Chloride Work Group
Policy Proposal for Minnesota

Recommendations for addressing chloride in municipal wastewater effluent

Minnesota Pollution Control Agency

April 2017

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Contents

Executive summary

Minnesota has a growing salty water problem that threatens its fresh-water fish and other aquatic life, despite being more than 1,000 miles from the nearest ocean. Salt – from chloride – can also impact groundwater used for drinking. It takes only one teaspoon of salt to permanently pollute five gallons of water. Once in the water, it is very difficult to remove the chloride.

While this policy proposal focuses on chloride, it would also apply to other salty parameters of concern:

- Total dissolved solids
- Bicarbonate
- Hardness
- Specific conductance

What is the water quality standard for chloride?

Minnesota freshwater streams and lakes naturally have low levels of chloride. High concentrations of chloride are harmful to aquatic plants and animals.

Based on guidance from the U.S. Environmental Protection Agency (EPA) and the levels of chloride shown to be toxic to fish, Minnesota has a water quality standard to protect aquatic life from chloride:

- Longer chronic exposure is a four-day average of 230 mg/L
- Shorter term acute exposure is a one-day average of 860 mg/L
- Chloride is a toxin that EPA and MPCA has found capable of impairing aquatic life when in concentrations at or above 230 mg/L under low-flow conditions. Furthermore, because of its conservative ionic properties, concentrations continue to build in water bodies to levels that are not compatible with aquatic life, and in time, may also cause health concerns for non-aquatic life.

Why do municipal wastewater plants have chloride in their discharge?

The answer starts with water hardness. People soften their water to make soaps lather more and prevent calcium buildup on appliances and fixtures. Point-of-entry ion exchange water softeners are widely used to treat water hardness in Minnesota. These individual softeners must be periodically regenerated with a high salt brine that contains chloride in order to keep treating the water used for bathing, washing and other purposes. This brine eventually drains to a municipal wastewater system. The cumulative loading from all the point-of-entry softeners in the sewer-shed contributes significantly to the high chloride concentrations in the wastewater plant discharge.

Where in Minnesota is chloride in wastewater a problem?

Chloride in wastewater discharge appears to be a problem where groundwater is hard and people soften the water as it enters the home. Hard water is found throughout the state and is common in the southern and western areas of the state. Chloride flows into wastewater treatment facilities from homes and businesses that use water softeners. Treatment facilities are designed to remove particles, like grit and sand, and to biologically degrade organic waste, such as food and human waste. They are not designed to remove chloride.

Once chloride is dissolved in water, it cannot be removed by settling, or biologically degraded by standard treatment processes. The technology to remove chloride is available, but is costly. It would involve microfiltration and reverse osmosis, which are the same treatment processes used to produce pure water used in laboratories.

How does the Minnesota Pollution Control Agency know it is a problem?

Water monitoring data show that salt concentrations are continuing to increase in lakes, streams and groundwater across Minnesota.

Some wastewater treatment facilities started monitoring for chloride and other salty parameters in 2009. The Minnesota Pollution Control Agency (MPCA) examined the data from these facilities and found that about 100 have the potential to contribute to levels of chloride higher than allowed by the standard. One common tool to reduce pollutants like chloride is to issue permits with limits on pollutants in the effluent – the treated water that is discharged – to control pollutants levels in the discharge, usually going to a river or lake in Minnesota.

What are the alternatives to comply with a chloride effluent limit?

The current alternatives for treating chloride at Wastewater Treatment Plants (WWTPs) are not feasible for reasons ranging from engineering to cost to legal constraints, as explained more in Appendix B, "Alternatives for addressing chloride in wastewater effluent."

Below are the three most feasible strategies for reducing chloride in source water coming to WWTPs, based on an MPCA analysis:

1) Upgrade residences and business to high efficiency point-of-entry softeners
2) Centralized lime softening and removing point-of-entry softeners
3) Centralized reverse-osmosis softening and removing point-of-entry softeners

What is the Chloride Work Group and how did it get started?

As MPCA staff examined chloride data from WWTPs and realized the impact to communities, they discussed ways to help communities meet the water quality standard. These discussions prompted MPCA Commissioner John Stine to turn to wastewater discharge permittees – those who must do the work to meet standards – for their input and ideas. Commissioner Stine directed MPCA staff to convene a group of community representatives to study the chloride problem and recommend ways for the MPCA to implement the standard in wastewater discharge permits. The goal is to protect Minnesota's lakes and streams while taking into account economic and political realities.

The MPCA recruited members for the Chloride Work Group from communities with potential to exceed the chloride standard. The agency also announced the formation of the group and invited communities to participate at seven listening sessions held throughout Minnesota in 2016-'17 and in its newsletter, "On Point," for wastewater professionals. The following community representatives and consulting engineers agreed to participate:

- Rick Ashling City of Albert Lea
- Joe Bischoff Wenck Associates

- Herman Dharmarajah Bolton & Menk
- Scott Gilbertson City of Detroit Lakes
- Scott Haas City of Jordan
- Blaine Hill City of Morris
- Doug Kammerer City of Watertown
- David Lane City of Rochester
- Steve Robinson City of Worthington
- Bob VanMoer City of Marshall

This work group met five times, for three - four hours at a time, at the MPCA Mankato office:

- December 6, 2016
- December 20, 2016
- January 17, 2017
- January 31, 2017
- February 28, 2017

It considered several options, including:

- Seeking revisions to state water quality standard for chloride
- Seeking site specific standards for chloride on case by case basis
- Keeping chloride limits out of permits while implementing management plans and continuing monitoring
- Implementing schedules of compliance through permits
- Seeking variances from standard to gain time to study and resolve chloride exceedances
- Issuing administrator orders to gain compliance

See Appendix A, "Pros and cons analysis of permitting options" for more information.

