

Madison Metropolitan Sewerage District
Second Annual Chloride Progress Report
(June 2012)

Prepared by Ralph Erickson

A. Introduction

The District's Wisconsin Pollutant Discharge Elimination System (WPDES) Permit specifies effluent limitations, monitoring and reporting requirements, and other terms/conditions that the District is required to meet. The permit contains a variance to the water quality based effluent limit for chloride. As conditions of the variance, the District is required to meet interim effluent limitations for chloride, implement specific chloride source reduction measures (SRMs), and submit annual progress reports to DNR.

The District is providing this second report of its chloride source reduction program. This report:

- Presents a summary of effluent chloride concentration and mass data and trends
- Summarizes Year-1 (2011) SRM activities undertaken
- Identifies future source reduction activities and priorities

In 2012, staffing resources have been bolstered with the hiring of an environmental specialist. The program has benefited greatly from the time and talents that the environmental specialist has brought to the team.

B. Chloride in Effluent

All wastewater generated in the District's 180 square mile service area is treated at the Nine Springs Wastewater Treatment Plant (NSWTP). In 2011, on average, 38.3 million gallons per day (MGD) of effluent were pumped to Badfish Creek (BFC) and 3.54 MGD were pumped to Badger Mill Creek (BMC). Both receiving streams are effluent dominated.

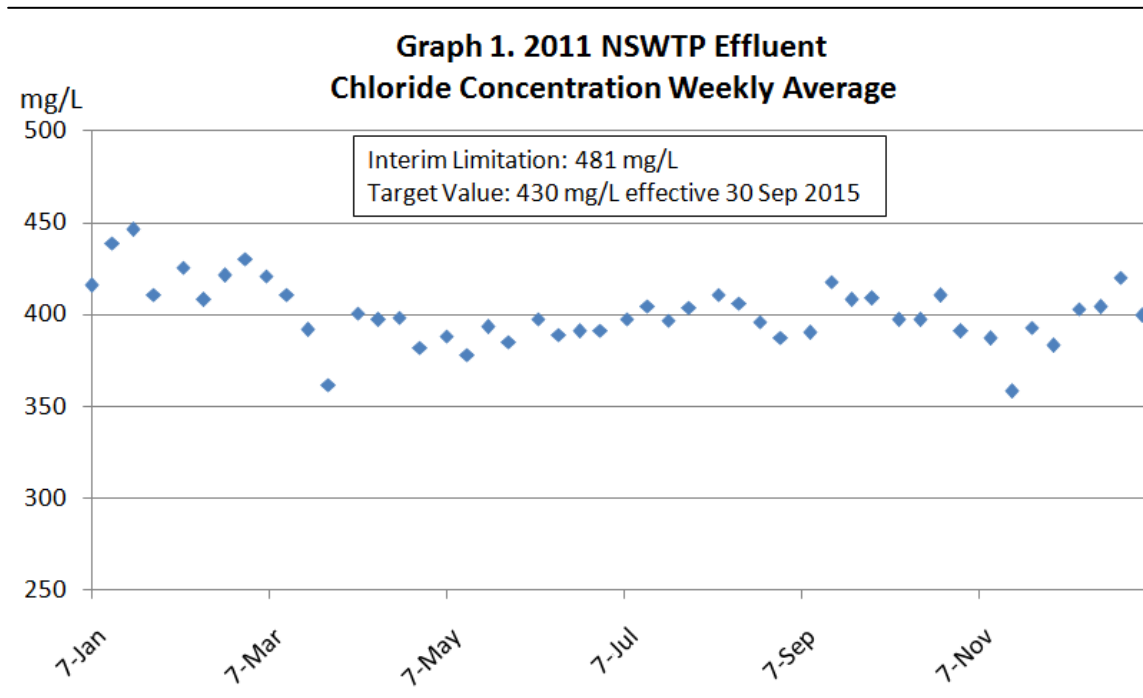
The District's permit, effective 2010-2015, contains chloride concentration and mass limitations expressed as weekly averages (Table 1). A single sampling point at NSWTP is used to characterize effluent chloride concentration for discharges to both receiving streams. Flow data from each effluent force-main is used to calculate chloride mass loadings to each receiving stream.

Effluent chloride concentration and mass data for 2011 is summarized in Table 1. At no time in 2011 did effluent chloride concentration or mass exceed permit limits. The mass of chloride discharged from NSWTP in 2011 was 50.9 million pounds; this mass of chloride was 1.3% less than observed in 2010.

