

# Madison Metropolitan Sewerage District Mercury Pollutant Minimization Plan/Source Reduction Report 2022

## Section I: General Information

**Name of Permittee:** Madison Metropolitan Sewerage District – Nine Springs Wastewater Treatment Plant

**Permit Number:** WI-0024597-09

**This is:** Not the first permit issuance requiring implementation of a PMP/SRM

Dates of previous PMP/SRM Plans: 12/12/2006

**Permit Effective Date:** 5/1/2020

**Date of First PMP/SRM:** 12/12/2006

**This variance is for:** Mercury

## Section II: Summary of Pollutant Reduction Work Done in 2022

In the district’s pollutant minimization plan (PMP) submitted to WDNR in 2017, mercury identification and reduction tasks were organized by nine broad categories, with specific activities in those categories to be determined each year. Those categories, in the shaded left hand column of the tables below, are taken verbatim from the PMP. The middle column indicates the activities that the district planned for 2022. The Status/Updates column on the right indicates the status of each action as of this report, as well as any observations or planned follow-up actions.

### A. Mercury Source Identification Efforts

PMP Action	2022 Planned Actions	Status/comments
<b>Mercury Source Identification Efforts</b>		
1. Explore possible operational influences on mercury levels, such as process chemicals.	To be carried out as needed. District pollution prevention staff periodically check in with District operations staff to get updates about activities and conditions in the plant that may influence mercury levels.	District pollution prevention staff continued occasional conversations with Operations staff for updates on conditions and changes at the plant. Effluent mercury levels were in line with values from recent years, and there were no known factors at the plant in 2022 influencing mercury removal. Mercury concentrations remained low despite lower flows.  The District also solicited proposals in 2022 for an expert to assist in a

		<p>comprehensive waste audit of the treatment plant. Although many mercury-containing materials have been discontinued or removed from the plant, mercury-containing devices still appear occasionally, such as mercury thermometers and float switches. By contracting with a consultant with waste expertise, the District aims to improve its identification and management of hazardous wastes that may be at the plant, including mercury-containing equipment. As of this report, the District has selected a consultant and plans to carry out the waste audit in 2023.</p>
<p>2. Conduct additional influent and/or collection system monitoring to identify variation in mercury levels based on time, location in the collection system, or other factors.</p>	<p>Continue work with USGS Mercury Research Lab to use mercury isotope fingerprinting to quantify contributions of different types of mercury to the plant, aiding in categorical source identification and determining controllable vs. uncontrollable sources of mercury.</p>	<p>As planned, the District continued special sampling and analysis with the USGS Mercury Research Lab to examine mercury isotopes in wastewater associated with distinct sources. More information about this sampling is in <a href="#">ATTACHMENT B</a>.</p> <p>Additionally, the District conducted opportunistic mercury analysis of sewer sediment collected during a sewer lining project, similar to sampling conducted in different areas of the collection system in 2018 and 2020. This type of sampling helps the District contextualize mercury levels in collection system sludge and identify potential mercury hotspots. More information about this sampling is in <a href="#">ATTACHMENT C</a>.</p>
<p>3. Review scientific literature and case studies from other POTWs to draw ideas from successful source identification/reduction activities elsewhere.</p>	<p>Connect with pretreatment and pollution prevention staff at other wastewater treatment plants to share information and resources about mercury reduction and other pollution prevention topics.</p>	<p>District staff held meetings in 2022 with staff at three other large POTWs: NEW Water, Western Lake Superior Sanitary District (WLSSD), and Milwaukee Metropolitan Sewerage District. Mercury source identification and management were core topics in these meetings. These discussions resulted in information and resource sharing</p>

		between utilities. For example, the District shared some of its dental amalgam minimization resources with NEW Water and WLSSD upon their request to help enhance their dental mercury reduction efforts.
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**If any action was not implemented, please explain why.**

See comments in Status/Activities column for specific actions.

**B. Actions Identified to Minimize Mercury Sources**

<b>Actions to Minimize Mercury Sources</b>		
<p>4. Work with partners to extend the reach of mercury disposal messages to specific audiences, such as students.</p>	<p>The District will be partnering with Sustain Dane and local water agencies to develop and deliver a water stewardship education program designed to help community members take individual actions that are protective of water. We anticipate that proper disposal of household hazardous waste, including mercury, will be part of this program's curriculum.</p> <p>The District is also hosting an artist-in-residence in 2022 who will be promoting One Water concepts through art, community engagement, and social media. The artist's work is expected to develop new audiences for District messages, including related to pollution prevention.</p>	<p>Along with the Madison Water Utility and Madison Area Municipal Stormwater Partnership (MAMSWaP), the District funded and collaborated with Sustain Dane to develop the Water Steward outreach program. This program was designed to be an entry point to community members to become more informed and active in water protection. Proper disposal of mercury and other hazardous wastes was covered as a stewardship action in this course. In total, 112 people participated in three instances of the course, including youth in the HOPE program exploring health careers.</p> <p>The District also coordinated with WDNR to share its mercury reduction resources. On the District's recommendation, WDNR staff in the small business assistance program and hazardous waste compliance section worked with the District to create web content for dental clinics with information and resources for mercury minimization. The District also shared its experience with dental clinic</p>

