Adaptation and Accomplishment

2021 Annual Report

Madison Metropolitan Sewerage District

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Introduction: Adaptation and accomplishment

Together with our vendors, contractors, partners and stakeholders, the District continued to navigate the pandemic in 2021 and adapt to changes and challenges in how we live, work and do business. While there was plenty of adaptation, there were also many accomplishments that reflect the positive impact and benefits we confer on our owner communities, the local economy, public health and the environment.

Moving ahead on inflow & infiltration (I/I)

Our Commission accepted the vision and framework for our I/I Reduction Program in April 2021, and the program will be rolled out and implemented over several years. Reducing clear water coming into the sewer system via I/I has numerous benefits, including minimizing overload of the sewer system, which can cause sewer backups. It also creates economic efficiencies as I/I increases flow and sewer bills for our owner communities. It also results in more energy usage to unnecessarily pump and treat clear water.

Completion of the Nine Springs Valley Interceptor project

Our Nine Springs Valley Interceptor project wrapped up earlier than expected in October 2021. Serving Madison's west side, Middleton, and the cities of Fitchburg and Verona, this project replaced a deteriorating portion of the interceptor and accommodates increased capacity needed for these fast-growing parts of the county. As the District always strives to leave the community better than we found it, we added a number of public amenities in this project, such as installing bike trail signage and a solar light at a dark section of the trail, removing invasive species and installing native plantings along the trail, and widening path curves to make them safer.

Completion of first phase of liquid processing improvements

The first phase of the District's Liquid Processing Improvements project was completed in 2021 after two years of construction on plant grounds. These improvements addressed a variety of needs, including increased capacity, infrastructure resiliency and flexibility to manage peak flows to ensure effective and reliable plant operation. Of particular note, we installed a new UV disinfection system that went online in April 2021. The new system has proven to be a worthy investment and a win for the environment by significantly reducing the amount of coliform units in our effluent to make the waters we discharge to even safer than before.

Leadership on PFAS

The District completed its initial PFAS sampling and analysis and presented the results in late September 2021. The results were favorable, showing that levels of PFOA and PFOS in the District's treated effluent are lower than currently proposed Wisconsin regulatory standards. The District continues to lead on the issue of PFAS in wastewater by sharing our approach and experience with others and executing a second phase of sampling and analysis in 2022.

This annual report highlights the value we strive to provide our owner communities and the public we serve. More than ever, we appreciate our role and duty as critical infrastructure and the opportunity to do our part to protect public health and the environment.

Thank you for your support. I welcome your comments and feedback on this annual report.

Sincerely,

Michael Mucha, P.E., ENV-SP

Chief Engineer and Director | Madison Metropolitan Sewerage District

About the District

WHO WE ARE

The District Defined

Madison Metropolitan Sewerage District (the District) is a body corporate with the powers of a municipal corporation for the purpose of carrying out the provisions of Sections 200.01 to 200.15 of the State of Wisconsin Statutes. These provisions allow for the creation of "metropolitan sewerage districts" governed by a Commission to manage wastewater collection and treatment in metropolitan areas in Wisconsin.

Our Mission

PROTECT PUBLIC HEALTH AND THE ENVIRONMENT

We are a passionate and experienced resource recovery team focused on protecting public health and the environment. Every time we clean and return wastewater safely back to nature or apply Metrogro to help farmers grow more food, we are taking steps to create a cleaner and better world. We are known for our innovative engineering, conservation leadership and expertise with resource recovery. We are also cost-conscious ratepayers, just like you.

Our Vision

ENRICH LIFE THROUGH CLEAN WATER AND RESOURCE RECOVERY

Our vision is to enrich the community by improving living conditions for people, plants and animals while seeking partnerships with others to better conserve our shared resources. Water is finite; we can't create more of it. By changing the way we think about and use water, together we have the power to enhance the quality of life on our planet. By making small changes and respecting every drop of water we have today, we can set the tone for a resource-conscious and sustainable community tomorrow.

Commission

The District is governed by a nine-member Commission appointed for staggered three-year terms. The Mayor of Madison appoints five individuals as members of the Commission. An executive council composed of the elected executive officers of each city and village that is wholly or partly within the boundaries of the District, except Madison, appoints three members of the Commission by a majority vote of the members of the executive council. An executive council composed of the elected executive officers of each town that is wholly or partly within the boundaries of the District appoints one member of the Commission by a majority vote of the members of the executive council.