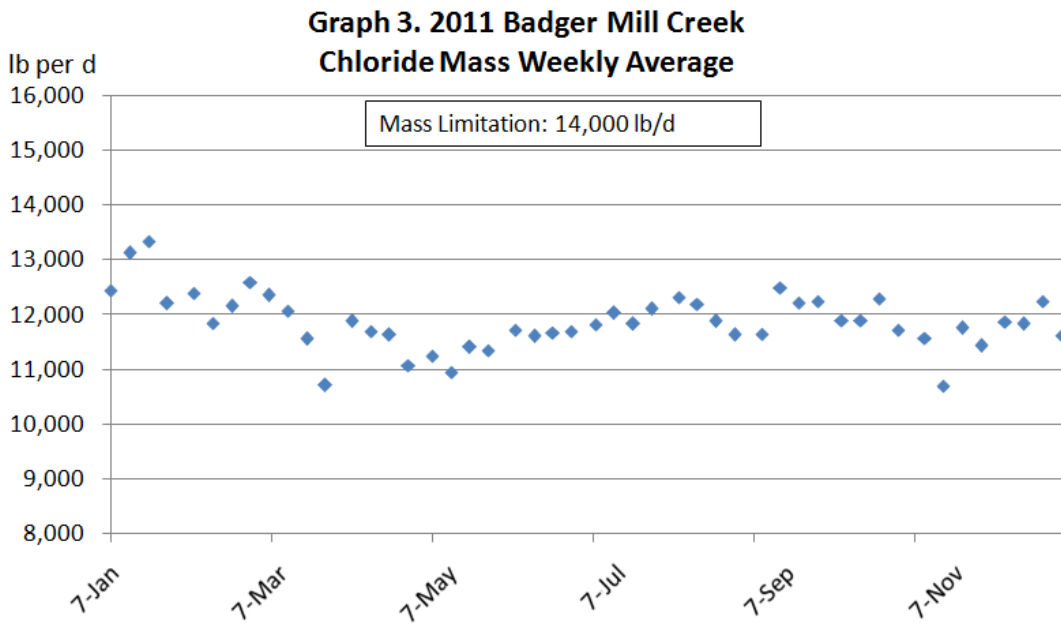
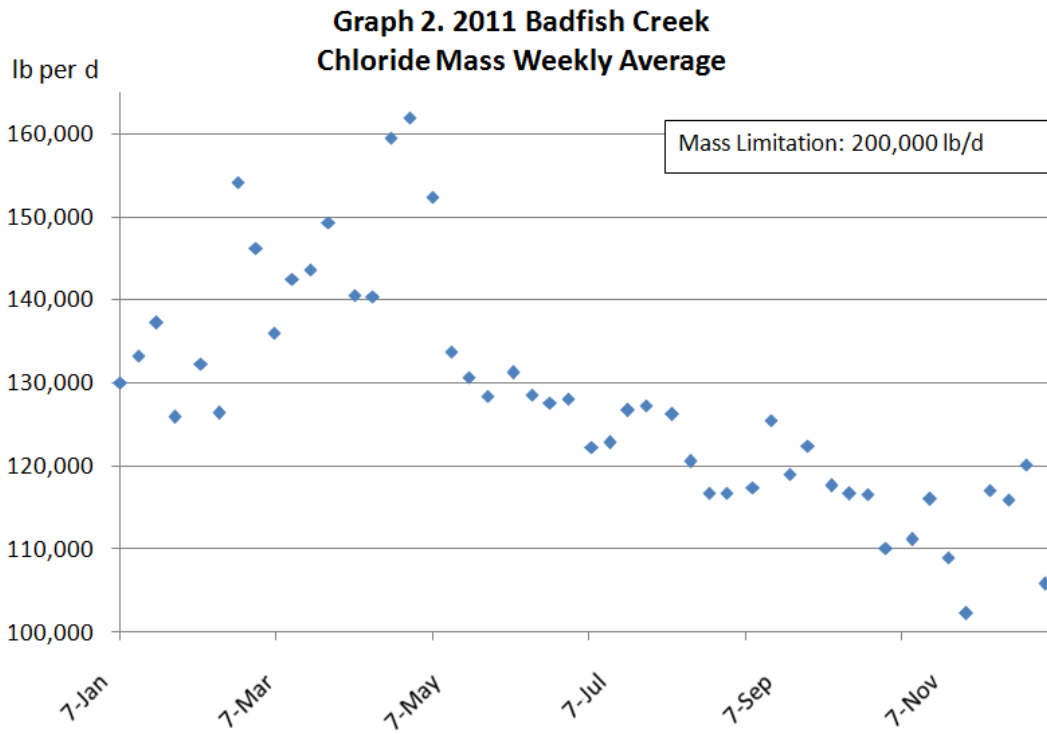
Table 1. Effluent Chloride Summary in Relation to Permit Limitations

