2024–2025 Stream Monitoring: North Branch of Bassett Creek

The Bassett Creek Watershed Management Commission (BCWMC) monitored the North Branch of Bassett Creek for water depth, flow, temperature, specific conductance, and water quality during 2024 and 2025. In 2024, the BCWMC monitored macroinvertebrates (bottom dwelling organisms like bugs and snails) and habitat. Macroinvertebrate data were used to assess overall community health through a biotic index, which evaluates selected community attributes, assigns scores to each, and sums the scores to produce an overall stream health score. This report presents the results of these monitoring efforts.

North Branch of Bassett Creek	
Stream length (miles)	4.6
Size of drainage area (acres)	2,578
Location of stream origin	Plymouth (origin), New Hope, Crystal
Downstream receiving waterbody	Ȟaȟá Wakpádaŋ/Bassett Creek
MPCA impairments	*Escherichia coli*

1. Summary

The BCWMC completed monitoring on the North Branch of Bassett Creek in 2024–2025. Monitoring activities included:

- Collecting macroinvertebrate and habitat data from the stream in 2024.
- Gathering water depth and flow measurements, continuous temperature and specific conductance readings, instantaneous pH and dissolved oxygen levels, and water quality samples during 2024 and 2025.
- Collecting continuous dissolved oxygen and temperature data during the summers of 2024 and 2025.

The 2024–2025 monitoring program represents an ongoing effort by the BCWMC to conduct long-term assessments of the North Branch of Bassett Creek. Previous monitoring efforts included:

- Collecting habitat data from the stream in 2015 and 2018.
- Sampling macroinvertebrates on 11 occasions between 1980 and 2018.
- Gathering water depth and flow measurements, continuous temperature, and specific conductance readings in 2018–2019.
- Collecting water quality samples in 2018–2019.

The objectives of this stream monitoring are to assess flow and water quality, identify temporal changes, evaluate compliance with Minnesota

Pollution Control Agency (MPCA) water quality and biological standards, and determine stressors affecting the biological community.

Monitoring results indicate that the North Branch of Bassett Creek does not meet MPCA standards for *E. coli* bacteria, chlorides, total suspended solids, or river eutrophication standards (RES), which include total phosphorus, chlorophyll *a*, and dissolved oxygen fluctuations (DO flux). However, MPCA standards were achieved for temperature, pH, dissolved oxygen, and metals (including total cadmium, chromium, copper, nickel, lead, and zinc).

Between 1980 and 2024, BCWMC collected benthic macroinvertebrates (bottom-dwelling organisms) from the North Branch of Bassett Creek on 12 occasions. The purpose of this sampling was to evaluate water quality and detect changes over time. Water quality monitoring often gives us small snap shots of conditions at the exact time of data collection. However, macroinvertebrates (e.g., aquatic bugs) live in the water during all or part of their life cycles. Some bugs can tolerate poor conditions like warm temperatures and low oxygen levels, while other species can only survive in streams with good water quality. Assessing the types and numbers of bugs in the stream provides insight on its water quality along with the overall ecological health of the creek.

The 2015, 2018, and 2024 monitoring programs also included habitat evaluations.

The Macroinvertebrate Index of Biotic Integrity (M-IBI) was used to assess the health of the macroinvertebrate community. Developed by the MPCA and incorporated into Minnesota's water quality standards, the M-IBI identifies biologically impaired rivers and streams. From 1980 to 2024, M-IBI scores for the North Branch ranged from 11 to 36; none met the MPCA impairment threshold of 37. The 2024 M-IBI score was 18, a modest increase from the 2018 score of 16, suggesting a slight improvement in macroinvertebrate community health during this timeframe.

A stream restoration project on the North Branch of Bassett Creek (completed in 2012–2013) improved water quality and aquatic habitat. After completion, the M-IBI score rose from 19 (2009) to 30 (2015). The main improvement was an increase in the proportion of clinger taxa (organisms that adhere to rocks or other substrates to resist displacement by stream flow), suggesting reduced sediment deposition in the stream. Following the project's completion, five IBI metrics improved in 2015 and then progressively worsened in 2018 and 2024. A sixth metric score remained unchanged following the completion of the stream restoration project; however, it declined from 5.7 in 2015 to 1.4 in 2024. The 2024 MIBI score was 18, which falls short of the requirement.

2. Recommendations

Because the North Branch of Bassett Creek did not meet MPCA standards for *E. coli* bacteria, chlorides, total suspended solids, or RES from 2018 through 2025, and because 1980–2024 M-IBI scores fell below the MPCA impairment threshold, the following actions are recommended:

- Evaluate the sources of elevated total suspended solids, *E. coli,* total phosphorus, and chlorophyll *a* in the stream, and develop strategies to improve water quality and support attainment of MPCA standards. The ongoing Total Maximum Daily Load (TMDL) study for Northwood Lake will identify the main sources of phosphorus loading within a portion of the North Branch watershed and recommend targeted pollution reduction projects. Implementing these projects is expected to lower total phosphorus and chlorophyll *a* levels, improve overall stream water quality, and have a positive effect on the stream's M-IBI score.
- Maintain ongoing initiatives aimed at reducing chloride (deicing salt) usage in the watershed, such as encouraging the Smart Salting Level 1 Certification course and requiring newly permitted properties to implement a chloride management plan.
- Review the stream corridor for erosion issues and develop and implement management solutions to address and repair these areas.

- Enhance habitat conditions within the North Branch of Bassett Creek to increase the stream's M-IBI score. Recommended strategies include integrating overhanging, submerged, and emergent vegetation, along with woody debris.
- Continue monitoring stream habitat, flow, water quality, and macroinvertebrates to assess compliance with MPCA water quality and biological standards, track trends over time, and identify stressors affecting the macroinvertebrate community.

3 2024–2025 stream monitoring program

Water quality in the North Branch of Bassett Creek was monitored from 2024 to 2025 at a station near 34th Avenue. As shown in Table 1 and Figure 1, the water quality monitoring site is within the reach of the North Branch of Bassett Creek, where a stream restoration project was completed from 2012 to 2013 to enhance water quality and aquatic habitat.

Table 1 Stream restoration projects along the North Branch of Bassett Creek

Project	Status	Location
North Branch Bassett Creek Restoration Project: 200 feet upstream of Douglas Drive to 32nd Avenue North	Construction began fall 2012; completed in fall 2013	Crystal

Figure 1 North Branch water quality and biological monitoring locations at 34th Avenue

Water depth, flow, specific conductance, and temperature were measured continuously during the monitoring period. Because ice conditions in the channel during the winter months prevent accurate measurements of continuous flow, temperature, and specific conductance, the monitoring period for these parameters was limited to spring through early winter.

Water quality samples were collected manually on 29 occasions to monitor base flow conditions and with an automatic sampler on 10 occasions to monitor storm events. Manual sample collections usually included instantaneous measurements of temperature, specific conductance, dissolved oxygen, and pH.

Storm and base flow samples were analyzed for nutrients (total phosphorus, ortho phosphorus, dissolved phosphorus, nitrate, nitrite, ammonia, and total Kjeldahl nitrogen), solids (total suspended solids and volatile suspended solids), chlorides, hardness, calcium, and magnesium. Base flow samples were also analyzed for chlorophyll *a*, and *E. coli* bacteria. Quarterly grab samples were analyzed for metals (chromium, cadmium, copper, lead, nickel, and zinc).

Dissolved oxygen was continuously measured from September 11 through September 18, 2024, and August 29 through September 6, 2025.

The following equipment was used for the monitoring program:

- **Radar water-level sensor, data logger, and flow meter:** A radar water-level sensor (Figure 2) measured water levels at 15-minute intervals, and a data logger (Figure 3 and Figure 4) recorded the measurements. A data logger is an electronic device that records data over time. Flow was measured at a range of depths using a flow meter, and a stage-rating curve was developed to estimate flow from the measured water depths. The stage-rating curve equation was added to the data logger program, enabling the automatic computation of flow from water depth throughout the monitoring period.
- **Cellular modem (Figure 3):** Enables staff to control equipment and download data from their office.
- **SunSaver regulator (Figure 3):** This instrument controls the current flowing from the solar panel to the battery and prevents the current from flowing in reverse (i.e., battery to the solar panel).
- **Solar panel (Figure 4):** Charges the battery used to operate the equipment.
- **Automatic sampler (Figure 5):** Collects storm samples.
- **Temperature probe and data logger:** The probe measures water temperature, and the data logger (Figure 3 and Figure 4) recorded the measurements.
- **Specific-conductance probe and data logger:** The probe measures specific conductance, and the data logger (Figure 3 and Figure 4) records the measurements.