- Thomas D. Hovel, President; term ending June 30, 2023
- Ezra Meyer, Vice President; term ending June 30, 2022
- Mary Swanson, Secretary; term ended September 30, 2021
- Brad Murphy; Interim Secretary effective September 30, 2021; term ending June 30, 2024
- Beth Bookland; term ending June 30, 2023
- Ken Clark; term ending June 30, 2022
- Sara Eskrich; term ending June 30, 2023
- Grant Foster; term ending June 30, 2023
- Tom Wilson; term ending June 30, 2024

Note: D. Michael Mucha serves as the Chief Engineer and Director of the District. Craig Franklin, the Treasurer of the City of Madison, serves as Treasurer of the District. Paul Kent, Stafford Rosenbaum, LLP is legal counsel for the District.

TIME AND PLACE OF MEETINGS

The Commissioners of the District meet one to two times each month. In-person meetings are held at the District's Maintenance Facility Training Center at 1610 Moorland Road, Madison, WI 53713; however, due to the pandemic that began in early 2020, Commission meetings were moved to the Zoom platform and conducted virtually. Virtual meetings are livestreamed via the District's YouTube channel. Special meetings are held upon call of any member of the Commission.

Executive Team

In 2020, the Executive Team consisted of five directors, a human resources manager, a communications and public affairs manager, a budget manager and the Chief Engineer and Director. The team meets Wednesdays.

The directors oversee the following departments:

- District Leadership and Support (Chief Engineer and Director)
- Ecosystem Services
- Engineering
- Operations and Maintenance
- Strategy

DISTRICT LEADERSHIP & SUPPORT

The purpose of the District Leadership and Support team is to provide human resources, Commission support, and business and communication services to the organization so that the District develops and invests in its workforce, advances a policy-driven strategic approach to governance, and deepens relationships with customers and the public. This department also provides financial services – procurement, accounting and financial process improvement – to internal and external customers so that the District can achieve its mission of protecting public health and the environment.

ECOSYSTEM SERVICES

The purpose of the Ecosystem Services department is to advance initiatives and provide support services so that treatment plant operating systems can be optimized, demand for traditional wastewater treatment infrastructure and collection services can be reduced, resources can be recovered, and environmental quality can be enhanced.

ENGINEERING

The Engineering team provides design and construction administration services to other departments and advisory services to District teams so that safe, reliable and cost-effective infrastructure is built.

