Chloride Monitoring Guidance for Streams and Storm Sewers

Minnesota Pollution Control Agency

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Minnesota Pollution Control Agency

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Procedures

Scope and application

This guidance document is applicable to the collection of water samples from streams and stormwater pipes for the purpose of chloride monitoring. It is applicable to samples taken from the surface and at any depth along a vertical column between the surface and bottom. For this application, samples should be collected at mid-stream and mid-depth whenever possible. It is limited to samples collected for physical and chemical analysis. Several local partners are collaborating on the current winter chloride monitoring effort; therefore, this guidance reflects general guidance for streams. For detailed procedures being followed please see Metropolitan Council Environmental Services Quality Assurance Program Plan: Stream Monitoring. For the specific procedures being followed at the storm sewer sites please see the Capitol Region Watershed District 2009 Monitoring Report and the Mississippi Watershed Management Organization (WMO) Annual Monitoring Report 2009. A table of streams and stormwater pipes to be monitored in this program is included in Appendix A.

Summary of sampling method

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

- Hand-collected sample – direct immersion of bottle by hand for collection of surface sample on shallow narrow streams.
- Pole or Swing sampler – bottle is attached to extended rod to reach the desired location and depth.
- Weighted Bucket – may be a weighted bucket or Van-Dorn style sampler for sampling in open water off of bridges.

Summary of analytical methods

This portion is designed to ensure that uniform analysis methods are 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.

Analyte	**Regulatory Program**	**Reference Method**
Chloride	CWA	EPA 325.2
Calcium as $CaCO_3$	CWA	EPA 200.7
Magnesium as $CaCO_3$	CWA	EPA 200.7
Alkalinity	CWA	SM 2320B
Hardness	CWA	SM 2340B\
Sulfate	CWA	EPA 300.0

Summary of sample seasons

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

- **Winter** – December through February (sampling frequency to be determined by winter thaw and rain events – see section below)
- **Spring** – March through April (sampling frequency to be determined by length of snow melt period)
- **Growing Season** – May through September (two to three samples to determine baseflow conditions)

Winter thaw and rain events

The primary goal for the current winter chloride monitoring effort is to collect grab samples at existing flow stations during wither thaw and rain events. The following draft information on winter thaw events was provided by Bruce Wilson of the Minnesota Pollution Control Agency (MPCA) (September 22, 2010).

Thaws of snow accumulations over the winter months have the potential to convey accumulated pollutants offsite and into the municipal stormwater flow networks. In general, snow cover loss and melting of ice from impervious surfaces is in response to daily solar/thermal fluxes that we call winter thaws. However, there is no working definition for winter thaws so we borrowed Mark Seeley's general description for the Minnesota Public Radio (MPR) audience in 2008. Dr. Seeley defined a "thaw" as a period of two or more days with daily temperatures above 32 degrees Fahrenheit (F). The broad patterns defined by these analyses are being advanced for chloride and winter stormwater monitoring planning purposes. Data was provided by Greg Spoden of Minnesota Department of Natural Resources (DNR) Climatology Office.

January Thaw Events (From Mark Seeley, 2008)

Table 1. Historical Frequency of January Thaws since 1948 (Defined as two or more consecutive days with daytime temperatures greater than 32ºF)

Twin Cities	92%
Rochester	95%
Pipestone	92%
Fairmont	93%
St. Cloud	87%
Morris	80%
Crookston	62%
Duluth	60%
International Falls	50%

From this analysis, the probability of January thaws is very high in southern Minnesota and parts of central Minnesota, and somewhat lower in Northern Minnesota (~ 50 percent likelihood (Table 1).

Expanded monthly analyses

In an attempt to better describe the number of winter thaw periods that result in measureable stormwater runoff, several analyses of the meteorological data were completed focusing on the Twin Cities area. Future analyses will incorporate representative cities from around Minnesota.

While daily thaws likely occur frequently due to sunshine on exposed road surfaces, ambient temperatures, degree of sun exposure/slopes and other factors, we are advancing these first cut analyses of the number of thaws that can be typically expected in the Twin Cities based on two or more consecutive days with ambient air temperatures greater than 32 degrees F recorded at the Minneapolis-St. Paul Airport. If two days reported consecutive max temps => 32 degrees F, a "thaw event" was recorded. For three consecutive days of TMAX => 32, two "thaw events" were noted.