Figure 2 Radar water level sensor

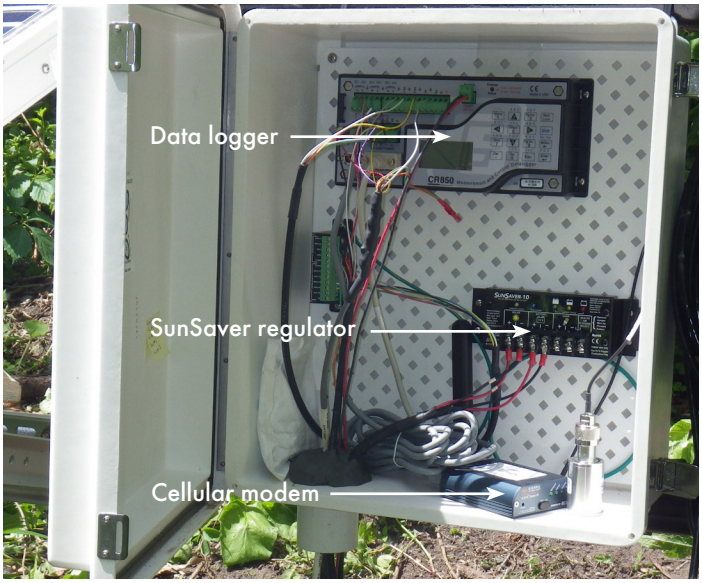

Figure 3 Data logger, SunSaver regulator, and cellular modem

Table 2 2018–2019 and 2024–2025 water depth and flow

Parameter	2018			2019			2024			2025		
	Low	High	Avg.	Low	High	Avg.	Low	High	Avg.	Low	High	Avg.
Average daily water depth (feet)	0.3	2.6	0.8	0.6	3.5	1.0	0.04	1.8	0.8	0.4	2.4	0.8
Average daily flow (cfs)	0.01	74.9	2.9	0.3	53.4	5.4	0.0	23.8	0.8	0.1	59.4	3.5

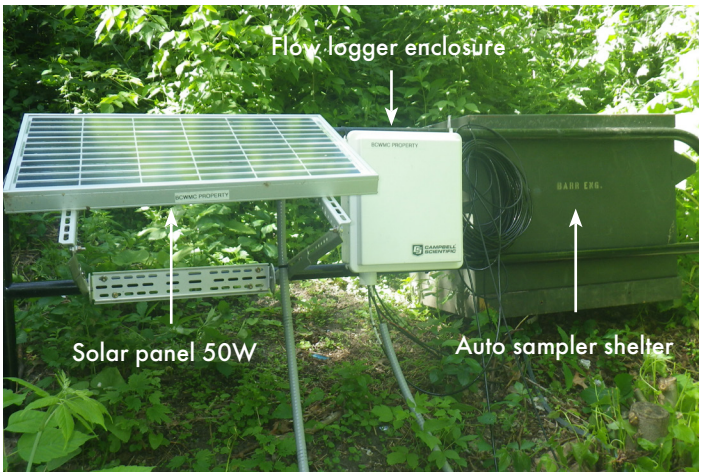

Figure 4 Flow logger enclosure, solar panel, and auto sampler shelter

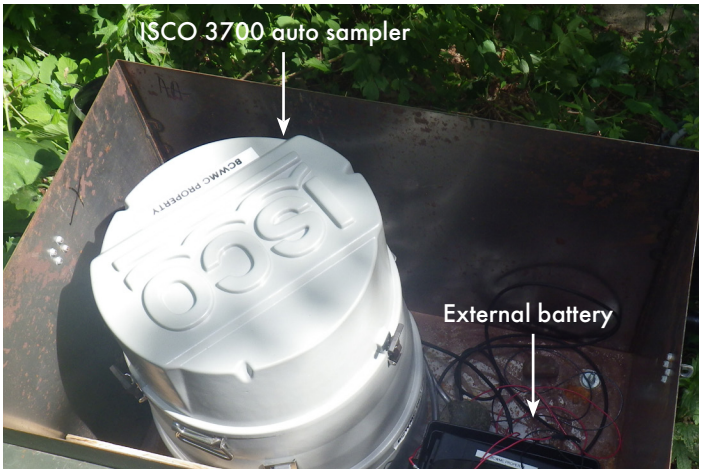

Figure 5 Automatic sampler and external battery

3.1 Results of 2024–2025 stream monitoring program

3.1.1 Water depth and flow

Water depth and flow were recorded at 15-minute intervals during the monitoring period (spring–late fall) in 2024 and 2025. For comparative purposes, data on water depth and flow collected in 2018 and 2019 are presented alongside the recent measurements in Table 2 and Figures 6 and 7. The average water depth in 2018, 2024, and 2025 remained consistent at 0.8 feet, whereas in 2019 it was slightly higher at 1.0 foot. In contrast, the average flow observed in 2024 (0.8 cfs) was lower than the averages recorded in 2018 (2.9 cfs), 2019 (5.4 cfs), and 2025 (3.5 cfs).

3.1.2 Temperature

Temperature was measured at 15-minute intervals throughout the 2024–2025 monitoring period. Temperature data collected in 2018 and 2019 are presented alongside the recent measurements in Table 3 and Figure 8 for comparative purposes.

In 2018, 2019, and 2024, the average water temperature was consistent at 60 degrees Fahrenheit (°F). In 2025, this value increased modestly to 64 degrees Fahrenheit (see Table 3). Daily average water temperatures ranged from a minimum of 30 °F in all assessed years to a maximum between 80 °F and 83 °F (see Table 3), a normal range for a warm-water stream.

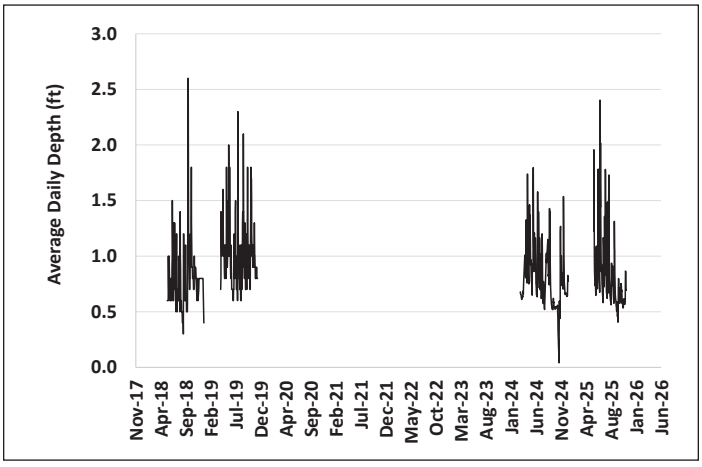

Figure 6 2018–2019 and 2024–2025 average daily water depth of the North Branch of Bassett Creek

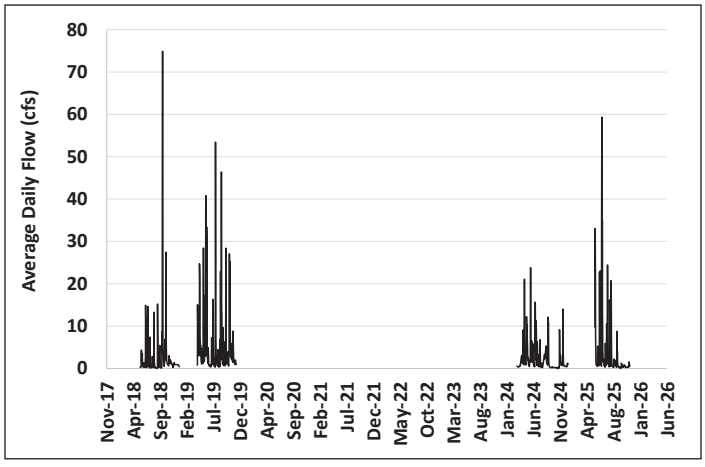

Figure 7 2018–2019 and 2024–2025 average daily flow in the North Branch of Bassett Creek

Table 3 2018–2019 and 2024–2025 water temperature in the North Branch of Bassett Creek

Parameter	2018			2019			2024			2025		
	Low	High	Avg.	Low	High	Avg.	Low	High	Avg.	Low	High	Avg.
Average daily water temperature °F	30	83	60	30	82	60	30	80	60	30	83	64

3.13 pH

The pH of water is a measure of the degree of its acidic or alkaline reaction. The applicable pH standard for the North Branch of Bassett Creek is a minimum of 6.5 and a maximum of 9.0. A stream meets the pH standard if it meets the standard at least 90 percent of the days of the monitoring season.

In 2024, pH ranged from 7.2 to 8.6; in 2025, it ranged from 7.4 to 8.1. The average for both years was 7.7 (Figure 8).

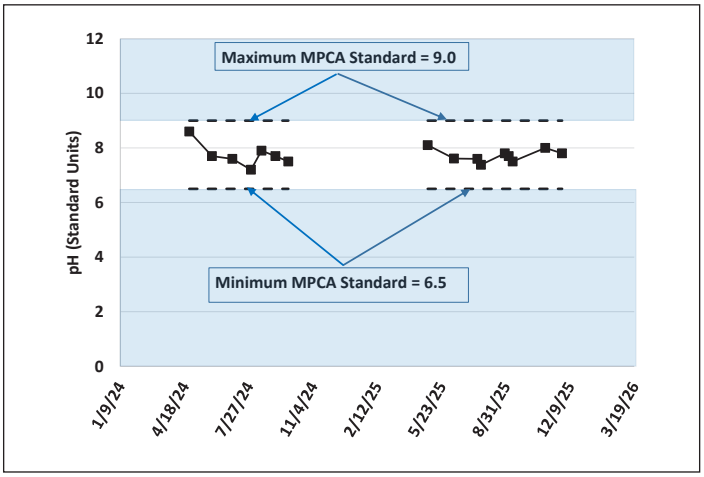

Figure 8 2024–2025 pH from the North Branch of Bassett Creek

3.14 Dissolved oxygen

Dissolved oxygen is required for all aquatic organisms to live. When dissolved oxygen drops below acceptable levels, desirable aquatic organisms, such as fish, can be harmed or killed. The MPCA dissolved oxygen standard for the North Branch of Bassett Creek is at least 5 mg/L as a daily minimum. A stream meets the dissolved oxygen standard if at least 90 percent of the measurements are at least 5 mg/L and there are at least three such measurements.

In 2024, instantaneous dissolved oxygen measurements in the North Branch of Bassett Creek ranged from 6.4 to 8.4; the average was 7.5 (Figure 9). In 2025, instantaneous measurements ranged from 6.6 to 12.5; the average was 8.7 (Figure 9). The 2024–2025 data included 17 instantaneous dissolved oxygen measurements, all of which were within the MPCA standard of at least 5 mg/L as the daily minimum (Figure 9).