<i>Year: 2011</i>	<i>NSWTP Conc. (mg/L)</i>	<i>BFC Mass (lb/d)</i>	<i>BMC Mass (lb/d)</i>
Avg Week	401	127,753	11,868
Max Week	446 <i>(15-21 Jan)</i>	161,890 <i>(22-28 Apr)</i>	13,341 <i>(15-21 Jan)</i>
<i>WPDES Permit Weekly Avg Limitations (value not to exceed)</i>			
Any Week	481	200,000	14,000

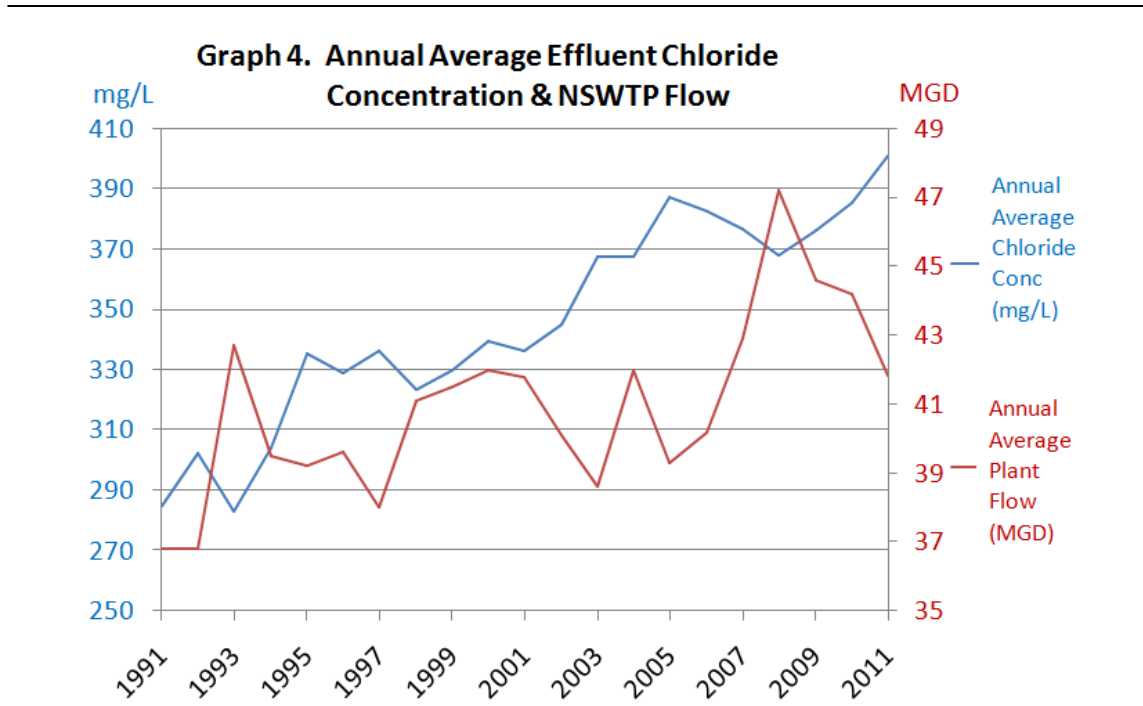
Graph 1 provides the weekly average effluent chloride concentration for 2011. The seasonal variation in concentration is not as pronounced as was observed in 2010. The winter peak (January – February 2011) in effluent concentration is due most likely to deicing salt contributions received during the period of relatively low sewer flows observed during most winters. Typically, a dip in concentration is observed in summer due to wet weather dilution of raw wastewater. In 2011, however, the weather was relatively dry, wastewater flows were low, and the dip in concentration was not observed. November and December were relatively free of weather requiring deicing activities and chloride concentration did not trend higher.