The Period of Record (POR = 1891-2010) data show that the Twin Cities averages 5.3 "thaw events" per January, 7.8 in February, and 8.5 in December. There is a great deal of interannual variation (Figure 1). There are quite a few months with zero "thaw events". Conversely, we have seen many months where more than one half of the days were at the back end of a two-day "thaw event". It is interesting to note that for a 14-year period beginning in 1969, we had seven Januarys with one or zero "thaw events".

Figure 1. Thaw cycles per month (1891-present)

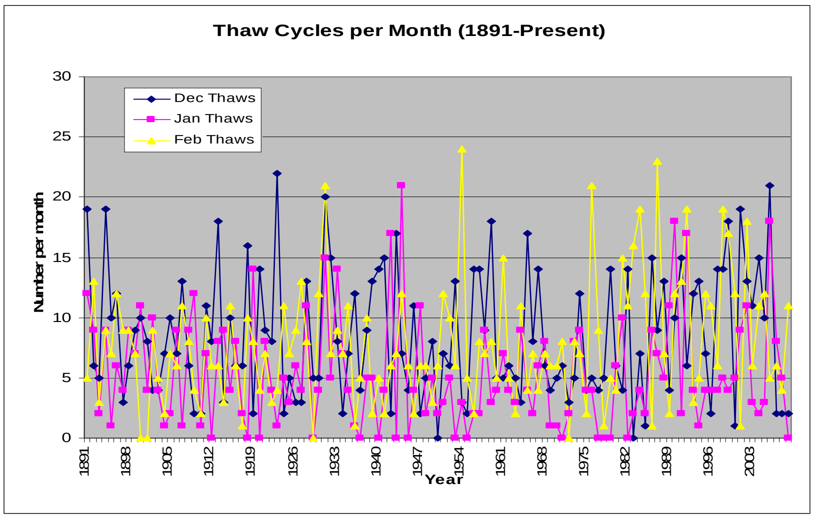


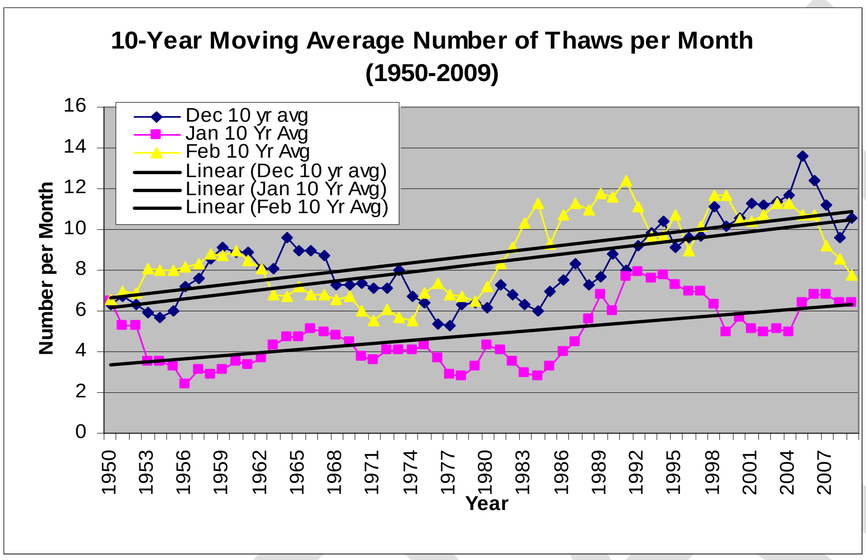
Table 2. Minneapolis, St Paul International Airport (MSP) Station 215435 Data. Number of occurrences where TMAX => 32 degrees F in two or more consecutive days

POR 1891 to 2010			
	December	**January**	**February**
Median	4	7	7
Average	5.3	7.8	8.5
Maximum	21	24	22
Minimum	0	0	0

1970-2010			
Median	4	8	7
Mean	5.3	9.37	8.58
Maximum	18	23	21
Minimum	0	0	0

Given this variability, an attempt was made to define broader patterns by using a 10 year moving average for data from the Minneapolis, St. Paul International Airport (MSP, National Weather Service Station 215435). Values in Table 2 were summarized from the annual data with the 10 year moving averages plotted for Period of Record (POR) and 1950 to present. This type of analysis has its drawbacks as the data is bounded by zero events and is not appropriate for trend detection including changing climate inferences. Nonetheless, as may be seen in the below plotted data from 1950 to present, there is an increasing pattern of number of thaws for December, January and February. Based on this analysis, monthly median number of thaws vary from about four to eight occurrences per month. The broad patterns are being advanced for chloride and winter thaw stormwater monitoring planning purposes.

Figure 2. 10 year moving average



Health and safety

Staff should not sample during adverse conditions (presence of lightning, swift current/flooding, gusts/waves or unsafe ice condition). Sampler should not attempt to sample from the ice if the water depth plus ice thickness is greater than two feet. Samplers entering confined spaces should abide by all rules and regulations regarding confined space entry.

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. Sampler should not attempt to sample from the ice if the water depth plus ice thickness is greater than two feet. It is recommended that all personnel wear ice safety picks and life jackets at all times while on the ice in the event of breaking through.

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. weighted bucket 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. Should this occur, the sampling device should be emptied, rinsed, and sample collection should be attempted again at a lesser depth to avoid this contact.

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. Samplers will be provided written SOPs/instruction and be trained in the field if necessary.

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:

Swing sampler	Multi-parameter sonde	Permanent markers	Ice auger (and spares)
Weighted bucket	Personal flotation device	Lab sheets	Ice scoop
Field notebook	Sample bottles	Camera	Ice chisel
Coolers	Preservatives (acid, methanol, Lugol's)	GPS unit	Ice cleats
Ice	Confined space safety equipment (if applicable)	Foul weather clothing	Ice safety picks
Swing sampler	Multi-parameter sonde	Permanent markers	Ice auger (and spares)
Weighted bucket	Personal flotation Device	Lab sheets	Ice scoop
Field notebook	Sample bottles	Camera	Ice chisel
Coolers	Preservatives (acid, methanol, Lugol's)	GPS unit	Ice cleats
Ice	Confined space safety equipment (if applicable)	Foul weather clothing	Ice safety picks

Sampling requirements

Travel to sampling location

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 maps or dash mounted global position system (GPS) units. Make sure the sampling vehicle is parked in a safe location with the safety hazards on and safety beacon is visible. Safety cones should also be used when working off the bridge, near the vehicle or alongside the road.

Field measurements

1. Place device in water and lower until the probes are estimated to be at mid-depth if stream velocities and sampling location allow.
2. Record data for that sample either electronically or on a field sheet.
3. Record any stream condition notes that are applicable.(i.e., is overland flow occurring, air temperature, watershed observations).

Sample collection – taken from a bridge

1. Lower the weighted bucket into the water and rinse three times.
2. Determine if the sampler is contamination free if so continue to step 3. If not repeat step 1.
3. Collect the sample and fill the sample bottles.
4. Add preservative to sample bottles if required.
5. Place and tighten caps on the sample bottles.
6. Double check to see if bottle is labeled properly.
7. Place bottle in a cooler with ice.

Surface sample – taken through the ice

1. Using a hand or gas powered ice auger or ice chisel, cut a hole in the ice.
2. Remove free floating ice shavings so the hole is completely open.
3. Lower swing sampler, or collect sample by directly immersing sample bottle in stream. If using a dipper or any device to scoop water, be sure to rinse the equipment three times. Caution must be taken to ensure that no rinse water flows back into the hole.
4. Add preservative to sample bottles if required.
5. Place and tighten caps on the sample bottles.
6. Continue with field measurements.
7. Place sample bottles in a cooler with ice.

Quality assurance/quality control sampling

To ensure that the adequate amount of quality assurance/quality control (QA/QC) samples are collected, the project manager will designate streams as QA/QC water bodies. The amount of QA/QC samples collected must equal 10 percent of the total number of regular samples. All groups collecting QA/QC samples may obtain them during the fall, winter, or spring monitoring timeframe. 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.

On shore – aquatic invasive species (AIS) field decontamination

1. Sampling equipment should be sprayed with a pressure washer if plant residue remains after initial cleaning.
2. If the lake to be sampled is known to have aquatic invasive species (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 equipment to minimize the possibility of transferring species between streams
3. Use a completely different set of equipment if the equipment is possibly contaminated with AIS.