		<p>inspections with hazardous waste compliance staff to help them understand how to carry out a dental clinic inspection for hazardous waste compliance, and District staff accompanied WDNR hazardous waste staff on a model dental clinic inspection.</p> <p>The <a href="#">2022 artist/educator in residence</a> sparked connection with many new audiences, expanding the District’s reach. They did this through a series of focus group/dialogues, and public events organized around different themes and affinity groups. These events and the supporting social media brand, <a href="#">@onewatermadison</a>, opened up direct conversations around topics that residents care about. This work will continue in 2023.</p>
<p>5. Discuss mercury management in direct meetings with users in healthcare, school and industrial sectors to identify any remaining mercury sources and provide information about disposal/alternatives.</p>	<p>The District has not observed significant remaining mercury use in members of these sectors, and so has not prioritized mercury-focused outreach to these sectors in recent years; however, the District will address mercury management as opportunities arise with these entities.</p>	<p>The District took actions to improve its internal mercury waste handling through staff outreach and process standardization. Although much mercury-containing equipment (MCE) has been removed from the plant, maintenance staff still occasionally encounter MCE throughout the collection system, such as float balls, and newer maintenance staff may not be familiar with identifying such waste and what to do when it’s found. District pollution prevention and pretreatment staff worked with the District’s safety coordinator to develop an internal mercury disposal SOP, and the safety coordinator delivered an overview of this process at an all-staff virtual meeting to educate staff.</p>
<p>6. Implement other outreach and/or regulatory approaches as may be</p>	<p>As needed.</p>	<p>District staff contacted Public Health-Madison Dane County to make them aware of mercury-containing skin lightening products,</p>

informed by research and analysis.		which are a threat to public health and could also end up in the sewer system (for example, the FDA released <a href="#">information</a> about such products, which can be sold illegally in the U.S.). The District encourages agencies at the local and state level, including the WDNR, to publicize the dangers of these products and prevent their use.
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**If any action was not implemented, please explain why.**  
See comments in Status/Activities column for specific actions.

**C. Actions Taken to Maintain Source Reduction**

<b>Maintenance of Source Reduction</b>		
7. Continue dental certification program, supplemented with direct site visits to dental clinics, to ensure compliance with amalgam separator and management requirements in the sewer use ordinance.	The District plans to conduct its annual certification using the same format as the previous year, with a focus on enhancing communication with clinics to maximize the response rate. To help increase the reach of mercury minimization messages and to emphasize best practices, the District plans to continue communication with dental stakeholders and share District-created resources for distribution to a larger audience.	The District conducted its annual certification of local dental clinics, with a large majority of clinics returning their online forms certifying adherence to amalgam best management practices and maintenance of amalgam separators. More information about the 2022 certification process is below.
8. Evaluate need for local limits and/or general permits related to mercury.	Not planned for 2022.	Not conducted in 2022.
9. Publicize options for residential and commercial disposal of mercury, particularly Dane County Clean Sweep.	The Dane County landfill is organizing another satellite Clean Sweep event in 2022, which the District intends to support in planning and promotion. Work on the water stewardship program will also be an opportunity to educate the public about proper	District pollution prevention staff participated in planning meetings for a remote Clean Sweep event that occurred on 4/23/22 in Middleton. The District promoted this event through social media posts: <ul style="list-style-type: none"> <li>• <a href="#">Facebook post</a></li> <li>• <a href="#">Tweet</a></li> </ul>

	household hazardous waste disposal.	<ul style="list-style-type: none"> <li>• <a href="#">Facebook video</a> (created in 2020 but re-shared for this event)</li> </ul>
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**If any action is not ongoing, please explain why.**

See comments in Status/Activities column for specific actions.

**Summary of annual dental certification:**

The District carried out its annual dental certification process, which it has done in some form since 2008. This certification verifies that local dental clinics are continuing to follow best practices to keep amalgam waste out of the sewer system to the greatest extent possible, including proper maintenance of their amalgam separators or other amalgam capture devices.

As of this report, 104 out of 118 area dental clinics (88%) had returned their 2022 certification report, slightly more than those that returned on time in 2021. The District hired a pollution prevention intern late in 2022 who helped contact clinics to remind them to submit their reports. One of the most time-consuming aspects of the District’s mercury minimization work is communicating with dental clinics to obtain their certification reports, and the intern was able to devote time to following up with clinics and reviewing their submitted amalgam separator pictures.

Of the clinics that submitted reports:

- 59 (57%) were in full compliance with amalgam best management practices
- 45 (43%) had at least one item that need correction based on their certification responses. The most common practices that needed correction were:
  - Switching to a vacuum line cleaner with a pH between 6 and 8 (18 clinics)
  - Checking their amalgam separator for proper function at least once a week (25 clinics)

Clinics with corrective actions needed receive a message during completion of the report about those actions, and they also receive an automatically generated emailed report after submitting their certifications that summarizes the actions they need to take to be in full compliance.

The District’s self-developed online amalgam certification form requires clinics with an amalgam separator to verify that the separator is still in place and is not getting too full. Of 93 clinics that uploaded photos of their amalgam separator, 83 separator photos appeared acceptable upon District review of the photo. The District intern followed up with clinics that submitted a photo that was unclear, missing, or had a visual cue indicating the separator needed maintenance (such as a full collection canister). The high proportion of clinics that submitted acceptable separator photos is an encouraging sign that most clinics are continuing to maintain their separators in a way that prevents amalgam waste from reaching the sewer system.

[Section III: Summary of Progress and Barriers to PMP Effectiveness](#)

**Average Effluent Mercury Concentration in Previous Year (2020):** 0.74 ng/L

**Average Effluent Mercury Concentration This Year (2022):** 0.92 ng/L

These values are the averages of 12 effluent grab samples, one per month.