The group then met April 4, 2017 at the MPCA St. Paul office to finalize its policy proposal to the MPCA Advisory Committee. All members present agreed on a policy that includes variances and schedules of compliance where needed to meet the chloride standard. This policy is summarized in the decision tree (Figure 1) on the following page.

This policy proposal is not intended to supersede any existing law. Instead, this proposal provides greater clarity on implementing existing rules. There may be unique circumstances that require solutions outside this policy. If so, the MPCA will determine a permitting option based on data and Minnesota law. Also, his policy would apply only to municipal National Pollutant Discharge Elimination System (NPDES) permits. The MPCA will continue to address chloride in industrial NPDES permits on a case-by-case basis.

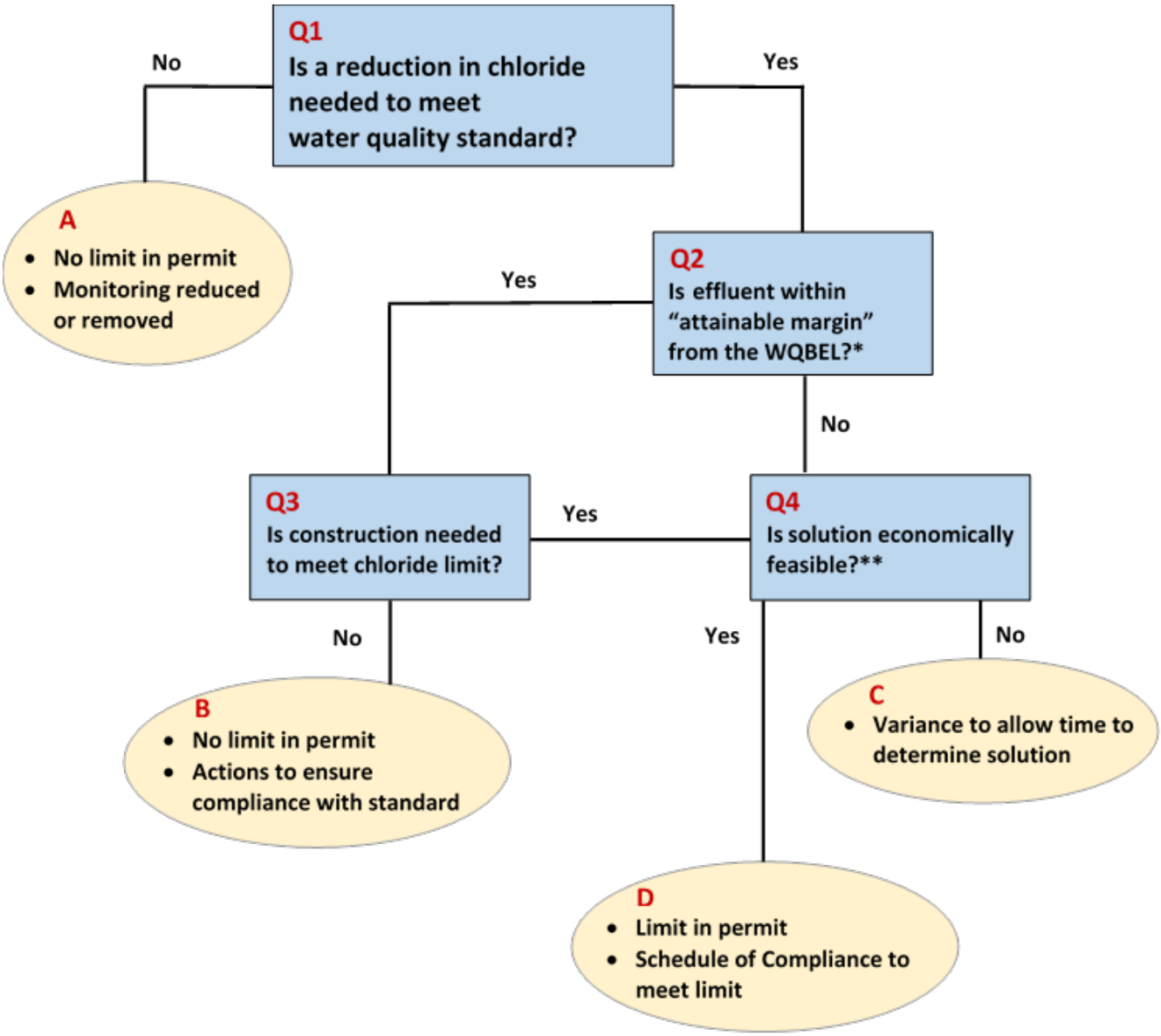

Figure 1. Chloride Decision Tree for implementing Minnesota's chloride water quality standard in wastewater discharge permits.

* "Attainable margin" may be defined by a numeric threshold or by the anticipated chloride reduction due to implementation of specific actions. See the Chloride Work Group Policy Proposal for details.

** Municipalities may use the MPCA variance screening calculator tool to evaluate the economic feasibility of a solution. See the policy proposal for details.