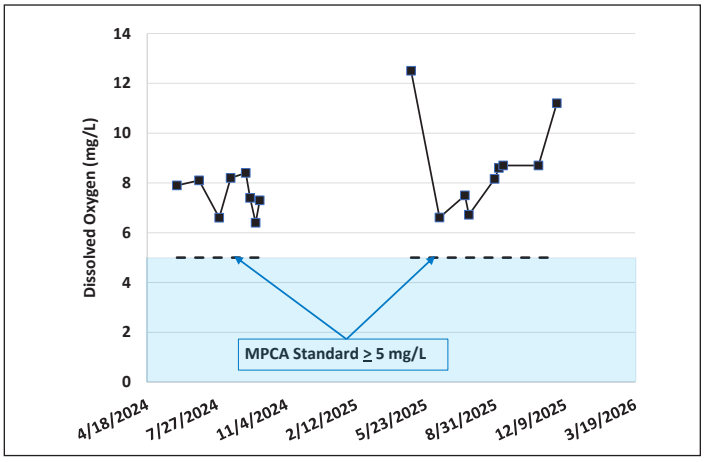

Figure 9 2024–2025 dissolved oxygen in the North Branch of Bassett Creek

Stream dissolved oxygen concentrations generally follow a diurnal cycle, with concentrations increasing during the day and decreasing overnight. When eutrophication causes excessive algae or rooted plants in a stream, the stream may experience oxygen levels below 5 mg/L overnight due to excess oxygen consumption by plant respiration. Photosynthesis by plants during the day adds oxygen to the stream. This daily fluctuation in dissolved oxygen (lower levels at night and higher levels during the day) is termed DO flux. DO flux is calculated by subtracting the daily minimum DO from the daily maximum DO to obtain the difference.

In order to measure the DO flux, continuous dissolved oxygen measurements were taken in the North Branch of Bassett Creek from September 11 through September 18, 2024, and August 29 through September 6, 2025. In 2024, measurements ranged from 3.0 to 8.3 mg/L. The overall average was 5.8 mg/L (Table 4 and Figure 10), and 18 percent of readings were below the 5 mg/L MPCA standard (Figure 10).

Table 4 2024–2025 summary of continuous dissolved oxygen (DO) measurements on the North Branch of Bassett Creek

Date	Daily Average DO (mg/l)	Daily Maximum DO (mg/l)	Daily Minimum DO (mg/L)	Daily DO Flux (mg/l)
9/11/2024	6.8	8.3	6.1	2.2
9/12/2024	6.6	7.7	5.8	1.9
9/13/2024	6.2	7.7	5.3	2.4
9/14/2024	4.9	6.6	3.2	3.4
9/15/2024	4.5	5.8	3.0	2.8
9/16/2024	5.4	7.1	4.5	2.6
9/17/2024	5.7	7.1	4.7	2.4
9/18/2024	6.0	7.6	5.0	2.6
2024 Average	**5.8**	**7.2**	**4.7**	**2.5**
8/29/2025	7.4	8.1	6.8	1.4
8/30/2025	7.2	8.0	6.8	1.3
8/31/2025	7.3	8.2	6.7	1.5
9/1/2025	7.2	8.1	6.3	1.8
9/2/2025	7.1	8.9	6.5	2.4
9/3/2025	7.8	8.2	7.3	0.8
9/4/2025	7.9	9.0	7.1	1.9
9/5/2025	8.3	9.0	7.5	1.5
9/6/2025	8.3	8.9	7.9	1.1
2025 Average	**7.6**	**8.5**	**7.0**	**1.5**

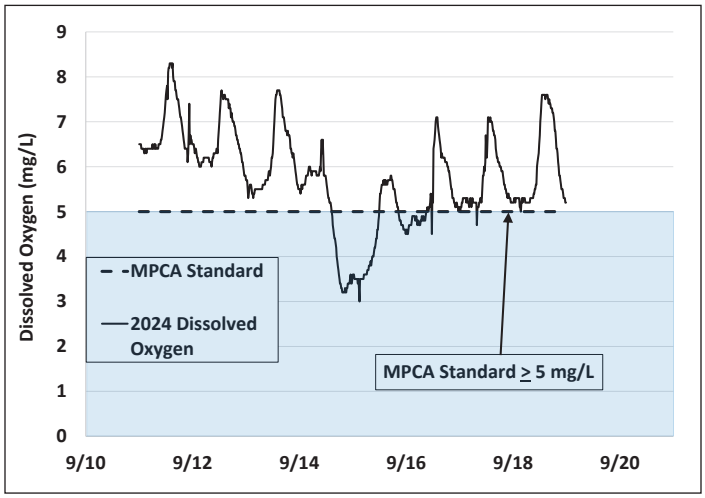

Figure 10 2024 North Branch of Bassett Creek summer continuous dissolved oxygen monitoring data

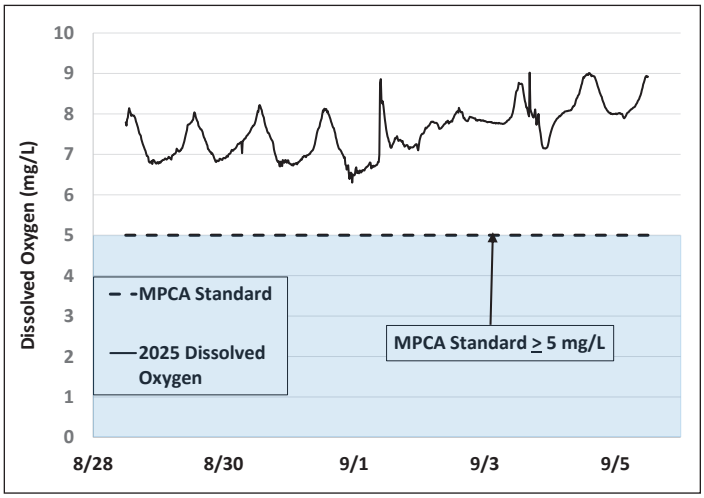

Figure 11 2025 North Branch of Bassett Creek summer continuous dissolved oxygen monitoring data

In 2025, continuous measurements ranged from 6.3 to 9.0 mg/L; the overall average was 7.6 mg/L (Table 4 and Figure 11). In 2025, no measurements were less than the 5 mg/L MPCA standard (Figure 11).

In total, during the 2024-2025 period, 91 percent of DO measurements met the MPCA standard of 5 mg/L or more. Because more than 90 percent of the measurements met the standard, and more than 20 measurements were made over the 2-year period, continuous dissolved oxygen met the MPCA standard (Figure 10 and Figure 11).

DO flux data are used to determine compliance with river eutrophication standards (RES) as described below.

3.15 River eutrophication standards (RES)

Total phosphorus, chlorophyll *a*, and DO flux data are used to determine compliance with RES. Phosphorus is essential for plant and algal growth; however, excessive phosphorus levels can lead to algal blooms, reduced water clarity, and overall degradation of water quality. Common sources of phosphorus include fertilizers, street leaves and grass clippings, atmospheric deposition, soil erosion, and decaying plant material. The concentration of algae in water is indicated by chlorophyll *a*, a pigment found within algae. The MPCA RES set criteria for total phosphorus, chlorophyll *a*, and DO flux, requiring both the "causative variable" (total phosphorus) and the "response variables" (chlorophyll *a* and DO flux) to be evaluated together to determine eutrophication.

To assess stream impairment, data for total phosphorus and chlorophyll *a* must be collected in at least 2 separate years over a 10-year period, with a minimum of 12 measurements per parameter from June through September used to establish seasonal averages. These averages are compared to MPCA standards: a maximum of 100 µg/L for total phosphorus and 18 µg/L for chlorophyll *a*.

For DO flux, a minimum 4-day deployment is required during summer months, and at least two deployments over different years are necessary; the maximum allowable DO flux is 3.5 mg/L. A stream is considered compliant with RES if either the causative or response variables meet the established thresholds.

The seasonal average for total phosphorus in the North Branch of Bassett Creek (June–September 2024–2025) was 189 µg/L, exceeding the MPCA maximum standard of 100 µg/L (Figure 12). Comparative data from 2018 and 2019 show a seasonal average total phosphorus concentration of 235 µg/L, also above the MPCA standard (Figure 13). The seasonal average for chlorophyll *a* in 2024–2025 was 28.7 µg/L, surpassing the MPCA maximum of 18 µg/L (Figure 14). In contrast, the 2018–2019 average was 17.6 µg/L, meeting the MPCA standard

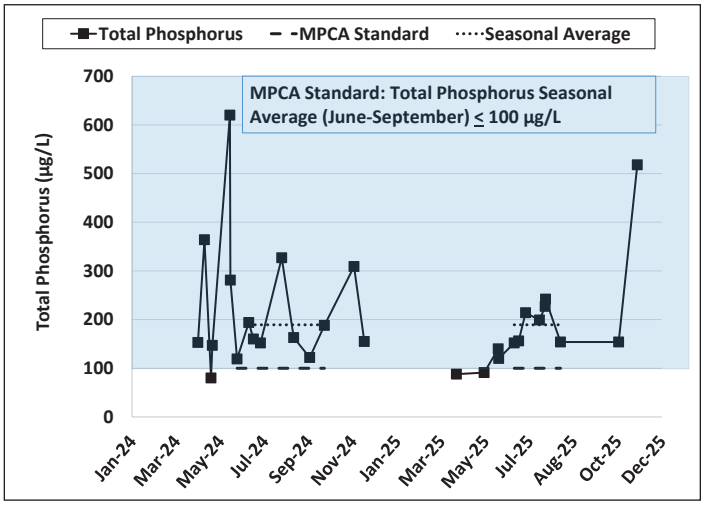

Figure 12 2024–2025 total phosphorus in the North Branch of Bassett Creek

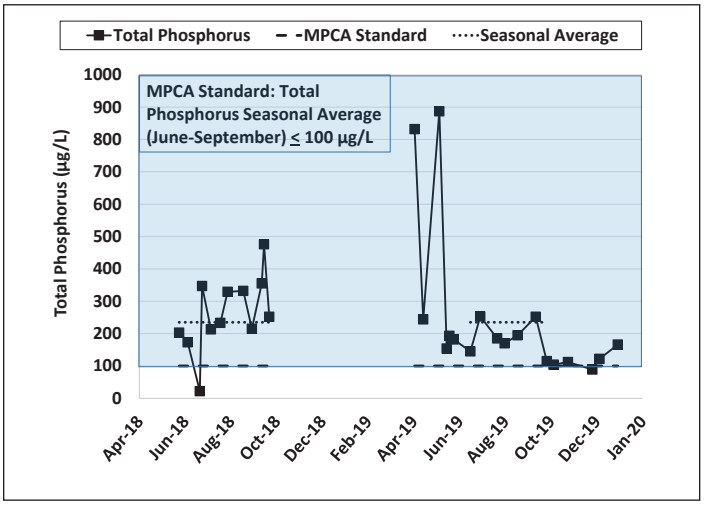

Figure 13 2018–2019 total phosphorus in the North Branch of Bassett Creek

(Figure 15). The DO flux response variable during 2024–2025 ranged from 0.8 mg/L to 3.4 mg/L, thus remaining within the MPCA threshold of 3.5 mg/L (Table 4).