**Please attach a graph of variance pollutant concentration data over the last five years.**

See [Attachment A](#).

**Have you encountered any barriers that have limited pollutant minimization program/source reduction measure effectiveness? If so, what adjustments will you make to the program during the next year to help address these barriers?**

Overall, the District continues to record low mercury values in influent, effluent and biosolids, indicating that mercury source reduction efforts have been effective. Many of the challenges that the District encounters in its mercury reduction work are systemic and would be most effectively addressed at a higher level, rather than at an individual treatment plant, because these challenges affect dental clinics and treatment plants in other areas as well. The District's communication with WDNR staff and other treatment plants in 2022 was an effort to elevate mercury minimization resources and problem solving to a more collective level, where lessons and resources from one entity can help others reduce mercury according to their own need.

Some of the challenges the District experiences in its mercury reduction are described below, along with work the District has done to address these challenges and potential systemic changes that could lessen these barriers across the dental and wastewater utility sectors:

- Continued use of amalgam in dental practices  
New mercury enters the collection system daily as new amalgam fillings are still placed in residents' mouths. Of the clinics that completed their 2022 amalgam certifications, 39 clinics (33% of total clinics) in the service area reported still placing new amalgam fillings. These fillings are in patients' mouths for an average of 15 years<sup>1</sup>, over which they will contribute trace amounts of mercury to wastewater from patients' waste. At the end of the fillings' lifespan, they may cause new mercury contributions to the District's collection system when they are removed, as amalgam separators are not 100% effective at capturing amalgam waste. The District has worked to encourage non-mercury fillings by changing its dental insurance plan to make composite fillings more affordable to employees. However, many dentists continue to stand by amalgam as a cheap, durable filling component, and some dental insurance plans make amalgam a more affordable filling material than amalgam alternatives.

A move among the dental industry, including insurers, to completely phase out the use of amalgam would eliminate a remaining source of mercury to the environment, not just in the District service area but across the state and beyond. This change will likely require education of both dentists and patients about amalgam alternatives and removal of structural barriers to amalgam alternatives (such as dental insurance policies that make amalgam more affordable to patients).

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<sup>1</sup> "How Long Do Fillings Last?", [www.healthline.com/health/how-long-do-fillings-last](http://www.healthline.com/health/how-long-do-fillings-last), accessed 1/12/2023.

- Turnover and lack of training at dental clinics

The District has put a great deal of effort over many years into educating dental clinic staff about required amalgam management practices through site visits, newsletters, and other educational resources. However, the District has found that staff turnover can disrupt continuity in a clinic’s amalgam management, leaving staff who are unfamiliar with amalgam management practices and requirements or leaving the clinic without a designated person responsible for amalgam waste. As a result, some amalgam management practices can be overlooked.

The District continues to educate clinics in its service area on corrective actions through its annual certification process. The WDNR and other entities that interact with dental clinics, such as OSHA trainers, could help widen the reach of this knowledge by disseminating information to dental clinics in their communication networks.

- Difficulty linking cause to effect in mercury values

With one influent and one effluent mercury sample per month, the District has limited ability to link mercury values to specific factors upstream that may influence mercury levels. When the District experiences occasional higher mercury concentrations, there’s no way of knowing if the high mercury value was due to a specific discharge, mercury-laden sediment in the collection system being dislodged, or just more mercury in the sample due to random chance.

The District is working to gain a more specific understanding of sources of mercury to the plant through its special sampling work in the collection system and in partnership with the USGS Mercury Research Lab. The District will also seek insight from wastewater operations research and information shared by other utilities to explore factors that affect mercury levels.

## Section IV: Planned Actions

The District included nine general actions in its application for a mercury variance in its upcoming permit. These actions, listed on the left in the table below, are the core planned activities for the District’s next permit term, and future annual reports will summarize specific steps taken in each of these efforts.

PMP Action	2023 Planned Actions
<b>Mercury Source Identification Efforts</b>	
1. Explore possible operational influences on mercury levels, such as process chemicals.	The District will be working with a consultant on a comprehensive waste audit of District facilities in 2023. The District anticipates improving its knowledge and processes related to mercury and other hazardous wastes as a result of this audit.
2. Conduct additional influent and/or collection system monitoring to identify variation in mercury levels based on time, location in the collection system, or other factors.	Depending on the results from the 2022 special sampling for mercury isotope analysis, and on availability of USGS staff and resources, the District may carry out additional sampling for mercury isotope analysis as a source identification measure.