OPERATIONS AND MAINTENANCE

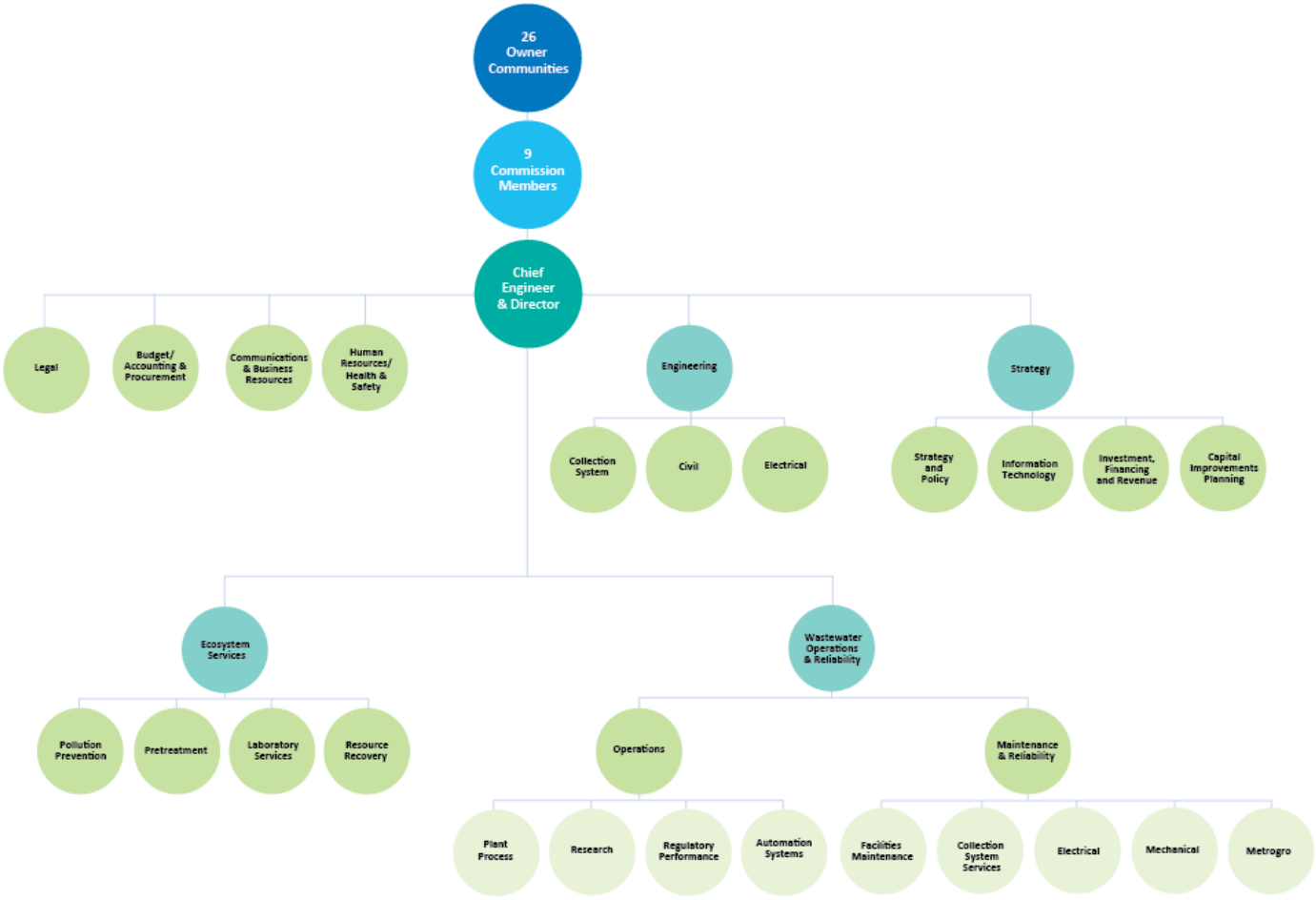
This department protects human health and the environment by ensuring that all wastewater generated in the District's service area is safely conveyed to the Nine Springs Wastewater Treatment Plant. They then recover the resources of clean water, biosolids, biogas and phosphorus fertilizer.

STRATEGY

The Strategy department monitors, evaluates, and reports on the overall health of District infrastructure in support of long-term planning and financial sustainability. The department uses analytical tools and data, which it develops in cooperation with other departments, including asset management, information technology, the computerized maintenance management system (CMMS) and the geographic information system (GIS), among others.

Figure 1 is an organization chart that represents the District's hierarchy at the end of 2021.

Figure 1 Organization Chart



Personnel

In 2021, the District employed 115 full-time employees (FTE). Table 1 represents the District's overall staffing from end of year 2020 to end of year 2021.

Table 1 – FTE Employees

DEPARTMENT	2020 FTE COUNT	2021 FTE COUNT
District Leadership and Support	14	15.5
Ecosystem Services	18	18
Engineering	8	8.5
Operations and Maintenance	57	58
Planning and Strategy	14	15
TOTALS	111	115

2021 NEW POSITIONS, RETIREMENTS AND PROMOTIONS OF DISTRICT EMPLOYEES

WHAT WE DO

For more than 90 years, the Madison Metropolitan Sewerage District has protected public health and the environment by monitoring, maintaining and operating the complex system of pipes and equipment that convey, treat and return wastewater to the environment.