Graphs 2 and 3 provide the weekly average mass of chloride discharged to the Badfish Creek and Badger Mill Creek outfalls. Graph 3 mass data demonstrates a nearly identical pattern to the concentration data of Graph 1. This is due to the relatively consistent rate of effluent pumping to BMC throughout 2011.



Graph 4 provides the historical trending of annual average plant flow graphed with annual average chloride concentration.



C. Source Reduction Measures

The WPDES Permit identifies six chloride source reduction measures that the District is required to implement over the course of the five-year permit term. For the purposes of planning and reporting, the SRMs have been expanded and grouped into two program focus areas, source identification and education & outreach. Source identification includes four core activities: wastewater monitoring, industrial inspections, survey methods, and deicing salt inflow evaluation. Education & outreach efforts are focused on five core activities: households outreach, significant water softening sources education, plumbing installers education, road salting professionals education, and significant industrial (non-softening) source education.

1. Wastewater Monitoring

a. Background: Chloride sampling and analysis has not typically been performed on collection system samples or on the four regional pipelines that comprise the influent at NSWTP. Effluent sampling has been the typical strategy used to track chloride concentration in wastewater. To successfully implement source identification measures, however, collection system and plant influent sampling must be more commonly employed. Sampling storm water during wintertime melting events can provide useful information for source identification purposes.

b. Regional Plant Influent Monitoring: The 2011 winter-spring sampling program generated chloride loading data for one week in January and one week in June from the four influent regional pipelines to NSWTP. The data indicates that Pumping Station

Number 2 has on average 7% greater chloride concentration than the three other influent pumping stations. The data suggests that one or more significant sources of chloride contribute to generally higher chloride loadings in the Station 2 service area. A large meat packing plant and an ice cream manufacturing facility are both served by Station 2. Additional work was performed in the Station 2 region in early 2012 and will be summarized in the next annual report.

c. Deicing Effects on Plant Influent: The winter of 2011-2012 started mild and ended somewhat summer-like. No monitoring data was collected late in 2011 to support evaluations of deicing impacts as large winter snows had not yet fallen. Considerable chloride (and conductivity) data was collected in wastewater and in storm water in the winter months of 2012. This data will be summarized in the next annual report.

d. Household Monitoring: The District has analyzed chloride concentrations in collection system wastewater samples collected as part the District's user-charge billing program on three occasions. The first sampling effort was conducted in 2003. Analysis of the sample set was conducted again during the first and second quarters of 2011. City of Madison surcharge billing samples, received in the District laboratory, were also analyzed for chloride. The District's laboratory analyzed 1240 samples to support this monitoring effort.

Seven neighborhood regions are typically studied in the user-charge billing program to determine average household loadings of compatible pollutants. These regions are all rural and all homes are served by private shallow wells. Chloride data obtained from the 2011 neighborhood sampling program demonstrated that the studied households contribute, on average, 0.8 pounds of chloride per day (1.3 lb/d salt equivalent). Chloride concentrations observed in the study regions ranged from 124 mg/L to 2235 mg/L. The median chloride concentration was 433 mg/L. This value is slightly greater than the average concentration measured at NSWTP during the study period (403 mg/L). Approximately one tenth of the household loading is estimated as originating as background chloride in the household potable water supply (estimated at 30-40 mg/L Cl⁻). The data suggests that households generate likely one half to three fourths of the chloride loading to the NSWTP.

Future monitoring efforts will be necessary in the seven household study regions and in other regions, including some served by municipal water systems. Resulting data will be vital in measuring the effectiveness of future pilot (educational and incentive based) programs targeting residential water softeners.

e. Industrial and Restaurant Monitoring: Industrial and restaurant samples were analyzed for chloride when samples were available during the 2011 user-charge sampling program. The flow and concentration data indicates the relative significance in chloride loadings from the limited industrial sample set.

- Grease rendering plant (1300 mg/L; 430 lb/d)
- Pharmaceutical manufacturing facility (1160 mg/L; 2560 lb/d)
- Meat packing plant (1560 mg/L; 18,200 lb/d).

More sampling, or survey, data is needed from these and possibly other industrial facilities to determine the significance of chloride loadings from industrial processes.

Seventy-eight restaurant samples obtained from the City of Madison indicate an average chloride concentration of 534 mg/L. Restaurant wastewater flows and chloride loadings are unknown to the District at this time.