<p>3. Review scientific literature and case studies from other POTWs to draw ideas from successful source identification/reduction activities elsewhere.</p>	<p>District staff will continue reviewing online research and articles as needed to find information relevant to mercury source reduction.</p>
<p><b>Actions to Minimize Mercury Sources</b></p>	
<p>4. Work with partners to extend the reach of mercury disposal messages to specific audiences, such as students.</p>	<p>The District plans to work with Sustain Dane to deliver additional classes as part of the Water Steward program. Proper mercury disposal actions will be part of course content.</p>
<p>5. Discuss mercury management in direct meetings with users in healthcare, school and industrial sectors to identify any remaining mercury sources and provide information about disposal/alternatives.</p>	<p>Previous District conversations with sectors other than dental have indicated that mercury-containing products have been largely phased out in schools and healthcare facilities. However, District collection system sampling has indicated that some sector locations could still be mercury sources, whether from current or historical mercury discharges. Special sampling in 2020 indicated high mercury values in sediment in a stretch of sewer where a healthcare facility discharges, so the District plans to investigate the cause of this high value through conversations with the facility and potentially additional sampling.</p>
<p>6. Implement other outreach and/or regulatory approaches as may be informed by research and analysis.</p>	<p>To be conducted if identified as necessary.</p>
<p><b>Maintenance of Source Reduction</b></p>	
<p>7. Continue dental certification program, supplemented with direct site visits to dental clinics, to ensure compliance with amalgam separator and management requirements in the sewer use ordinance.</p>	<p>The District plans to conduct its annual dental certification again in 2023. The District also plans to reassess the frequency of the dental certification, with the potential of lowering the frequency for consistently compliant clinics.</p>
<p>8. Evaluate need for local limits and/or general permits related to mercury.</p>	<p>Not planned for 2023.</p>
<p>9. Publicize options for residential and commercial disposal of mercury, particularly Dane County Clean Sweep.</p>	<p>The District has an active social media presence and occasionally promotes information about proper waste disposal to its followers. The pollution prevention team suggests topics to communication staff and will promote household hazardous waste disposal when appropriate.</p>

Section V: Notes

No additional notes.

Section VI: Certification

I certify that the information contained in this document and all attachments were gathered and prepared under my supervision and based on inquiry of people directly under my supervision and that, to the best of my knowledge, the information is true, accurate, and complete.

Authorized Representative Signature: \_\_\_\_\_

Date of PMP Annual Report Submittal to WDNR: \_\_\_\_\_

## Attachment A – Mercury Data and Graphs

Sampled date	Influent Hg concentration (ppt)	Effluent Hg concentration (ppt)
1/11/22	35	0.70
2/8/22	36	0.69
3/1/22 <sup>1</sup>	36	0.73
4/5/22	44	1.52
5/3/22	36	0.95
6/7/22	48	0.82
7/12/22	37	0.71
8/2/22	83	1.35
9/8/22	50	1.30
10/4/22	60	0.98
11/9/22	64	0.75
12/6/22	79	0.59
<b>Average</b>	<b>51</b>	<b>0.92</b>

Month (monthly composite)	GBT biosolids Hg concentration (mg/kg, dry weight)
1/2022	0.2
2/2022	0.3
3/2022	0.3
4/2022	0.3
5/2022	0.3
6/2022	0.4
7/2022	0.4
8/2022	0.3
9/2022	0.3
10/2022	0.3
11/2022	0.2
12/2022	0.3
<b>Average</b>	<b>0.3</b>

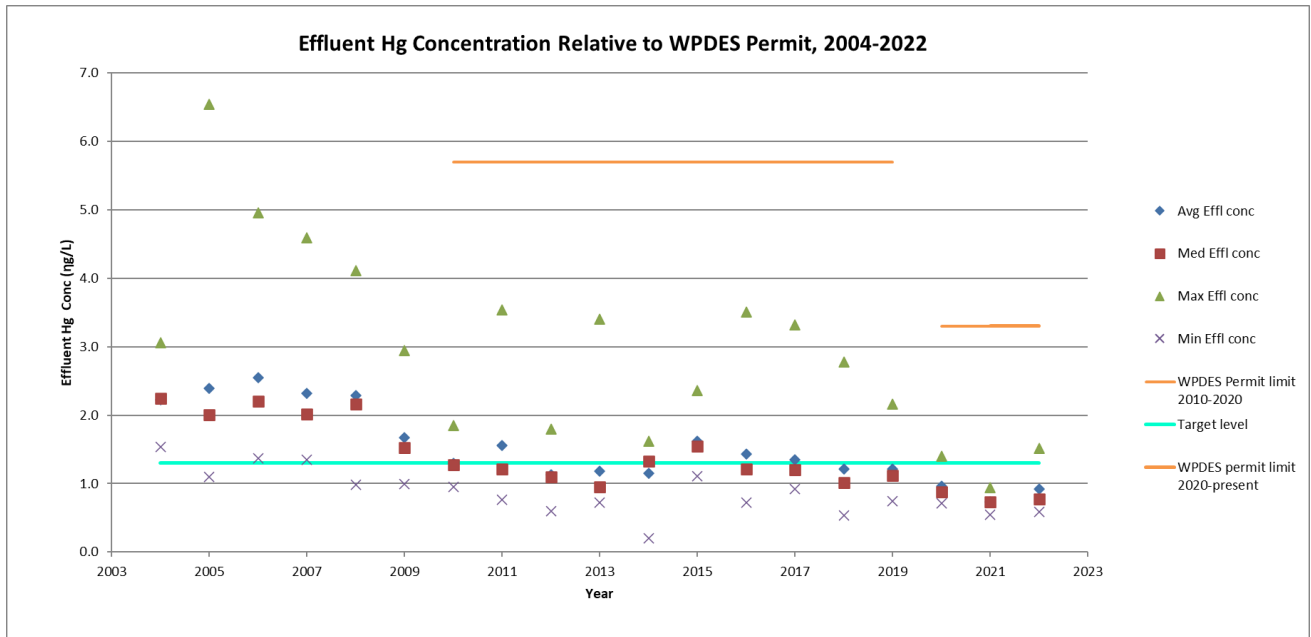
<sup>1</sup>The influent composite for March was reported for 3/2/22