Implementing the chloride standard in permits

The Chloride Working Group developed the decision tree in Figure 1 for the MPCA to use when working with municipalities to implement chloride limits in NPDES permits. The agency and permittees will use the decision tree together when an MPCA analysis finds that a WWTP has reasonable potential to exceed the chloride water quality standard.

Reasonable potential

When data are available, the MPCA analyzes a WWTP's discharge for reasonable potential to exceed water quality standards as part of issuing or reissuing a permit. This is the general process for the MPCA issuing or reissuing a permit:

- Permittee submits application and MPCA reviews it for completeness
- MPCA team reviews all information to develop permit, including a reasonable potential analysis
- MPCA notifies permit holder with a letter called "As Soon as Possible," which notifies permittee of any new limits and requests a response to a schedule for meeting the new limits as soon as possible
- MCA develops permit and supporting documents
- Permittee and sometimes the EPA review the draft permit
- Permit goes on public notice for 30 days, providing interested parties with a chance to comment
- MPCA issues the final permit

When the agency determines reasonable potential to exceed a standard, it assigns a Water Quality Based Effluent Limit (WQBEL). The MPCA notifies permittees of new limits in the "As Soon as Possible" letter.

For chloride, the MPCA will use the chloride decision tree **with the permittee** to determine the best permit approach to meet the standard:

- No chloride limit with actions specified to ensure compliance with standard
- Variance to allow time to determine solution for meeting standard
- Schedule of compliance for meeting standard

The permittee will then respond to the "As Soon as Possible" letter with its intended permitting option and all supporting information for that option.

Explanation of chloride decision tree elements

The decision tree is comprised of questions labeled by number – Q1, Q2, Q3 and Q4 – and outcomes labeled by letter – A, B, C and D. The following information provides context and guidance on how questions and outcomes are to be interpreted and realized in applicable permits.

Question 1: Is a reduction in chloride needed to meet the water quality standard?

The Effluent Limits Unit at the MPCA will conduct an analysis to determine whether the wastewater discharge has the reasonable potential to cause an exceedance of the applicable chloride water quality standard. To complete this analysis, the MPCA must have a minimum of two years of effluent chloride monitoring data.

Outcome A: No limit, monitoring reduced or removed

If there is no reasonable potential for a facility to exceed the chloride standard, then there will be no limit for chloride in its wastewater discharge permit. The MPCA may maintain, reduce or remove the facility's required monitoring for chloride in its effluent, depending on the chloride concentration, variability, and quality of data.

Question 2: Is the effluent within an attainable margin from the WQBEL?

The intent of this question is to identify whether actions conducted within the upcoming permit cycle can eliminate the reasonable potential to exceed the chloride standard.

"Attainable margin" may be defined by:

- A numeric threshold
- Anticipated chloride reduction due to implementation of specific actions

Numeric threshold

The data used in the numeric determination needs to be representative of the current potential discharge from the facility, typically the most recent five years or all available data. When examining the data, the MPCA may take into account major changes in source chloride loading or treatment processes.

The numeric estimate of "attainable margin" is as follows:

- Measured maximum effluent chloride concentrations are within 100mg/L of the predicted monthly average chloride effluent limit
- Measured average effluent chloride concentrations are within 50 mg/L of the predicted monthly average chloride effluent limit

Implementation of specific actions

A facility may also be within the "attainable margin" if it has specific documented plans to complete work to eliminate reasonable potential within the first year or two of the upcoming permit cycle. In this case, the agency could reasonably estimate that following implementation of the activities, effluent would not continue to exceed the standard.

Question 3: Is construction necessary to meet the *chloride* limit?

Construction, in the context of this question, refers to construction projects directly related to the reduction of chloride. This could include construction at the drinking water treatment plant or WWTP facilities.

If the answer is "Yes," then proceed to Question 4.

A facility may answer "No" to Question 3 if:

- Chloride reduction projects do not require construction
- Construction is planned to address a pollutant *other than chloride*

For instance, a facility may alter phosphorus removal processes, which in turn, may reduce the need for using chloride-containing additives.

The permittee may find that the data include a sample that is not representative of the facility's normal operation, such as one high value from an unusual source or action.

If the answer is "no," then proceed to Outcome "B."

Outcome B: No limit but actions to ensure compliance with chloride standard

Under this scenario, the permittee must provide technical justification and support to the MPCA to ensure that its chloride-reduction actions will eliminate reasonable potential within a specified period of time. The project will need to be implemented in three years or less to ensure that MPCA has at least two years of effluent data (after completion of the actions) in order to conduct a reasonable potential analysis for the next permit cycle.

The facility will **not** receive a chloride limit in its permit, but the facility will need to:

- Continue to monitor chloride
- Complete a chloride management plan
- Provide updates to the MPCA on predetermined projects related to chloride reduction

Question 4: Is the solution economically feasible?

Permittees may use the MPCA's variance screening calculator to determine economic feasibility.

Treatment for chloride at the end of the wastewater treatment plant is **not** economically feasible, according to MPCA's "Alternatives for addressing chloride in wastewater effluent" (Appendix B).

As such, the variance-screening calculator assumes the cost of centralized drinking water softening, either through a lime or reverse osmosis process. Centralized softening may reduce or eliminate the need for home ion exchange (sodium chloride) softening.

If the solution is unknown at the time of permit issuance/reissuance, then a permittee can still use the variance screening calculator tool to determine the economic feasibility of implementing any solution to comply with the chloride standard.