2. Industrial Pretreatment / Source Control Inspection Program

Permitted Industrial Users: Annual inspections of the permitted industrial facilities allow the District the opportunity to provide updates on the chloride reduction program and to discuss source reduction measures with the industrial user.

3. Survey Methods

a. Sector -Targeted Survey Methods: Surveys designed to assess chloride usage data from industries and institutions of similar sectors were mailed in 2010 and processed in 2011. Survey questions were sector specific. Thirty surveys were returned from facilities in the targeted sectors. The data indicates that water softening is prevalent at most industrial/institutional facilities, and salt consumption/usage is reportable by the industrial/institutional users. More survey work is necessary to support source identification efforts. Table 2 provides selected measured and approximated data for industrial and institutional facilities.

Table 2: Selected 2011 Sector Survey Chloride Consumption Data

<i>Type of Facility</i>	<i>Number of Surveys Returned</i>	<i>Range Salt Purchase (1000s lb/mo)</i>	<i>Approx. Chloride Loading (lb CT/day)</i>
Hospital	3	16 to 50	320 to 1000
Industrial Laundry	4	8 to 24	160 to 480
Food & Biotech	2	4 to 12	80 to 240
Other	3	1 to 7	20 to 140

4. Deicing Salt Monitoring

The previous annual report estimated that annually, deicing salt contributes three percent of the chloride load in NSWTP wastewater. However, inflow of salt-laden storm water during snow melt periods can contribute to increased chloride loads at the treatment plant. Therefore, identifying and tightening-up of inflow sources carrying significant deicing salt loadings will be a high priority.

Effluent monitoring data for late April (2011) indicated a spike in the mass of chloride over three weeks which corresponded to snow and rain events. This is typical of the late winter or early spring and these periods warrant future field monitoring activities.

In 2011, there were no obvious warm-weather spikes in chloride mass that could be attributed to legacy deicing salt. Such spikes were observed twice in wet weather periods during the summer of 2010. Identifying the sources of these warm-weather chloride spikes might not be possible since a network of sampling stations for monitoring infiltration and inflow does not exist.

E. Education & Outreach Updates

The District has engaged in many education and outreach efforts related to chloride and expects to continue to do so throughout the course of the permit term. A half-time communications and outreach specialist position has been approved in the 2012 budget. When hired, this communications specialist will offer vital assistance to the education and outreach programs at the District.

1. Households Outreach

The District web site for chloride education, coined The Salt Page, was unchanged and continues to serve as a resource for homeowners. Meetings held with the local water quality providers related to softening initiatives are laying the groundwork for education and outreach programs.

A water softening best practices document was issued in August. The document and associated educational materials will provide valuable educational background to the water quality providers for their meetings with customers at home shows or within the customers' homes. The text of the August 2011 best practices document is provided in Addendum 1.

2. Significant Water Softening Sources Education

The sector survey forms provided some educational benefit to the survey responders in the form of the introductory statements regarding chloride sources and WPDES limitations and also in a survey section titled Opportunities for Reducing Salt Consumption. Two survey questions, shown below, hopefully will spur survey responders to evaluate their water softening systems with potential assistance from their water quality providers.

Question 1: Softening Controls: Have you worked with your water conditioning provider to evaluate innovative technologies that can help you reduce water and salt consumption during the regeneration of your softening media?

Question 2: Recirculating Systems: Do you maintain a reservoir of conditioned water such as might be used for a recirculating chilled water system?

If yes, have you evaluated salt-free techniques, such as electrostatic hardness precipitation, for your recirculating systems?

The District believes that large water softening systems represent the low-hanging fruit for chloride reductions. To address this source, more work is necessary in regards to surveys, on-site meetings, and educational strategies for significant water softening sources.

3. Road Salting Professionals Education

Three types of deicing salting activities are to be considered for educational activities: municipal agencies, private contract applicators, and households. In September 2011, the District prepared and presented an education presentation for the Dane County Highway Department “Roadeo.” Deicing crews were addressed during six 20-minute sessions. The presentation, The Road Salt and Sewage Connection, will be presented to other municipal crews and possibly even to private contractors during future educational sessions.

The District may need to seek the assistance of road salting professionals in identifying trouble spots where salt-laden runoff pools on or near wastewater collection system structures. All known trouble spots would be prime target areas for source identification and remediation activities.

4. Significant Industrial Sources Education

Where an industrial facility is known to discharge significant mass of chloride from processes other than softening, District staff will meet with and educate the user. Each significant chloride discharger will be asked to self-evaluate chloride discharges to set baseline discharge levels and to identify reduction measures and goals.

A meeting was held in December at a meat packing plant that is the largest known source of industrial chloride loadings to NSWTP. The District presented background materials regarding the chloride source reduction program. Follow up meetings are expected to be held in 2012.

This type of introductory meeting will need to be held with several other industrial facilities where significant quantities of chloride are discharged from industrial processes. Follow-up meetings and demonstrations of reduction measures are required as well.

F. Chloride Source Reduction Program Planning

Program planning for 2012 has identified four chloride source reduction priorities:

- Targeted meetings
- More robust data set
- Regulatory/administrative reviews
- District in-house demonstration projects.

Ongoing planning for 2013 will necessarily build upon the above priorities and will provide targets for reduction strategies.

Priority 1: Targeted Meetings: These meetings will enhance relationships and attempt to seek agreement on courses of action. The meetings will focus on chloride sources such as large and small softening systems, industrial processes, deicing salt, and swimming pools/spas. Local environmental groups, water quality providers, and UW-Extension will be approached as potential partners.

Meeting goals include:

- Educate issues regarding Dane Co. water quality and POTW permit variances
- Develop lists of opportunities (issues)
- Strategize for optimization of systems and programs
- Determine drivers for improvement
- Develop pilot projects, monitoring techniques, and metrics

Priority 2: Robust Data Warehouse: Pilot projects and source reduction measures necessarily will rely on the data generated. Household surveys will provide water softener and salt consumption data. A meat packing plant is the largest industrial source; continual (real-time) monitoring of this industrial loading will be evaluated. Additional survey and monitoring data will be generated to help set chloride reduction goals.

Priority 3: Regulatory and Administrative Reviews: The District chloride reduction program will begin to evaluate possible administrative tools that may be helpful in achieving reductions in chloride loads. These could include:

- Ordinance revisions
- Best management practices
- Incentives
- Industrial limitations
- Surcharge and user-charge fees

Priority 4: District In-House Demonstration Projects: The District must lead by example by demonstrating source reduction measures related to large and small scale water softening, deicing activities, and industrial chemical usage. The District will evaluate and consider implementing demonstration projects and process improvements in 2012.

G. Summary

In 2011, The District was fully compliant with its WPDES permit chloride concentration and mass limitations. The total mass of chloride discharged decreased by over one percent from the previous year. Cooperative chloride source reduction initiatives undertaken in 2011 included working with water quality professionals to set best practices for softening systems, providing educational information to highway department road salting professionals, and initiating discussions with the largest industrial source of chloride. Sampling and survey efforts confirmed that the reduction program must take multi-faceted approaches targeting household softeners, large

industrial and institutional softening systems, significant industrial sources, and deicing salt. The District has revised the 2012 work plan with the second half of the year focusing on numerous meetings with potential partners. Projects directed at District in-house usage of chloride containing materials are progressing. Planning for 2013 and beyond is focusing on source reduction strategies, incentives, and metrics.

Appendix A:

Water Softening Best Practices Guidelines

The following best practices guidelines are steps that can be taken by water treatment professionals, whenever practicable, as part of an effort to reduce chloride contributions to wastewater treated by the Madison Metropolitan Sewerage District (MMSD):

1. Evaluate existing softening units during service calls and make adjustments as necessary to more efficiently use salt.
2. Provide the consumer with educational material developed by MMSD and/or water treatment representatives regarding the benefits of upgrading to a more efficient softening system.
3. Setting residential and commercial applications to the same softening criteria.
4. Following typical sizing criteria, which include: 50 gallons of water consumed per person per day, using an average family size of four persons as the minimum sizing criteria for household applications.
5. Using a minimum softening efficiency for new softening equipment of 3,350 grains per pound of salt.
6. Setting a regeneration frequency of no less than 3 days.

The replacement of existing water softening systems or installation of new water softening systems within the Madison Metropolitan Sewerage District service area should be consistent with requirements in Wisconsin Administrative Code Comm 82.40(8)(j), which states that *ion exchange water softeners used primarily for water hardness reduction that, during regeneration, discharge a brine solution shall be of a demand initiated regeneration type equipped with a water meter or a sensor unless a wastewater treatment system downstream of the water softener specifically documents the reduction of chlorides.*

August 16, 2011