### Summary of year:

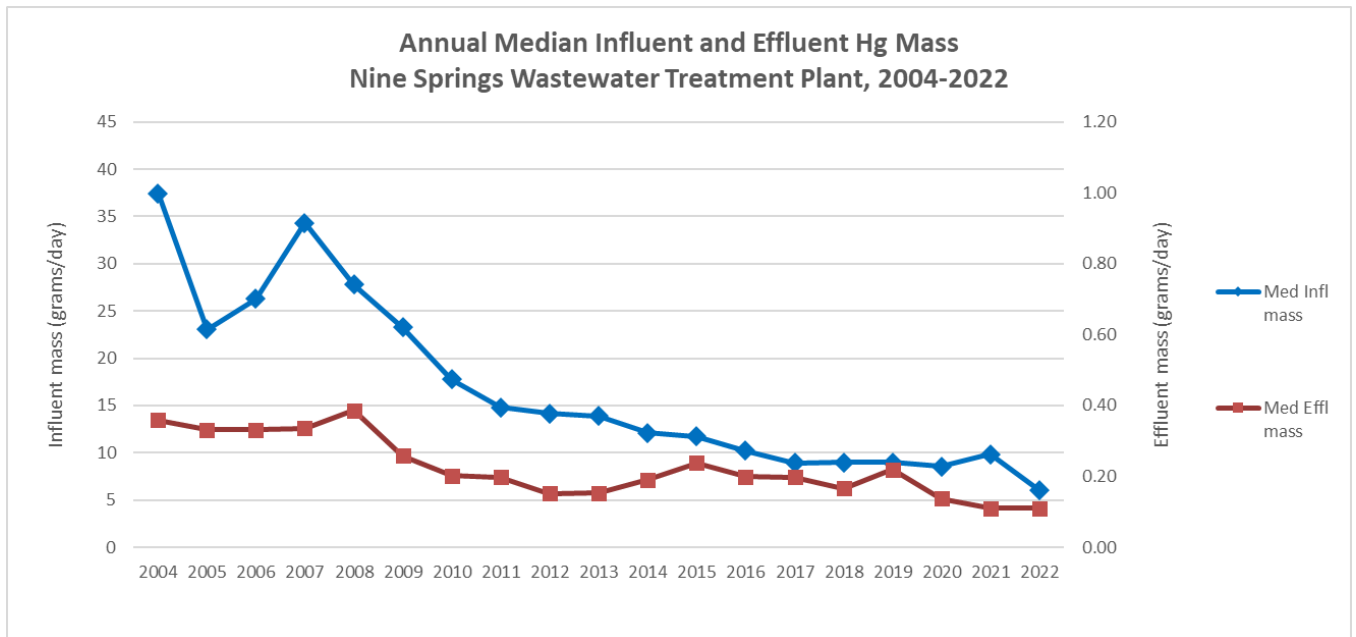
The District conducts influent mercury analysis in-house, using EPA method 254.7. The influent sample is a 24-hour composite. Biosolids samples are collected from the gravity belt thickener (GBT) and also analyzed in-house. The effluent sample is a grab sample collected according to the “clean hands-dirty hands” protocol. This sample is sent out for low-level mercury analysis via EPA method 1631E at Pace Analytical in Green Bay, WI.

Mercury levels remained low overall in 2022, consistent with values recorded in recent years. There were no unexpectedly high mercury values in influent, effluent, or biosolids. All effluent mercury concentration values were below the District’s variance permit limit of 3.3 ng/L.

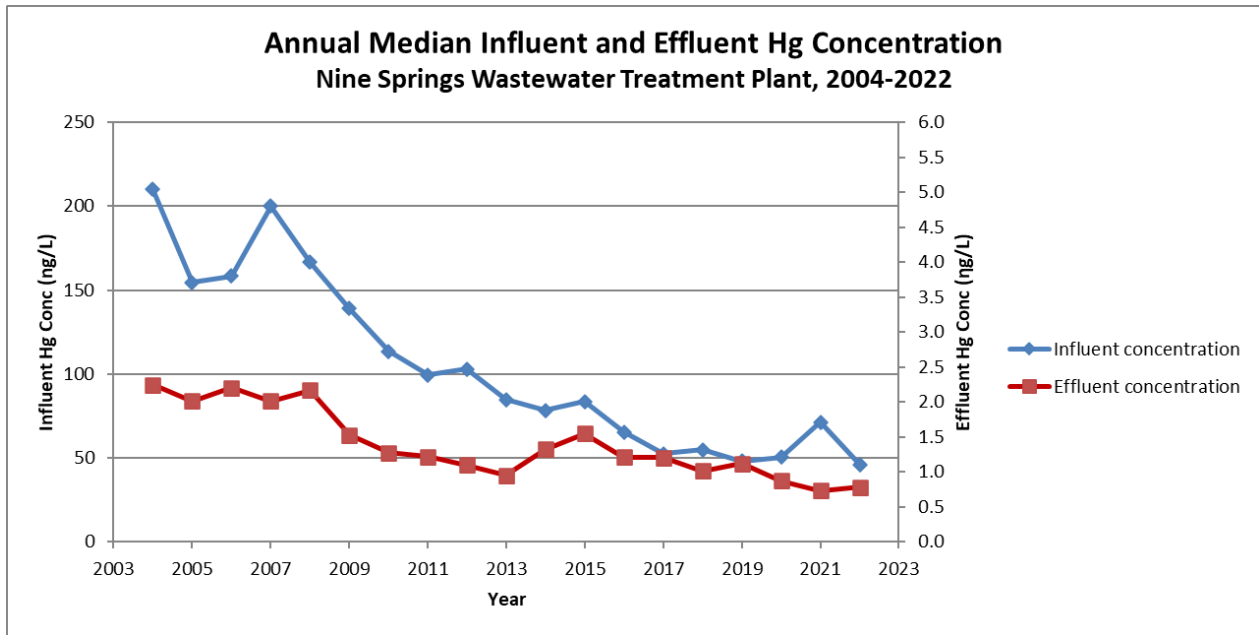
**Graph 1 – Annual Effluent Mercury Concentration, 2004-2021**