During 2024–2025, both total phosphorus and chlorophyll *a* concentrations exceeded their respective MPCA standards, resulting in the North Branch of Bassett Creek failing to meet the RES criteria. Although this stream is not currently included on Minnesota's 303(d) list of impaired waters for RES, the failure to meet RES criteria for total phosphorus and chlorophyll *a* during this period indicates that it would be classified as impaired for RES.

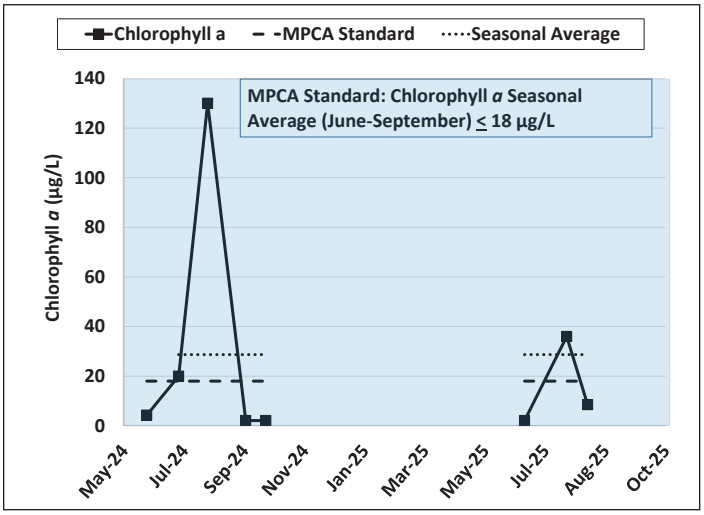

Figure 14 2024–2025 chlorophyll *a* in the North Branch of Bassett Creek

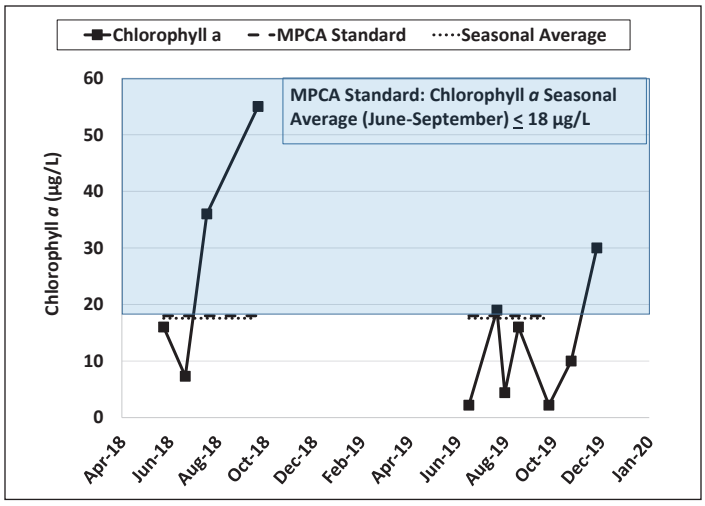

Figure 15 2018–2019 chlorophyll *a* in the North Branch of Bassett Creek

3.1.6 Chlorides

Chloride concentrations in area streams have increased since the early 1990s, when many government agencies switched from sand or sand/salt mixtures to salt for winter road maintenance. When snow and ice melt, the salt goes with it, washing into lakes, streams, wetlands, and groundwater. It only takes 1 teaspoon of road salt to pollute 5 gallons of water such that it can no longer support freshwater life. Once in the water, chloride pollution is essentially permanent, as there is no easy or affordable way to remove it.

Because high chloride concentrations can harm fish and plant life, the MPCA has established maximum and chronic chloride standards. The maximum standard is the highest concentration of chloride that aquatic organisms can be exposed to for a brief period with zero-to-slight mortality. The chronic standard is the highest chloride concentration to which aquatic life can be exposed indefinitely without causing chronic toxicity. Chronic toxicity is defined as a stimulus that lingers or continues for a long period, often one-tenth the life span or more. A chronic effect can be mortality, reduced growth, impaired reproduction, harmful changes in behavior, and other nonlethal effects. A stream is considered impaired if two or more measurements exceed the chronic criterion (230 mg/L) within 3 years or if one measurement exceeds the maximum criterion (860 mg/L).

Based on samples collected in 2024 and 2025, chloride concentrations in the North Branch of Bassett Creek ranged from 32 mg/L (measured June 26, 2025) to 287 mg/L (measured March 24, 2025), as shown in Figure 16. All samples obtained by BCWMC during 2024 and 2025 complied with the MPCA maximum chloride standard; however, one out of 29 samples (3 percent) exceeded the MPCA chronic chloride standard.

Comparative analysis of data from 2018–2019 revealed chloride concentrations ranging from 10 mg/L (measured September 28, 2018) to 437 mg/L (measured December 28, 2019) (Figure 16). All samples met the MPCA maximum chloride standard, though two out of 30 samples (7 percent) surpassed the MPCA chronic chloride standard—both were collected in December 2019.

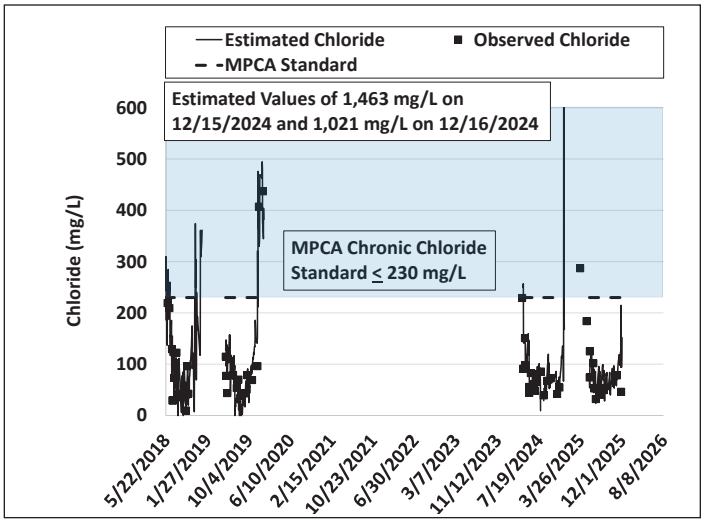

Figure 16 2018–2019 and 2024–2025 chloride concentrations: observed and estimated from average daily specific conductance measurements in the North Branch of Bassett Creek

Further information regarding chloride levels was obtained via the analysis of specific conductance. Specific conductance evaluates water's ability to conduct electricity, reflecting dissolved substances such as chloride ions. A linear regression analysis indicated that 78 percent of the observed specific conductance at the North Branch of Bassett Creek monitoring station was attributable to chloride ions in the stream. The resulting statistical model was used to estimate average daily chloride values based on observed specific conductance. In 2024, estimated chloride concentrations ranged from 9 mg/L to 1,463 mg/L using this approach, averaging 96 mg/L (Figure 16). Chloride concentrations exceeded the MPCA maximum chloride standard of 860 mg/L on 2 of the 229 days that were estimated (1 percent) and the chronic chloride standard on 6 of the 229 days that were estimated (3 percent). In 2025, estimated chloride concentrations ranged from 24 mg/L to 215 mg/L, with an average of 77 mg/L (Figure 16); all 2025 estimates met the MPCA maximum and chronic chloride standards.

Analysis of comparative data from 2018–2019 showed that 2018 stream chloride concentrations estimated from specific conductance ranged from 0 mg/L to 374 mg/L, with an average of 134 mg/L (Figure 16). Exceedances of the MPCA chronic chloride standard occurred on 32 of the 177 days estimated (18 percent). In 2019, chloride concentrations estimated from specific conductance ranged from 0 mg/L to 495 mg/L, averaging 114 mg/L (Figure 16), with exceedances on 23 of 195 days (12 percent).

The North Branch of Bassett Creek is not currently included on Minnesota's 303(d) impaired waters list for chloride. Nonetheless, as more than two chloride measurements exceeded the MPCA chronic chloride standard during both 2018–2019 and in 2024, the stream would be classified as impaired for chloride in accordance with current regulatory criteria.

3.1.7 *E. coli* bacteria

The Environmental Protection Agency (EPA) determined that *E. coli* is the preferred indicator of the potential presence of waterborne pathogens. The MPCA standard for *E. coli* protects streams used for two types of recreation: primary body contact (e.g., swimming, where inadvertent ingestion of water is likely) and secondary body contact (e.g., wading, where the likelihood of ingesting water is much smaller). The MPCA uses average and maximum *E. coli* values to determine impairment. *E. coli* standards are applicable only during the warmer months of April through October, since swimming or wading in Minnesota streams during the November through March period is not expected.

The North Branch of Bassett Creek does not meet water quality standards for bacteria and thus is included on Minnesota's 303(d) impaired waters list. The 2018–2025 bacteria data described below are consistent with that listing.

Average *E. coli* is assessed by a standard based on a geometric mean Environmental Protection Agency (EPA) criterion of 126 *E. coli* colony-forming units (cfu) per 100 mL. Data are aggregated by individual month (e.g., all April values, all May values, etc.) for up to 10 years to determine impairment due to high average monthly *E. coli* values. At least 3 months of data must be collected, preferably between June and September, and at least five samples must be collected during those 3 months (15 samples) to determine impairment due to high average *E. coli* levels.

