



# Onsite Sewage Treatment Program

## Communities Addressing Chloride Case Study: Saint Peter, MN



Minnesota River, St. Peter Photo: Fortin Consulting

<p><b>The problem:</b> High chloride levels in wastewater that discharges to the Minnesota River</p> <p><b>Chloride reduction strategy:</b> Reverse osmosis of drinking water Education on shut-off or turning down of water softeners, implemented 2011</p> <p><b>Chloride reduction achieved:</b> 354-464 mg/L down to 168 – 389mg/L (Average 266 mg/L)</p>
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Minnesota municipalities are wrestling with high chloride levels in their wastewater. Chloride is one of the components of salt, which is used in forms such as sodium chloride (table salt), calcium chloride and magnesium chloride (road salts). Sodium chloride is commonly used in home water softeners and by water treatment plants to treat “hard” water. Minnesota generally has groundwater with high levels of calcium and magnesium that must be removed through softening in order to improve taste and prevent lime scale buildup in appliances, pipes and water fixtures. The majority of home water softeners use sodium chloride (NaCl) in a softening process that replaces calcium and magnesium ions with sodium, while the chloride ions are discharged in the wastewater and eventually end up in the environment.

High chloride use can lead to environmental issues. Chloride released into local lakes and streams does not break down, and instead accumulates in the environment, potentially reaching levels that are toxic to aquatic wildlife and plants. Because salt water is more dense than fresh water, it settles at the bottom of lakes potentially preventing the natural mixing of oxygen and nutrients and in effect creating a “dead zone.”

The Minnesota Pollution Control Agency (MPCA) has authority to require discharges to comply with water quality standards using the Clean Water Act and National Pollutant Discharge Elimination System (NPDES) permits. This ensures the protection of aquatic plants, invertebrates and fish. Compliance schedules and variances can be used to assist in meeting permit requirements. Both permitting tools allow time to comply with the permit; however, the variance process considers economic factors that allow more flexible timelines, and offers the potential for renewal of a variance if the permit goal remains unachievable. The variance process may take longer than a compliance schedule and requires approval by the Environmental Protection Agency (EPA). Each community needs to determine which tool is appropriate for their situation.



Saint Peter Broadway Water Treatment Facility-Photo: Gretchen Koehler

### Saint Peter background

The City of Saint Peter discharges wastewater into the Minnesota River under a permit regulated by the Minnesota Pollution Control Agency (MPCA). Prior to upgrades, chloride levels in the wastewater discharge ranged from 354 to 464 mg/L. Minnesota Rule 7050.0222 Subp. 2 sets discharge levels into lakes and streams at 230 mg/L, and at 400 mg/L for larger flowing rivers.

### City Demographics

Total Population	Number of Households	Median Income
11,784	3,076	56,071

Saint Peter is located in Nicollet County and has approximately 11,748 residents who receive their water from the Saint Peter Water Treatment Plants. The City draws its drinking water from nine wells ranging from 130 to 780 feet deep. Three are in the Jordan sandstone aquifer, three in the Wonewoc sandstone aquifer, and three in the Mt. Simon sandstone aquifer (MDH, 2016). Prior to treatment, water hardness levels are at about 24 grains. Many Saint Peter residents used water softeners to remove this hardness. Saint Peter residents and businesses use approximately 1.7 million gallons per day (2008). The recommended water hardness level for taste and to prevent the buildup of lime on pipes and home appliances is less than 5 grains, though many homeowners prefer levels closer to 0 grains. Individual home water softeners are a large contributor of chloride in Saint Peter, though some industries release wastewater with brine byproducts that contain chloride as well. The City’s consultant estimated salt use from home softeners of 18,460 lbs/day, with annual salt discharge to the sanitary sewer of 3,400 tons.

### Solutions

The City of Saint Peter worked with a consultant, Bolton and Menk, to conduct an evaluation of water treatment system options and provide recommendations to upgrade their drinking water treatment. The upgrades were needed to meet expected demand and remove high levels of nitrates, chlorides and total dissolved solids as well as resolve taste issues. The evaluation was completed in 2008. Three alternatives were considered for their drinking water and wastewater treatment to meet their needs; 1. Lime Softening, 2. Ion Exchange, and 3. Reverse Osmosis. Lime softening was not chosen due to sludge disposal issues and its inability to remove nitrate, sulfate, and chloride. Ion exchange was considered but determined to be not practical due to the high ion levels in Saint Peter’s water source, the large volume of water used by the City, chemical costs to recharge resins and the physical space required to hold the system.

Reverse osmosis (RO) was the alternative recommended by the City’s engineering consultant. It could remove most of the contaminants of concern in the City’s drinking water. Aeration detention and gravity filtration was recommended in addition to RO to remove iron and manganese and prevent premature fouling of the RO membranes.

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The City's consultant estimated reductions in chloride discharge of approximately 2000 tons per year through discontinued use or turning down salt use settings of residential water softeners. A public campaign was conducted to educate Saint Peter residents on the need to turn down or shut off their softeners. Although no data is available on the effectiveness of the campaign, the chloride discharge to the Minnesota River was greatly reduced. A flier with instructions on setting water softeners that is posted on the City of Saint Peter web site.



St. Peter wastewater treatment facility

The final total project cost was \$18.8 million (Minnesota Department of Health 2011). The City raised water rates over time to help cover the costs of the new system. According to the Saint Peter Utility department average residential consumption is 3,000 to 4,000 gallons per month and the water cost to the consumer almost tripled, compared to the cost prior to the installation of the reverse osmosis system. (Allen, L. Oct 2016).

## Conclusion

Following installation of the RO system, water hardness was reduced by 80%, from 24 grains down to 5 grains. The graph below is the total chloride discharge concentration in mg/L from the Saint Peter Wastewater Treatment Plant (Station SD 004) prior to and after installation of the RO system in early 2011. Chloride discharge concentrations prior to the RO system installation ranged from 354 to 464 mg/L. Chloride discharge concentrations since installation of the RO system and education on water softening needs range from 168 – 389mg/L, with an average of 266 mg/L for September 2011 to March 2017.

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