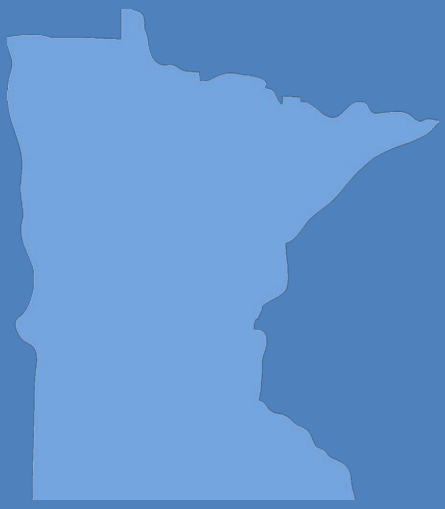
Chloride Monitoring Guidance for Lakes



Minnesota Pollution Control Agency

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Minnesota Pollution Control Agency

520 Lafayette Road North | Saint Paul, MN 55155-4194 | www.pca.state.mn.us | 651-296-6300

Toll free 800-657-3864 | TTY 651-282-5332

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Purpose

The Chloride Monitoring Guidance for Lakes was developed as a result of the Twin Cities Metropolitan Area (TCMA) Chloride Project. The purpose of this guidance is to provide recommendations for collecting water samples from lakes, shallow lakes, and reservoirs for the purpose of chloride monitoring. The chloride data will be used to assess lakes, evaluate trends, and determine the effectiveness of best management practices (BMP).

As part of the TCMA Chloride Project, a Monitoring Sub-Group was formed and assisted in the development of the Chloride Monitoring Guidance documents. The Monitoring Sub-Group included partners from the US Geological Survey, Metropolitan Council Environmental Services, Minnesota Department of Natural Resources, Capitol Region Watershed District, Ramsey-Washington Metro Watershed District, Rice Creek Watershed District, Minnehaha Creek Watershed District, Minneapolis Park and Recreation Board, Ramsey County, Mississippi Watershed Management Organization, and Three Rivers Park District.

Scope and application

This general guidance document is applicable to the collection of water samples from lakes, shallow lakes, and reservoirs for the purpose of chloride monitoring. It is applicable to samples collected from the surface and at any depth along a vertical column between the surface and bottom. This guidance is limited to samples collected for physical and chemical analyses.

Sampling method

No single sampling procedure can be used for all sampling situations; therefore, no single procedure is recommended. Water samples from surface waters are generally collected in one of the following ways:

- **Hand-collected sample –** bottle in hand for collection of surface sample in shallow lakes
- **Integrated sampler –** composite sample collected from the top 2 meters of the water column
- **Depth sample -** sample collected at depth (Kemmerer or Van Dorn depth sampling equipment)

Analytical methods

It is important that a uniform analysis method is used by all groups participating in sample collection. It is the responsibility of each partnering group to confirm the proper analytical methods with their individual certified lab. The proper analytical method for chloride is EPA reference method 325.2.
It may be important to consider additional anlalytes, such as hardness and sulfate. The US Environmental Protection Agency (EPA) has found empirical relationships between hardness and sulfate and chloride's toxicity. The EPA is expected to promulgate new ambient aquatic life criteria for chloride that account for these relationships. Calcium, magnesium, and alkalinity may also be considered, as they are closely related to hardness.

Sample seasons

Ice conditions must remain the determining factor for all winter monitoring. Water sampling periods are generally defined as the following for lakes:

Winter – January through February (sampling window to be determined by ice conditions)

Early Spring – mid-March to mid-April (target sample events as close to after ice out as possible)

Late Spring – three weeks after ice out (target sampling during melt and rain events)

Summer – July through August

Fall – mid-October through mid-November

Health and safety

Staff should not sample during adverse conditions (presence of lightning, swift current/flooding, gusts/waves greater than the boat can safely navigate). If lightning is present, staff should return to the vehicle (trailer the boat) and wait a minimum of 20 minutes from the last visible lightning flash before returning to the water.

All Minnesota Department of Natural Resources (DNR) boating safety rules and regulations must be followed. By law, personal flotation devices (PFD) must be easily accessible (not in storage) when the boat is in operation and /or occupied, including throwable (Type IV) PFDs. Lakes and Streams Unit policy requires Minnesota Pollution Control Agency (MPCA) staff to wear PFDs while on the water. The motor kill switch should be attached to the boat operator (clip to PDF or wrap around wrist) to prevent loss of control should the operator fall out of the boat.

During winter events samples must not be collected when the ice is not of adequate thickness to support the weight of staff and/or a vehicle. It is recommended that all personnel wear ice safety picks at all times while on the ice in the event of breaking through. A minimal thickness of 4 inches must exist for staff and a minimal thickness of 15 inches must be present to operate a vehicle on the ice.

Cautions and interferences

Contamination of the sample can occur if the sampling device is not properly rinsed prior to sample collection. For standard sampling equipment (i.e., integrated samplers) the sample device should be rinsed three times from the opposite side of the boat from where the sample will be collected. For depth samplers, the lowering of the device through the water column provides the necessary rinsing. Sample contamination can also occur if the bottom sediments are disturbed during the sample collection or the release of the anchor in shallow lakes. If this occurs, the sampling device should be emptied, rinsed, and sample collection should be attempted again at a lesser depth to avoid this contact. For depth samples, the sample may need to be taken from a different location on the boat to avoid already disturbed bottom sediments. If sediment disturbance occurs due to the release of the anchor, samples must be collected on the opposite end of the boat to avoid disturbed sediments being collected.

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 Standard Operating Procedures (SOP)/instruction and be trained in the field.

Equipment and supplies

A variety of sampling equipment may be utilized for surface water sample collection. Examples of general equipment needed for chloride monitoring are listed below:

Boat/Canoe/PFDs	Integrated sampler	Permanent Markers	Ice Auger
Anchor	Depth Sampler	Lab Sheets	Ice Scoop
Paddles	Sample bottles	Camera	Ice Chisel
Coolers	Preservatives (acid, methanol, Lugol's)	GPS Unit	Ice Cleats
Ice	Profiling Probes	Foul weather clothing	Ice Safety Picks

Procedure

This section details the steps necessary to collect a sample, process the sample, and prepare it for delivery to the designated laboratory.

Pre-trip requirements

Probe calibration

Probe calibration is required for pH, conductivity, and dissolved oxygen. These calibrations should be completed a minimum of monthly with the exception of dissolved oxygen, which should be calibrated at the beginning of each sampling day. All manufacturers recommended calibration instructions should be followed.

Equipment preparation

Equipment should be prepared to complete sampling trip. Ensure the correct number of bottles and preservative necessary to complete all regular and duplicate sampling. Ensure the ice auger is sufficiently fueled and operational. On multi-day trips, sufficient tap water is necessary to conduct dissolved oxygen calibration. Coolers, ice, bottles, preservative(s), depth sampler, integrated sampler, lab sheets, Global Positioning System (GPS)/maps, and profiling probe should be loaded into the trip vehicle. Staff should have reviewed the MPCA's aquatic invasive species (AIS) SOP, DNR's infested waters list, and planned monitoring trip accordingly. It is recommended that a spare set of equipment be included for use in infested waters or plan sampling trips to ensure that infested waters are the last lakes visited. At the conclusion of all monitoring trips all equipment must be cleaned and laid to dry before being used for further monitoring. Additional information regarding infested waters and procedures to reduce the threat of spreading aquatic invasive species can be found at: http://www.dnr.state.mn.us/invasives/index.html.

Onshore requirements

Profile data collection preparation

Prior to collecting profile data, the data retrieval device must be prepared to store data or data sheets should be prepared to accurately record data. Profile data is to be collected in meters starting from the surface and ending at approximately one half meter from the bottom of the lake.

Equipment preparation

The sample bottle location should be labeled with the sample location. Depth sampler, integrated sampler, profile equipment, GPS/maps, camera, and field sheets/field notebook should be prepared.

Boat preparation

Remove gunnel straps/tie downs from the boat and trailer. Ensure the plug is in the boat and raise the motor up. Trailer lights should be unplugged from the vehicle. Leave the boat safety chain and winch strap connected to the trailer until it is safely backed into the water. At this point, the vehicle should be moved to the boat launch and backed in. The emergency brake must be on prior to leaving the vehicle and attempting a launch. Care must be taken with the winch, so that the crank arm/handle does not slip loose and cause potential injury to field staff. The winch should be unlocked only when the boat launch rope is tied to the boat and held securely by field staff. Remove the winch strap and safety chain and push the boat into the water. Once off the trailer, one staff member should remain with the boat at the dock/launch while the other moves the vehicle and trailer to the appropriate parking area.

Sampling requirements

Travel to sampling location

From the dock, travel to the sample location(s) predetermined for the lake via the handheld or boat mounted GPS units. Stop the boat and drop the anchor, ensuring the boat is not drifting. If windy conditions prevail, a second anchor may be necessary to hold the boat in place.

During winter sampling events ensure ice is of adequate thickness to support staff and/or the vehicle before proceeding to the predetermined location. Travel to the location via handheld or dash mounted GPS units. It is recommended that two holes be drilled in the ice to collect profile measurements and water chemistry samples simultaneously. The second hole will also provide an alternative sampling location should bottom sediment become disturbed.

Profile Measurements

1. Place device in water and lower until the probes are just in the water and allow values to stabilize.
2. Record data for that depth interval either electronically or on a field sheet.
3. Lower the device 1.0 meter, and repeat step 2 until the bottom has been reached; after a depth of 10 meters, take a reading every 2.0 meters. Raise the device approximately one half meter from the bottom for the final reading. Care must be given to avoid disturbing bottom sediment and thus contaminating the depth sample. If this occurs monitoring staff must move to a different sample location no less than 3 meters away.

Surface Sample – taken from a boat

1. Remove caps from the integrated sampler.
2. Lower into water, cap, remove from water and release cap
3. Repeat two more times.
4. On the other side of the boat, **slowly** lower the unstoppered tube into the water column until the top is at the water surface. Be sure to keep hands on the outside of the tube and stopper only.
5. Place the stopper in the tube.
6. Slowly raise the tube to just below the water surface.
7. As the tube breaks the surface, either quickly cap, or allow contents to pour into a clean, open 1- L plastic sample bottle. Again, ensure that hands to do not touch the inside of the bottle or cap.
8. Cap the bottle.
9. Place bottle in a cooler with ice.

Surface Sample – taken through the ice

1. Using a hand or gas powered ice auger drill a hole in the ice.
2. Remove free floating ice shavings so the hole is completely open.
3. Remove caps from the integrated sampler.
4. Lower into water, cap, and remove from water and release cap a minimum of ten feet away from the hole. Caution must be taken to ensure that no rinse water flows back into the hole.
5. Repeat two more times.
6. Place integrated sampler to the side and proceed with collecting profile measurements and the depth sample.
7. Lower the unstoppered tube into the water column until the top is at the water surface. Be sure to keep hands on the outside of the tube and stopper only.
8. Place the stopper in the tube.
9. Slowly raise the tube to just below the water surface.
10. As the tube breaks the surface, either quickly cap, or allow contents to pour into a clean, open 2- L plastic mixing bottle. Again, ensure that hands to do not touch the inside of the bottle or cap. Pour contents of tube into the 2-L bottle, shake, and distribute to sample bottles that are to be distributed to the lab. The 2-L mixing bottle must undergo a triple rinse before being used at a different location or a new 2-L mixing bottle may be used.
11. Cap the sample bottles.

12. Place bottles in a cooler with ice.

Depth Sample

1. Prepare vertical sampler for deployment to desired depth.
2. Slowly lower the device over the side of the boat or through the ice hole to approximately one half meter from the bottom.
3. Release the messenger down the taut rope to release closing mechanism. (If it is a deep lake, it may require two messengers).
4. Raise the device to the water surface. There may or may not be a stop valve on the sampler – be sure you have your bottle ready (uncapped).
5. Ensure there is no sediment in the sample. If there is, discard the sample and repeat steps 1 through 4, going to a lesser depth to avoid bottom sediments.
6. Drain the contents of the device into the sample bottle.
7. Place sample in cooler.

Quality Assurance/Quality Control Sampling

The project manager will designate streams as Quality Assurance/Quality Control (QA/QC) water bodies to ensure that adequate QA/QC samples are collected. The amount of QA/QC samples collected must equal 10% of the total number of regular samples. A QA/QC will be sent to the lab as a field replicate and a sample must be collected for each analyte. QA/QC profiles are not required.

Return to launch and trailer boat

Upon completion of sampling, return the boat to the dock/launch. Be sure to raise the motor prior to loading the boat onto the trailer. All switches should be shut off and if any water was taken on, the bilge pump should be run to empty the boat. One field staff stays at the dock with the boat while the other backs the vehicle into the water. Load the boat onto the trailer; walk on the trailer only if decking is in place, otherwise use waders to assist with the loading of the boat. Once the winch strap is attached to the boat, lock the winch prior to cranking in the boat to avoid injury from a free-spinning crank handle. Secure the safety strap and pull the boat away from the launch area.

On shore – aquatic invasive species (AIS) field decontamination

1. Once trailered, move vehicle/boat away from access.
2. Place all bottles in the large coolers.
3. Visible aquatic plants and animals should be removed from the boat, motor, and trailer.
4. Water should be drained from the boat and the motor after each lake. Plug must be left out of drain during transport.

5. Sampling equipment and boats should be sprayed with a pressure washer if plant residue remains after initial cleaning.
6. If the lake to be sampled is known to have AIS, this should be sampled at the end of a trip and/or should be sampled with separate equipment (i.e., for spiny water flea). If necessary, stop at a car wash and spray down the boat to minimize the possibility of transferring species between lakes.

Post-trip requirements

End of trip processing

1. Unload all samples from vehicle – transfer to staging area.
2. Organize bottles and field sheets by lake.
3. Ensure that bottles containing samples from AIS waters are labeled as such.
4. Fill out lab sheet verifying that the information matches the sample bottles.

Guidance for monitoring high risk waters

The following guidance applies to waters that were assessed for chloride, but were not included on the 2014 303(d) list of impaired waters due to (1) insufficient data or (2) were found to be unimpaired. These waters are considered high risk because they either (a) showed a strong indication of impairment, despite insufficient data, (e.g., only one or two exceedances far apart in time) or (b) showed a high risk of impairment because of frequent high concentrations close to (but not exceeding) the standard.

The Class 2B, 2Bd, and 2A chronic standard for chloride is 230 mg/L and applies as a 4-day average. In practice, impairment is often assessed from monthly sampling results when there is a clear pattern of prolonged concentrations exceeding the standard. In the cases cited above, we expect that weekly or twice-weekly sampling would provide the basis for a clear determination of impairment or non-impairment. Long-term sampling at such high frequencies, however, is unreasonably expensive in most cases.

With the above in mind, the MPCA suggests the following guidance for additional monitoring of the high risk waters described above:

1. Identify dates or periods of past chloride concentrations that include:
    a. Exceedances (exceeded the chronic chloride standard), or
    b. "High" occurrences, defining "high" as less than but within 10% of the chronic standard (thus >207 mg/L)

2. Select a 4-week period centered on each such date or period, and for each:
    a. Sample for chloride weekly, always on the same day of the week
    b. Sample at the same depth(s) as past sampling
3. If an electrical conductivity meter is available, take and record a "matching" conductivity reading with each lab sample collected:
    a. "matching" = from the same primary sample that provides the lab subsample, if the primary sample is a sufficiently larger volume than the laboratory bottle used; or
    b. "matching" = same location and depth as the lab sample
4. Possible expanded effort:
    a. Monitor twice weekly rather than once, always on the same days of the week (e.g., Mon. and Thurs.) including, as resources permit:
        i. Chloride sample and “matching” conductivity measurement if possible
        ii. Chloride sample only, if lacking conductivity meter
        iii. Conductivity measurement only on the increased frequency, if laboratory costs limit sampling but a meter is available

To clarify, sampling for chloride at least weekly during the selected 4-week period(s) is a necessary minimum effort for ensuring the value of this additional monitoring; conductivity measurements alone will not suffice at present. This could change in the future if a reliable and accurate relationship between chloride and conductivity is developed for the water body or for an area including the water body.