Maximum *E. coli* is assessed using a maximum criterion of 1,260 cfu, not to be exceeded by 10 percent of all samples collected from April through October over the 10-year assessment period (independent of month).

If either the geometric mean of the aggregated monthly values for one or more months exceeds 126 cfu per 100 mL, or more than 10 percent of individual values exceed 1,260 cfu per 100 mL over the 10-year assessment period, the waterbody is considered impaired.

E. coli data from 2018, 2019, 2024, and 2025 were evaluated to assess compliance with the MPCA impairment standard. The calculated geometric means for April through October ranged from

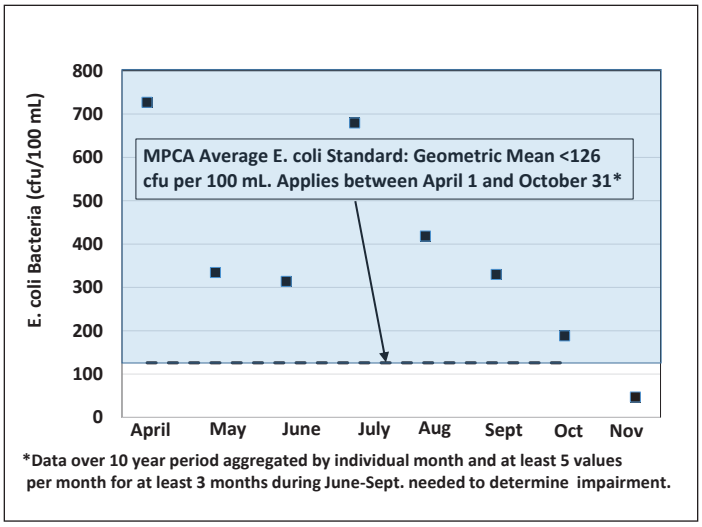

Figure 17 2018–2019 and 2024–2025 monthly geometric means of *E. coli* bacteria in the North Branch of Bassett Creek

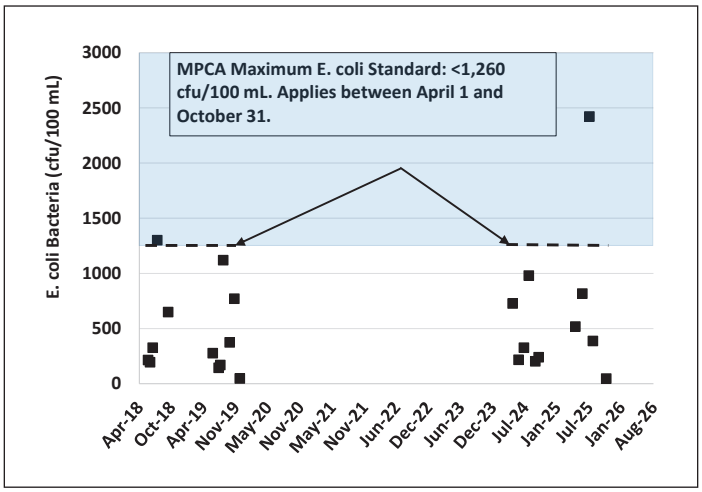

Figure 18 2018–2019 and 2024–2025 *E. coli* bacteria in the North Branch of Bassett Creek

a minimum of 314 cfu per 100 mL in June to a maximum of 727 cfu per 100 mL in April (see Figure 17). None of these monthly means met the MPCA standard of 126 cfu per 100 mL (refer to Figure 17), indicating that the stream would be classified as impaired by this metric. Nevertheless, an official determination of impairment cannot be made due to an insufficient number of samples: five samples were collected across two months (June and July), and only four samples during a third month (September), which does not fulfill the requirement of a minimum of five samples per month for three separate months.

Of the 23 samples gathered between April and October in the monitored years, two (9 percent) surpassed the MPCA maximum *E. coli* standard (sample results of 1,300 cfu/100 mL on July 25, 2018, and 2,421 cfu/100 mL on July 23, 2025—see Figure 18). Since fewer than 10 percent of collected samples exceeded the maximum criterion during the 7-year monitoring period, this portion of the standard was considered satisfied.

3.1.8 Total suspended solids

Total suspended solids consist of soil particles, algae, and other materials that are suspended in water and reduce water clarity. They typically increase during rain events or snowmelt when runoff from the watershed flows into the stream. Excessive total suspended solids can harm aquatic life and degrade aesthetic and recreational qualities. A stream is considered to exceed the standard for total suspended solids (30 mg/L) if (1) the standard is exceeded more than 10 percent of the days of the assessment season (April through September) and (2) at least three such measurements exceed the standard.

In 2024, total suspended solids concentrations in the North Branch of Bassett Creek ranged from a minimum of less than 3 mg/L (recorded on May 30 and September 6) to a maximum of 408 mg/L (observed on May 21), with an average value of 58 mg/L (Figure 19). Of the 14 samples collected between April and September, three (21 percent) exceeded the MPCA standard of 30 mg/L (Figure 19).

In 2025, measured concentrations ranged from less than 3 mg/L (June 11 and August 13) to 40 mg/L (November 25), averaging 13 mg/L (Figure 19). Only one of the 10 samples obtained from April through September (10 percent) surpassed the MPCA threshold (Figure 19).

A comparative analysis of data from 2018–2019 indicates that total suspended solids concentrations were higher overall during those years. In 2018, values ranged from a low of 2 mg/L (June 12) to a high of 248 mg/L (September 20), with an average of 67 mg/L (Figure 19). Five of 12 samples (42 percent) collected between April and September exceeded the MPCA standard (Figure 19).

In 2019, concentrations ranged from 1 mg/L (June 18) to 487 mg/L (May 9), averaging 72 mg/L (Figure 19). Seven out of 13 samples (54 percent) taken from April through September exceeded the MPCA criterion (Figure 19).

The North Branch of Bassett Creek is not presently listed on Minnesota's 303(d) list of impaired waters for total suspended solids. However, given that more than 10 percent of samples collected from April through September in 2018, 2019, 2024, and 2025 exceeded the standard, the stream would qualify as impaired for total suspended solids.

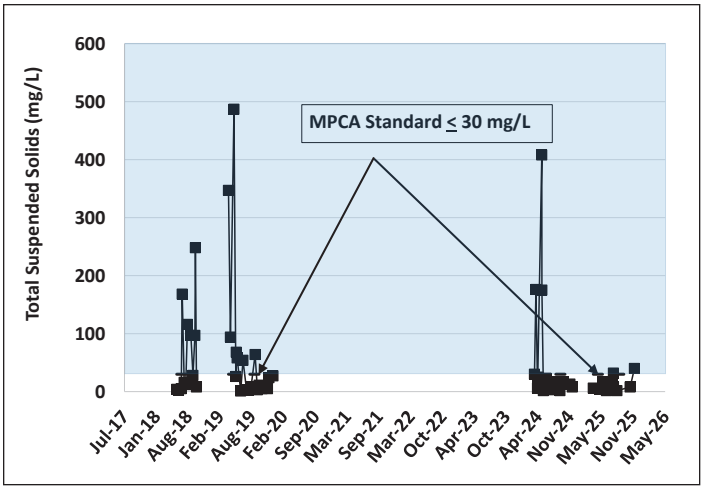

Figure 19 2018–2019 and 2024–2025 total suspended solids in the North Branch of Bassett Creek

3.1.9 Metals

Metals are naturally occurring elements found throughout the Earth's crust. Their multiple industrial, domestic, agricultural, medical, and technological applications have led to their widespread distribution in the environment. Because heavy metal-induced toxicity can harm aquatic life, the MPCA has established three standards for Class 2B waters—chronic, maximum, and final acute values (FAVs)—for each metal type. (The MPCA has classified Bassett Creek as a Class 2B water.)

The chronic standard is the highest toxicant concentration at which aquatic organisms can be indefinitely exposed without harmful effects. The maximum standard is a concentration that protects aquatic organisms from the potentially lethal effects of a short-term "spike" in toxicant concentrations. The maximum standard is always equal to one-half of the FAV: the concentration that would kill about one-half of the exposed individuals of a very sensitive species. The FAV is most often used as an "end-of-pipe" effluent limit to prevent an acutely toxic condition in the effluent or the mixing zone. Because higher water hardness reduces metal toxicity, the MPCA metals standards vary with water hardness. To show this variation (Figures 21 through 26), metal concentrations are plotted on the y-axis and hardness on the x-axis.

Quarterly samples from the North Branch of Bassett Creek were analyzed for total cadmium, chromium, copper, nickel, lead, and zinc during the 2024 and 2025 monitoring period. All results met MPCA standards (see Figures 20–25). Comparative data from 2018–2019 also show that all samples complied with MPCA standards. These findings indicate that metals are not causing toxicity to aquatic organisms in the stream.