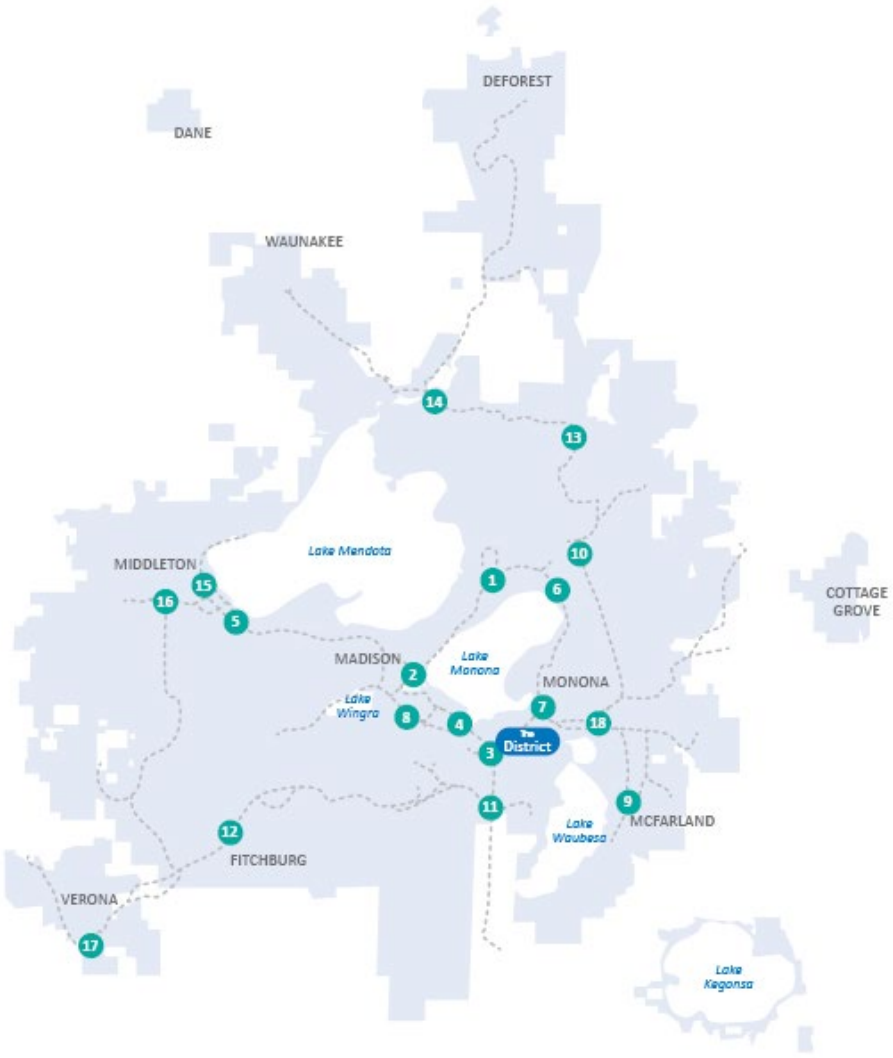
To convey the wastewater generated from homes, businesses and industries throughout our service area, we operate and maintain just under 98 miles of gravity sewers known as interceptors. These interceptors collect and transport wastewater from smaller sewers, owned by local municipalities, to 18 regional pumping stations operated by the District. The 18 District-owned pumping stations and the 32 miles of pressurized force mains associated with the pumping stations are required due to the relatively flat topography in the region. All wastewater flow generated in the region, approximately 40 million gallons per day, is pumped to the Nine Springs Wastewater Treatment Plant.

Once at the plant, the wastewater proceeds through an advanced treatment process that recovers three valuable resources: treated effluent, energy and biosolids. An additional 15 miles of effluent force mains convey cleaned, treated wastewater to the Badfish and Lower Badger Mill creeks, where it supports diverse ecological environments, including numerous species of fish and other aquatic life. Energy is produced via methane, a combustible gas, which is recovered during the treatment process and used to power engines that drive generators and a blower. Biosolids, also known as Metrogro, are an organic fertilizer and soil conditioner that are recycled to area farm fields in the spring and fall.

WHO WE SERVE

In 2021, the District served over 380,000 people in the greater Madison area. Our 187 square-mile service area includes five cities, eight villages and 13 sanitary/utility districts. The District's service area stretches from the Village of Dane in the north to the City of Verona and Lake Kegonsa Sanitary District in the south. Figure 2 shows the District collection system including its 18 pumping stations.

Figure 2 District Collection System



ANNEXATIONS TO THE DISTRICT

In 2021, the District added 47.9 acres in annexations to the District. Table 2 shows information related to these annexations.