Outcome C: Variance to allow time to determine solution

If the solution is not economically feasible, the permittee may apply for a variance. The variance provides time for wastewater permittees to move toward attainment of a WQBEL. A variance allows the permittee to discharge in excess of the designated WQBEL for the period of time specified in the control document. A variance will contain an interim limit and a chloride management plan as directed through a "schedule of compliance activities":

- The interim limit will be equivalent to the maximum effluent chloride concentration recorded in discharge monitoring reports during the previous period of record. The interim limit reduces the authorized load of chloride to the receiving water and ensures that pollutant loading does not increase.
- The schedule of compliance activities, or chloride management plan, will require the permittee to explore chloride sources and the potential for reductions throughout the course of the variance.

For chloride, the MPCA is exploring a streamlined variance process in which applicability criteria are made available at a public meeting. For most communities, chloride sources and potential solutions are similar, and costs are reasonably scalable by population. Predetermined eligibility criteria will provide more certainty for communities and lower administrative costs for permittees and the MPCA. The schedule of compliance activities will also be standardized to the extent possible.

Outcome D: Chloride limit in permit with Schedule of Compliance

If the community plans to build a centralized drinking water softening facility, the need for home and business softening may be significantly reduced or eliminated. Within a reasonable degree of certainty, the MPCA may estimate the anticipated chloride reduction due to this change. The permit will contain a schedule of compliance with a duration as soon as possible to meet the effluent limit. The permittee will be required to comply with the final effluent limit after completion of the actions outlined in the schedule. As part of the schedule of compliance, the permittee will also be required to complete a chloride management plan.

Background

How was the chloride water quality standard developed?

The EPA developed criteria for chloride water quality standards in 1988, with the MPCA adopting the standard in 1990.

In September 2009, Iowa adopted a formula-based standard for chloride. In 2012, Missouri tried to adopt Iowa's standard with no changes. Due to new studies published in 2010 and 2011, the EPA determined Missouri's proposed standard was not scientifically defensible and not protective of aquatic life. The EPA disapproved Missouri's chloride standard in in January 2015.

Since 2013, MPCA has received requests to revise the existing chloride water quality standard designed to protect aquatic life. MPCA requested assistance from the EPA in evaluating data. The data included more recent toxicity tests than those included in the 1988 dataset, as well as recent studies on the relationship between chloride toxicity and other water quality parameters, such as water hardness and sulfate. Water hardness is an important water chemistry parameter and is strongly correlated to the toxicity of chloride to aquatic organisms.

The evaluation showed that revising the chloride standard, based on the more recent studies, would result in a more stringent standard. Because it is so difficult for permittees to meet the current chloride standard, the MPCA decided to devote time and resources to developing a permitting strategy to meet the current standard instead of developing a lower standard without a clear path to compliance.

Why are chloride concentrations so high for many municipalities?

There is a strong link between high water hardness in community's water supply and chloride concentrations in its wastewater effluent. High levels of calcium and magnesium hardness in the water supply will shorten the useful life of water heaters and other appliances. Water hardness can also cause scaling in service lines. Hard water has an undesirable aesthetic that diminishes the bubbles in soaps and can cause water spots on glassware. In Minnesota areas with high hardness in the water supply, individual users run ion exchange softeners to treat excess hardness, also known as point-of-entry softeners.

Point-of-entry ion-exchange softeners require a sodium chloride brine to recharge the resin that removes water hardness. This high-chloride brine is ultimately discharged to the WWTP where it elevates the concentration of chloride in the effluent. No single point-of-entry ion exchange softener causes high effluent chloride concentrations, but collectively, all the point-of-entry water softeners can contribute to exceedances of chloride above the protective water quality standard of 230 mg/L.

Ion exchange softening is not a "chloride efficient" way to treat high hardness; a high salt efficiency softener will send about 1 mg of chloride to the WWTP for every 1 mg of hardness it treats. In certain conditions, even high efficiency water softeners can elevate the chloride concentrations by several hundred mg/L and cumulatively cause a WWTP to violate the chloride water quality standard.

How is chloride related to other salty parameters in a WWTP effluent?

The MPCA has performed statistical analyses showing that high effluent chloride and high salty parameter levels are highly correlated. For example, if a facility has reasonable potential to exceed the

chloride standard, then that facility is 30 times more likely to also have reasonable potential to exceed the standard for total dissolved salts.

The MPCA has also developed a limit-setting policy for salty parameters called the "Chloride Linkage." The Chloride Linkage policy describes how compliance with a final effluent limit for chloride is protective of the other salty parameter water quality standards, if specific compliance strategies are used. The justification for this chloride linkage compliance strategy is based:

- Chemistry of using lime softening to treat drinking water, meaning communities provide water that is already softened to homes and business
- Because water is already softened, homes and businesses eliminate point-of-entry, ion-exchange water softeners
- Eliminating the softeners vastly decreases the chloride loading to WWTPs, meaning permittees meet the chloride standard for protecting aquatic life

Assigning chloride limits using the Chloride Linkage commits the permittee to evaluating the technical and economic viability of moving toward centralized lime softening for community water and removing the loading from softeners. For more information on this analysis, see Appendix B, "Alternatives for addressing chloride in wastewater effluent."

Is it economically feasible to treat chloride at the WWTP?

Treating chloride at the WWTP is technologically possible but not economically feasible. The best way to treat or manage chloride is to not put it in the water in the first place.

Treating chloride at the WWTP involves extreme treatment technologies such as reverse osmosis with evaporation and crystallization of the resulting waste brine stream. This option is prohibitively expensive, up to capital costs of $28 million per 1 million gallons per day of flow, with many secondary consequences such as increased energy use, waste disposal costs, and increased operator training.