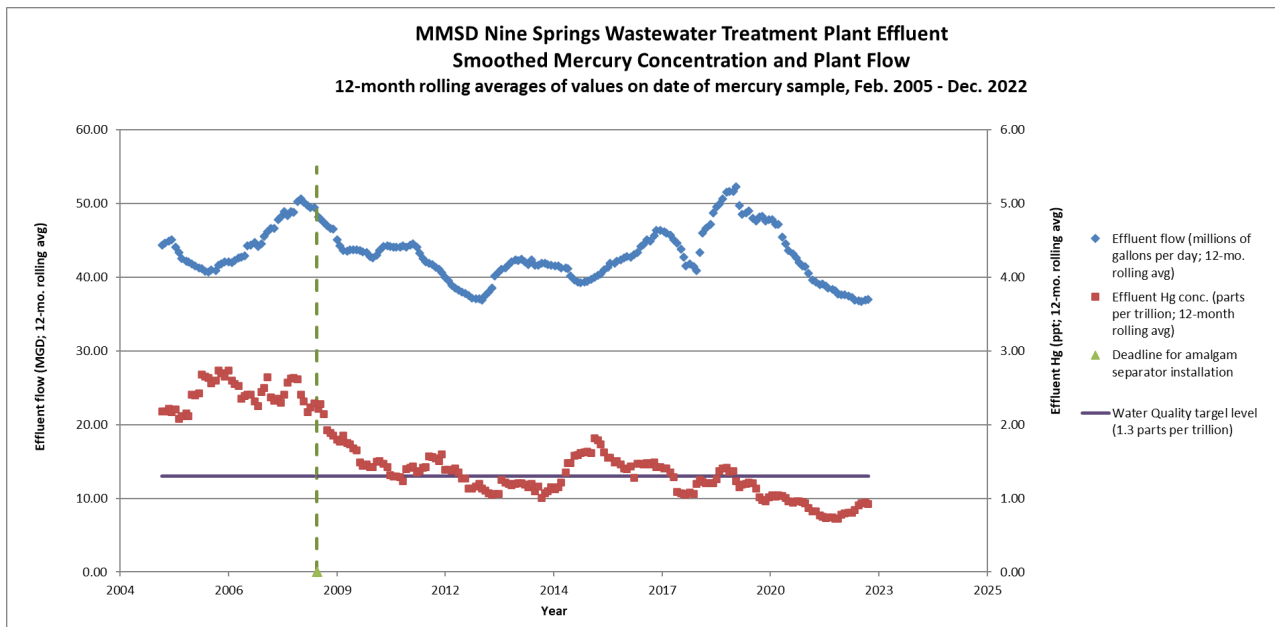
**Graph 2 – Annual Median Influent and Effluent Mercury Concentration**