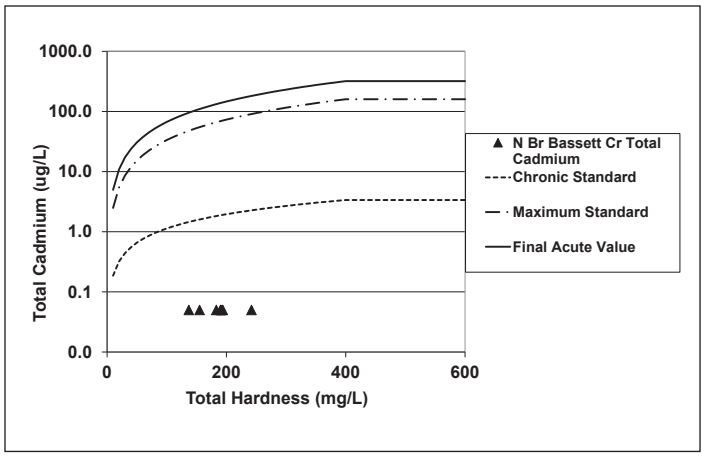

Figure 20 2024–2025 total cadmium in the North Branch of Bassett Creek compared to MPCA standards

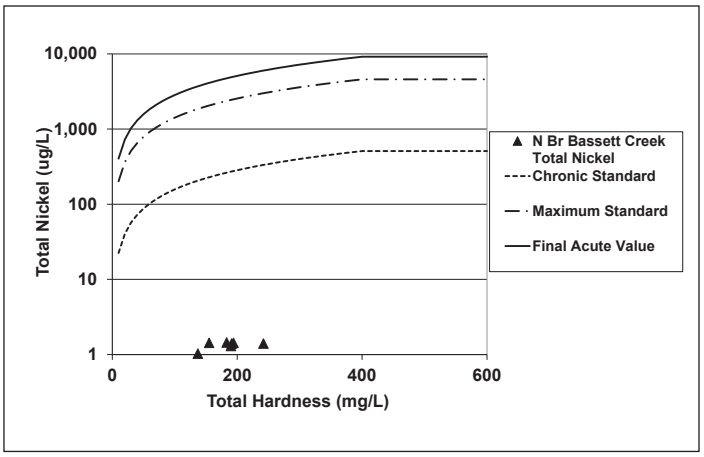

Figure 23 2024–2025 total nickel in the North Branch of Bassett Creek compared to MPCA standards

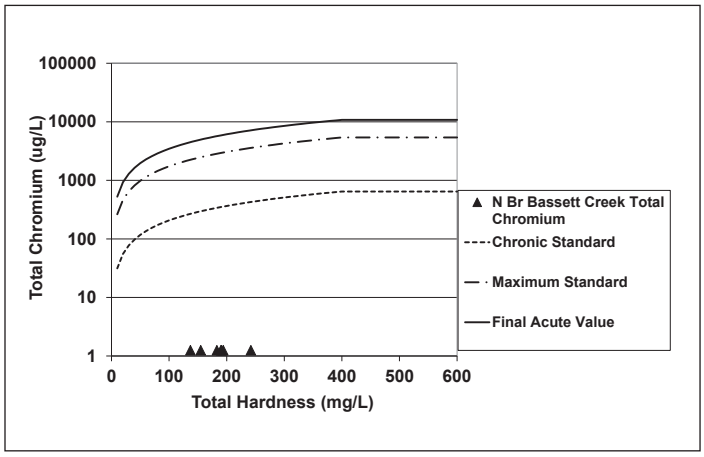

Figure 21 2024–2025 total chromium in the North Branch of Bassett Creek compared to MPCA standards

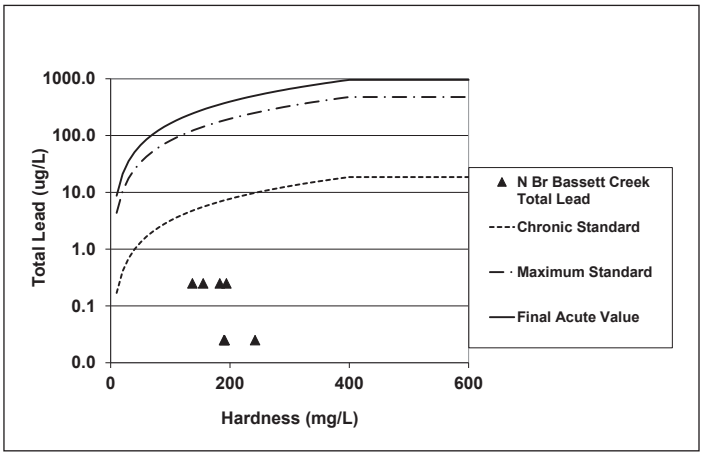

Figure 24 2024–2025 total lead in the North Branch of Bassett Creek compared to MPCA standards

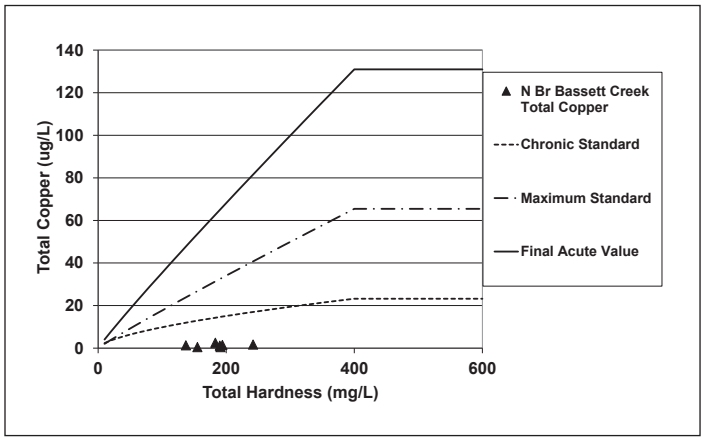

Figure 22 2024–2025 total copper in the North Branch of Bassett Creek compared to MPCA standards

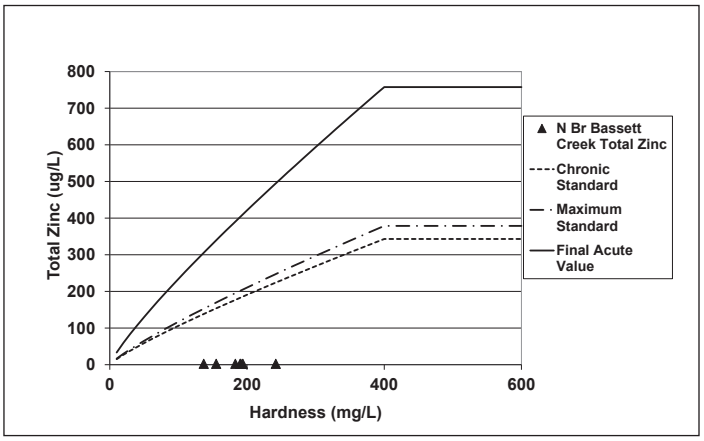

Figure 25 2024–2025 total zinc in the North Branch of Bassett Creek compared to MPCA standards

4 Biotic index evaluation of the North Branch of Bassett Creek

In 2024, the BCWMC monitored the North Branch of Bassett Creek for benthic macroinvertebrates (bottom-dwelling organisms like bugs and snails) and assessed the stream's habitat (see Figure 1 for the sampling location). This sampling has been conducted 12 times between 1980 and 2024 to evaluate water quality and detect changes over time. The Macroinvertebrate Index of Biotic Integrity (M-IBI) was used to evaluate the health of the stream's macroinvertebrate community. The MPCA developed the M-IBI and added it to Minnesota's water quality standards to help identify biologically impaired rivers and streams.

4.1 North Branch Bassett Creek Habitat

Habitat is a key factor in determining the presence and distribution of macroinvertebrates in streams. Stream macroinvertebrates are influenced by habitat factors such as substrate size and composition, the quantity of fine sediment deposited on the substrate, and the presence of vegetation. The substrate provides places for food and refuge for macroinvertebrates. Aquatic vegetation provides shelter against predation by small fish. Adverse changes in habitat can result in adverse changes to the macroinvertebrate community.

Habitat surveys of the North Branch of Bassett Creek at 34th Avenue were completed in 2015, 2018 (Figure 26), and 2024 (Figure 27) using the MPCA quantitative habitat survey method.

A summary of the results is presented in Table 5. Habitat conditions differed between the 2018 and 2024 surveys, with improvements in some metrics, but degradation in others.

Habitat improvements included:

- Higher average filamentous algae abundance.
- Reduced fine sediment depth.

Habitat degradation included:

- Increased embeddedness, indicating that larger coarse substrates such as gravel, cobble, and boulders were more surrounded, covered, or buried by finer sediments such as silt, sand, or mud.
- Greater extent and length of erosion along the left and right banks.
- Shorter transect length with boulders present in water deeper than 10 cm.

As shown in Table 5, habitat scores of zero were recorded in 2015, 2018, and 2024 for aquatic plants, overhanging vegetation, submerged vegetation, and woody debris. The absence of these habitat features creates deficiencies that limit the types of macroinvertebrates the stream can support.

Also as shown in Table 5, changes in flow between the 2015, 2018, and 2024 monitoring events included an increase and then reduction in flow at this location. These changes in flow do not clearly correlate with the recorded IBI scores during these years.

Figure 26 2018 biological sample reach

Figure 27 2024 biological sample reach

Table 5 2015, 2018, and 2024 North Branch Bassett Creek habitat comparison at 34th Avenue

Parameter	North Branch		
	2015	2018	2024
Discharge (flow) (cfs)[1]	0.03	8.2	0.04
Average depth of water (cm)	6	25	8.5
Average depth of fine sediment (cm)	0.6	0.7	0.3
Average embeddedness of coarse sediment (%)	51	38	44
Percent of transects with left-bank erosion	15	0	39
Percent of transects with right-bank erosion	0	0	31
Average length of bank erosion per transect: left bank (m)	0.3	0.0	1.1
Average length of bank erosion per transect: right bank (m)	0.0	0.0	0.2
Average amount of algae (filamentous or attached) observed on quadrate (%)	31.0	0.0	3.8
Average number of macrophytes observed on quadrate (%)	0.0	0.0	0.0
Percent length of transect over at least 10 cm of water depth with overhanging vegetation	0.0	0.0	0.0
Percent length of transect over at least 10 cm of water depth with submergent vegetation	0.0	0.0	0.0
Percent length of transect over at least 10 cm of water depth with emergent vegetation	0.0	0.0	0.0
Percent length of transect over at least 10 cm of water depth with woody debris	0.0	0.0	0.0
Percent length of transect over at least 10 cm of water depth with boulders	13.8	19.2	0.0

[1]Discharge when macroinvertebrate samples were collected.

