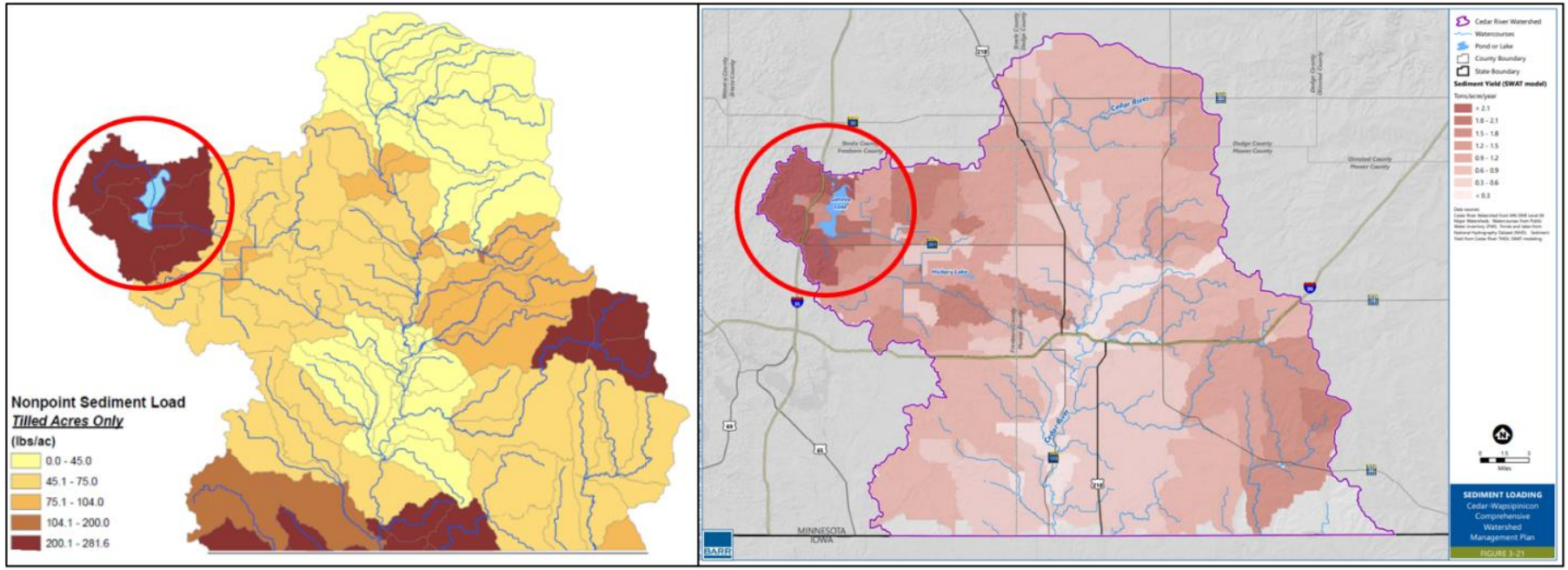


Figure 5: Habitat examples from biological monitoring stations in the Turtle Creek Watershed in 2019. Stations 09CD019, 07CD001, and 09CD061 are located in the upper portion of the watershed on channelized reaches and have "poor" habitat; station 09CD062 is located near the mouth of Turtle Creek on a natural stream section and has "good" habitat. Natural streams generally provide much better habitat for fish and macroinvertebrates than altered streams (i.e. channelized ditches) via coarse substrate, woody debris, overhanging vegetation, and diverse stream features (i.e. riffles, pools, and runs); many of these characteristics are absent and/or limited in altered streams. Stations 07CD001 and 09CD061 received Cycle 2 MIBI scores of zero because there was no macroinvertebrate habitat available to sample.

Figure 6: Examples of eutrophic and low flow conditions in the Turtle Creek Watershed in 2021.