**Graph 3- Annual Median Influent and Effluent Mercury Mass**

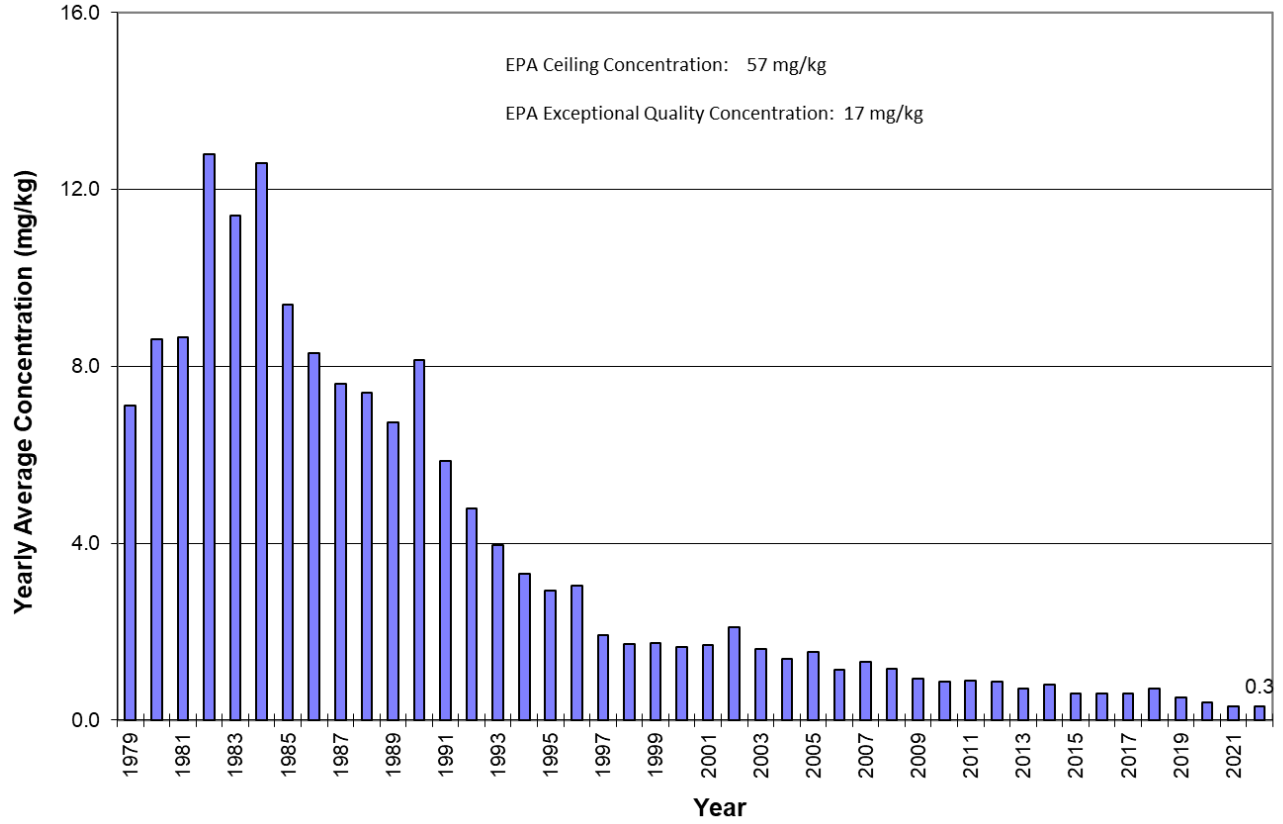


**Graph 4 – Rolling Average Flow and Effluent Mercury Concentration**



Graph 5 – Gravity Belt Thickened Biosolids Mercury Levels

Historical Digested Biosolids Quality - Madison MSD  
(Mercury, dry wt. annual average)



## Attachment B – Summary of Mercury Isotope Sampling and Analysis

The District built on work initiated in 2021 with the USGS Mercury Research Lab (MRL) to get further insight into types of mercury from different sources reaching the treatment plant. The District hopes that data from this analysis can provide insight into categories of mercury sources reaching the plant so the District can address these sources more efficiently.

### **Background:**

The researchers at the USGS MRL analyzed mercury stable isotopes in dissolved and particulate phases of water to determine the proportion of different mercury sources in wastewater effluents. Specifically, mercury isotopes in water can identify both source (e.g., mercury that comes from a manufacturer, or “industrial mercury” versus mercury from atmospheric deposition) and processing of mercury (e.g., exposure to sunlight or atmospheric transport). Examples of watershed-type mercury sources could include inflow and infiltration or human waste from suburb or rural regions, while examples of industrial-type mercury sources could include dental amalgam or elemental mercury discharges. The relative proportion of watershed to industrial mercury can give a sense of where mercury may be coming from, helping with targeted source identification.

District staff initiated discussion with the USGS MRL in late 2020 and began designing a plan to apply this analysis process to District wastewater samples. While the mercury isotope fingerprinting process had been used before on surface water, it had not previously been used on wastewater. This initial round of sampling and analysis was designed to test the isotope fingerprinting process on wastewater and to establish mercury isotope fingerprints for discrete sources of wastewater. This first sampling attempt was successful, in that the analysis method worked on wastewater and the results of isotope analysis were as predicted given the sources of the samples.

### **2022 sampling process**

With a baseline established from initial sampling and analysis, the District continued this work in 2022 to build on the data set and examine mercury isotope proportions, and their variations, in real-world conditions in the collection system and at the plant. The District collected the following samples for mercury isotope analysis by USGS:

- Five 24-hour composite influent samples, intended to demonstrate the degree of daily fluctuation in the proportion of watershed-type to industrial-type mercury isotopes in plant influent.
- Two 24-hour composite samples each at sampling manholes that correspond to areas of the collection system with characteristics that may influence their mercury contributions:
  - Site 1: A subdivision built in 2019 that is primarily residential, with an elementary school and daycare. The newness of this subdivision, and the absence of industrial dischargers, made it a good candidate to assess background mercury isotope types in domestic-only wastewater, without interference from legacy mercury that may be found in older areas of the collection system.
  - Site 2: A sewershed that contains mixed wastewater sources, including residential homes, a dental clinic, an auto shop, and schools. In contrast with the first site, this site may provide a more representative picture of the types of mercury isotopes found throughout the District’s collection system.

As of this report, the USGS MRL is still analyzing the 2022 samples. The results from this sampling may inform future additional sampling and mercury isotope analysis that the District pursues for its mercury source identification efforts.