Table 2 – Annexations to the District

Annexation Name	Number	Municipality	Acres Added
7111-7115 Twin Sunset Road Parcels	2021-01	City of Middleton	1.2
Schiller and Madison Water Utility Properties	2021-02	City of Madison	17.5
Epic 2021	2021-03	City of Verona	2.2
6101 Hogan Road	2021-04	Village of Waunakee	27.0
		TOTAL	47.9

Department Summaries

DISTRICT LEADERSHIP AND SUPPORT

Staffing

The District Leadership and Support workgroup has 15 full-time employees and 3 part-time employees:

- Chief Engineer and Director
- Budget Manager/Comptroller
- Communications and Public Affairs Manager
- Communications & Marketing Specialist (part-time)
- Human Resources Manager
- Health, Safety and Security Leader
- HR Generalist
- Executive Coordinator
- Program Resource Associate (2)
- Program Resource Assistant (part-time)
- Staff Accountant
- Accountant (2)
- Accounting Assistant
- Procurement Agent
- Purchasing and Inventory Assistant (2; 1 full-time and 1 part-time)

Responsibilities of Workgroup

The workgroup's main responsibilities are as follows:

- Business services
- Communications/marketing and public affairs
- Commission management
- Executive management
- Human resources
- Safety, health, insurance management and security

- Budget, accounting, payroll, purchasing and procurement support for all District departments
- Clean Water Fund loans administration, including loan applications and disbursements
- Accounting services for the Yahara Watershed Improvement Networks (Yahara WINS)

Programs, Initiatives and Work Reporting

RESOURCE TEAM/COMMUNICATIONS

The District's success in fulfilling its mission is supported by our owner communities and the residents who live in them, which requires public outreach and engagement. Of particular note in 2021, the Communications team added a part-time Communications and Marketing Specialist to assist with the District's outreach work; this position specifically works on social and digital media but assists in other communications and marketing work as well. Also in 2021, a large success of the Resource and Communications team was the redevelopment of its public-facing website, madsewer.org. The team also developed and launched a standalone website for Yahara WINS.

In order to manage the ever-increasing number of District photos, images and videos required for successful marketing and communications work, the team initiated a photo management project. After conducting research and evaluation on digital asset management (DAM) systems, a program was purchased at the end of 2021 and planning for its implementation in 2022 began. The DAM will provide staff with a centralized, accessible location for images and a robust system for searching and managing them.

HUMAN RESOURCES

A new Human Resources (HR) Manager, Mike Lipski, started in January 2021, and the HR Generalist, Ileana Rodriguez, became full-time in April 2021. In addition, Health, Safety and Security Leader Kayce Board resigned effective April 2, 2021, but the District was lucky to hire former Health, Safety, and Security Leader Marcus Canty back into the position in May.

The COVID-19 pandemic continued to affect the District greatly. HR took the lead on the District's Emergency Management Team, which was responsible for developing policies and procedures to respond to the pandemic. The Health, Safety and Security Leader played an important advisory role to the Emergency Management Team. Through the experiences learned from COVID-19, the HR Manager developed a long-term Remote Work policy and engaged the Executive Team and Employee Leadership Council (ELC) in its development. When the Dane County mask mandate ended in June, the District followed suit, and when it was reinstated in August, the District again followed suit. Keeping in mind the District's status as critical infrastructure throughout, the District's response was conservative and thoughtful to keep COVID-19 outbreaks to a minimum. While there were isolated cases at the District, overall, no COVID-19 cases were tied directly to the workplace.

Although the HR Department almost completely turned over in 2021, many projects were completed. A retirement checklist was created to assist retirees in making relevant decisions relating to benefits before retirement. HR also worked with Quartz to clarify how long retirees could stay on the District's health insurance plan. In addition to the Remote Work policy, a COVID-19 Vaccination Policy was developed in response to the Federal OSHA guidance. However, this policy was never implemented as a result of Supreme Court rulings.

The HR Manager and Health, Safety, and Security Leader also wrote a District Security policy to be implemented in 2022 and incorporated feedback from the ELC.

In 2021, the HR Department, primarily through the efforts of the HR Generalist, successfully recruited and filled positions for Chemist; Director of Engineering; Biosolids Specialist; Resource Assistant; Marketing & Communications Specialist; Capital Investment Policy Advisor; Health, Safety, and Security Leader; Accountant; Pre-Treatment/Waste Acceptance Coordinator; Maintenance Technician; Wastewater Treatment Operator; and Collection System Service Worker positions. In addition, the HR Generalist developed and established the District's formal Summer Internship Program. A main goal of the program is to offer internship opportunities to women and people of color. The first group of four interns included two women and two people of color. Finally, the HR Manager and Director of Operations & Maintenance collaborated on developing a trainee and succession planning program that was included in the 2022 operating budget.