4.2 M-IBI

The MPCA has established biological water quality standards for all Minnesota streams and rivers, including Bassett Creek. An M-IBI and a fish index of biotic integrity (F-IBI) were added to Minnesota standards and approved by the United States Environmental Protection Agency on June 26, 2018.

The M-IBI helps identify biologically impaired rivers and streams by assessing the health of their macroinvertebrate communities. The M-IBI score is the sum of the scores from 10 individual metrics. Each metric assesses an attribute of the macroinvertebrate community; collectively, the metrics assess the community's overall health. Each M-IBI metric ranges from 0 to 10; the lowest possible score is 0, and the highest is 10. Increasing scores indicate improving conditions. Because 10 metrics are summed to attain the M-IBI score, and each metric has a maximum score of 10, the maximum possible score is 100. To meet the MPCA macroinvertebrate standard, the sum of the scores from the 10 individual metrics must equal or exceed the impairment threshold. The MPCA Macroinvertebrate Class 5 (Southern Streams) standard of 37 applies to the North Branch of Bassett Creek.

The BCWMC collected macroinvertebrate samples from the North Branch of Bassett Creek on September 30, 2024, and the MPCA computed the M-IBI score to determine whether the stream met the M-IBI biological standard. The 2024 score of 18 did not meet the M-IBI biological standard (Figure 28).

Macroinvertebrate data collected by BCWMC from 1980 through 2024 were analyzed using the M-IBI. All M-IBI scores were assessed against the MPCA standard; however, none met the required benchmark. The BCWMC's M-IBI scores ranged from 11 in 2000 to 36 in 2003 (Figure 28). Notably, the 2024 M-IBI score of 18 was a modest increase from the 2018 score of 16, suggesting a slight improvement in macroinvertebrate community health during this period (Figure 28).

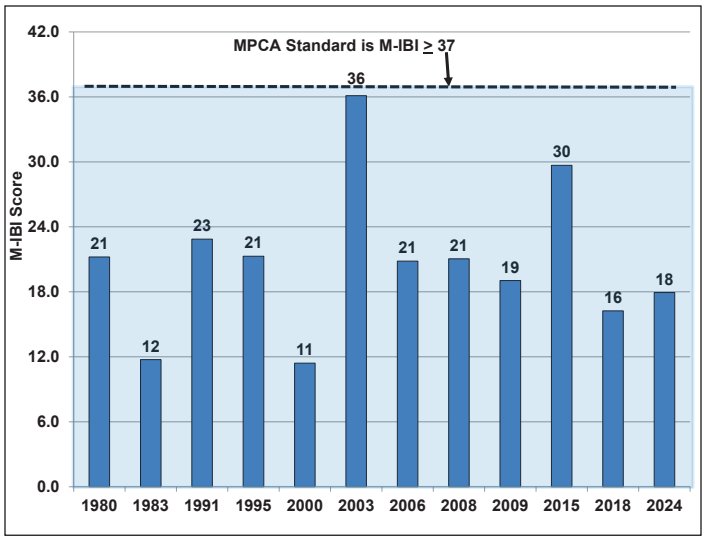

Figure 28 1980–2024 M-IBI metric scores for the North Branch of Bassett Creek

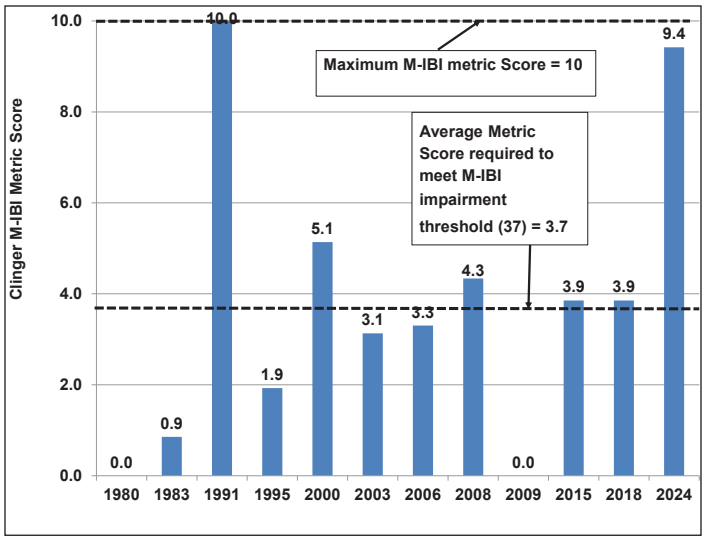

Figure 29 1980-2024 M-IBI clinger metric scores for the North Branch of Bassett Creek

As shown in Figure 1 and Table 1, a stream restoration project was completed on the North Branch of Bassett Creek from 2012 to 2013, to improve water quality and aquatic habitat. Following the project's completion, the M-IBI score rose from 19 in 2009 to 30 in 2015 (Figure 28). Notably, the macroinvertebrate community exhibited a substantial increase in clinger taxa—organisms that adhere to rocks or other substrates to resist displacement by stream flow—resulting in enhanced clinger scores and suggesting decreased sediment accumulation along the streambed.

Reduced sediment levels contribute to substrate stability, thereby facilitating secure attachment through diminished surface slipperiness. The proportion of clinger taxa in the stream has progressively increased, with elevated post-project clinger metric scores recorded from 2015 through 2024. In 2024, the score reached 9.4, approaching the maximum value of 10 (see Figure 29). Collectively, these findings confirm that the stream restoration initiative successfully reduced sediment deposition and that favorable conditions were sustained through 2024.

Below, from left to right, pictures of macroinvertebrates found in the North Branch of Bassett Creek that are clingers: Top row—*Baetis flavistriga* (mayfly nymph), *Cheumatopshyche* (caddisfly larvae), *Simulium* (blackfly larvae). Bottom row—*Cricotopus* (midge larvae), and *Stenacron* (mayfly nymph)

After the project's completion, five M-IBI metrics—Odonata (dragonflies and damselflies), predator, Trichoptera, tolerant, and HBI_MN—improved initially in 2015, then declined in 2018 and 2024. The climbers metric remained unchanged in 2015 but decreased in subsequent years. Together, declines in these six metrics reduced the overall M-IBI score by 19 points from 2015 to 2024. This decline was partially offset by increases in the clinger and insect taxa metrics, adding 7 points and limiting the net decline to 12 points. Had the six declining metrics remained at 2015 levels, the resulting 2024 M-IBI score would have been 37, which would have met the MPCA standard. However, the actual score was 18, which does not satisfy this requirement. Additional information regarding the reductions in these metrics is provided on page 17.

Odonata taxa were present in the North Branch of Bassett Creek during eight of the 11 sample events between 1980 and 2018 but were not observed in 2024 (Figure 30). The Odonata taxa (dragonflies and damselflies) score increased from 3.9 in 2009 to 6.1 in 2015, declined in 2018, and was zero in 2024 (Figure 30), indicating habitat and/or water quality degradation occurred from 2015 through 2024.

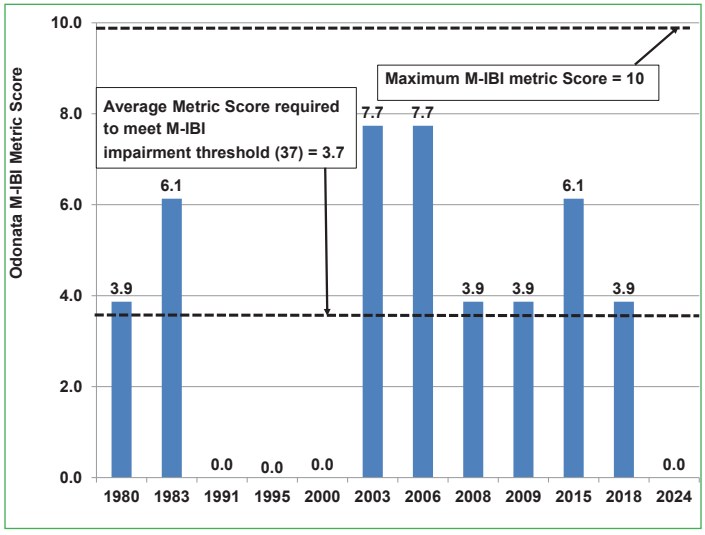

Figure 30 1980-2024 M-IBI Odonata metric scores for the North Branch of Bassett Creek

Below, pictures of Odonata taxa found in the North Branch of Bassett Creek from left to right: *Calopteryx* (damselfly larvae present in 2003, 2006, 2008, and 2015), *Ishnura* (damselfly larvae present in 2003, 2006, 2009, and 2015), and *Enallagma* (damselfly larvae present in 1980 and 1983).

Predator taxa, defined as organisms that feed on other macroinvertebrates, showed an increase in scores from 3.1 in 2009 to 3.8 in 2015, followed by a consistent decline to zero by 2024 (Figure 31). This downward trajectory indicates potential habitat or water quality degradation between 2015 and 2024. Common predator groups include Odonata larvae (damselflies and dragonflies) and giant water bugs. The documented decrease in Odonata during this period contributed to the reduction of the M-IBI score for the predator metric.

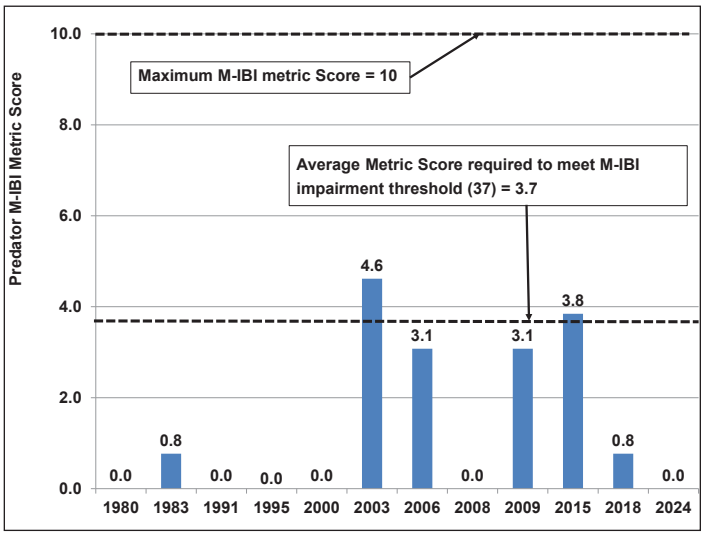

Figure 31 1980-2024 M-IBI predator metric scores for the North Branch of Bassett Creek

Below, pictures of predator taxa found in the North Branch of Bassett Creek in 2015, but not in 2024, from left to right: *Belostoma* (giant water bug), *Erpobdella punctata* (leech), *and Ishnura sp.* (damselfly larvae).

