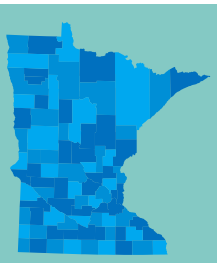
Streams

April 2023

Standard Operating Procedures

Intensive Watershed Monitoring – Stream Water Quality Sampling

MINNESOTA POLLUTION CONTROL AGENCY



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Foreword

This document of standard procedures is specific to stream chemistry and bacteria sampling and field monitoring conducted by Surface Water Assessment Grant local partners. These procedures are applicable to Cycle II of the Intensive Watershed Monitoring Program.

Contents

Executive summary

Scope and application

This standard operating procedure (SOP) is applicable to field observations and collection of water quality samples from streams and rivers for condition monitoring. This SOP details the steps necessary to prepare for stream monitoring, make proper field observations, collect and process water quality samples, and complete the proper documentation for sample delivery and analysis from a State certified lab.

Personnel qualifications and responsibilities

The Minnesota Pollution Control Agency (MPCA) and local partner's monitoring staff must be familiar with proper sampling techniques, sample handling, safety procedures, and record keeping. New staff and seasonal staff must be trained and accompanied in the field by experienced staff until competence is assured. Seasonal staff shall be provided written SOPs/instructions and one-on-one training at the start of their employment.

Summary of method

No single procedure will be applicable to all sampling situations i.e., sampling from a bridge, shore, or wading. The sampling method chosen must ensure that the sample collected is representative of in-flow conditions, while also considering safety and efficiency. Water samples from flowing surface waters should represent the flow in the stream, and not simply conditions that might occur in a small portion of the cross-section. Selection of one of the following methods should be based on access to a well-mixed, flowing portion of the stream, and the ability to pull water from below the surface without disturbing bottom sediments.

- **Hand-collected (grab) sample**: Stream water is collected directly into the bottle in wadable streams.
- **Telescoping rod**: Collection of a sample from the shore or a low bridge using a bottle attached to a telescoping arm.
- **Weighted bucket or Van Dorn/Kemmerer sampler**: Collection of a sample from a bridge using equipment that is lowered to water surface via a rope. Suitable for normal to high flows where bridge height is greater than 24 feet.

Under no circumstances are samples to be collected from standing or stagnant water. If there is no discernable flow, no sample shall be collected. Document the flow conditions and contact your project manager to report your observations.

Cautions and interferences

The sample may be contaminated if the sampling device is not properly rinsed prior to collection. For standard sampling equipment i.e., a telescoping rod or weighted bucket, the sample device should be rinsed three times with stream water prior to sample collection. For sampling equipment, such as the Van Dorn, the device must be triple rinsed by action of lowering and raising the sampler in and out of flowing water three times.

Sample contamination can also occur if bottom sediments are disturbed during sample collection. Should this occur, the sampling device must be emptied and rinsed. Move to a different location in the cross section or upstream to avoid collection of disturbed sediment.

Also, avoid touching the inner surfaces of the lid, bottle, and sampling equipment to reduce chance of contamination, especially for bacteria sampling. This includes when adding preservatives to the corresponding samples.

Samples should be collected between sunrise and sunset only. Inaccurate Secchi tube measurements occur when readings are taken at dusk or dawn.

Procedures

This section details the steps necessary to collect, process, and prepare samples for delivery to a State certified lab. Contractors must use laboratories listed within the MPCA's Master Lab Services Contract or an approved University lab within Minnesota. Under MPCA guidance, contractors are expected to work directly with the lab for specific instructions on bottle rinsing, sample preservation, bottle labeling, and submission instructions. It is expected that all contactors will coordinate with the MPCA Project Manager to ensure these details have been established prior to the sampling season. It is also the contractor's responsibility to keep a **physical, signed copy** of a current Minnesota DNR General Permit to Transport Water for Water Quality Sampling, as provided by the MPCA Project Manager. This permit is required to be carried for all water quality monitoring events.

Pre-sampling requirements

Sonde/Field meter calibration

Calibration is required for pH, conductivity, depth, and dissolved oxygen (DO). A detailed calibration record is necessary for quality assurance/quality control (QA/QC). **Calibration for DO shall occur each day of monitoring at the first sampling location.** Additional parameters shall be calibrated per manufacturer's recommendations but not to exceed 30 days during monitoring season.

Local partners may use the Field Meter Calibration Records Form located on the Surface Water Assessment Grant (SWAG) guidance webpage and submit with the progress reports. Alternative forms of documentation are acceptable and shall be discussed with the MPCA Project Manager.

Sensor calibration records support the accuracy of the data collected using these instruments. Contractors are expected to report all calibration logs recorded throughout the monitoring season. For any calibration record keeping method used, the following information must be provided: For each parameter calibrated, a measurement must be taken on the standard solution prior to calibration and recorded in the 'pre-calibration' field. The value obtained from the sonde after the calibration will be entered in the 'post-calibration' field. If applicable, the expiration date of the calibration standard must also be recorded in the 'Expiration Date' field. Error readings or complications with the meter will be recorded in the appropriate field. Technicians calibrating the sonde/field meter will sign off to indicate a calibration has been completed.

The frequency of recorded calibration logs is also determined by the amount of time observed for a sensor to drift beyond an acceptable difference from the factory-defined limits or, in the case of DO, the expected concentration at 100% saturation. It is up to user discretion to understand and to report

sensor drift based on factory defined limits established for each sonde/field meter. Contractors are expected to coordinate with the MPCA Project Manager when sensors have drifted beyond an acceptable difference from the factory-defined limits, and therefore sensor efficacy, has been identified. It is expected that the user shall, in coordination with the MPCA Project Manager, take the steps necessary to troubleshoot the sonde/field meter according to manufacturer's specifications.

Further issues for faulty sondes/ field meters shall be discussed with the MPCA Project Manager and documented within the progress report. A record of maintenance for each sonde/field meter should also be kept and shared. The expectation in sharing sonde/field meter information is to increase the longevity of the equipment and ensure the accuracy of readings.

Equipment preparation

Equipment necessary to conduct a complete sampling trip should be gathered prior to departure. Confirm that the number of bottles and preservatives necessary to complete all regular and duplicate sampling are packed. The required analyses and observations for each sampling are displayed in the table in **Appendix A**. The use of a trip specific checklist of equipment and supplies is recommended when preparing for all monitoring trips, see **equipment and supply checklist** below.

The use of additional equipment and decontamination materials may be necessary when monitoring locations that are designated with an invasive species infestation. Samples collected in infested waters shall be labeled "AIS" in accordance with lab requirements to ensure proper disposal. Additionally, documentation shall be provided within the Chain of Custody (COC). See the MPCA procedures for monitoring in infested waters on the Water Monitoring Resources webpage, under Aquatic Invasive Species

Due to short *E. coli* holding times, it is recommended that the designated lab be notified of sample arrival 24 hours prior to delivery.

Equipment and supply checklist

A variety of sampling equipment is needed for surface water sample collection. The following checklist is a guide for sampling needs. Check all electronic equipment and batteries for proper operation. If you have any doubts about the condition of a piece of equipment, bring along a replacement if available.

Field survival/personal protective equipment (PPE)

- ☐ First aid kit
- ☐ Insect repellent and sunscreen (wash hands thoroughly after applying to avoid sample contamination)
- ☐ Rain gear/rain boots
- ☐ Hip waders or wading boots
- ☐ Personal floatation device (PFD)
- ☐ Cell phone
- ☐ GPS unit (optional)
- ☐ Orange traffic cones
- ☐ Replacement batteries
- ☐ Toolbox with basic tools

Field equipment/documentation

- ☐ Physical signed copy of valid DNR Permit: *Transport Water for Water Quality Sampling*
- ☐ Electronic field capture of field datasheets/Chain of Custody, and photos
- ☐ Physical copy of field datasheet(s) and Chain of Custody
- ☐ Camera
- ☐ 100 cm Secchi Tube
- ☐ Calibrated multiparameter sonde with pH, conductivity, temperature, and dissolved oxygen (DO) sensors
- ☐ Waterproof pens, markers and/or pencils

Surface water sampling equipment

- ☐ Sample bottles and preservatives (including extra sets)
- ☐ Telescoping rod, 12-foot and/or 24-foot
- ☐ Weighted bucket, Van Dorn or Kemmerer sampler
- ☐ Spare parts for repair of samplers
- ☐ Coolers and ice
- ☐ Lab filtered purified water for QC-FB (if applicable)
- ☐ Sample shipping supplies (if applicable)