Summary

- Nitrate, TSS, habitat, and flow alteration are stressing the biology in the Turtle Creek Watershed (Table 3), while stream temperature is not currently a stressor and eutrophication, DO, and fish passage are inconclusive.
- Flow alteration has significant influence in the Turtle Creek Watershed. Nitrate and habitat in particular are impacted by flow alteration through tile drainage and channelization. The Turtle Creek Watershed is dominated by ditch systems. Channelization is often associated with poor habitat, an abundance of fine substrate, excess nutrients and productivity, altered DO regimes (low DO and high DO flux), and minimal flow time periods. Tile drainage is also common in these landscapes and typically a large source of the nitrogen load. All of these characteristics associated with channelization exist in the Turtle Creek Watershed.
- Data suggest that water leaving Geneva Lake has generally low (below standards) TSS, TP, and nitrate concentrations. However, the lake is impaired for nutrients and is a probable source of low DO as low DO exceedances have been documented just downstream of the lake. These exceedances are likely linked to plant and/or algal production in the lake. Very low flow conditions, which are common during summer/fall in drainage ditches, may also be driving low DO periods and environments. It should be noted that a drawdown occurred in 2019 on Geneva Lake, which may have impacted monitoring results.
- In general, stream/ditch TP concentrations were elevated with numerous exceedances, and low DO (and very high DO) has been documented as well as excess productivity. However, eutrophication and DO are inconclusive stressors at this time as their impact on biology is unclear due to limited data, mixed response between chemistry and biology data, ambiguous data, and/or the potential for other stressors to be driving the biological response. Regardless of current stressor status, reducing phosphorus loading to surface waters in Turtle Creek Watershed is necessary as TP concentrations are elevated and often exceed the standard. Eutrophication and low DO are likely impacting biology to some degree during low flow time periods, especially in the upper part of Turtle Creek (just downstream of Geneva Lake) and the upper ditch tributaries that flow into Turtle Creek.
- The watershed areas upstream of stations S010-954, S004-429, and S004-431 stand out as priority areas for nitrate reduction; concentrations are consistently moderate to elevated and higher than other stations sampled. This document is designed to complement existing Cedar River Watershed Reports (e.g., the Cedar River Watershed Restoration and Protection Strategy (WRAPS) and Cedar-Wapsipinicon Comprehensive Watershed Management Plan (CWMP), which should also be used to inform prioritization; these documents contain information such as priority issues, priority areas, and pollutant loading data, which are critical in prioritizing implementation work.
- Elevated TSS concentrations have been documented and most of main stem Turtle Creek is impaired for TSS/turbidity, but only the lower portion of Turtle Creek (stations 04CD010 and 09CD062, AUID -540) has a conclusive TSS stressor. Although often inconclusive as a stressor, signals of TSS stress exist but there is limited data and/or concern that the biological response may be due to another stressor(s). Regardless, sediment is a concern via habitat loss and

degradation from an abundance of fine substrate and embeddedness. TSS concentrations increased significantly near Hollandale (S010-939), highlighting the need for sediment reduction upstream; the Cedar WRAPS and CWMP also identify this area as having some of the highest sediment loading rates in the entire Cedar River Watershed (Figure 4).

- No obvious fish barriers were identified on County Ditch 8 during a survey in August 2021. However, low flows and a culvert with a small perch (780th Avenue) were observed; it's possible that both could impact fish passage during certain years/time periods.
- Overall, reducing nutrient and sediment loading, improving in-stream habitat and DO conditions, and addressing flow alteration related issues (e.g., poor habitat, fine substrate, nitrogen rich tile water, etc.) are critical to improve fish and macroinvertebrate health in the Turtle Creek Watershed.

Table 3: Summary of stressors in the Turtle Creek Watershed (• = stressor, ○ = inconclusive stressor, blank = not a stressor, NE = not evaluated).

Waterbody	AUID	Biological Stations	Biological Impairment	Class	Stressors							
					Temperature	Nitrate	Eutrophication	DO	TSS	Habitat	Fish Passage	Flow Alteration
Mud Creek	528	09CD038	Macroinvertebrates	2Bm		●	○	○	○	●	NE	●
Turtle Creek	540	04CD010, 09CD062	Macroinvertebrates	2Bg		○	○	○	●	○	NE	●
Unnamed Creek	547	04CD041	Macroinvertebrates	2Bg	NE[C1]	○[C1]	○[C1]	○[C1]	○[C1]	[C1]	NE[C1]	● [C1]
Unnamed Creek	572	09CD061	Macroinvertebrates	2Bm		●	○	○	○	●	NE	●
County Ditch 8	584	09CD035	Fish, Macroinvertebrates	2Bg		●	○	○		●	○	●
Judicial Ditch 24	587	09CD039	Macroinvertebrates	2Bm		●	○	○	○	●	NE	●

C1 = Cycle 1 (C1) stressor conclusions. This AUID was assessed (not deferred) C1 and C1 SID was performed; no new data (biology or chemistry) has been collected therefore no Cycle 2 (C2) SID was conducted.

For more information

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

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