Typically, Trichoptera (caddisflies) are sensitive to elevated nutrient levels, excessive sedimentation, and diminished diversity and complexity within their habitat. The Trichoptera taxa score increased from 1.0 in 2009 to 2.0 in 2015, followed by a decrease to zero in 2018, where it remained through 2024 (Figure 32). This pattern indicates potential habitat or water quality degradation during the period from 2015 to 2024.

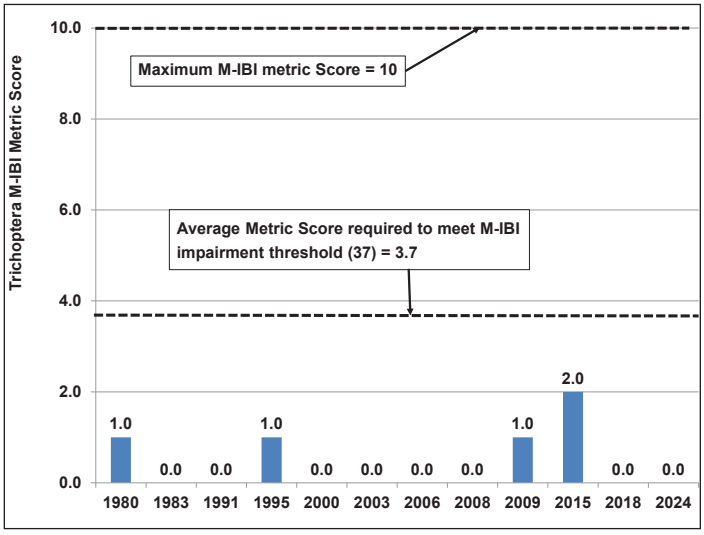

Figure 32 1980-2024 M-IBI Trichoptera metric scores for the North Branch of Bassett Creek

Below, from left to right: Trichoptera taxa found in the North Branch of Bassett Creek in 2015 but not in 2018 and 2024—*Hydroptila* (microcaddisfly) and *Oecetis* (longhorn caddisfly).

The tolerant metric assesses the relative proportion of taxa able to endure environmental degradation, determined by a tolerance value of 6 or higher. This metric uses tolerance values assigned by the MPCA to macroinvertebrate taxa observed in Minnesota, with higher values indicating more significant stream degradation. An increased percentage of tolerant taxa correlates with lower scores on this metric. The tolerant metric score increased from 2.4 in 2009 to 4.4 in 2015, subsequently declined in 2018, and rose slightly in 2024; however, it remained below the 2015 peak (Figure 33). The reduction in the tolerant metric score between 2015 and 2024 suggests a deterioration in stream conditions during this interval.

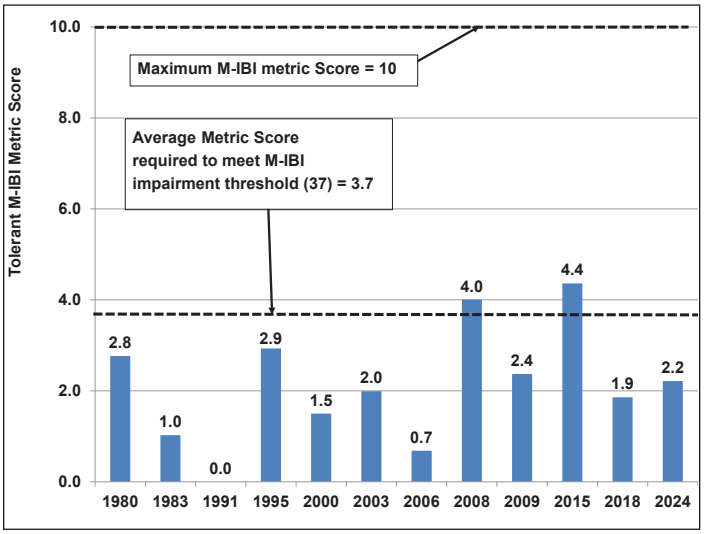

Figure 33 1980-2024 M-IBI tolerant metric scores for the North Branch of Bassett Creek

Below, from left to right: taxa with tolerance values greater than 6 found in the North Branch of Bassett Creek in 2024—*Baetis flavistriga* (mayfly larvae) and *Simulium* (black fly larvae).

The climber metric score remained unchanged following the completion of the stream restoration project on the North Branch of Bassett Creek; however, it declined from 5.7 in 2015 to 1.4 in 2024 (Figure 34). Climbers are macroinvertebrates that climb on various substrates, including overhanging vegetation, submerged and emergent vegetation, woody debris, and boulders. Climber taxa encompass Odonata (dragonflies and damselflies), leeches, and snails. Surveys conducted in 2015, 2018, and 2024 consistently reported a habitat score of zero for overhanging vegetation, submerged and emergent vegetation, and woody debris. The absence of these habitat types, coupled with decreasing "percent length of transect over at least 10 cm of water with boulders" scores from 2018 to 2024, and a reduction in Odonata scores between 2015 and 2024, collectively contributed to the decline in the climber metric score during this period.

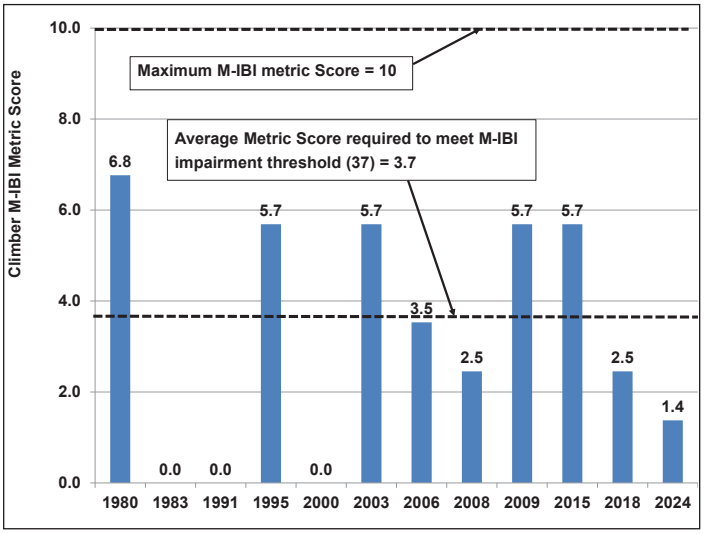

Figure 34 1980-2024 climber metric scores for the North Branch of Bassett Creek

Below, pictures of macroinvertebrates found in Bassett Creek that are climbers, from left to right: *Helobdella stagnalis* (leech, present in 2015, 2018, and 2024), *Physa* (snail, present in 2015 and 2018 but not 2024), and *Belostoma sp.* (giant water bug, present in 2015 and 2018, but not 2024).

The HBI_MN metric score is determined from abundance-weighted averages for each taxon, based on the MPCA tolerance values and the count of individuals per taxon. A decline in water quality or habitat conditions adversely affects the M-IBI score for this metric. The HBI-MN score increased from 3.0 in 2009 to 3.8 in 2015, then gradually decreased to 2.9 in 2024 (Figure 35). This trend suggests that water quality and/or habitat likely degraded between 2015 and 2024.

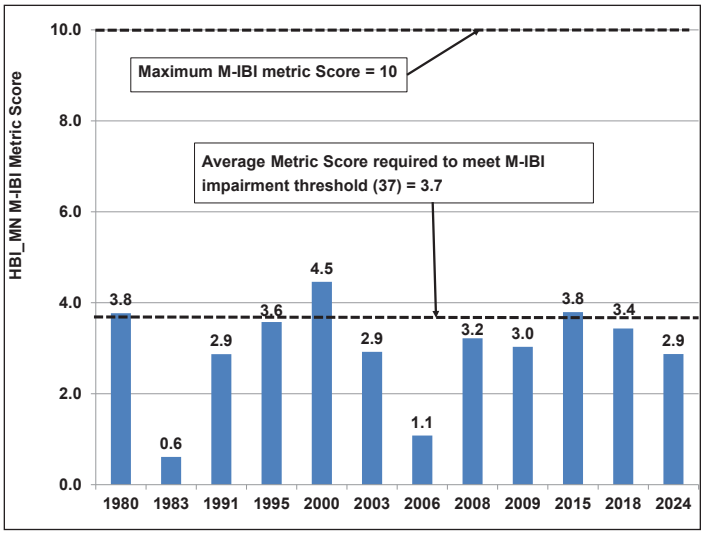

Figure 35 1980-2024 M-IBI HBI_MN metric scores for the North Branch of Bassett Creek

Enhancing habitat within the North Branch of Bassett Creek is recommended to increase the stream's M-IBI score. Proposed actions include introducing overhanging, submerged, and emergent vegetation, as well as woody debris, to improve the stream's ecological conditions. A small-scale habitat improvement project at the North Branch biological monitoring site near 34th Avenue is suggested to evaluate whether such enhancements can help the North Branch of Bassett Creek meet the MPCA biological standard.

Barr recommends pursuing water quality improvements to decrease nutrient and sediment concentrations and chlorides to enhance the M-IBI scores further. The implementation of projects identified in the ongoing Total Maximum Daily Load (TMDL) study for Northwood Lake would contribute to nutrient reduction, improved water quality, and have a positive effect on the M-IBI score for the North Branch of Bassett Creek.