The HR Manager made a concerted effort to engage the ELC on issues related to work conditions and policy development. As noted, the ELC provided feedback which was incorporated into policies related to Remote Work, Vaccination, and District Security. The HR Manager and ELC started a process to update the Employee Handbook, which has not been reviewed since its implementation in 2016. This process will continue through 2022. The ELC worked on updating its Operating Guidelines and will continue that work in 2022. Finally, HR helped implement items from the 2020 Morale Report, including providing notifications to all staff when there is turnover and developing and implementing an Onboarding Companion program for new employees.

SAFETY

2021 OSHA recordable incident rates remain at an all-time low with low lost time rates from work-related injuries as shown below in Table 3. The District had an Experience Modification Rate (MOD Rate) of 0.69 as it relates to worker's compensation. The MOD Rate compares the District's worker's compensation claims to other employers of a similar size and in the same industry. Viewing a MOD Rate of 1.0 as average, the District's rate of 0.69 is excellent and contributes to lower costs for our worker's compensation premium.

Table 3 – OSHA Recordable Incident and DART Rate Comparison

Year	OSHA Recordable Incident Rate	DART Rate
2015	5.70	2.30
2016	3.4	1.1
2017	3.7	3.7
2018	6.5	4.3
2019	0.88	0
2020	2.43	0
2021	2.41	.85

BUDGET AND ACCOUNTING

This team provides budget, accounting, payroll, and insurance management services for the District.

Significant achievements and work advanced in 2021 include:

- Obtained an audit for the District and Yahara Watershed Improvement Networks (Yahara WINS) for fiscal year 2021 that found no material weaknesses or significant deficiencies (a “clean” audit).
- Implemented a new automated accounts payable (A/P) system to create efficiencies and reduce paper. A/P is the process by which we pay invoices and bills for our contractors and vendors. The former process was time-consuming and resource-intensive, with 4,500 invoices being processed manually each year using paper. The new system has created efficiencies and eliminated 20,000 sheets of paper a year. Other benefits include reduced errors, freeing up 200 hours of staff time, and improved customer service for staff and vendors by using a new tracking process that indicates where an invoice is in the process and alerts us to deadlines.
- Developed the 2022 annual budget. The budget is $48 million with a 6.6% increase in expenditures and service charges. This increase included the investment of $3 million in our capital program. The team made process improvements which saved Accounting and other departments staff time by removing non-value-added steps in the process. The new streamlined process helps us meet tight budget timelines. The Commission adopted the budget with no changes in October 2021.

PURCHASING

This team focuses on the purchasing, receiving, kitting and replenishment of parts and materials for the Operations and Maintenance department. Utilizing our systems to maintain a spare part inventory of 3,100 items valued at $1.6 million. The team also maintains an open storeroom of expense consumable and safety-related materials.

Significant achievements and work advanced in 2021 include:

- Supported Reliability Centered Maintenance (RCM) project implementation of new workflows that have impacted purchasing, receiving and inventory management. New workflows and system changes have created better standard inputs and outputs for work order status, work order generated requisitions, storeroom parts ordering, required date, purchase order estimated delivery and total priority prioritization.
- Completed the alignment of a designated storeroom storage space from a spare parts kitting area into an office space.
- Completed the creation of a new efficient and streamlined workstation at the entrance to the receiving area. The workstation better aligns with parts kitting and storeroom receiving activities.
- Completed the transition from quarterly inventory disbursement counting to weekly disbursement counting improving customer service.
- Advanced the reassignment of buyer duties from the procurement agent to the purchasing and inventory assistant.

CLEAN WATER FUND LOANS

In 1989, the State of Wisconsin replaced the Wisconsin Fund Grant Program with the Clean Water Fund Loan Program. The Clean Water Fund is a state revolving loan fund that was capitalized initially with grants from the U.S. Environmental Protection Agency and by bonds issued by the State of Wisconsin. The District has issued general obligation bonds and notes to the State of Wisconsin for 29 loans under this program. A total amount of $271.9 million has been financed through these Clean Water Fund loans. One new Clean Water Fund loan was obtained in 2021. The District had three Clean Water Fund loans for which the final disbursement had not been received by the end of 2020. The status of each loan is as follows:

Northeast Interceptor Truax Extension Relief and Southeast Interceptor Hayward Drive Rehabilitation

The District issued General Obligation Sewerage System Promissory Notes, Series 2020A, on June 10, 2020, to the State of Wisconsin Clean Water Fund (CWF Project 4010-58). These bonds are for an aggregate amount not to exceed $10,088,624 and are to be repaid at an annualized interest rate of 1.89%. The first interest payment on the loan was made on Nov. 1, 2020. The first principal payment was made on May 1, 2021. The final payment will be made on May 1,

2040. The District received the final disbursement for this loan in 2021, bringing the final total for the loan to $9,787,236.13.