## Attachment C – Collection System Sludge Sampling

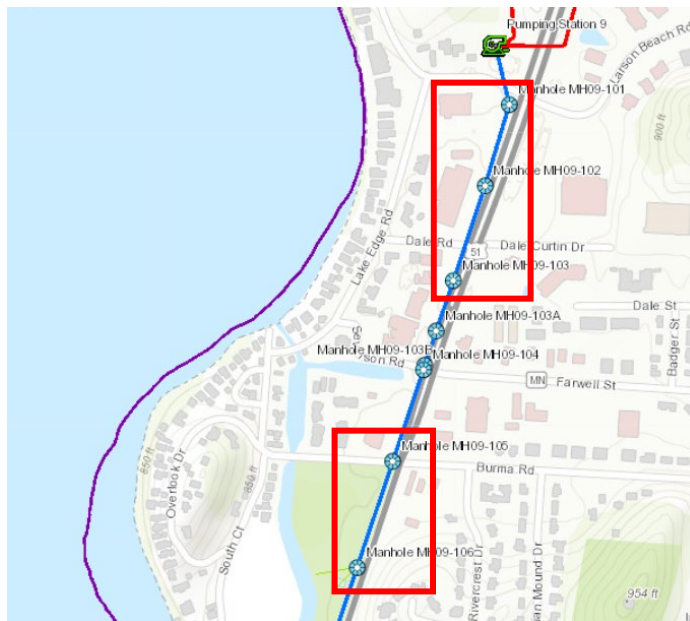
The District pollution prevention team has worked with District engineers and contractors in recent years to collect sewer sludge when opportunities arise and analyze them for mercury. This is a relatively straightforward add-on to sewer cleaning and lining projects that helps the District identify areas that include potential mercury sources. The samples are also helping the District build a data set that creates a context for interpretation of individual values.

This section includes data from sampling in recent years to show the context for individual mercury values. Most notably, the District observed a much higher value in 2020 sampling for a stretch of sewer that receives wastewater from multiple healthcare facilities, including a lab. This high value may indicate past or current mercury discharges from one of these facilities. The District will be contacting these facilities in 2023 to ensure that they are not contributing new mercury to the sewer system. Discovering anomalous values like this demonstrates the utility of adding mercury sampling to projects that provide an opportunity to access sewer sediment.

### 2018 – Southeast Interceptor cleaning (sewer located in McFarland)

Date	Location	Hg concentration (mg/kg)
12/3/2018	106 to 105	1.10
12/3/2018	106 to 105	0.13
12/3/2018	106 to 105	0.07
12/13/2018	103 to 101	0.44
12/13/2018	103 to 101	0.33
12/13/2018	103 to 101	1.07

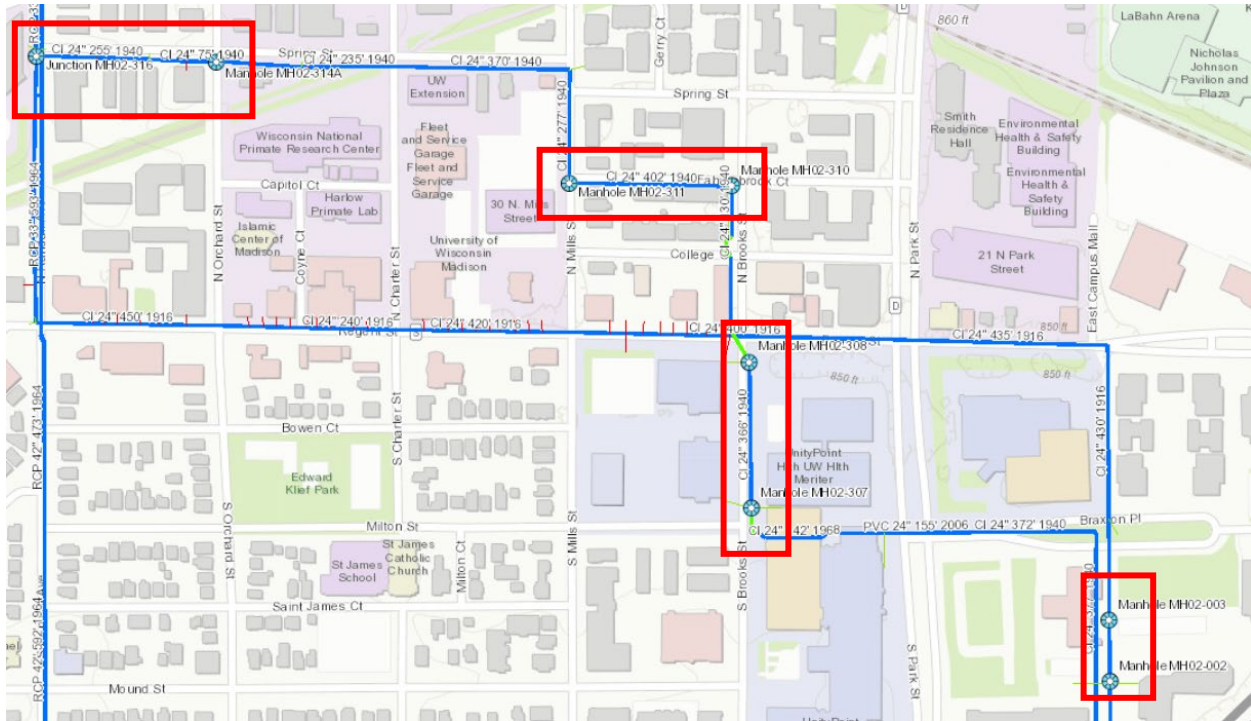
Map of sampling locations:



**2020 Spring Street Interceptor cleaning:**

Date	Location	Hg concentration (ppm)
9/8/2020	MH 003 to 002	1.07
9/14/2020	MH 308 to 307	302.17
9/15/2020	MH 311 to 310	3.48807
9/22/2020	MH 316 to 314A	1.67

**Map of sampling locations:**



**2022 Pump Station 10 interceptor cleaning**

	Location	Hg concentration (ppm)	Average concentration
2/7/2022	105 to 106	0.005400	0.005802
2/7/2022	105 to 106	0.005800	
2/7/2022	105 to 106	0.006205	
3/3/2022	104 to 402	0.387208	0.235885
3/3/2022	104 to 402	0.084562	

Map of sampling locations:

