Standard Operating Procedures (SOP)

Intensive Watershed Monitoring
– Stream Water Quality Component

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Forward

This document of standard procedures is specific to stream chemistry and bacteria sampling and field monitoring conducted by MPCA staff and Surface Water Assessment grantee staff under the Intensive Watershed Monitoring Program.

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Procedures

Scope and Application

This standard operating procedure (SOP) is applicable to the field measurement and collection of water column samples from streams and rivers for the purpose of condition monitoring. It is limited to samples collected for physical, conventional chemical and bacteriological analysis. This section details the steps necessary to collect a sample, process the sample, and prepare it for delivery to a State certified lab for analysis. Follow the bottle rinsing, sample preservation and submission instructions from the lab that will perform the analyses.

Summary of Method

No single sampling procedure can be applicable to all sampling situations (sampling from bridge, from shore, or via wading); therefore, the sampler must make a judgment based on which would produce the most representative sample, 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 wade-able streams
- **Telescoping Rod –** collection of sample from shore or low bridge using a bottle attached to a telescoping arm
- **Weighted bucket or Van Dorn sampler –** collection of sample from bridge – equipment lowered to water surface via a rope.
- **Open bucket –** collection of sampling from bridge – equipment lowered to water surface via a rope. Suitable where collection of floating materials can be avoided.

Health and Safety

Staff will use chemicals in the preservation of samples. Material Safety Data Sheets should be consulted for proper handling of these preservatives, such as sulfuric acid, to avoid inhalation and eye/skin irritation problems.

Staff should not sample during adverse conditions (presence of lightning, swift current/flooding). If lightning is present, staff should return to the vehicle and wait a minimum of 20 minutes from the last visible lightning flash before returning to the water. 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. A fast current can undermine footing in even relatively shallow water.

Cautions and Interferences

The sample can be contaminated if the sampling device is not properly rinsed prior to sample collection. For standard sampling equipment (i.e. telescoping rod, weighted bucket) the sample device should be rinsed three times with stream water prior to sample collection.

Sample contamination can also occur if the bottom sediments are disturbed during the sample collection. Should this occur, the sampling device should be emptied, rinsed, and sample collection should be attempted again at a lesser depth in the water column to avoid this contact. It may be necessary to move to a different location in the cross section or upstream to avoid disturbed bottom sediments.

Care must be taken to avoid contacting the inner surfaces of the lid, bottle, and sampling equipment to reduce the chance of sample contamination, especially for bacteria sampling.

Personnel Qualifications/Responsibilities

Field staff must be familiar with proper sampling techniques, sample handling, safety procedures, and record keeping. New staff and student workers must be trained and accompanied in the field by experienced staff until competence is assured. Refresher training events are held each spring for permanent field staff; these must be attended by all returning field staff. Student workers will be provided written SOPs/instructions at the start of their employment.

Equipment and Supplies

A variety of sampling equipment is needed for surface water sample collection. The general equipment needed for monitoring trips is listed below:

Waders/Rain Gear

Transparency Tubes

Weighted bucket sampler/Van Dorn/Simple bucket

Telescoping rod

Coolers

Ice

Sample bottles

Preservatives (acid)

Paint pen

Permanent Markers

Field/Lab Sheets

De-ionized water and tap water

Filtering kit for chlorophyll-a samples

Field meter for WQ measurements

Camera

GPS Unit

Weighted tape measure

Water chemistry sampling manual

Roadway safety equipment (reflective vest, orange cones and flashing light)

Procedures

This section details the steps necessary to collect a sample, process the sample, and prepare it for delivery to the Minnesota Department of Health Laboratory (MDH Lab). If a different lab is used, follow bottle rinsing, sample preservation, and submission instructions from that lab.

Pre-trip requirements

Field meter sensor calibration

Meter sensor calibration is required for pH, conductivity, and dissolved oxygen. The record of calibration checks both prior to and after sampling provides the data user with the assurance that the sensors and meter functioned properly throughout the field trip. The frequency of recorded calibration checks will depend on the amount of time it takes for a particular sensor to drift beyond an acceptable difference from the measurement standard or, in the case of dissolved oxygen, the expected concentration at 100% saturation. It is prudent to check calibration daily until a sensor demonstrates that it will hold calibration for a longer period. Calibration resets should be performed according to the manufacturer's recommendation and recorded with the checks against standard solution or expected reading. Use the calibration form in Appendix C and submit it with reports in paper or scan into electronic format at the end of each field season. For calibration of Hydrolab Quanta meters, see Appendix A or manufacturer's user manual. For calibration of Hach HQ4d meters, see Appendix B or manufacturer's user manual.

Equipment preparation

Equipment necessary to conduct a complete sampling trip should be gathered prior to departure. The required analyses and observations for each sampling are displayed in Appendix G of this document. Confirm that the number of bottles and preservative necessary to complete all regular and duplicate sampling are packed. On multi-day trips, sufficient tap water is necessary to conduct dissolved oxygen calibration, cleaning, and sufficient fresh DI water for equipment blanks and rinsing. Using a trip specific checklist of equipment and supplies, check the all for proper functioning and sufficiency while packing the vehicle.

Use additional equipment and sampler cleaning materials needed if a sampling trip includes sites that are infested with invasive species. Samples collected in infested waters must be labeled "AIS" and the lab notified on the Chain of Custody form so that the sample water will be disposed of appropriately. See the Minnesota Pollution Control Agency protocol for sampling in infested waters at the Surface Water Assessment Grant Web page behind the "For grantees" tab at this link: http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/surface-water-assessment-grants.html?menuid=&redirect=1%20

To meet bacteria holding times, be sure to alert the lab several days ahead of your trip, and ensure that the planned sample drop-off time will work for them.

Sampling requirements

Travel to sampling location

Travel to the sample location(s) with the assistance of a GPS unit or map. Park the vehicle in a nearby field approach or public parking lot. If none is available, park on the road shoulder, ensuring the vehicle is clear of the traffic lane and turn on flashers. A yellow flasher may be put on the roof to increase visibility and an orange cone should be placed on the road behind the vehicle as an early warning to other drivers of a vehicle and sampler being near the lane of traffic. Sampler(s) should wear reflective vests when working on road shoulders or bridge decks.

Prepare bottles and gather equipment

Prepare field data sheets with the time and location. Identify which analyses and respective bottles are needed for the location, including field replicates and sampler blanks for quality control. Mark bottle labels prior to fillling, according to the instructions provided by the analytical laboratory that will be used. (Note that sample bottles for the MDH Lab should be labeled with the EQuIS unique "S" code only, with the exception of field replicates and sampler blanks, to which "FR" or "SB", respectively, should be added).

Bottles, camera, transparency tube, sampling equipment, and field sheets/notebook/pen should be loaded into the meter container and an extra toting bucket, as needed.

Field/Lab Datasheet Completion

1. Visually assess the stream condition, appearance rating and recreational suitability rating at the sampling site, referring toAppendix G for ratings, abbreviations, and observation codes.
2. On the field datasheet, determine from the 1 to 5 scale provided the appearance and suitability of recreation of the stream at the sampling site.
3. Note the stream condition ("interstitial", "low", "high", etc.) on the field sheet.
4. Determine the type of sampling gear necessary at the site; bridge, shoreline, or in-stream sampling. This includes determining if the flow of the stream will allow for wading.

Photo

1. Take a photo of the field datasheet header box (with site and date visible).
2. Take a photo facing upstream from the sampling site. Try to 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. It is acceptable to choose to consistently photograph the downstream view instead if it will provide a better view of general stream physical conditions.

3. Optional additional photos include any factors at the site, such as bank erosion, construction sediment, algae, etc., that may be affecting or demonstrating stream conditions.
4. Mark on the field datasheet any comments that will help describe the photos.
5. Instructions for naming and storing photo files follow under "Post-trip Requirements".

Field Meter Measurements

Temperature, specific conductance, dissolved oxygen (DO) and pH measurements are measured with a 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.

Use a reliable meter for which calibration checks have been performed and recorded. Specific instructions for deploying a Hydrolab Quanta and the Hach HQ4d meters follow.

Hydrolab Quanta Meter Instructions -

1. Replace the sonde travel cover with the sonde guard.
2. Turn on the meter. If flow is very slow, turn on the stirrer and confirm that it is working prior to lowering the sonde.
3. Lower the sonde until the probe is in the water column. Allow the sensor readings to stabilize by leaving the sonde in the water while collecting the sample. Note the D.O., turn off the stirrer, and note the other measurements. If the water is too turbulent to safely deploy the sonde, instead take the measurements in stream water collected into the sample bucket from the bridge.

Hach HQ4d Meter Instructions -

1. Turn on the meter.
2. Lower the DO and conductivity probes into the water column. Press the read (green) button and wait for the data to stabilize and lock. If the cables will not reach the water surface, and only bridge access is possible, measurements should be taken in stream water collected into the sample bucket from the bridge.
3. Once locked, record the measurements onto the field sheet.
4. Repeat steps 2 through 3 for the pH probe (requires unplugging the conductivity probe and replacing it with the pH probe).

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.
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 (elbow depth) and allow to fill.
6. Raise the bottle to the surface, taking care to avoid any surface material.
7. Cap the bottle.
8. Repeat steps 3 through 7 for any additional bottles.
9. Take transparency reading with the secchi tube according to the instructions below.
10. Take field meter measurements, ensuring that the sensors are not obstructed by vegetation or sediment.
11. Return to the vehicle from the sampling site.

In-stream Sampling - shoreline

1. Bring telescoping rod and necessary bottles to the shoreline adjacent to the sampling site. Bring field meter if taking measurements from the shore.
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.
8. Repeat steps 3 through 6 if additional samples are needed.
9. Fill secchi tube from the telescoping rod sampling bottle. Measure the transparency according to the instructions below.
10. Take field meter measurements, ensuring that the sensors are not obstructed by vegetation or sediment. If not practical, take measurements from sample bucket.
11. Return to the vehicle from the sampling site.

In-stream Sampling - bridge

1. Bring weighted or open bucket sampler or Van Dorn sampler and necessary bottles to the bridge above the sampling location.
2. Ensure the weighted bucket sampler is securely attached to the rope. Rinse the sampler 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 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 analysis bottles before sediment has time to settle to the bottom of the bucket.
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 dip of the bucket sampler.
7. Fill secchi tube from the weighted bucket sampler. Measure the transparency according to the instructions below.
8. Take field meter measurements, ensuring that the sensors are not obstructed by vegetation or sediment. If not practical, take measurements from sample bucket.
9. Return to the vehicle from the sampling site.

Secchi Tube Transparency Measurement

1. Remove sunglasses. If you wear prescription glasses that darken to protect eyes from sun, wear a billed cap to shade the glasses. 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".

Equipment Blank and Sample Preservation

1. Add preservative to the nutrient and metals bottles and place in large cooler with ice.
2. If an equipment blank is scheduled for the trip/site complete the following:
    - Rinse sampler three times with DI water.
    - Fill the sampler a fourth time with fresh DI water and pour into the sample bottles.
    - Label bottles as noted above; add 'SB' on the label, to identify the sample as a sampler blank.
3. Place all additional sample bottles in coolers with ice.

Post-trip Requirements

End of Trip Processing

1. If unprocessed chlorophyll-a samples remain, complete processing before proceeding to step 3.
2. Organize bottles and field sheets by site.
3. Fill out lab sheet according to the requirements of the laboratory and the data management process used by the sampling organization. MPCA staff submitting samples to the MDH Lab can use instructions in Appendix G.
4. Deliver samples to the laboratory for analysis or make arrangements for shipping within holding times for each analysis. Sampling staff must sign off on the Chain of Custody form when submitting the physical samples or when transferring them to the custody of a shipper.
5. Conduct calibration checks on the field meter sensor and record the results on the calibration check sheet for the meter. Note any problems and perform sensor maintenance, as needed. If a sensor performs poorly in this post-trip check, consult with the project manager to decide whether the field measurements recorded on the trip should be stored with qualifying remarks or expunged due to meter malfunction.

Processing Photos

At the end of each trip, photos should be downloaded and labeled in the office using the following naming protocol and storage instructions.

1. Download the photos from the camera.
2. Rename the photos with the following name:
    - XXXXXXX_MM-DD-YY_U.jpg
        - XXXXXXX = Biological Monitoring Site ID (example: 09UM045)
        - MM-DD-YY = month-day-year
        - U = U for upstream (D for downstream)
3. Delete the photos of the field sheets if taken to help identify site photos.

4. Delete the photos off the camera.
5. Place the photo files in the appropriate watershed site folder on the MPCA server at (X:\Databases\Water_Quality\Biological_Monitoring\Streams\Pictures\IntensivePics) or submit the files, organized by site ID, to the MPCA SWAG Project Manager.
6. Charge or change camera batteries, as needed

Appendix A. Quanta Calibration Procedure

For the complete users manual, go to
http://www.hydrolab.com/web/ott_hach.nsf/gfx/Quanta_manual.pdf/$file/Quanta_manual.pdf or
This is an excerpt from the manual.

Calibration Preparation

The following is a general outline of the steps required to calibrate all the sensors:

- Select a calibration standard whose value is near that of your field samples.
- Remove the Storage Cup from the Transmitter.
- Clean and prepare the sensors as detailed in Sections 3.4.4 through 3.4.9.
- Attach the Calibration Cup.
- Using the Calibration Cap, thoroughly rinse the sensors several times by half-filling the calibration cup with deionized water and shaking the Transmitter to make sure each sensor is free from contaminants that might alter your calibration standard.
- In a similar manner, rinse the sensors twice with a small portion of the calibration standard, each time discarding the rinse.
- With the Transmitter sensors pointing up (toward the ceiling), fill the Calibration Cup with the calibration standard. See parameters below for sensor specific details.
- If the circulator is on, press the **Esc** ∞ key to toggle the circulator off, so that it doesn't splash your calibration standard.
- Place the sensors in the appropriate calibration standard for the parameter being calibrated.
- Monitor the parameter's stability on **Screen 1** and/or **Screen 2**, select **Calib**, then the item to calibrate.
- Enter the one or two values as required to complete calibration.
- If the Transmitter rejects the calibration, the Display LCD shows 'FAIL' before returning to the **Calib** screen.
- Return to **Screen 1** and/or **Screen 2** to confirm calibration.
- Finally, discard used calibration standards appropriately. Do not attempt to reuse calibration standards.

Generally, you should calibrate all Quanta parameters as often as your accuracy requirements dictate. If you want exceptionally accurate data, you must calibrate frequently. Calibration requirements also vary with deployment conditions – in very turbid or biologically-active waters, for instance, generally require more frequent calibrations than do cleaner waters

Temperature

Cleaning and Preparation:

Soap or rubbing alcohol may be used to remove grease, oil, or biological material.

Rinse with water.

Calibration Standard: Factory-set and no recalibration required.

Specific Conductance

Cleaning and Preparation: Clean the oval measurement cell on the specific conductance sensor with a small, nonabrasive brush or cotton swab. Soap or rubbing alcohol may be used to remove grease, oil, or biological material. Rinse with water.

Calibration Standard:

- Pour the specific conductance or salinity standard to within a centimeter of the top of the cup.
- Make sure there are no bubbles in the measurement cell of the specific conductance sensor.

Dissolved Oxygen % Saturation and mg/L

Cleaning and Preparation: Remove the o-ring securing the DO membrane. Shake out the old electrolyte and rinse with fresh DO electrolyte. Refill with fresh DO electrolyte until there is a perceptible meniscus of electrolyte rising above the entire electrode surface of the sensor. Make sure there are no bubbles in the electrolyte. Hold one end of a new membrane against the body of the DO sensor with your thumb and with a smooth, firm motion, stretch the other end of the membrane over the sensor surface and hold it in place with your index finger. Secure the membrane with the o-ring. Make sure there are no wrinkles in the membrane or bubbles in the electrolyte. Trim away the excess membrane extending below the o-ring. Ideally, let the sensor soak overnight to allow the membrane to relax to its final shape.

DO % Saturation Calibration Standard (Saturated-Air Method):

- Fill the Calibration Cup with tap water (specific conductance less than 0.5 mS/cm) until the water is just level with the o-ring used to secure the membrane.
- Carefully remove any water droplets from the membrane with the corner of a tissue.
- Turn the black calibration cup cover upside down (concave upward) and lay it over the top of the Calibration Cup.
- Determine the barometric pressure for entry as the calibration standard.

Notes:

Calibration of DO %Saturation also calibrates DO mg/L.

pH

Cleaning and Preparation of pH: If the pH sensor is obviously coated with oil, sediment, or biological growth, clean the glass with a very clean, soft, non-scratching cloth wet with rubbing alcohol (a cotton ball will do). Rinse with tap water.

Calibration Standard: Pour the pH or ORP standard to within a centimeter of the top of the cup.

Notes:

pH is a two-point calibration. A pH standard between 6.8 and 7.2 is treated as the “zero” and all other values are treated as the “slope”. First calibrate “zero”, then calibrate “slope”.

Appendix B. Hach Calibration Procedure

For the complete manual, go to http://www.hach.com/fmmimghach?/CODE%3AHQ40D18_5ED10935%7C1. This is an excerpt from the manual.

Calibrating the pH, DO, and conductivity probes on the Hach meter HQ4d

pH (Calibrate once per week)

1. The meter must be in single display mode (use the up key for the left probe, the down key for the right probe).
2. Press the blue/left key under calibrate
3. The display will show the buffer values to be measured. They should be 4, 7, and 10. If not, change them in the Calibration options menu. Rinse the probe with DI water and place in buffer solution 4.
4. Press the green/right button under read
5. When the reading is stable, the buffer being measured will be highlighted on the screen. Rinse the probe with DI water, and place in buffer solution 7
6. Follow steps 4 and 5, and place probe in buffer solution 10
7. Hit done with the up arrow when all three buffers have been used
8. If the calibration summary appears, hit the right/green key under store
9. OK will appear in the top left corner when the calibration is successful. If a question mark appears, the calibration has either expired or not been successful, try again

Conductivity (Calibrate once per week)

1. Keep the meter in single display mode, and change the meter to read the conductivity meter by using the up or down keys
2. Press the blue/left key under calibrate
3. The display will show the required conductivity standard solution. Rinse the probe with DI water, and place in solution
4. Press the green/right key under read
5. When stable the value will be highlighted on the screen, press the up button under done
6. The calibration summary will appear, press the green/right button under store
7. When the calibration is successful, OK will appear in the upper left corner of the screen.
8. Place back in dual screen mode by using the up and down arrows

DO (Calibrate once per month)

1. Keep the meter in single display mode, and change the meter to read the conductivity meter by using the up or down keys
2. Press the blue/left key under calibrate
3. Dry the probe
4. Place the probe in a narrow necked bottle that has been filled with 1 cm of water and shaken vigorously for several minutes (use a stopper if available).
5. Insert probe in the bottle; be careful not to get it wet.
6. Press the green/right button under read

7. When stable the value will be highlighted on the screen, press the up button under done
8. The calibration summary will appear, press the green/right button under store
9. When the calibration is successful, OK will appear in the upper left corner of the screen.
10. Place back in dual screen mode by using the up and down arrows,

Appendix C. Sample Calibration Sheet

Meter ID: _____

Brand/Model: _____

Program: _____

pH Calibration Log

Date	4 Before Reset	Reset 4 Reading	Buffer Expiration Date	7 Before Reset	Reset 7 Reading	Buffer Expiration Date	10 Before Reset	Reset 10 reading	Buffer Expiration Date	Problem Y or N (if Y make comments)	Initials

Meter ID: _____

Brand/Model: _____

Program: _____

Other Parameter Calibration

Date	Conductivity Before Reset	Conductivity Reset Reading	Buffer Expiration Date	DO Before Reset	DO Reset Reading (monthly)	Battery Life	Problem Y or N (if Y make comments)	Initials

Meter ID: _____

Brand/Model: _____

Program: _____

Comments (To be filled out when problems are identified with meter.)

Date:_____

Technician:_____

_____

_____

Date:_____

Technician:_____

_____

_____

Date:_____

Technician:_____

_____

_____

Date:_____

Technician:_____

_____

_____

Date:_____

Technician:_____

_____

Meter ID: _____

Brand/Model: _____

Program: _____

Maintenance Log

Date: _____
Issue: _____
_____
Employee managing problem: _____
Sent to manufacture? Y N If Y, Date sent: _____ returned: _____
Date problem resolved: _____

Date: _____
Issue: _____
_____
Employee managing problem: _____
Sent to manufacture? Y N If Y, Date sent: _____ returned: _____
Date problem resolved: _____

Date: _____
Issue: _____
_____
Employee managing problem: _____
Sent to manufacture? Y N If Y, Date sent: _____ returned: _____
Date problem resolved: _____

Date: _____
Issue: _____
_____
Employee managing problem: _____
Sent to manufacture? Y N If Y, Date sent: _____ returned: _____
Date problem resolved: _____

Guidance for Calibration Sheet

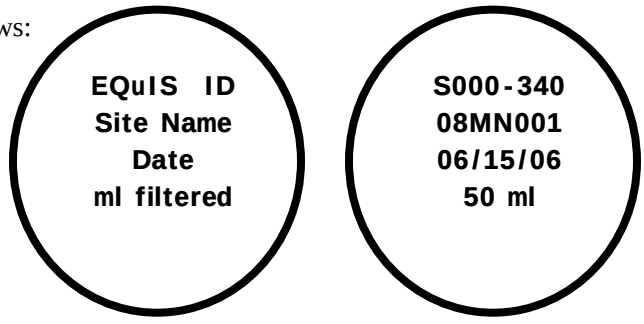
Meter calibration records support the accuracy of the data collected using these instruments. For each parameter calibrated, a measurement must be taken on the standard solution prior to calibration and recorded in the "Before Reset" field. The value obtained from the sonde after the calibration will be entered in the "Reset Reading" field which corresponds to the parameter being calibrated. Also record the expiration date of the calibration standard in the "Expiration Date" field, if applicable. Battery life should also be recorded, using a scale: (100%, 75%, 50% or 25%). Error readings or complications with the meter will be recorded in the appropriate box and the technician calibrating the sonde will sign off to indicate the calibration has been completed. Further comments for faulty meters can be addressed in the comments page. A record of maintenance for each sonde should also be kept to share information with the expectation of increasing the longevity of the equipment and insuring the accuracy of readings.

The field notes should include the designation of the meter. The calibration paper record should be kept with the meter in a rugged binder. It can be scanned into electronic format periodically, and at least annually, with the file named for the meter designation and dates included in the record of sampling them Electronic records will then be stored on the MPCA X drive: X:\Databases\Water_Quality\Biological_Monitoring\Streams\Documents\Equipment, records will be organized by year and 10 water quality project.

Non PCA partners will copy these records at the end of each sampling year and forward them to the MPCA biologist lead. The biologist lead will then be responsible for converting the documents into an electronic format and placing them in the appropriate X drive folder.

Appendix D. Procedure for Filtering Samples for Chlorophyll Analysis

1. Remove chlorophyll-a sample water from cooler.
2. Assemble chlorophyll-a kit.
   - Place filter holder in the flask.
   - Attach brake bleeder pump, if not already attached.
   - Place glass fiber filter (rough side up) on the filter holder using forceps.
   - Wet filter with DI water
   - Place funnel on top of filter and tighten
3. Invert chlorophyll-a sample bottle several times to mix the sample.
4. Pour sample into graduated cylinder. Turbid streams may need as little as 50 mL; clear, headwaters streams may require up to 1000 mL.
5. Pour **known** amount of sample into funnel. Be sure to note the volume of the sample being filtered.
6. Draw the liquid through the filter using the hand pump (electric pump, if at the FOC). Do not exceed 15 PSI.
7. Check color of filter
   - If no color is visible, repeat steps 4 through 6 and total the volume filtered.
   - Filter should be pale yellow/green to green in color
   - If not all of the water will draw through the filter, you must discard the remaining water in the funnel and the filter, rinse the funnel, and repeat steps 2 through 7 again.
8. Once proper color is achieved and all liquid has drawn through the filter, loosen and remove the funnel.
9. Using forceps, fold the filter in half (colored side on the inside).
10. Place in petri dish.
11. Label Petri dish as follows:



12. Write volume filtered on field/lab sheet.
13. Wrap Petri dish(es) in foil, place in plastic bag, and put in ice filled cooler with remaining samples.
14. Discard remaining sample water from 2 mL bottle.
15. Rinse filtering kit, disassemble and place back in travel case.

Appendix E. Preservation and Holding Times

Parameter	Sample Collection Method	Container Type	Preservation	Holding Time
Dissolved Oxygen	Meter reading measured just below the surface	Measured in the field	None	Instantaneous
pH	Meter reading measured just below the surface	Measured in the field	None	Instantaneous
Specific Conductance	Meter reading measured just below the surface	Measured in the field	None	Instantaneous
Temperature	Meter reading measured just below the surface	Measured in the field	None	Instantaneous
TSS	Grab sample	1 1000-ml general chem.	None	7 days
TS Volatile solids	Grab sample	1 1000-ml general chem.	None	7 days
Total Phosphorus	Grab sample	1 250-mL nutrient	10% H_2SO_4 @ 4 C	28 days
Ammonia	Grab sample	1 250-mL nutrient	10% H_2SO_4 @ 4 C	28 days
NO2+NO3	Grab sample	1 250-mL nutrient	10% H_2SO_4 @ 4 C	28 days
Chloride	Grab sample	1 1000-ml general chem.	4°C	28 days
Sulfate	Grab sample	1 1000-ml general chem.	4°C	28 days
E.coli	Grab sample	1 125 mL bacteria	4°C	48 hours
Kjeldahl Nitrogen	Grab sample	1 250-mL nutrient	10% H_2SO_4 @ 4 C	28 days
Chlorophyll a	Grab sample	petri dish	4°C	30 days
Pheophytin	Grab sample	petri dish	4°C	30 days
Calcium	Grab sample	1 500 mL metal	20% HNO3	6 months
Magnesium	Grab sample	1 500 mL metal	20% HNO3	6 months
Hardness	Grab sample	1 500 mL metal	20% HNO3	6 months

Appendix F. Instructions for MDH Lab Submission Sheet

INSTRUCTIONS FOR COMPLETING THE MPCA LAKE OR STREAM LAB SHEET

1. **Program Code (2 letters) –** Billing Code.
2. **Collected By** – Sample collector(s), enter your name(s).
3. **Project ID** – Enter the Project ID (e.g. PRJ06848). Note that samples for only one project may be listed on a single form.
4. **Collector Phone** – List the contact phone number for resolving questions about the samples.
5. **MPCA PM Name and Phone** – List the name and phone number for the MPCA Project Manager who should be contacted regarding questions about the project.
6. **Location ID (written)** – Enter the Location ID for each sample (e.g. 27-0016-00-101 or S005-515). Identification on bottles must match this Location ID.
7. **Location ID (bar code)** – The bar code will be automatically generated from the Location ID entered on the line above.
8. **Field Name/Lake Name –** Enter the lake or stream name, or other field identifier.
9. **BioDB Code –** Enter the BioDB Code, if appropriate.
10. **Date (MM/DD/YY) –** Enter the date in the format, MM/DD/YY (e.g. 03/07/11).
11. **Time (military) –** Enter the time in military format (i.e. 0900 for 9:00 a.m. or 1400 for 2:00 p.m.).
12. **Quality Assurance* –** Enter codes for quality assurance samples, such as Field Duplicates (FD), Sampler Blanks (SB), etc.
13. **Analysis Group No.**** – If you are requesting an analysis group rather than or in addition to individual analyses, enter the group number here.
14. **Sample Depth (Top) m –** For lakes only, enter the depth at which the upper sample was taken.
15. **Sample Depth (Bot) m –** For lakes only, enter the depth at which the lower sample was taken.
16. **Filter Volume (for chlorophyll a) –** If you field filter a chlorophyll a sample, specify the volume of the sample that was filtered.
17. **Sample Analyses:**
    a. List the desired analyses or sample processing in the left column
    b. Place an "X" in the large box in each of the sample columns if the analysis is needed for that sample.
    c. If a container was field filtered, place an "X" in the "Field filtered" box for the dissolved analysis requested.
18. **Chain of Custody (COC)** – FOC staff will only transport samples to MDH Lab if the COC on the lab form has been signed and dated.
    a. **Relinquished By / Affiliation** – When you drop off the samples at the Field Operations Center or MDH Lab, sign in the Relinquished By / Affiliation box and specify the agency or firm you are collecting these samples for.
    b. **Date/Time –** Write the date and time when you drop off samples in the Date/Time box.
    c. **Accepted By/Affiliation** - The samples will be signed for upon receipt at MDH Laboratory by a designated Environmental Lab Chain of Custody Custodian.
    d. **Date**/**Time** – The MDH Environmental Lab custodian will record the time and date that they accept the samples.
19. **Sampler Comments –** Write additional instructions for the MDH Lab, identify potential hazards, enter identifying notes, etc
20. **Receiving Comments –** For laboratory use only.

Appendix G. IWM – Water Quality Component Parameters and Frequency

First Year[1]

	Jan	Feb	March	April	May		June			July			August			Sept		Oct	Nov	Dec
					Early	Late	Early	Mid	Late	Early	Mid	Late	Early	Mid	Late	Early	Late			
TSVS					x	x	x		x	x		x	x		x	x	x			
TSS					x	x	x		x	x		x	x		x	x	x			
Total P					x	x	x		x	x		x	x		x	x	x			
Ammonia-N					x	x	x		x	x		x	x		x	x	x			
TKN					x	x	x		x	x		x	x		x	x	x			
NO_2+NO_3					x	x	x		x	x		x	x		x	x	x			
Sulfate					x	x	x		x	x		x	x		x	x	x			
Chloride					x	x	x		x	x		x	x		x	x	x			
Hardness as $CaCO_3$					x	x	x		x	x		x	x		x	x	x			
Chlorophyll a corrected for pheophytin[3]									x			x			x	x				
E. coli							x	x	x	x	x	x	x	x	x					
Secchi tube					x	x	x	x	x	x	x	x	x	x	x	x	x			
Specific conductance					x	x	x	x	x	x	x	x	x	x	x	x	x			
Temperature					x	x	x	x	x	x	x	x	x	x	x	x	x			
pH					x	x	x	x	x	x	x	x	x	x	x	x	x			
DO[2]					x	x	x	x	x	x	x	x	x	x	x	x	x			
One photograph					x	x	x	x	x	x	x	x	x	x	x	x	x			
Rec. suitability, appearance, stage estimate					x	x	x	x	x	x	x	x	x	x	x	x	x			

1. Every ninth sampling event should include a field replicate for QA/QC. Samplers should also take a sampler blank with the field replicate, if using a bucket or rod bottle.
2. Having DO concentrations before 9 a.m. is critical for understanding impacts to fish and invertebrates. The more pre-9 a.m. data you can collect, the better. Strive to collect at least one DO sample for each site before 9 a.m. over the course of the grant.
3. Collected at selected sites with large drainage area. See contract for details.

(continued next page)

Second Year[1]

	Jan	Feb	March	April	May	June		July		August		Oct	Nov	Dec
						Early	Late	Early	Late	Early	Late			
E. coli						x	x	x	x	x	x			
Secchi tube						x	x	x	x	x	x			
Specific conductance						x	x	x	x	x	x			
Temperature						x	x	x	x	x	x			
pH						x	x	x	x	x	x			
DO[2]						x	x	x	x	x	x			
One photograph						x	x	x	x	x	x			
Rec. suitability, appearance, stage estimate						x	x	x	x	x	x			

1. Every ninth sampling event should include a field replicate for QA/QC. Samplers should also take a sampler blank with the field replicate, if using a bucket or rod bottle.
2. Having DO concentrations before 9 a.m. is critical for understanding impacts to fish and invertebrates. The more pre-9 a.m. data you can collect, the better. Strive to collect at least one DO sample for each site before 9 a.m. over the course of the grant.

Appendix H. Metadata Coding for Field Observations in EQuIS

ADDITIONAL INSTRUCTIONS/INFORMATION

Metadata forms and Data Process Information located at
http://www.pca.state.mn.us/index.php/water/water-monitoring-and-reporting/equis/equis-program-and-surface-water-data.html

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
CF	Composite – Flow-weighted with auto-sampler
CO	Composite – Other (describe in comments)
CF-T	Composite – Flow-weighted/time-paced with auto-sampler
D-T	Discrete – Time-paced with auto-sampler
G-DLF	Grab – Disturbed, Low-Flow

ABBREVIATION	SAMPLING DEVICE DEFINITION
SIM	Simple Open Plastic Bucket
ROD	Telescoping Rod with Bottle
ICE1	Ice Conditions Water Sampler (straight rod with bottle attached to lower through ice)
DI	Depth Integrating (USGS type)
WB	Weighted Bucket with Cover
Other	Another type of sampler (describe in notes)
None	Sample collected directly into sample bottle
AS	Automatic Sampler

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.