Post-trip requirements

End of trip processing

1. Unload all samples from vehicle – transfer to staging area.
2. Organize bottles and field sheets by stream.
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.
5. Deliver samples in a cooler of ice to lab.

Appendix A Stream and Storm Sewer Monitoring Sites

Site name	Type	Operator	Program Contact	Monitoring Contact
Trout Brook - East Branch	Stormsewer	CRWD	Matt Loyas	Matt Loyas
Trout Brook - West Branch	Stormsewer	CRWD	Matt Loyas	Matt Loyas
Trout Brook Outlet	Stormsewer	CRWD	Matt Loyas	Matt Loyas
Bassett Creek at Irving Ave	Stream	MCES/Mpls Park and Rec	Kent Johnson	Leigh Harrod
Battle Creek below Hwy-61	Stream	MCES/RWMWD	Kent Johnson	Cassie Champion
Beltline Interceptor above Warner Rd	Stormsewer	MCES/RWMWD	Kent Johnson	Cassie Champion
Bevens Creek (Lower) at Co Rd 40	Stream	MCES	Kent Johnson	Tim Pattock
Bevens Creek (Upper) at Maplewood Rd	Stream	MCES	Kent Johnson	Tim Pattock
Bluff Creek Inlet to Rice Lake	Stream	MCES	Kent Johnson	Tim Pattock
Browns Creek at Dellwood Rd	Stream	MCES/Washington SWCD	Kent Johnson	Cassie Champion
Cannon River near Welch	Stream	MCES/Dakota SWCD	Kent Johnson	Leigh Harrod
Carver Creek at Co Rd 40	Stream	MCES	Kent Johnson	Tim Pattock
Credit River near 126th St in Savage	Stream	MCES	Kent Johnson	Tim Pattock
Crow River at Rockford	Stream	MCES/Wright SWCD	Kent Johnson	Leigh Harrod
Crow River South Fork near Mayer	Stream	MCES/Carver County	Kent Johnson	Cassie Champion
Eagle Creek above 126th Street	Stream	MCES/Scott SWCD	Kent Johnson	Leigh Harrod
Fish Creek above Hwy-61	Stream	MCES/RWMWD	Kent Johnson	Cassie Champion
Minnehaha Creek at 32nd Ave	Stream	MCES/Mpls Park and Rec	Kent Johnson	Leigh Harrod
Nine Mile Creek below 106th St	Stream	MCES	Kent Johnson	Tim Pattock
Riley Creek Creek Inlet to Grass Lake	Stream	MCES/Eden Prairie/Barr	Kent Johnson	Leigh Harrod
Rum River at Anoka Dam	Stream	MCES/Anoka SWCD	Kent Johnson	Cassie Champion
Sand Creek upstream of Louisville Swamp	Stream	MCES	Kent Johnson	Tim Pattock
Silver Creek at Hwy 95	Stream	MCES/Washington SWCD	Kent Johnson	Cassie Champion
Valley Creek at Putnam Blvd	Stream	MCES/SCWRS	Kent Johnson	Leigh Harrod
Vermillion River below Hwy-61	Stream	MCES/Dakota SWCD	Kent Johnson	Cassie Champion

Site name	Type	Operator	Program Contact	Monitoring Contact
Ravens Creek	Stream	MPCA	Mike Walerak	Mike Walerak
1NE (Northeast Minneapolis)	Stormsewer	MWMO	Kari Oquist	Kari Oquist
4PP (35W tunnel)	Stormsewer	MWMO	Kari Oquist	Kari Oquist
6UMN (Como tunnel)	Stormsewer	MWMO	Kari Oquist	Kari Oquist
10SA (Saint Anthony Village)	Stormsewer	MWMO	Kari Oquist	Kari Oquist
Elm Creek	Stream	USGS	James Fallon	
Rice Creek	Stream	USGS	James Fallon	
Shingle Creek	Stream	USGS	James Fallon	
Kohlman Creek	Stream	RWMWD	Eric Korte	David Vlasin
Gervias Creek	Stream	RWMWD	Eric Korte	David Vlasin