Equipment decontamination

- ☐ Distilled water
- ☐ Low pressure sprayer
- ☐ High pressure, high-heat sprayer (if applicable)

Document preparation

Prior to any field monitoring preparations, all local partners, in coordination with the MPCA, shall obtain guidance from their designated laboratory regarding appropriate bottle labelling and completion of the COC. Local partners may complete COCs prior to sampling trips for trip planning guidance. In this instance, local partners may submit COCs to the MPCA project manager for prior review. Indicate the correct EQuIS Project (PRJ) code, contact information, site information, and designated analyses and bottles details for each specific monitoring location. When relevant, include field replicates and sample blanks for quality control. Label bottles prior to filling and provide identifying information in accordance with instructions provided by the analytical laboratory.

Prepare stream monitoring field datasheets with specific site/date information relevant to the sampling event. Note that information recorded on the stream monitoring datasheet will be transcribed to EQuIS at a later date. It is imperative that accurate documentation occurs at this step to prevent future errors.

On-site procedures

Travel to sampling location

Travel to the sample location(s) with the assistance of a GPS unit or map. Wherever possible, park the vehicle in a nearby field approach or public parking lot. If these options are not available, park on the road shoulder, ensuring the vehicle is clear of the traffic lane and follow instructions detailed within the **Health and Safety** section of this document.

Sampling preparation

The following preparations shall be completed before launching.

- Label bottles
- Prepare field datasheets with site ID, stream name, date, and time
- Calibrate sonde/field meter for DO, if at the first sampling location for the day
- Prepare water quality collection equipment (telescoping rod, Secchi tube, etc.)

Once preparations are complete, identify an appropriate sample collection location by assessing current flow conditions at the time of sampling. Sampling may occur within 500 linear feet from the designated coordinates of your S-code location. Bottles, camera, 100 cm Secchi tube, water sampling device, and field datasheets/notebook/pen should accompany the samplers to the sample location as needed.

Sonde/Field meter measurements

Temperature, specific conductance, DO and pH measurements shall be recorded with a sonde/field meter. Place the sensors in a well-mixed, flowing portion of the stream at or near the sampling location. If flow conditions are such that the sensors could be damaged, move to the closest accessible point in the stream that is safe for the equipment. The individual probes or multi-probe sonde can be placed in the water while wading, sampling from the bank, or lowered from a bridge. If wading, place the sonde/ field meter upstream of sampler. Use a reliable sonde/field meter with documented calibration records. Follow the operation instructions supplied by the manufacturer of your specific sonde/field meter. General steps to take a measurement follow.

1. Remove the protective storage cover from the sonde/field meter and replace it with the weighted probe guard. Turn on the sonde/field meter display unit.
2. Lower from a bridge deck or wade into the stream to place sonde/field meter in a location with well mixed water with adequate flow. Make sure the device is not in the sediment.
3. Allow the probes to stabilize.
4. Record the measurements onto the field datasheet.

In-stream sampling – wading

1. Enter the stream downstream of the sampling location with the bucket of bottles.
2. Walk upstream to the sampling location and face upstream.
3. Remove the lid from the sample bottle.
4. Without touching the inside of the bottle or lid, lower the bottle upside down into the stream.
5. Invert the bottle below the water surface to elbow depth, if applicable, and allow it to fill.
6. Raise the bottle to the surface, taking care to avoid any surface material. Return to shore and add preservative where necessary.
7. Cap the bottle.
8. Repeat steps 3 through 7 for any additional bottles.
9. Take transparency reading with the 100 cm Secchi tube according to the instructions below.
10. Take sonde/field meter measurements, ensuring that the sensors are not obstructed by vegetation or within the sediment.

In-stream sampling - shoreline

1. Bring telescoping rod, bottles, and sonde to the shoreline adjacent to the sampling site.
2. Ensure the collection bottle on the rod is securely attached. Rinse the bottle three times in the stream.
3. Extend the telescoping rod to the length necessary to reach the point of flow. Dip the rod into the water with the bottle opening facing the water.
4. Invert the bottle and fill from just below the water surface.
5. Carefully retract the rod and bring the collection bottle to shore.
6. Remove the lid from the sample bottle.
7. Without touching the inside of the bottle or lid, pour the contents of the collection bottle into the sample bottle. Add preservative where necessary.
8. Repeat steps 3 through 7 if additional water is required. If collecting a field duplicate for a quality control check, remember to fill these bottles from a separate sample collection from the collection bottle.
9. Fill the 100 cm Secchi tube from the telescoping rod collection bottle. Measure the transparency according to the instructions below.
10. Take sonde/field meter measurements, ensuring that the sensors are not obstructed by vegetation or within the sediment. If not practical, take measurements from sample bucket.

In-stream sampling - bridge

1. Bring the weighted bucket sampler, Van Dorn, or Kemmerer sampler and necessary bottles to the bridge above the sampling location.
2. Ensure the weighted bucket sampler is securely attached to a rope. Rinse the bucket three times in the stream by lowering the bucket, collecting a water sample, and emptying out the bucket.
3. Lower the weighted bucked into the stream. Be sure to carefully uncoil the rope, so that it does not scrape against the bridge wall or pick up excess debris from the bridge deck.
4. Once filled, retrieve the sample, taking care to avoid scraping the rope against the bridge and shaking particles from the rope into the sample. If using the Van Dorn or Kemmerer sampler, trip the closing mechanism prior to removing the sampler from the water.
5. Without touching the inside of the bottle or lid, pour the contents of the bucket into the sample bottles before sediment has time to settle to the bottom of the bucket. Add preservative where necessary.
6. Repeat steps 3 through 5 if additional samples are needed. If collecting a field duplicate for a quality control check, remember to fill these bottles from a separate sample collection of the bucket sampler, Van Dorn, or Kemmerer.
7. Fill the 100 cm Secchi tube from the weighted bucket sampler. Measure the transparency according to the instructions below.
8. Take sonde/field meter measurements, ensuring that the sensors are not obstructed by vegetation or sediment. If not practical, take measurements from sample bucket.

100 cm Secchi tube transparency measurement

1. Remove sunglasses or polarized eyeglasses, and removing brimmed hats. Turn your back to the sun and position the tube to avoid direct sun the full length of the tube.

2. Gently pull up the inside string to remove the black and white Secchi disk from the tube.
3. Fill the tube to the top with water from the sampling bottle or bucket. Let the water drain out of the string guide hole to the zero mark on the tape measure attached to the side of the tube.
4. While looking down into your tube from the top, slowly lower the Secchi disk down into the tube until the disk disappears from sight. When it disappears, stop lowering.
5. While continuing to look down the top of the tube, slowly pull the string to raise the disk until it reappears. Lower and raise the disk until you have found the midpoint between disappearance and reappearance of the disk.
6. Pinch the string against the top rim of the tube to hold the disk at this measured depth of disappearance/reappearance. Look at the side of the tube, across the top of the disk, to see the closest centimeter mark on the tape.
7. Write down this depth, to the nearest centimeter, on your stream data sheet under "Secchi tube depth." If the disk does not disappear, and you see it clearly sitting on the bottom of the tube, record "greater than 100".

Field datasheet completion

1. Ensure the specific site ID, stream name, date and time have accurately been recorded onto the datasheet.
2. Visually assess the stream condition, appearance rating and recreational suitability rating at the sampling site, referring to **Appendix B** for ratings, abbreviations, and observation codes.
3. On the field datasheet, determine the appearance and suitability of recreation of the stream sampling site using the 1-5 scale provided.
4. Note the stream condition ("interstitial", "low", "high", etc.) on the field datasheet.
5. Record the type of sampling equipment used at the site; bridge, shoreline, or in-stream sampling.
6. Ensure the sonde/field meter readings have been accurately recorded.
7. Add any additional observations that may aid in assessment decisions (i.e., stream bank failure, no-flow, flooding, excessive algae, blue-green blooms, etc.).

Photo

1. Photograph the field datasheet header box with site and date visible. This photo will be used for picture file naming to be completed post-trip. Datasheet photos do not require retention.
2. Take a photo facing upstream from the sampling site. Include at least one upstream bank or permanent feature along the shoreline that will help interpret the conditions at the site as the seasons and water level vary throughout the sampling period.
3. Alternatively, it is acceptable to consistently photograph downstream if it provides information on significant events, unique circumstances, or a better view of general stream physical conditions.
4. Take additional photos that document stream conditions, such as bank erosion, construction sediment, algae, etc.
5. Mark on the field datasheet any comments that will help describe the photos.
6. Instructions for uploading and naming photos can be found under the **Post-trip Requirements** section of this document.

Post-sampling bottle organization

1. Ensure preservative is added to appropriate sample bottle.
2. Organize sample bottles by site and double check bottle labeling. Ensure that all identification is correct and easily readable.
3. Place samples in a cooler with adequate ice to account for shipment or delivery time. Ensure all bottle caps are tightly sealed and that all bottles are packed within the cooler securely to avoid breakage.

Aquatic invasive species decontamination

If the body of water is listed with a presence of aquatic invasive species, necessary measures shall be taken to prevent the spread to other waterbodies. Decontamination procedures listed within the MPCA AIS SOP must be followed before proceeding to any further waterbodies. **All bottles from designated Aquatic Invasive Species (AIS) waterbodies must be labeled appropriately in accordance with your labs COC documentation procedures.**

Quality assurance/quality control

Field replicates shall be collected in July of the first monitoring season at each monitoring location for all scheduled parameters. Equipment blanks shall be collected by each stream monitoring team at one site in July of the first monitoring year. Contact your laboratory to verify the quality assurance/quality control (QA/QC) labeling they have designated for use. For definitions on QA/QC see **Appendix C**.

Guidelines for collecting a field replicate

1. Label bottles as directed by the lab, ensuring that you identify the sample as a field replicate. If time is used, record as 1-5 minutes after the original sample is collected.
2. Collect the sample using one of the methods previously described.
3. Add preservative—if needed—and place sample bottles in coolers with ice.
4. Be sure to note the appropriate sample type on the COC for a field replicate.

Guidelines for collecting a field blank

1. Label bottles as directed by the lab, ensuring that you identify the sample as a field blank. If time is used, record as 1-5 minutes after the original sample is collected.
2. Fill the sample bottle with laboratory-prepared reagent water.
3. Add preservative, if needed, and place sample bottles in coolers with ice.
4. Be sure to note the appropriate sample type on the COC for a field blank.

Guidelines for collecting an equipment blank

1. Label bottles as directed by the lab, ensuring that you identify the sample as an equipment blank. If time is used, record as 1-5 minutes after the original sample is collected.
2. Rinse sampler three times with laboratory prepared reagent water.
3. Fill the sampler a fourth time with distilled water and pour into the sample bottles.
4. Add preservative, if needed, and place sample bottles in coolers with ice.
5. Be sure to note the appropriate sample type on the COC for an equipment blank.

Post-trip requirements

Chain of custody guideline

1. Verify that information on the COC matches information on the bottles.
2. Ensure the correct EQuIS Project ID has been added to the form. Only one COC can be used per EQuIS Project ID (i.e., PRJ07081, PRJ07082).
3. All bottles from Aquatic Invasive Species (AIS) sampling locations must be labeled appropriately, and identified on the COC, in accordance with the designated lab's COC documentation procedures.
4. Include the correct stream site ID, date, and time.
5. Depth recorded is 0 m for both start and end depth.
6. Replicate samples must be recorded in their own row.
7. Document preservative use.
8. Sign and date upon transfer of possession with laboratory receiving staff or shipper.

Shipping preparation

1. Verify that preservatives have been added to the appropriate bottles.
2. Ensure that caps on bottles are adequately sealed.
3. Place all sample bottles in coolers with adequate amount of ice to account for shipment/delivery time. Monitoring staff must note that all water quality sample bottles must not exceed 6° C.
4. Ensure that bottles and ice are tightly packed into the cooler to avoid jostling and potential bottle breakage.

Post sampling equipment management

All equipment used for the collection of stream samples shall be properly cleaned and prepared for its next use. This includes a visual inspection for damage or excessive wear.

- Remove all sampling equipment from vehicle and visually inspect for any aquatic vegetation or sediment.
- Wash equipment and allow adequate time for drying.
- Unused, clean bottles should be returned to the appropriate clean bottle storage.
- Coolers should be rinsed, drained, and allowed to dry.
- If used, inspect and clean waders, and allow adequate time for drying.
- Inspect equipment rope/line, wash, and allow to dry.

- Inspect Van Dorn or Kemmerer sampler and Secchi tube, wash, and allow to dry.
- Properly clean, dry, and store sonde/field meters and display unit. If data were collected electronically, download all files for submittal. Follow manufacturer's instructions for download.
- If the last body of water visited is listed with the presence of aquatic invasive species, ensure any additional measures to decontaminate field equipment are followed. See the **Aquatic Invasive Species Decontamination** section for more information.

Processing photos

At the end of each trip, download and label photos using the following naming protocol.

1. Download photos from the camera.
2. Rename them using the following naming convention: S004-552 20150720A.JPG
   a. S-code include a space after
   b. date collected YYYYMMDD
   c. then the alphabetic identifier 'A' shall be used for the upstream photo
   d. if there are multiple pictures, then additional alphabetic identifiers will be necessary
3. Delete the photos of field sheets if taken to help identify specific stream sites.
4. Delete photos from camera.
5. Local partners shall submit photos to the MPCA Project Manager utilizing the Sharebase application, as directed.

Data management

Data collected through the SWAG program is characterized by two categories: field observations and recordings and analytical laboratory data. Separate procedures and management practices are required for the collection, storage, and submittal of data collected.

Field observations

All observations documented in the field shall be transferred from the Stream Datasheet to the EQuIS Excel Template. Local partners are not required to submit the Stream Datasheet but must retain a record for future references. The following information must be included within the template:

a. The designated Project ID.
b. Stream name, S- code ID, date, and time.
c. Correct observations with correct units of measurement.

Laboratory results

All laboratories contracted under the SWAG program are required to submit analytical results to the MPCA electronically. Laboratories shall submit the results as an electronic data deliverable utilizing the LAB_MN feature of EQuIS. Local partners shall coordinate and monitor Electronic Data Deliverable (EDD) submittal with their contracted laboratory and retain the hard copies of the results. These documents shall be used at the end of the monitoring season for QA/QC data review. Local partners are not required to transcribe the lab results to the EQuIS Template.

Health and safety

Chemical safety

The most common acid preservatives used in water quality monitoring are sulfuric and nitric acid. Sulfuric acid is used for nutrient preservation and nitric acid is used for metals preservation. Local partners must uphold their local guidance and policies on safety surrounding handling of chemicals. Safety Data Sheets (SDS) shall be filed in an easily accessible location near the chemical storage and handling area and consulted for first aid measures and proper handling, storage, and disposal requirements. General information regarding preservatives:

- When handling sample preservatives, always use extreme care; splash-proof goggles and non-contaminating gloves are recommended.
- Avoid contact between preservatives and the skin, eyes, nose, and mouth.
- Sulfuric and other acids will eat through clothing. Immediately wash shoes and clothes that are exposed to acid.
- Leave ample room at the top of the sample bottle for the addition of preservatives and room for mixing.
- Store chemicals and preservatives in a safe place. Do not store chemicals where they will be subject to temperature extremes or long-term direct sunlight. Follow storage and handling requirements spelled out in the SDS.
- When using pre-measured preservative vials from a lab, put the empty vials in a sealed plastic bag and dispose of properly.

Road and vehicle safety

One of the most dangerous components of water quality sampling is the risk of injury posed by oncoming traffic. The Minnesota Department of Transportation has guidance relating to road safety. MPCA staff and local partners are required to abide by the requirements when working on Minnesota's roadways. Use of traffic control devices are essential and should be used as needed based on site location.

Whenever possible, park the vehicle in a nearby field approach, driveway, or public parking lot. If off road parking is not available, please refer to the Minnesota Temporary Traffic Control Zone Layouts Field Manual January 2018 for guidance. The Temporary Traffic Control Zone Layouts Field Manual 2018 or the most up to date version must be followed. It is recommended that each person have a copy of the manual in the field vehicle.

Different protocols should be implemented depending on location and access to sampling site. In most situations, layout 6, 7, and 8 can be used. This is dependent on traffic volume.

Traffic control devices

These devices are commonly used in the layout diagrams to direct and warn traffic. MPCA staff and local partners should have these items as needed based on site location.

Vehicle warning lights – amber in color, should be turned on when parking on the shoulder of the road and visible to drivers from 360 degrees. Vehicle warning lights attract the attention of road users and can result in a potentially hazardous situation.

Work zone warning sign – a 36" x 36" "ROAD WORK AHEAD" sign may be needed depending on the site. Placement should be far enough from vehicle to slow traffic and give drivers adequate time to react. The appropriate distance is the "A" distance on the back flip out page (6K-ap) of the *Minnesota Temporary Traffic Control Zone Layouts Field Manual January 2018*.

Cones – Must be orange, contain retro-reflective bands, and be at least 36 inches high. Spend the least amount of time necessary to set up and remove the cones to limit exposure to oncoming traffic.

Personal protection gear – High visibility safety apparel with retro-reflective material should be worn at all times. The minimum requirement is a Class 2 safety vest. In low light conditions, additional safety apparel such as a retroreflective hat and pants are recommended.

General sampling safety

The safety of sampling staff is of utmost importance. Water quality samples are to be collected only if conditions allow. Site accessibility and safety precautions can vary significantly from site to site. Collecting samples from a bridge with wide shoulders and speeding traffic can be much different from a remote site requiring a hike into a gorge with an extended pole. In the first instance, flashers, cones, and reflective wear are imperative. While in the second instance, safety precautions may involve protective outwear, waders and bug repellent. Regardless, sampling personnel are required to understand the differences in accessibility and safety for each site and plan accordingly.

In no case should a sampler put themselves at risk when sampling rivers or lakes. Water quality samples are to be collected only if defined sampling methods are adhered to. If samples cannot be collected using approved methods, sampling shall not occur. The final decision to safely sample at a location should be up to staff discretion. If the sampling site continues to be a safety issue, an alternative sampling location can be discussed and established with the MPCA Project Manager. In general the following decision factors shall be applied:

- Do not collect samples during adverse weather conditions (presence of lightning, swift current/flooding). If lightning is present, return to the vehicle and wait a minimum of 20 minutes from the last visible lightning flash before returning to the water.
- Wear a United States Coast Guard certified personal floatation device (PFD) when collecting samples directly from the stream (the wading method).
- If the stream depth (in feet) multiplied by its velocity (feet per second) exceeds your height (in feet), then do not wade into the water.
- When wading to collect samples, wear hip boots or waders that protect from the cold, pollutants, and other potentially dangerous field conditions. Be aware of your surroundings while wading; look for debris upstream, use a wading rod or walking stick to determine stream bed conditions, especially in turbid conditions.
- Always let someone know where you are, your planned return time, and what to do if not back (or cannot be reached) by the appointed arrival time.
- Develop a safety plan. Determine the location and telephone number of the nearest medical centers within your defined sampling area. Determine directions on how to get from the nearest medical centers to your sites in case you need to give directions during an emergency.

Appendix A – Preservation and holding times

Information in this table is based off the Minnesota Department of Health (MDH) Environmental Health Laboratory standard practices. Alternative laboratories may have different standard procedures per parameter preservation, container type, and holding time. **Staff and contractors are expected to consult with contracted labs to specify standard procedures for preservatives, container type, and holding times for the analytical methods selected and approved by MPCA QA/QC staff.**

Parameter	Sample collection method	Container type	Preservation	Holding time
Dissolved oxygen	Sensor reading	Field measurement	None	Instantaneous
pH	Sensor reading	Field measurement	None	Instantaneous
Specific conductance	Sensor reading	Field measurement	None	Instantaneous
Temperature	Sensor reading	Field measurement	None	Instantaneous
TSS	Grab sample	1 L general chem.	None	7 days
Total phosphorus	Grab sample	250-mL nutrient	10% H2SO4 & 4°C	28 days
NO2+NO3	Grab sample	250-mL nutrient	10% H2SO4 & 4°C	28 days
Chloride	Grab sample	1 L general chem.	4°C	28 days
Sulfate	Grab sample	1 L general chem.	4°C	28 days
E. coli	Grab sample	125 mL bacteria	4°C	8 hours*
Chlorophyll-a	Grab sample	petri dish	4°C	30 days
Pheophytin	Grab sample	petri dish	4°C	30 days
Calcium	Grab sample	500 mL metal	20% HNO3	6 months
Magnesium	Grab sample	500 mL metal	20% HNO3	6 months
Hardness	Grab sample	500 mL metal	20% HNO3	6 months
BOD, 5 day	Grab sample	2 L general chem.	4°C	48 hours

* The MPCA will accept data for samples that have been set up for incubation past the 8-hour hold time. All data up to 24 hours from the time of collection must be qualified if the 8-hour holding time is exceeded. Additionally, documentation indicating the duration of the exceedance shall be provided for all samples exceeding 24 hours. Samples exceeding 30 hours will be evaluated to determine the necessity for makeup sample collection.

Appendix B – Metadata coding for field observations in EQuIS

Metadata forms and data process information located online.

Rating	Appearance definition	Rating	Recreational suitability definition
1A	Clear – crystal, clear transparent water	1	Beautiful, could not be better
1B	Tea-colored – transparent water, which has been colored by dissolved organic matter from upstream bogs or wetlands	2	Very minor aesthetic problems: excellent for body-contact recreation
2	Cloudy – not quite crystal clear; cloudy white, gray, or light brown	3	Body-contact recreation and aesthetic enjoyment slightly impaired
3	Muddy – cloudy brown due to high sediment levels	4	Recreation potential and level of enjoyment of the stream substantially reduced (would not swim but boating/canoeing is okay)
4	Green – due to algae growth; indicative of excess nutrients released into the stream		
5	Muddy **and** Green – a combination of cloudy brown from high sediment levels and green from algae growth	5	Swimming and aesthetic enjoyment of the stream nearly impossible

Abbreviation	Sample type definition
G	Grab – Sampling vessel or bottle filled at one point in water column and cross section of a waterbody

Abbreviation	Sampling device definition
SIM	Simple Open Plastic Bucket
ROD	Telescoping Rod with Bottle
DI	Depth Integrating (USGS type)
WB	Weighted Bucket with Cover
WSVD	Water Sampler Van Dorn
Other	Another type of sampler (describe in notes)
Bottle	Sample collected directly into sample bottle

Stream condition: **D**=Dry, **Z**=No Flow, **I**=Interstitial, **L**=Low, **N**=Normal, **H**=High / **SW**=Swift, **SL**=Slow, **MO**=Moderate / **C**=Clear, **M**=Muddy, **O**=Other

Stream flow (cfs): Note in Field Observations if stream flow was determined by direct measurement, rating curve, L&D gate rating or other.

Appendix C – Quality assurance/quality control

Overview

The purpose of quality assurance and quality control (QA/QC)is to ensure that the data collected by the MPCA and their local partners is of known and suitable quality to meet water quality monitoring goals and objectives. High-quality data enables the MPCA to make assessments and decisions regarding Minnesota's water resources in accordance with the U.S. Environmental Protection Agency (EPA) requirements. For more information on the MPCA's Quality System requirements, access the Quality Management Plan (QMP).

Quality assurance is a term used to describe the integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed, and expected, by the customer.

Quality control is a term used to describe the overall system of technical activities that measure the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established. It is a system of operational techniques and activities that are used to fulfill requirements for quality. The following table provides a list of abbreviations typically used in QA/QC protocols.

Abbreviation	Sample type definition
QC-FR	Field Replicate Sample
QC-FB	Field Blank Sample
QC-EB	Equipment Blank Sample
QC-TB	Trip Blank Sample
OT	Other

For the intent and purposes of the Intensive Watershed Monitoring program, a field replicate herein defines the process to which a replicate sample is collected alongside the regularly scheduled sampling techniques. To ensure high-quality data, the MPCA along with local partners shall collect a replicate sample using the same monitoring techniques separate from samples collected as part of regular scheduling. This means collecting an additional sample(s) following the same techniques as one would for a typical sampling event. The purpose of a field replicate is to ensure consistency and assurance of sampling techniques and to account for and quantify environmental variability.

Field blank defines the process in which a blank sample is collected while in the field. Typically, this involves using laboratory-prepared reagent water that is then transferred to the sampling bottle at the sampling location. The purpose of the field blank is to ensure that sample bottles provided for regularly scheduled monitoring are not contaminating samples collected.

Equipment blank defines the process to which a blank sample is collected through the equipment used in the field. Again, laboratory-prepared reagent water is needed to perform an equipment blank. In this procedure, the lab prepared reagent water is passed through the sampling equipment, such as a Van Dorn, in the same technique that is administered to collect a regularly scheduled sample. This initial passing through of reagent water through the equipment counts as a rinsing cycle before collecting the sample. Once the equipment has been rinsed three times with the reagent water. The procedure should be followed an additional fourth time in which the reagent water is transferred to a sample bottle post passing through the equipment. The purpose of the equipment blank is to ensure that the equipment used has been properly rinsed and is not contaminating samples collected.