How can a municipality comply with chloride limits?

Ranked below are the three best strategies for reducing chloride in source water coming to WWTPs, according to Appendix B, "Alternatives for addressing chloride in wastewater effluent."

Upgrade residences and businesses to high efficiency point-of-entry softeners

This option was ranked first because it would maintain the municipalities' water infrastructure status quo. However, the MPCA predicts that greater than 90% of municipalities will not be able to reliably meet their WWTP chloride effluent limits by upgrading inefficient ion exchange softeners to high efficiency softeners. This option will not work for municipalities unless they are within an "attainable margin" of their chloride limits. This working group does not recommend a ban on point-of-entry ion exchange softeners without an analysis of whether it is necessary. A discussion of how the MPCA defines "attainable margin" is provided in appendix A of this document.

Centralized lime softening and evaluating the need to remove all point-of-entry softeners

Switching a city's drinking water to centralized lime softening and removing all point-of-entry softeners is one way to comply with chloride limits at the WWTP through chloride source reduction. Installing

centralized lime softening and removing all point-of-entry softeners has the highest degree of certainty of ensuring compliance with chloride effluent limits and other salty parameter limits.

In specific circumstances, it may be possible to reliably meet chloride effluent limits through centralized lime softening while still allowing the use of high efficiency point-of-entry softeners in the distribution network. A discussion of this option is provided on Page 8 of this document.

Centralized reverse-osmosis softening and evaluating the need to remove all point-of-entry softeners

Switching a city's drinking water to centralized reverse osmosis softening and removing all point-of-entry softeners is another way to comply with chloride limits at the WWTP through chloride source reduction. Installing centralized reverse osmosis softening and removing all point-of-entry softeners also has the highest degree of certainty of ensuring compliance with chloride effluent limits.

In specific circumstances, it may be possible to reliably meet chloride effluent limits through centralized reverse osmosis softening while still allowing the use of high efficiency point-of-entry softeners in the distribution network. A discussion of this is provided in Appendix B of this document.

How much would it cost to comply with chloride limits?

According to daily water monitoring by WWTPs, the municipalities that most need a chloride limit are those that can least afford it. The problem is disproportionately found in small communities (Figure 2).

Minnesota communities that may need chloride reduction in wastewater

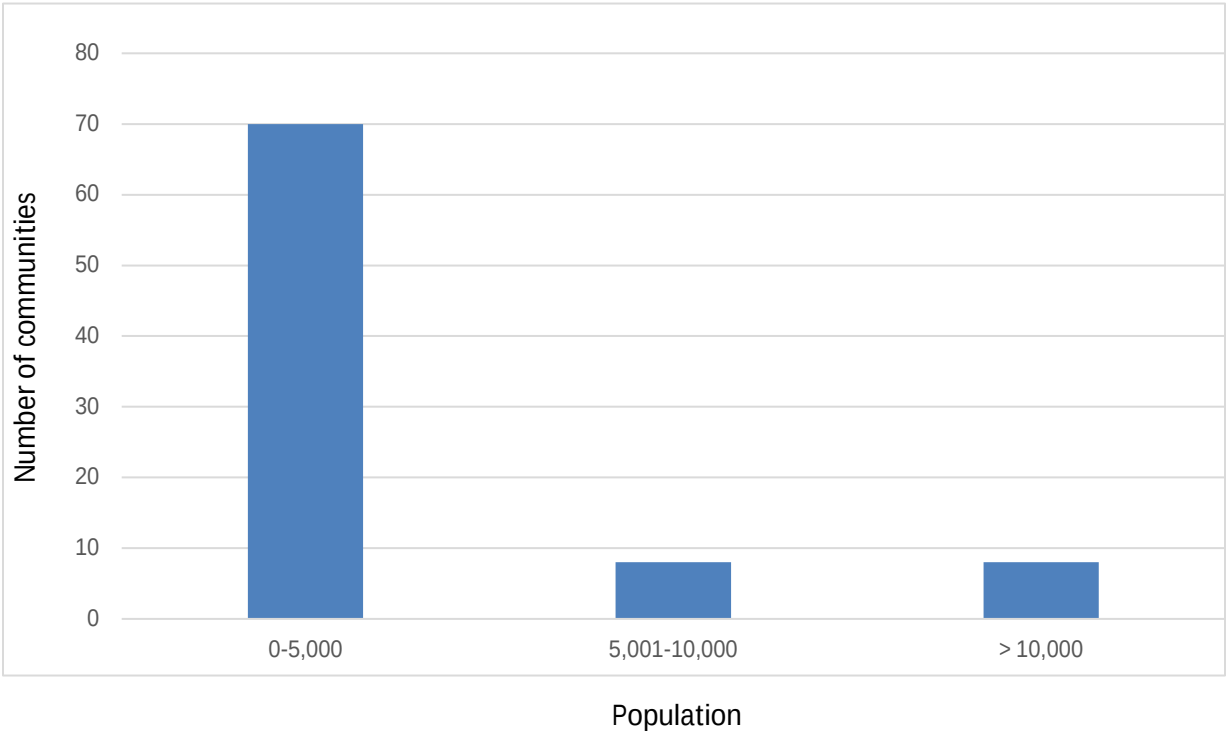

Figure 2. Number of Minnesota municipalities with reasonable potential for exceeding the chloride standard in wastewater.

