
Bassett Creek Watershed Management Commission Monitoring Plan

A.1. Bassett Creek Watershed Management Commission (BCWMC) Monitoring Programs

This section describes the different types of monitoring activities performed by the BCWMC. The BCWMC collects and analyzes monitoring data to support and inform a number of its activities. Primary goals of the BCWMC's monitoring program include:

- Assess waterbodies against state standards, including ecological health
- Detect issues within waterbodies early for proactive management
- Track changes and trends over time
- Understand impacts of climate change
- Gather data needed to understand aquatic ecology and chemistry conditions, and to maintain the Commission's pollutant loading and hydrologic/hydraulic models
- Effectively target projects and programs
- Detect new aquatic invasive species (AIS)
- Assess effectiveness of specific BMPs, including CIP projects. Also understand the effectiveness and function of stormwater ponds as nutrient sources or sinks.
- Gather data and analyze effects of high chlorides.
- Avoid duplication of monitoring efforts.

In certain situations, the BCWMC may also extend their monitoring activities to achieve the following objectives:

- Assessing for harmful algal blooms
- Identify biological stressors
- Understanding impacts of carp (e.g., subwatershed assessments, potential implementation activities from Medicine Lake TMDL assessment)
- Gather data to help with grant applications or grant requirements

The planned performance of each type of monitoring in each BCWMC priority waterbody over the next 10 years is outlined in Table MP-9. Non-priority lakes and streams will not be monitored through regular

BCWMC monitoring programs. The types of monitoring performed by the BCWMC (and the respective abbreviations in Table MP-9) include:

- Detailed lake water quality monitoring (BC-LWQ)
- Zooplankton and phytoplankton monitoring (ZOO-PHYTO)
- Aquatic plant (macrophyte) monitoring (PLANT)
- Stream biotic (invertebrate) monitoring (BIO)
- Stream water quality monitoring (SWQ)

A.1.1. Detailed Lake Water Quality Monitoring

Monitoring Plan ID: BC-LWQ

Planned Monitoring Interval: 3 years (Priority 1 management classification)
5 years (Priority 2 management classification)

Description:

Water quality samples will be collected from one or two (depending on the lake) lake sampling stations representing the deepest location(s). Lakes will be monitored on six occasions from approximately April (depending on ice-out date) through September. Details follow:

1. One sample will be collected within two weeks after ice out
2. One sample will be collected in mid-June
3. One sample will be collected in mid-July
4. Two samples will be collected in August, biweekly, during 1st and 3rd weeks
5. One sample will be collected during the first week of September

To ensure the safety of staff collecting the samples, two individuals must be present in the boat and collect the samples during each sample event.

Dissolved oxygen, temperature, specific conductance, pH, and Secchi disc transparency will be measured in the field at the depths shown in Table MP-1. Water samples will be collected for laboratory analysis for total phosphorus, soluble reactive phosphorus, total nitrogen, chlorophyll *a*, and chloride at depths as specified in Table MP-1.

In addition to the above, at least one winter sampling event will be completed in January or February of each year. Water samples will be collected for laboratory analysis for chloride and dissolved oxygen, and temperature, specific conductance, and pH will be measured in the field at the depths shown in Table MP-1.

Table MP-1 Parameters measured and depth interval

Parameter	Sample Depth (Meters)	Sample or Measurement Frequency
Field Parameters		
Dissolved Oxygen	Surface to bottom (1-meter intervals)	Each Sample Event
Temperature	Surface to bottom (1-meter intervals)	Each Sample Event
Specific Conductance	Surface to bottom (1-meter intervals)	Each Sample Event
pH	Surface to bottom (1-meter intervals)	Each Sample Event
Secchi Disc	Measured from surface to depth at which the disc is no longer visible	Each Sample Event
Laboratory Parameters		
Total Phosphorus	4 samples collected: <ul style="list-style-type: none"> 0-2 meter composite sample Above thermocline sample Below thermocline sample 0.5 meters above bottom sample 	Each Sample Event
Soluble Reactive Phosphorus	0-2 meter composite sample	Each Sample Event
Total Nitrogen	0-2 meter composite sample	Each Sample Event
Chlorophyll <i>a</i>	0-2 meter composite sample	Each Sample Event
Chloride	2 samples collected: <ul style="list-style-type: none"> 0-2 meter composite sample 0.5 meters above bottom sample 	Each Sample Event

Table MP-2 presents the analytical details for phosphorus, nitrogen, and chlorophyll *a* analyses. Methods (and limits) are subject to change, but the laboratory will use a method that is Minnesota Department of Health accredited under the Clean Water Program, where applicable. All analytical results will be reported per the laboratory’s reporting limit (RL) and will attain the laboratory control sample limits (LCS Limits %), matrix spike (MS)/matrix spike duplicate (MSD) limits (%), and MS/MSD or duplicate relative percent difference (Dup RPD %) shown in Table MP-2.

Table MP-2 Analytical Method Details

Method	Analyte	RL	Units	LCS Limits %	MS/MSD Limits %	MS/MSD or Dup RPD %
Timberline-001	Total Kjeldahl Nitrogen	0.10	mg/L	84-115	84-115	20
EPA 365.3	Orthophosphate as P	0.003	mg/L	90-110	80-120	20
EPA 365.3	Phosphorus, Total as P	0.003	mg/L	80-120	80-120	80-120
EPA 353.2	Nitrate + Nitrite as N	0.03	mg/L	90-110	90-110	20
EPA 300.0 or SM 4500 CL-E	Chloride	0.5 or 3.0	mg/L	90-110	80-120	20
SM10200H-2011, NRR1-94	Chlorophyll <i>a</i> Pheophytin Corrected	1.0	µg/L	Not Available	Not Available	20

A.1.2. Zooplankton and Phytoplankton Monitoring

Monitoring Plan ID: ZOO-PHYTO

Planned Monitoring Interval: 3 years (Priority 1 management classification)
5 years (Priority 2 management classification)

Description:

Lakes will be monitored for zooplankton and phytoplankton on six occasions from April through September, concurrent with water quality sampling events. Phytoplankton will be sampled as a single 0-2 meter composite sample at the location of water quality sampling and preserved with Lugol's preservative at a volume of 1 mL preservative per 100 mL of sample. Zooplankton will be sampled using a bottom to surface tow with a zooplankton net at the location of water quality sampling. Zooplankton samples will be preserved with 40 percent formalin with sugar preservative at a volume of 5 mL preservative per 100 mL of sample.

Phytoplankton analyses will be completed using the inverted microscope procedure of Utermohl as described by Lund et al. (1958). Subsamples will be settled in a 5-milliliter inverted microscope settling chamber for approximately 24 hours prior to counting. Replicate fields of view located in a transect across the center of the counting chamber will be enumerated at a magnification of at least 500 times until the entire transect has been enumerated or at least 500 algal units have been counted. An algal unit is 1 single cell, 1 colony, or 1 filament. Results will be expressed as units per milliliter. All algal units will be identified to the lowest practicable level.

Zooplankton analyses will be completed using the Sedgwick Rafter procedure described in Standard Methods. Zooplankton within two Sedgwick Rafter counting chambers will be identified and enumerated until at least 500 individuals have been counted. All zooplankton will be identified to the lowest practicable level. Results will be expressed as number of zooplankton per square meter.

A.1.3. Aquatic Plant (Macrophyte) Monitoring

Monitoring Plan ID: PLANT

Planned Monitoring Interval: 3 years (Priority 1 management classification)
5 years (Priority 2 management classification)

Description:

Lakes will be monitored for aquatic plants (macrophytes) every 3 years (lakes classified as Priority 1) or every 5 years (lakes classified as Priority 2), in the same year as detailed BCWMC water quality monitoring. Point intercept aquatic plant (macrophyte) surveys will be performed and each lake will be surveyed twice, once in June and once in August.

The aquatic plant (macrophyte) surveys will assess the distribution and growth density of all plants. All sampling and data analysis will be conducted according to the methodologies described in the Minnesota Department of Natural Resources (MDNR) protocol for aquatic vegetation surveys. This methodology is based upon the point intercept survey method developed by John Madsen in Aquatic Plant Control Technical Note MI-02, 1999. This method consists of the following:

- All future plant surveys in BCWMC lakes will use the same sample points that have been surveyed in past plant surveys. A grid of evenly spaced points across each lake has been pre-determined and mapped. Grid spacing in BCWMC lakes ranges from 21 meters to 100 meters, depending on lake surface area.
- Personnel performing the plant survey will navigate to each point using a global positioning system (GPS) where a double-sided rake attached to a pole or rope will be tossed from the side of the boat or canoe and retrieved to obtain a sample of aquatic vegetation. A boat will be used for the plant survey whenever possible.
- All species of aquatic vegetation will be identified and an abundance ranking from 1 to 3 will be assigned to each species where:
 - 1 = Sparse; plants covering <25% of the rake head
 - 2 = Common; plants covering 25%-75% of the rake head
 - 3 = Abundant; plants covering >75% of the rake head
- Water depth will be recorded at each sampling location to the nearest tenth of a foot.
- Dominant sediment type will be recorded at each sampling location.

All data will be recorded. In addition to basic parameters and species statistics, the following indices will be reported:

- **Simpson Diversity Index Value**—index used to measure plant diversity, which assesses the overall health of the lake’s plant communities. The index, with scores ranging from 0 to 1, considers both the number of species present and the evenness of species distribution. A high score indicates a more diverse plant community.
- **C value**—scale of values used to measure the average tolerance of the plant community to degraded conditions. Plant species are assigned C values on a scale of 0 to 10, with increasing values indicating plants are less tolerant of degraded conditions and, hence, are of better quality. An average of the C values for individual species within a lake’s plant community indicates the average tolerance of the community to degraded conditions. C values provided by MDNR will be used for BCWMC lakes.
- **Floristic Quality Index (FQI) value**—FQI will be used to assess the quality of the plant communities. FQI considers both the quality of the individual native species found in the lake (C value) and the number of native species collected on the rake.

June and August data from each lake will be analyzed using Chi Squared analyses to identify any significant changes in species frequency of occurrence between June and August. In addition, Chi Squared analyses will be used to identify any significant changes between the present survey and the most recent previous year of monitoring. For this analysis, June data from the present year of monitoring will be compared with June data from the most recent previous year of monitoring; August data from the present year of monitoring will be compared with August data from the most recent previous year of monitoring.

The MDNR developed a Lake Plant Eutrophication Index of Biological Integrity (IBI) to measure the response of a lake plant community to eutrophication. The Lake Plant Eutrophication IBI includes two metrics: (1) the number of species in a lake and (2) the “quality” of the species, as measured by the FQI. The MDNR developed a threshold for each metric; lakes that score below the thresholds are considered to have degraded plant communities and are likely stressed from anthropogenic (human-caused) eutrophication. FQI scores and the number of species from plant surveys completed in BCWMC lakes will be compared to the MDNR Plant IBI thresholds. Resultant FQI scores and the number of species will also be compared with historical data to assess plant IBI trends.

A.1.4. Stream Biotic Monitoring (Macroinvertebrate Monitoring)

Monitoring Plan ID: BIO

Planned Monitoring Interval: 6 years (Priority streams)

Description:

Macroinvertebrate samples will be collected from Plymouth Creek, Main Stem of Bassett Creek, North Branch of Bassett Creek, and Sweeney Branch of Bassett Creek. The sampling locations are identified as follows (see [Figure X-XX](#) of the Plan):

- Plymouth Creek at Industrial Park Boulevard in Plymouth
- North Branch of Bassett Creek at 34th Avenue North in Crystal
- Main Stem of Bassett Creek east of Brookridge Avenue in Golden Valley
- Main Stem of Bassett Creek at Rhode Island Avenue in Golden Valley
- Main Stem of Bassett Creek at Irving Avenue in Minneapolis
- Sweeney Lake Branch of Bassett Creek at Woodstock Avenue (East) in Golden Valley

Minnesota Pollution Control Agency (MPCA) Invertebrate Sampling Procedures ([Macroinvertebrate data Collection Protocols for Lotic Waters in Minnesota \(state.mn.us\)](#)) will be used to collect macroinvertebrate samples. The MPCA multihabitat method will be used to collect a composite sample from up to five different habitat types to get a sample representative of the invertebrate community at each sample location. The habitats to be sampled may include:

- Hard bottom (riffle/cobble/boulder)
- Aquatic macrophytes (submerged/emergent vegetation)
- Undercut banks (undercut banks/overhanging vegetation)
- Snags (snags/rootwads)
- Leaf packs

Sampling will consist of dividing 20 sampling efforts equally among the dominant, productive habitats present in each reach. If the 20 sampling efforts are not equally divisible by the number of habitats present, the least dominant of the habitats will receive the lower number of sampling efforts (i.e., the remainder).

A sample effort is defined as taking a single dip or sweep in a habitat (e.g., hard bottom). A sweep is taken by placing the D-net on the substrate and disturbing an area directly in front of the net opening equal to the net width (1 ft²) and allowing dislodged invertebrates to drift into the D-net positioned downstream from the disturbed area. Each sample effort should cover approximately 1 ft² (0.09 m²) of substrate. The 20 sampling efforts will sample a total area of 20 ft² (1.8 m²).

The sampling will proceed from downstream to upstream, sampling the various habitats present. All samples will be preserved in 100 percent reagent alcohol and later identified in the laboratory.

Flow and water quality parameters will be sampled at the downstream end of the reach prior to disturbing the area by the macroinvertebrate sampling activity. The following parameters will be measured using field instruments: discharge (flow), temperature, dissolved oxygen, specific conductance, turbidity, and pH.

Physical habitat will be monitored at each sample location every 6 years when benthic macroinvertebrate samples are collected. Physical habitat will be assessed using the MPCA quantitative method ([Quantitative Physical Habitat Assessment Protocol for Wadeable Stream Monitoring Sites \(state.mn.us\)](https://www.state.mn.us/mcpa/quantitative-physical-habitat-assessment-protocol-for-wadeable-stream-monitoring-sites)). Habitat will be sampled using the transect point method. Thirteen transects will be established within each sample reach. The sample reach is determined by mean stream width (MSW) and is generally from 150 to 500 meters in length. For the locations in Bassett Creek, the sample reach will be at least 150 meters in length. The reach segment that is sampled will be documented with global positioning system (GPS) measurements. Four equally spaced points, plus the thalweg (or deepest point along the transect line), will be established along each transect; measurements or visual estimates will be made at each sample point to characterize key components of the physical habitat structure. Variables measured include water depth, depth of fine sediment and water, embeddedness, substrate, percent algae, and percent macrophytes. In addition, visual estimates of the following will be made:

- The amount of cover for fish, determined from the percent of transect occupied by undercut banks, overhanging vegetation, woody debris, boulders, submergent macrophytes, emergent macrophytes, and other debris
- The amount of the stream bank that is actively eroding through break down, soil sloughing, or false banks
- The predominant riparian land use within the riparian zone (within 30 meters of the water's edge)
- Riparian buffer width, which is the amount of contiguous undisturbed land use within a 10-meter area adjacent to the stream
- Canopy/shading, which is a measure of overhead canopy cover that is shading the stream channel

The MPCA established biological water quality standards for all Minnesota streams and rivers, including Plymouth Creek and Bassett Creek (North Branch, Main Stem, and Sweeney Branch). A Macroinvertebrate Index of Biotic Integrity (M-IBI) was 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 has a scale of 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 Riffle Run) standard of 37 is applicable to Plymouth Creek, the Main Stem of Bassett Creek, and the North Branch of Bassett Creek. The MPCA Macroinvertebrate Class 6 (Southern Forest Streams Glide Pool) standard of 43 is applicable to the Sweeney Branch of Bassett Creek.

M-IBI will be computed from macroinvertebrate data collected from Plymouth Creek and Bassett Creek (North Branch, Main Stem, and Sweeney Branch). Samples will be processed and enumerated by a BCWMC-approved laboratory. M-IBI scores will be computed using MPCA Methods ([Macroinvertebrate data Collection Protocols for Lotic Waters in Minnesota \(state.mn.us\)](https://state.mn.us/BCWMC/Methods/Macroinvertebrate%20Data%20Collection%20Protocols%20for%20Lotic%20Waters%20in%20Minnesota)).

A.1.5. Stream Water Quality Monitoring

Monitoring Plan ID: SWQ

Planned Monitoring Interval: 2 consecutive years of monitoring initiated every 6 years (Priority streams)

Description:

The BCWMC will monitor the chemical water quality and streamflow of the North Branch of Bassett Creek, Sweeney Branch of Bassett Creek, and Plymouth Creek for two consecutive years of monitoring initiated every 6 years. The City of Plymouth also monitors Plymouth Creek annually and intends to continue this monitoring until data is no longer required or funds do not allow. The BCWMC will partner with the City of Plymouth to monitor the creek in those years when both entities are collecting data. Details of the partnership between BCWMC and the City of Plymouth will be determined each time the two entities work together to monitor Plymouth Creek.

The BCWMC purchased equipment for completion of the stream water quality and flow monitoring program. Table MP-3 includes a list of the equipment that BCWMC owns for monitoring the North Branch of Bassett Creek and Sweeney Branch of Bassett Creek. The equipment may also be used for monitoring Plymouth Creek although past monitoring of Plymouth Creek has been completed using equipment owned by Three Rivers Park District under contract with the City of Plymouth. The BCWMC's equipment is installed at each stream monitoring location during the monitoring season and stored at the Edina Field Office of the BCWMC Engineer (Barr Engineering Co.) when not in use.

Following is a description of the equipment shown in Table MP-3:

- **Radar water-level sensor and measurement and control data logger:** A radar water-level sensor measures water levels at 15-minute intervals, and a measurement and control data logger records the measurements.
- **Cellular modem:** Enables staff to remotely control equipment and download data.
- **SunSaver regulator:** 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:** Charges the battery used to operate the equipment.
- **Automatic sampler:** Programmable autosampler that collects storm samples.
- **Temperature probe and data logger:** The probe measures water temperature, and the data logger records the measurements.
- **Specific-conductance probe and data logger:** The probe measures specific conductance, and the data logger records the measurements.
- **Dissolved oxygen data logger:** Self-contained unit (i.e., includes sensor and datalogger) that records dissolved oxygen measurements. Telemetry is not included.

Table MP-3 BCWMC Owned Equipment for Stream Water Quality Monitoring

Equipment Description	Make	Model No.	Qty.
Portable Auto-Sampler	Teledyne Isco	3700	1
Radar Water Level Sensor	Campbell Scientific Inc.	CS475	1
Water Conductivity/Temperature Probe	Campbell Scientific Inc.	CS547A	1
Measurement and Control Datalogger	Campbell Scientific Inc.	CR850	1
50 Watt Solar Panel	Campbell Scientific Inc.	SP50	1
Solar Regulator	Morning Star	SunSaver-10	1
Weather -Resistant Enclosure 14" x 16"	Campbell Scientific Inc.	ENC14/16	1
Sampler Control Cable	Campbell Scientific Inc.	10164	1
Cellular Modem (Verizon 4G)	Campbell Scientific Inc.	Cell210	1
HOBO Dissolved Oxygen Data Logger	Onset Corp.	U26-001	1

The automated sampler and equipment to continuously measure water depth, flow, temperature, and specific conductance will be installed and operated for two consecutive years (from snowmelt of year 1 until shortly before ice-in and from snowmelt of year 2 to shortly before ice-in). Water depth, flow, temperature, and specific conductance will be measured every 30 seconds, and 15-minute averages will be recorded throughout the monitoring period. Continuous dissolved oxygen will be measured for at least 4 days in summer (June through September) during each year. Dissolved oxygen will be measured and recorded every 15 minutes during the monitored period.

For QAQC purposes, manual verification measurements of stage, specific conductance, and temperature will be taken periodically (i.e., approximately monthly). When required, the specific conductance probe will be calibrated. The radar water level and temperature sensors cannot be calibrated. If discrepancies are found, these sensors will be returned to the manufacturer for repair or replacement. The manual measurements will also be used to correct for sensor drift during the final year-end QAQC effort. Data are remotely downloaded periodically (i.e., approximately weekly) and reviewed to check for sensor interferences or malfunctions.

The automated sampler will collect water quality samples in periods of high flow (i.e., snowmelt and after storm events). Samples are pumped from the stream through an intake tube and deposited in 1-liter bottles of which there are 24. The 1-liter bottle samples are composited into a single storm event sample. Each discrete sample is collected at an interval based on flow volume creating a flow-weighted sample. Parameters analyzed will include chloride, total and volatile suspended solids, and nutrients (soluble reactive phosphorus, ortho phosphate, total phosphorus, nitrate and nitrite nitrogen, total Kjeldahl nitrogen, and ammonia nitrogen). Grab samples will be manually collected during periods of baseflow. Parameters analyzed will include chloride, *Escherichia coli* bacteria, total and volatile suspended solids, turbidity, nutrients (dissolved phosphorus, ortho phosphate, total phosphorus, nitrate and nitrite nitrogen, total Kjeldahl nitrogen, and ammonia nitrogen), and chlorophyll *a*. Instantaneous pH, dissolved oxygen, temperature and specific conductance will be measured when samples are manually collected. Samples for hardness and metals (cadmium, chromium, copper, lead, nickel, and zinc) will be manually collected quarterly during the 2-year monitoring period.

All samples collected from the North Branch of Bassett Creek and the Sweeney Branch of Bassett Creek will be analyzed by the Metropolitan Council Environmental Services (MCES) laboratory. MCES laboratory method details are shown in Table MP-4. Samples collected from Plymouth Creek will be analyzed by the Three Rivers Park District laboratory or the MCES laboratory. Three Rivers Park District laboratory method details are shown in Table MP-5. Methods (and limits) shown in Table MP-4 and Table MP-5 are subject to change, but the laboratories will use a method that is Minnesota Department of Health accredited under the Clean Water Program, where applicable. All analytical results will be reported per the laboratory's reporting limit (RL) and will attain the laboratory control sample limits (LCS Limits %), matrix spike (MS)/matrix spike duplicate (MSD) limits (%), and MS/MSD or duplicate relative percent difference (Dup RPD %) shown in Table MP-4 and Table MP-5.

Table MP-4 Metropolitan Council Environmental Services Laboratory Analytical Method Details

Method	Analyte	RL	Units	LCS Limits %	MS/MSD Limits %	MS/MSD or Dup RPD %
SM 4500-Cl- E-2011	Chloride	5	mg/L	90-110	90-110	90-110
USGS I-3765-85	Total Suspended Solids	3	mg/L	n/a	n/a	n/a
USGS I-3767-85	Volatile Suspended Solids	3	mg/L	n/a	n/a	n/a
n/a	Turbidity	n/a	n/a	n/a	n/a	n/a
EPA 365.1	Phosphorus, Total as P (low-level)	0.005	mg/L	90-110	90-110	90-110
EPA 365.1	Phosphorus, Dissolved as P (low-level)	0.005	mg/L	90-110	90-110	90-110
EPA 365.4	Phosphorus, Total as P	0.05	mg/L	90-110	90-110	90-110
EPA 365.4	Phosphorus, Dissolved as P	0.05	mg/L	90-110	90-110	90-110
SM 4500-P F-2011	Ortho-phosphate	0.01	mg/L	90-110	90-110	90-110
EPA 353.2	Nitrate + Nitrite as N	0.2	mg/L	90-110	90-110	90-110
EPA 351.2	Total Kjeldahl Nitrogen	0.2	mg/L	90-110	90-110	90-110
EPA 350.1	Ammonia Nitrogen	0.06	mg/L	90-110	90-110	90-110
ASTM D3731-87	Chlorophyll <i>a</i>	1	ug/L	n/a	n/a	n/a
SM 9223 B-2016	<i>Escherichia coli</i> bacteria	1	mpn/100 mL	n/a	n/a	n/a
SM 2340 B-2011 (calculation)	Total Hardness	3.3	mg/L	n/a	n/a	n/a
EPA 200.8	Cadmium	0.1	ug/L	85-115	70-130	70-130
EPA 200.8	Chromium	2.5	ug/L	85-115	70-130	70-130
EPA 200.8	Copper	1	ug/L	85-115	70-130	70-130
EPA 200.8	Lead	0.5	ug/L	85-115	70-130	70-130
EPA 200.8	Nickel	0.5	ug/L	85-115	70-130	70-130
EPA 200.8	Zinc	5	ug/L	85-115	70-130	70-130

Table MP-5 Three Rivers Park District Analytical Method Details

Method	Analyte	RL	Units	LCS Limits %	MS/MSD Limits %	MS/MSD or Dup RPD %
SM 4500-Cl ⁻ B-11	Chloride	10	mg/L	80-120%	80-120%	20% RPD
SM 2540 D-11	Total Suspended Solids	2.5	mg/L	80-120%	80-120%	20% RPD
EPA 365.3	Phosphorus, Total as P	15	ug/L	80-120%	80-120%	20% RPD
EPA 365.3	Phosphorus, Soluble Reactive as P	6	ug/L	80-120%	80-120%	20% RPD
SM 4500-N-C	Total Nitrogen	0.5	mg/L	80-120%	80-120%	20% RPD
SM 10200H	Chlorophyll a	5	ug/L	NA	NA	20% RPD
9223 B Colilert-18	<i>Escherichia coli</i> bacteria	1	CFU/100mL	NA	NA	20% RPD

Approximately 30 samples will be collected during the two-year monitoring period. Assuming climatic conditions provide an adequate number of storms, the samples will be evenly split between samples collected by automated samplers and manually collected samples.

The BCWMC intends to complete a special project to monitor the specific conductance and chloride concentrations of inflows to Crane Lake. For this project, the BCWMC intends to purchase the equipment shown in Table MP-6. The equipment will be installed on-site during the stream monitoring season and stored at the Edina Field Office of the BCWMC Engineer (Barr Engineering Co.) when not in use.

Table MP-6 Equipment for Crane Lake Specific Conductance Monitoring

Equipment Description	Make	Model No.	Qty.
Measurement and Control Datalogger	Campbell Scientific Inc.	CR350	5
20 Watt Solar Panel	Campbell Scientific Inc.	SP20	5
Weather -Resistant Enclosure 12" x 14"	Campbell Scientific Inc.	ENC12/14	5
Water Conductivity/Temperature Probe	Campbell Scientific Inc.	CS547A	5
12 Amp-Hour 12 Volt Rechargeable Battery	Campbell Scientific Inc.	BP12	5

A.2. Other Monitoring Programs

A.2.1 City of Plymouth (Plymouth Creek Monitoring)

Monitoring Plan ID: CITY PLMTH

Planned Monitoring Interval: Annually until data is not required or funds do not allow for continuation

Description:

The City of Plymouth has annually contracted with the Three Rivers Park District (TRPD) since 2001 to monitor Plymouth Creek. Monitoring location Industrial Park 2 (IP2) has been monitored annually since 2004 except for 2007, 2010, and 2011. IP2 is located at a 14-foot-wide concrete weir behind an industrial building at 12940 Teakwood Lane North. This site captures drainage from upstream portions of Plymouth Creek. Monitoring location Plymouth Creek 2 (PC2) has been monitored annually since 2001. PC2 is located on Medicine Lake Drive West near West Medicine Lake Beach. This site captures drainage from IP2 as well as the Parkers Lake watershed just before it reaches Medicine Lake. In 2022-2023, the City of Plymouth monitored a third location, Industrial Park 1 (IP1), located within a pipe just before it discharges into Plymouth Creek a short distance downstream from IP2. The site was added primarily to evaluate flow and chlorides coming from a subwatershed west of Highway 55.

The City of Plymouth intends to monitor Plymouth Creek annually until data is no longer required or funds do not allow for continuation. The city plans to contract the monitoring to TRPD if they are willing to continue with the partnership. Stage and flow would be continuously measured and automated samplers would collect water quality samples in periods of high flow (i.e., snowmelt and after storm events) at locations IP2 and PC2. In addition, samples would be collected manually at a biweekly frequency during periods of baseflow. Parameters analyzed would include total phosphorus, soluble reactive phosphorus, total nitrogen, total suspended solids, and chloride.

The BCWMC will partner with the city to monitor Plymouth Creek whenever both entities are collecting data during the same year. Details of this partnership will be determined between the parties in advance of each shared monitoring year. The BCWMC and the City of Plymouth partnered to monitor Plymouth Creek during 2022-2023. During that period, BCWMC collected quarterly samples from IP2 for hardness and metals (cadmium, chromium, copper, lead, nickel, and zinc) and continuously measured dissolved oxygen at IP2 for one week during each year. All other monitoring of Plymouth Creek was completed by the City of Plymouth as a part of its annual monitoring program of the stream.

A.2.2 Three Rivers Park District (Medicine Lake Water Quality Monitoring)

Monitoring Plan ID: TRPD

Planned Monitoring Interval: Annually in Medicine Lake – Main Basin (subject to change)
3 year intervals in Medicine Lake – Southwest Basin (per BCWMC request)

Description:

Although the TRPD has annually monitored Medicine Lake, future programs are subject to change. The following discussion of planned monitoring for Medicine Lake is based on past programs with the caveat

that sampling frequency, sample locations, types of samples collected, and sampling parameters are subject to change in the future.

The TRPD monitors water quality in the main basin of Medicine Lake annually. Samples are collected bi-weekly from ice-out through September and once after fall turnover in October. Profiles of dissolved oxygen, temperature, specific conductance, and pH are measured at 1-meter intervals from the lake's surface to its bottom. Secchi disc transparency is measured from the lake's surface to the depth at which the disc is no longer visible. Total nitrogen and chlorophyll *a* samples are collected at or near the lake's surface. Total phosphorus and soluble reactive phosphorus samples are collected at or near the lake's surface, at the middle of the lake's water column, and near the lake's bottom. Chloride samples are collected at or near the lake's surface and near the lake's bottom. All samples are analyzed by the TRPD laboratory.

The TRPD annually completes two point-intercept aquatic plant surveys in Medicine Lake (spring and fall).

The TRPD annually monitors its swimming beaches for *Escherichia coli* every week from Memorial Day to Labor Day.

At 3-year intervals, the BCWMC will request that the TRPD perform additional sampling and analysis in the southwest basin of Medicine Lake while conducting its routine monitoring on Medicine Lake as outlined in Section A.1.1. The sampling will occur at one location in the deepest part of the southwest basin. Samples will be collected bi-weekly from ice-out through September and once after fall turnover in October.

Dissolved oxygen, temperature, specific conductance, pH, and Secchi disc transparency will be measured in the field at depths shown in Table MP-7. Water samples will be collected for laboratory analysis for total phosphorus, soluble reactive phosphorus, total nitrogen, chlorophyll *a*, and chloride at depths as specified in Table MP-7. All samples will be analyzed by the TRPD laboratory.

TRPD collects one set of field duplicates from each field crew that samples each day and rotates the field duplicate sites each week in a randomized way. Because each field crew samples multiple sites each day, field duplicates will sometimes be collected from Medicine Lake and sometimes from other sites.

Table MP-7 TRPD Medicine Lake Water Quality Sampling

Parameter	Sample or Measurement Depth (Meters)	Sample or Measurement Frequency
Dissolved Oxygen	Surface to bottom (1-meter intervals)	Each Sample Event
Temperature	Surface to bottom (1-meter intervals)	Each Sample Event
Specific Conductance	Surface to bottom (1-meter intervals)	Each Sample Event
pH	Surface to bottom (1-meter intervals)	Each Sample Event
Secchi Disc	Measured from surface to depth at which it disappears from view	Each Sample Event
Total Phosphorus	3 samples collected: 0-2 meter composite, above the thermocline, and about 1 meter above the bottom	Each Sample Event
Soluble Reactive Phosphorus	3 samples collected: 0-2 meter composite, above the thermocline, and about 1 meter above the bottom	Each Sample Event
Total Nitrogen	0-2 meter composite sample	Each Sample Event
Chlorophyll <i>a</i>	0-2 meter composite sample	Each Sample Event
Chloride	2 samples collected: 0-2 meter composite and about 1 meter above the bottom	Each Sample Event

TRPD will collect phytoplankton and zooplankton samples from the main basin and the southwest basin in accordance with the BCWMC protocols outlined in Section A.1.2. A total of 6 samples will be collected from each basin per the following schedule:

1. Within two weeks after ice-out
2. Mid-June
3. Mid-July
4. First and third weeks in August
5. First week in September

Each phytoplankton sample will be a 0-2-meter composite sample and each zooplankton sample will be collected using a zooplankton net towed from near the bottom to the surface of the lake.

A.2.3 City of Plymouth (Parkers Lake Inflow Monitoring)

Monitoring Plan ID: CITY PLMTH

Planned Monitoring Interval: Annually until data is not required or funds do not allow for continuation

Description:

The City of Plymouth has contracted with the TRPD since 2000 to monitor inflows to Parkers Lake from two locations. Monitoring location Parkers Lake 1 (PL1) has been monitored annually since 2000, except for 2008 and 2010 through 2012. PL1 is located on the south side of Parkers Lake at the Luce Line State

Trail. It drains approximately 258 acres into Parkers Lake. Monitoring location Parkers Lake 2 (PL2) was monitored annually during 2000 through 2008 and has been annually monitored since 2013. PL2 conveys water under County Road 6 and outlets near the lake. It is located on the northwest side of the lake adjacent to the public boat access. There are 189 acres of multi-residential and industrial land use that drain to PL2.

The City of Plymouth intends to annually monitor PL-1 and PL-2 until data is not required or funds do not allow for continued monitoring. The city could choose to spot monitor in other locations within the watershed as well. The city intends to annually contract the monitoring to the TRPD if they are willing to continue performing the work. Stage and flow would be continuously measured and automated samplers would collect water quality samples in periods of high flow (i.e., snowmelt and after storm events) at locations PL1 and PL2. In addition, samples would be collected manually at a biweekly frequency during periods of baseflow from PL2. Parameters analyzed would include total phosphorus, soluble reactive phosphorus, total nitrogen, total suspended solids, and chloride.

A.2.4 City of Plymouth (Parkers Lake Monitoring)

Monitoring Plan ID: CITY PLMTH

Planned Monitoring Interval: Regular basis

Description:

The City of Plymouth contracted with the TRPD to monitor Parkers Lake annually during 2001 through 2009 and during 2013, 2014, 2016, 2018, 2019, and 2022. The city intends to continue monitoring Parkers Lake on a regular basis, but will not duplicate the efforts of the BCWMC. The city intends to contract with the TRPD to complete the monitoring if they are willing to continue the partnership. During monitored years, Parkers Lake would be monitored bi-weekly from ice-out through September and once after fall turnover in October. Profiles of dissolved oxygen, temperature, specific conductance, oxidation reduction potential, and pH would be measured at 1-meter intervals from the lake's surface to its bottom. Secchi disc transparency would be measured from the lake's surface to the depth at which the disc is no longer visible. Total nitrogen and chlorophyll *a* samples would be collected at or near the lake's surface. Total phosphorus and soluble reactive phosphorus samples would be collected at or near the lake's surface, at the middle of the lake's water column, and near the lake's bottom. Chloride samples would be collected at or near the lake's surface and near the lake's bottom.

TRPD collects one set of field duplicates from each field crew that samples each day and rotates the field duplicate sites each week in a randomized way. Because each field crew samples multiple sites each day, field duplicates will sometimes be collected from Parkers Lake and sometimes from other sites.

During monitored years, the TRPD would also complete two point-intercept aquatic plant surveys (spring and fall).

A.2.5 Metropolitan Council Citizen Assisted Monitoring Program (CAMP)

Monitoring Plan ID: CAMP

Planned Monitoring Interval: Annually in Priority 1 and Priority 2 waterbodies

To be determined in non-Priority waterbodies (as requested by the member cities and approved by the Commission)

Description:

The Metropolitan Council's Citizen Assisted Monitoring Program (CAMP) has been collecting water quality data on dozens Twin Cities metropolitan area lakes since 1980. On a bi-weekly or monthly basis (April - October), citizen volunteers collect a surface water sample for laboratory analysis of total phosphorus, total Kjeldahl nitrogen, and chlorophyll-a, obtain a Secchi transparency measurement, and provide some user perception information about each lake's physical and recreational condition. Laboratory analysis of collected samples is performed by the Metropolitan Council Environmental Services.

The BCWMC will fund the inclusion of Priority 1 and Priority 2 waterbodies in CAMP.

A.2.6 Metropolitan Council Watershed Outlet Monitoring Program

Monitoring Plan ID: WOMP

Planned Monitoring Interval: Annually on the Main Stem of Bassett Creek

Description:

The Watershed Outlet Monitoring Program (WOMP) is coordinated by the Metropolitan Council Environmental Services (MCES) and consists of a network of monitoring stations located throughout the Twin Cities Metro Area. The Bassett Creek WOMP site is located at Mile 1.7 near Van White Boulevard, about a half mile upstream of the storm sewer tunnel that runs beneath downtown Minneapolis to the Mississippi River. The BCWMC performs flow monitoring at the Bassett Creek WOMP station to assist MCES with the rating curve development through an agreement with MCES. The BCWMC is partially reimbursed (\$5,000) for its costs to perform the flow monitoring. MCES pays for all equipment, maintenance, power, cell service and laboratory analysis of samples for the monitoring site and maintains the rating curve. The BCWMC runs the monitoring station including measuring flow to assist MCES with the rating curve and collecting water quality samples.

The Bassett Creek station measures stage and calculates the conversion of stage readings into discharge using a rating curve polynomial. The BCWMC performs rating curve measurements routinely every six weeks and performs additional measurements as conditions require. The BCWMC downloads the rating curve data via modem and shares the data with MCES.

An automatic sampler equipped with 1-liter sample bottles is also housed at the station. When stream stage increases to a chosen trigger depth the data logger controls and activates flow pacing to the sampler. The sampler collects flow-weighted samples during each storm. Specific conductance and temperature are continually recorded.

During runoff events, the individual flow paced samples are collected and combined into one large sample for analysis. In addition, the BCWMC manually collects biweekly grab samples year-round as conditions permit. The BCWMC delivers the samples to MCES where they are analyzed in the MCES laboratory for water quality parameters, including chloride, *Escherichia coli* bacteria, total and volatile suspended solids, nutrients (total dissolved phosphorus, ortho phosphorus, total phosphorus, nitrate plus nitrite nitrogen, total Kjeldahl nitrogen, and ammonia nitrogen), and chlorophyll *a*. Parameters analyzed quarterly (the first grab sample of March, June, September, and December) include hardness (calcium plus magnesium), total alkalinity, sulfate, total organic carbon, and metals (cadmium, chromium, copper, lead, nickel, and zinc). Analytical methods and details are shown in Table MP-4. Instantaneous stage, flow, pH, dissolved oxygen, temperature and specific conductance are measured during grab sampling events.

The BCWMC collects one field blank and one field replicate annually. The field blank and field replicate samples are analyzed for the same parameters as the original sample.

The MCES collects macroinvertebrate samples annually at the WOMP station location in August/September.

The BCWMC will continue to cooperate with the Metropolitan Council on monitoring activities at the WOMP station.

A.2.7 Minneapolis Park and Recreational Board (Wirth Lake Monitoring)

Monitoring Plan ID: MPRB

Planned Monitoring Interval: Annually in Wirth Lake

Description:

The Minneapolis Park and Recreational Board (MPRB) monitors Wirth Lake annually. Monitoring includes one winter sample in January or February, one spring sample in March or April, two samples per month from May through September, and one fall sample in October or November. All samples are collected at mid-lake from a point directly over the deepest point in Wirth Lake. In addition, samples are collected weekly from mid-May through August near the swimming beach. Sampling parameters and frequency at the time this watershed management plan was written are shown in Table MP-8, but may be subject to change in the future.

Table MP-8 Sample location, parameters measured, and sampling frequency

Sample Location	Sampling Frequency	Parameters
Beach	Weekly from mid-May through August	<i>Escherichia coli</i> bacteria
Beach	Weekly from mid-May through August	Cyanotoxins
Mid-Lake	Once winter, once spring, twice per month May-September, and once fall	Chloride, chlorophyll <i>a</i> , specific conductance, dissolved oxygen, pH, phycocyanin, phytoplankton, Secchi disc transparency, temperature, and nutrients (total nitrogen, total phosphorus, and soluble reactive phosphorus)

Sample Location	Sampling Frequency	Parameters
Mid-Lake	Once winter, once spring, once per month May-September, and once fall	Silica
Mid-Lake	Once spring, once per month May-September, and once fall	Zooplankton
Mid-Lake	Once winter, once spring, twice between May-September, and once fall	Alkalinity, hardness, and nitrogen (ammonia nitrogen, nitrate/nitrite nitrogen, and total Kjeldahl nitrogen)
Mid-Lake	Once in August	<i>Escherichia coli</i> bacteria
Mid-Lake	Once August	Zebra mussel eDNA
Mid-Lake	Three times between June and September	Zebra mussel veliger tow

Aquatic invasive plants in Wirth Lake are delineated annually, typically in August, at the swimming beach and boat launch areas to meet MDNR permitting requirements for MPRB’s aquatic plant harvesting operations. The MPRB intends to conduct a point intercept survey in Wirth Lake for aquatic plants at least one time during the 2025 through 2034 period, but had not determined the survey year at the time this watershed management plan was written. The BCWMC intends to conduct a point intercept plant survey in Wirth Lake every three years, but will not duplicate the efforts of the MPRB.

A.2.8 City of Minnetonka (Crane Lake Monitoring)

Monitoring Plan ID: CITY MTKA

Planned Monitoring Interval: 3-year cycle in Crane Lake

Description:

The City of Minnetonka monitors Crane Lake on a 3-year cycle. The city program has typically been flexible and willing to shift their schedule to prevent overlap with monitoring efforts by BCWMC on Crane Lake in a given year. Monitoring includes collecting one sample within two weeks of ice-out and monthly samples during June through September for a total of five samples during each year of monitoring. Parameters monitored during each sample event include Secchi disc transparency, temperature, dissolved oxygen, pH, specific conductance, turbidity, total phosphorus, chlorophyll *a*, and chloride. The City of Minnetonka typically does not perform an aquatic plant survey as a part of their Crane Lake monitoring program.

Table MP-9 BCWMC 10-year Monitoring Plan

Waterbody Type	BCWMC Management Classification	Waterbody Name	Year									
			2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Lake	Priority 1 Deep	Medicine Lake	TRPD	TRPD	TRPD+ PLANT ZOO-PHYTO	TRPD	TRPD	TRPD+ PLANT ZOO-PHYTO	TRPD	TRPD	TRPD+ PLANT ZOO-PHYTO	TRPD
		Parkers Lake	CAMP/CITY PLMTH ¹	CAMP/CITY PLMTH ¹	CAMP/CITY PLMTH ¹	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP/CITY PLMTH ¹	CAMP/CITY PLMTH ¹	BC-LWQ/CAMP PLANT ZOO-PHYTO ¹ CAMP	CAMP/CITY PLMTH ¹	CAMP/CITY PLMTH ¹	BC-LWQ/ CAMP PLANT ZOO-PHYTO
		Sweeney Lake	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP	CAMP
		Twin Lake	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP	CAMP
		Wirth Lake	PLANT/MPRB ²	MPRB ²	MPRB ²	PLANT/MPRB ²	MPRB ²	MPRB ²	PLANT/MPRB ²	MPRB ²	MPRB ²	PLANT/MPRB ²
	Priority 1 Shallow	Northwood Lake	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO
		Westwood Lake	CAMP	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP
	Priority 2 Shallow	Crane Lake	BC-LWQ/CAMP/CITY MTNKA PLANT ZOO-PHYTO	CAMP	CAMP	CAMP/CITY MTKA	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP/CITY MTKA	CAMP	CAMP	CAMP/CITY MTKA
		Lost Lake	CAMP	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP	CAMP	CAMP	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP	CAMP
		Cavanaugh Lake (Sunset Pond/Sunset Hills Pond)	CAMP	CAMP	CAMP	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO	CAMP	CAMP	CAMP	CAMP	BC-LWQ/CAMP PLANT ZOO-PHYTO

Table MP-9 BCWMC 10-year Monitoring Plan (Continued)													
Waterbody Type	BCWMC Management Classification	Waterbody Name	Year										
			2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	
Stream	Priority Stream	Main Stem Bassett Creek	WOMP	WOMP	WOMP	WOMP	WOMP	WOMP	BIO WOMP	WOMP	WOMP	WOMP	WOMP
		North Branch Bassett Creek	SWQ	--	--	--	--	--	BIO SWQ	SWQ	--	--	--
		Plymouth Creek	CITY PLMTH	CITY PLMTH	CITY PLMTH	BIO SWQ/CITY PLMTH	SWQ/CITY PLMTH	CITY PLMTH	CITY PLMTH	CITY PLMTH	CITY PLMTH	CITY PLMTH	BIO SWQ/CITY PLMTH
		Sweeney Branch Bassett Creek	--	BIO SWQ	SWQ	--	--	--	--	BIO SWQ	SWQ	--	--

Notes:

- TRPD Detailed water quality monitoring of Medicine Lake performed by Three Rivers Park District
- TRPD+ Same as TRPD, but BCWMC contracts with TRPD to collect and analyze samples at second monitoring location
- BC-LWQ Detailed lake water quality monitoring performed by BCWMC (or contracted party)
- CAMP Surface water quality monitoring by Metropolitan Council's Citizen Assisted Monitoring Program (CAMP), or equivalent program
- MPRB Detailed water quality and phytoplankton/zooplankton monitoring performed by Minneapolis Park and Recreation Board
- ZOO-PHYTO Zooplankton/phytoplankton monitoring performed by BCWMC (for Medicine Lake TRPD collects the samples and BCWMC analyzes the samples)
- PLANT Aquatic plant survey performed by BCWMC twice per monitoring season (June and August) (for Medicine Lake TRPD performs the aquatic plant surveys; TRPD performs these at no cost to BCWMC)
- BIO Invertebrate monitoring and biotic index analysis performed by the BCWMC
- SWQ Automated water quality monitoring of stream locations performed by BCWMC (or contracted party)
- WOMP Watershed Outlet Monitoring Program facilitated by Metropolitan Council Environmental Services
- CITY MTKA Detailed water quality monitoring performed by the City of Minnetonka (or contracted party)
- CITY PLMTH Detailed water quality monitoring performed by the City of Plymouth (or contracted party)
- 1 The City of Plymouth intends to continue contracting with TRPD to monitor Parkers Lake on a regular basis; monitoring will not duplicate efforts of the BCWMC. The City of Plymouth will also monitor the South inlet to Parkers Lake (PL-1) and the North Inlet to Parkers Lake (PL2) annually until data isn't required or funds do not allow for monitoring the inflow.
- 2 MPRB plans to conduct a point intercept plant survey at least once during 2025-2034 but has not set a date for the survey. The BCWMC will complete an aquatic plant survey every three years; monitoring will not duplicate efforts of the MPRB.