Softening source water before it is delivered to homes and businesses can be an effective means to reduce elevated chloride concentrations. Lime softening or reverse osmosis are viable central-softening technologies, and when partnered with a concerted effort to remove individual water softeners, chloride levels are likely to meet limits that are sufficiently protective for aquatic life.

These technologies require capital expenditures. Most municipalities do not have drinking water treatment plants and would need to build new systems. Where treatment plants are operating, they would likely need to be adapted to lime softening or reverse osmosis. In addition, the operation and maintenance costs would increase.

For a small city of less than 2,000 residents, the costs to adapt new centralized water softening technology into a municipality's source water can range from $500,000 to $8 million. As population increases, so do the capital costs.

Potential impact to municipalities

When monitoring data reveal that a permittee has reasonable potential to cause or contribute to the impairment of a water of the state, the MPCA is obligated to respond with a corresponding limit in the permittee's NPDES permit. The permittee must take steps to reach compliance as soon as possible. There are several means available toward that end. In a perfect world, the facility will construct, optimize, or modify operations in such a way that it can meet a new limit, thereby reaching compliance as soon as possible. Frequently, however, the permittee is not able to take on a construction project to add the infrastructure required to meet new limits. Costs and technical barriers are a reality.

The responsibility falls to the WWTP to limit the chloride contribution to the receiving water. Municipal wastewater facilities operate under NPDES permits, which regulate the concentration chloride that facilities can discharge as reflected in an effluent limit. Effluent limits are protective of water quality standards, in the case of chloride, 230 mg/L or less. Where chloride exceeds the standard, municipalities must identify the sources of elevated chloride concentrations and seek to reduce the levels.

According to an MPCA analysis, removing chloride from wastewater is infeasible, economically and technically. Two technologies are viable for chloride removal at WWTPs:

- Reverse osmosis, which creates a waste stream that cannot be discharged with wastewater as it could impair the water intended to be protected
- Evaporation and crystallization, costing up to $28 million per 1 million gallons of wastewater per day, according to cost estimates by Bolton and Menk.

This Chloride Work Group rejects treatment of chloride at the wastewater treatment plant as feasible or viable.

In many situations, chloride can be managed at the water supply source. Some municipalities have installed reverse osmosis at their water plants, delivering pre-softened water to homes and businesses. Point-of-entry ion exchange softeners then become unnecessary and can be eliminated. However, many users find the degree of softness to be insufficient. They keep using ion exchange softeners and discharging chloride into the wastewater. Reverse osmosis central softening is a solution only when users discontinue their individual softeners.

Likewise, lime softening of source water also makes individual softeners unnecessary. This too is only a solution when users discontinue point-of-entry softeners. While centralized lime softening has the advantage of also eliminating other ions that contribute to specific conductance, bicarbonate, etc., the increase in operation and maintenance costs are dramatic. Lime softening plants are difficult to

automate and require frequent adjustments as conditions change. The byproduct of lime softening is a lime sludge that also must be disposed of – ether by land application or to landfill.

Both reverse osmosis and lime softening take time to design and construct. A schedule of compliance is a permitting tool that municipalities can use to take the time required to explore alternatives, design, and construct the infrastructure required.

While the schedule of compliance must advance the permittee to compliance as soon as possible, there is latitude under Minnesota R. 40 CFR 122.47 to develop and justify the "as soon as possible" timeframe. Considerations included:

- Source identification and management
- Facility planning
- Construction of necessary improvements to the water treatment plant or WWTP
- Stormwater-related projects in capital improvement plans that are congruous with chloride management

A compliance schedule typically ranges from four to eight years, but when integrated management considerations are in effect, compliance schedules have extended in permits as long as 20 years. There is no additional cost associated with schedules of compliance, but compliance is expected at the end of the schedule. As a result, compliance schedules can only be used once and cannot be extended.

There are reporting benchmarks that municipalities must strictly observe within schedules of compliance, including:

- Completion of a chloride management plan
- Submittal of annual progress reports
- An assigned and achievable interim chloride effluent limit

Water quality variances are another permitting tool available to municipalities under Minn. R. 7050.0190 and Title 40 Code of Federal Regulations (CFR) part 131.14. Water quality variances are "intended to serve as a mechanism to provide time for states, tribes, and stakeholders to implement actions to improve water quality over an identified period of time when and where the designated use currently in place is not being met," according to the EPA Water Quality Handbook (Chapter 5, Page 15). Variances can be issued under the following six criteria:

- Naturally occurring pollutant concentrations
- Dams or other hydrologic modifications
- Natural, ephemeral intermittent low-flow
- Natural physical conditions preclude attainment of aquatic life uses
- Human-caused conditions or pollutant sources that cannot be remedied or would cause more environmental damage to correct than to leave in place
- Substantial and widespread economic and social impact

The most common criterion for the issuance of a variance is the sixth relating to economic impact. Many small or economically depressed cities cannot pay for the infrastructure improvements needed to reach compliance. They are simply too expensive and the associated rate increases would cause an economic hardship on the users.

Under Minnesota's requirements of water quality variances, municipalities must provide a, "quantifiable expression of the highest attainable condition" and "must commit to optimization of current treatment and a pollutant minimization program if additional controls are not feasible." In short, the water quality

cannot get worse under a variance and municipalities must evaluate and adopt best management practices such as public outreach and education efforts.

Excessive chloride in wastewater will force municipalities to balance potentially expensive compliance options with adverse environmental impacts.

Legislative proposals may provide some certainty for municipalities by delaying compliance with limits until a WWTP needs replacement or a specified period of time has passed.

However, any new qualifying facility would likely need to meet all new limits that apply in its NPDES permit before it could take advantage of the benefits of regulatory certainty. Chloride will likely continue to be a problem that water and wastewater managers need to resolve.

Recommendations after pros and cons analysis

Other than immediate compliance, the Chloride Work Group identified six permitting options for NPDES permits when facilities have reasonable potential to cause or contribute to a chloride impairment:

1. No chloride limit in the NPDES permit but chloride management plans and monitoring required
2. Compliance schedules
3. Variances
4. Administrative orders
5. Revising the statewide chloride standard
6. Site-specific standards

These permitting options give facilities time to identity solutions without having to immediately invest resources in construction or other major compliance issues.

The work group conducted a simple pros and cons analysis of each option to evaluate the strengths and weaknesses of each option, as detailed in Appendix A.

The work group determined that excluding chloride limits in permits, administrative orders, and site-specific standards would not be appropriate in most cases.

That leaves schedules of compliance and variances as the remaining permitting options. The Chloride Work Group then developed the flow chart in Figure 1, on the next page (repeated from Page 6) as the implementation policy for these options.

While a schedule of compliance may not be the solution for every facility in the state of Minnesota, a variance may likewise be unsuitable. Each will likely have to do an analysis on its own to determine its course toward meeting the chloride standard.

Other permit options to address chloride

The Chloride Work Group did have reservations about recommending schedules of compliance and variances for permitting options to address chloride in wastewater. Both options mandate compliance with the chloride standard, even where meeting the standard may not be needed to protect aquatic life.

Site specific standards

For example, some facilities discharge into receiving waters that may not fit the broader, statewide chloride standard. Where chloride-sensitive species have never been present, site specific standards –

higher than the statewide standard – may be more appropriate for protecting aquatic life and preventing costly changes in a community's infrastructure. Site-specific standards are and should remain an option for these facilities.

EPA offers the following guidance for site-specific standards:

- Recalculation procedure—to account for differences in resident species' sensitivity to a material.
- Water-effect ratio procedure—to account for differences in biological availability and/or toxicity of a material caused by physical and/or chemical characteristics of site water.
- Resident species procedures—to account for differences in residential species sensitivity and differences in the biological availability and/or toxicity of a material due to physical and/or chemical characteristics of site water.

Use attainability analysis

A use attainability analysis is another tool that could lead to a different approach of protecting water through the statewide chloride standard. Attaining water quality that protects a designated beneficial use requires a greater understanding of the receiving water's uses.

Table 1 on the following page identifies the use classifications that have water quality standards for various salty parameters. The 230 mg/L is protective of Use Class 2 – Aquatic Life and Recreation. The Chloride Work Group recommends the MPCA explore the capacity of protecting Minnesota waters for their actual beneficial use such as irrigation. NPDES permits should reflect the actual uses of the receiving water and protecting those uses only.

Table 1. Minnesota water quality standards associated with the common major ions or salty parameters

Parameter	Units	Water Quality Standard Value	Use Classification	Designated Protective Use
Chloride	mg/L	230 (Chronic)	2	Aquatic Life and Recreation
Hardness	mg/L as CaCO3	500	3C	Industrial Cooling and Materials Transport
Total Dissolved Solids	mg/L	700	4A	Irrigation
Bicarbonates	mg/L as CaCO3	250	4A	Irrigation
Specific Conductance	µmho/cm	1000	4A	Irrigation
Total Salinity	mg/L	1000	4B	Wildlife and Livestock

Next steps and additional suggestions

The Chloride Work Group is conflicted about what the next steps should be. There is some evidence that the 230 mg/L value may not be protective enough for the aquatic life in Minnesota lakes and streams.

On one hand, amending the standard to account for additional species could result in a lower standard, and thus a more restrictive limit for WWTPs. But a revised standard would provide more certainty for facilities, which could make changes to meet the current standard and then face the risk of needing to make more changes to meet a revised standard in the future.

On the other hand, few facilities are capable of meeting limits set by the current chloride standard.

While the state continues to examine the standard and further changes, the MPCA needs to communicate more with communities and facilities about the chloride issue. The agency needs to contact facilities with reasonable potential to exceed the chloride standard to make sure they know about the ramifications. This communication needs to come directly from the MPCA.

Also, the MPCA should develop materials that municipalities can use to educate their rate payers about the chloride issue. Most municipalities do not have communications staff available to develop these outreach efforts. If municipalities could use MPCA materials, they can deliver an accurate and consistent message that may go far in achieving the low-hanging fruit of source reduction from ion-exchange softeners.

In addition, the MPCA's streamlined variance tool should be made broadly available to municipalities with reasonable potential for a chloride impairment. The Chloride Work Group has reviewed it and sees that it can save municipalities the costs of paying a consulting engineer to formalize a variance application. The streamlined variance tool provides the necessary economic information to allow for a permittee to qualify for a variance without knowing the exact solution. As a result, the permittee would be completing work to identify the solution to comply with the final chloride limit while covered under a variance, rather than under a schedule of compliance. The Chloride Work Group recommends that the MPCA keep the data sources updated on a regular schedule. If the tool can be improved, the work group suggests that the MPCA dedicate resources to doing so as it has the capacity to be a useful tool.

Along with the use of a streamlined variance tool, the Chloride Work Group recommends the agency waive the variance fee. Currently, the cost of applying for a variance is $10,850. Many cities find this cost to be too high. With the streamlined tool, much of the work has been conducted up-front, saving the MPCA time and work once a variance is requested. In addition, because the request for a variance stems from economic hardship, charging for a variance contradicts the underlying claim that costs are too high. Therefore, the work group recommends municipalities not be charged if using the streamlined variance tool.

MPCA should further explore the use of integrated management plans. The city of Willmar's NPDES permit contains a model for other municipalities to follow. It establishes a compliance schedule that accounts for a municipality's capital improvement plans and finance management plans. The work group expects that chloride management will require a holistic approach of point source and nonpoint-source reductions to protect aquatic life. Storm sewer maintenance – because of road salt runoff – will play an important role, as will source reduction in the water system.

Conclusion

The MPCA has taken a different approach to addressing chloride in wastewater effluent. By involving municipalities in the permitting solution, MPCA has allowed permittees to tell the agency what would work best for them in protecting Minnesota's waters from chloride impairments. There will be costs associated with compliance. The Chloride Work Group hopes the agency can take a larger partnership role with municipalities.

The Chloride Work Group believes its recommendations of using schedules of compliance and variances will allow municipalities to take those critical steps toward compliance.

Appendix A: Pros and cons analysis of permitting options

No chloride limits in permits

This option would keep chloride limits out of permits, but would require additional steps, such as monitoring and source identification, to ensure water quality does not further degrade.

Table A-1: No chloride limits in wastewater discharge permits

Pros	Cons
Easy for operator and MPCA staff	Exposure to lawsuits
Time to determine where chloride is coming from	Management plan would result in strategies to comply with limit anyway
No violations of permit	No limit means you are not highlighting a problem
No expenses (capital, design or permitting)	Unfair to facilities that already have limits on salty parameters
Allows time for chloride standard to be updated	

Compliance schedules

This is a tool that MPCA frequently uses in NPDES permits to move the permittee toward compliance by identifying actions that must occur to reach compliance (actions considered "as soon as possible").

Table A-2: Implementing schedule of compliance through permits

Pros	Cons
Allows time to find a solution	Debate with EPA over timing and length of compliance schedule
No expenses (capital, design or permitting) until solution identified	MPCA will set length and timing of schedule, though in cooperation with permittee
No time needed to seek EPA approval because federal agency does not officially approve compliance schedules	No extension on final date of compliance schedule
Makes planning easier for complying with limit	Locks you into a permit limit because of anti-backsliding
Provides a non-moving target for planning discussions with city council and rate-payers	Must comply as "soon as possible" and provide yearly progress reports to MPCA
	Lots of back and forth between MPCA and permittee to determine compliance schedule dates and objectives

Variances

This is a tool that other states frequently use in NPDES permits to allow permittees time to comply with a new limit. The MPCA has not received many applications for variances to permit requirements. To date, only five facilities have active variances in their NPDES permits. It allows a permittee to continue to discharge under an alternative limit that protects against further degradation of water quality.

Table A-3: Seeking variances from standard to gain time to study and resolve chloride exceedances

Pros	Cons
Chloride management plan required (reducing potential for legal challenge from environmental groups)	Variance eligibility must be re-evaluated every permit re-issuance
Length of time could be over several permit cycles	One-time application fee of $10,800
MPCA commissioner is willing to waive application fee	Time needed to gain EPA approval
MPCA has already developed variance application tools and criteria	Time need for variances to go through public comment process
Most facilities would qualify based on substantial and widespread social and economic impacts	Perception that variance is a “permit to pollute”
Allows time for research into best compliance strategy without locking facilities into specific compliance dates	Expansion issues for significant industrial users of chloride if net chloride loading increases
Reduced legal exposure in terms of justifying infeasibility of high treatment costs	
Relief from immediate financial responsibility of compliance	

Administrative orders

The MPCA commissioner can issue an administrative order to address specific concerns. The agency could issue administrative orders concurrently with the issuance of a permit.

Table A-4: Issuing administrator orders to gain compliance

Pros	Cons
No time needed for EPA review	Heavy-handed approach while similar goals can be met with a softer approach of compliance schedules
Steps in schedule not officially in permit but in the administrative order	Implies that compliance strategy is fully known
No time needed for public comment	Requirements must be met as soon as possible
No penalty	Administered by MPCA compliance and enforcement staff instead of permitting staff
	Implies there is an out-of-control problem
	Optics are the MPCA is making you meet requirements
	Any necessary changes to schedule would require amending the administrative order

Revised state-wide chloride standard

This action would provide the most protective chloride limits for aquatic life. It would require more time to develop and adopt.

Table A-5: Seeking revisions to state water quality standard for chloride

Pros	Cons
Highest degree of certainty of final chloride standard	Chloride standard in future likely to be lower than current standard, meaning more changes for facilities
Appropriately protective of aquatic life	Changing water quality standards takes years and is almost always legally contentious
	Possibility of sulfate and hardness standards in the future, opening up the possibility of future effluent limits for these parameters

Site-specific standards

This option would allow the facility to enact the most accurate protective limits for its situation. It would account for the biota of the specific location of the outfall reach.

Table A-6: Seeking site specific standards for chloride on case by case basis

Pros	Cons
Appropriately protects receiving waters	Time to receive EPA approval, for formal rule-making, and public comment
Ability to distinguish between different types of receiving waters	Consulting costs
Provides certainty with regards to future effluent limits	Uncertainty that site-specific standard would be lower than current standard
	Increased scientific complexity is likely