Liquid Processing Improvements Phase 1, Headworks Flow Metering Improvements and Pump Station Number 7 Improvements

The District issued General Obligation Sewerage System Promissory Notes, Series 2020B, on Aug. 12, 2020, to the State of Wisconsin Clean Water Fund (CWF Project 4010-57). These bonds are for an aggregate amount not to exceed $23,540,644 and are to be repaid at an annualized interest rate of 1.89%. The first interest payment on the loan was made on Nov. 1, 2020. The first principal payment will be made on May 1, 2022. The final payment will be made on May 1, 2040. The District had received $22,038,995.90 for this project as of Dec. 31, 2021.

Pump Stations 13 & 14 Rehabilitation, West Interceptor Spring Street Relief Lining, Nine Springs Hot Water and Workshop One Piping Improvements, Operations Building 1st Floor Remodel

The District issued General Obligation Sewerage System Promissory Notes, Series 2021 A, on June 23, 2021, to the State of Wisconsin Clean Water Fund (CWF Project 4010-61). These bonds are for an aggregate amount not to exceed $14,610,172 and are to be repaid at an annualized interest rate of 1.529%. The first interest payment on the loan was made on Nov. 1, 2021. The first principal payment will be made on May 1, 2022. The final payment will be made on May 1, 2041. The District had received $5,360,412.09 for this project as of Dec. 31, 2021.

ECOSYSTEM SERVICES

Staffing

The Ecosystem Services department has 14 full-time employees:

- Director of Ecosystem Services
- Pretreatment Coordinator
- Watershed Programs Coordinator
- Biosolids Specialist
- Lab Manager
- Chemist (6)
- Pollution Prevention Manager
- Pollution Prevention Specialist (2)
- Wisconsin Salt Wise Coordinator (Grant funded limited-term position)

Responsibilities of Workgroup

The purpose of the Ecosystem Services department is to envision and execute next-generation water quality and resource recovery solutions. It is responsible for resource recovery, laboratory, pollution prevention, pretreatment and waste acceptance programs. The team advances initiatives and provides support services so that treatment plant operating systems can be optimized, demand for traditional wastewater treatment infrastructure and collection services can be reduced, resources can be recovered, and environmental quality can be both protected and enhanced. This includes working to advance regulatory and strategic initiatives that provide flexibility and encourage innovation. Ecosystem Services staff work across other District departments on a variety of initiatives, in some cases leading the initiative, while in other cases providing supporting services.

Programs, Initiatives and Work Reporting

POLLUTION PREVENTION

The pollution prevention team works to reduce pollutants in the sewer system that the treatment plant is not designed to remove, which helps with protecting the environment and complying with permit requirements at a lower cost to our community. The team continued working mostly remotely throughout 2021. Major pollution prevention activities in 2021 included continued efforts to reduce chloride and mercury and limited outreach as possible in the context of the pandemic.

Chloride Reduction

The District experienced higher chloride concentrations in its influent and effluent in 2021 than observed in recent years, which was likely due to the extremely dry weather in 2021 and less water in the sewer system to bring the concentration down. However, despite these challenges, the District stayed within its variance chloride limits and continued to build a foundation for long-term changes in how salt is used in water softeners and on roads.

Salt Savers Pilot Program

Throughout 2021 a major focus of the chloride reduction initiative was running the Salt Savers pilot program, which the pollution prevention team designed to test out an incentive structure for home water softener improvements to reduce salt discharges to the sewer. Starting in the Town of Dunn in late 2019, the program expanded to McFarland in November 2020 and then to Pleasant Springs Sanitary District in July 2021, covering the entire Pumping Station 9 service area.

In 2021, with the help of an intern, the District experimented with different ways of engaging residents in the program, including the release of an online softener self-screen tool in March 2021 that provides residents with tailored recommendations to reduce their home salt use. The tool received over 220 submissions by the end of December 2021. The District also tried multiple outreach methods to promote the pilot program, including mailers, social media posts, promotions and in-person outreach in McFarland. The pilot programs are scheduled to end in 2022, and the District will develop a white paper detailing the program, its outcomes, and resultant recommendations for future chloride reduction approaches.

Softener Service Professionals Training

The District resumed in-person training on water softening efficiency in 2021, delivering training to plumbing apprentices affiliated with Plumbers Local 75 as part of their Green Plumbing curriculum, as well as to licensed plumbers who attended the union's annual meeting. The relationship the District has built with Plumbers Local 75 is laying the groundwork for future training that will provide plumbers with information and tools to configure softeners and plumbing to minimize salt discharge.

Chloride Reduction Innovation Grants

For several years, the District has offered grants to support local chloride reduction projects. In 2021, the District awarded an innovation grant to the USDA Forest Products Lab to capture water softener brine for use as pavement de-icing material. On the softener side, the District awarded a grant to Sustain Dane for a project to evaluate and improve water softeners in naturally occurring affordable housing. This is helping to gather insights from owners of multifamily residences about barriers and motivators to improve their water softeners or reduce soft water use.

Wisconsin Salt Wise

Salt Wise kicked off 2021 with Wisconsin Salt Awareness Week, a statewide public awareness initiative. The energy around Salt Awareness Week generated a spike in interest for the Smart Salting training; in total, 561 people attended Smart Salting classes. In the fall, we partnered with municipalities from Menomonie to Cudahy to host nine regional equipment open houses; these events engaged over 300 individuals from dozens of municipalities in conversations around winter best management practices.

Additional projects in 2021 included the successful application for a Wisconsin Department of Natural Resources (DNR) grant with the City of Milwaukee to develop training videos and public service announcements for operators and residents, respectively, around winter maintenance operations.

In the summer of 2021, Salt Wise partnered with Madison Boats to install water softener buoys on Lake Wingra to raise public awareness about salt pollution from water softeners. The buoys landed a front-page story in the Wisconsin State Journal titled “The downstream impacts of salt-based water softeners” and also garnered the attention of local TV stations.

Salt Wise also began a monthly webinar series, providing a platform for public agencies and private companies to share their salt reduction success stories and expertise. The Salt Wise partnership continues to grow with contributions from throughout the state and the Fund for Lake Michigan providing $75,000 toward the partnership in 2021.

Mercury Minimization

The treatment plant released record-low levels of mercury in 2021. All 12 of the monthly effluent samples had a mercury concentration below the Great Lakes target of 1.3 parts per trillion, and the average mercury concentration in biosolids for the year was the lowest recorded.

Although these values are encouraging to see, the District interprets these results cautiously because the factors that influence the amount of mercury in District outputs are not completely understood. The District continues to carry out activities that minimize known sources of mercury, including its annual dental amalgam certification and encouraging residents to take mercury-containing materials to Clean Sweep. While the District recognizes the inherent value in these activities that keep mercury waste out of the sewer and landfill, it does not have a way to measure the direct impact of these activities on mercury levels in the sewer.

To work toward a better understanding of remaining sources of mercury entering the treatment plant, the District partnered with the U.S. Geological Survey (USGS) Mercury Research Lab on a special mercury sampling and analysis project in 2021. The District collected samples of wastewater at the plant, in a residential area of the sewer system, and in dental

wastewater holding tanks for analysis by USGS scientists. The scientists analyzed the samples for different forms of mercury, called isotopes, to associate the forms with different sources of mercury. The initial round of sampling demonstrated that the process, which had previously never been used on wastewater, successfully identified mercury isotopes in the different wastewater samples. This innovative approach to mercury source reduction could help the District better identify and target sources of mercury in the future.

The District also made an internal administrative change in 2021 designed to remove barriers to mercury minimization. A pollution prevention specialist learned from her dentist that the District's dental insurance plan covered mercury-containing amalgam fillings but did not cover mercury-free composite fillings. This results in a financial incentive for employees to choose the less expensive amalgam fillings that could contribute trace mercury to the sewer in the future. After providing this information to the District's Human Resources Manager, the District's dental insurer was contacted and the insurer was able to change the plan to cover composite fillings for employees, all without raising employee insurance premiums. This was a victory for mercury minimization in 2021. This experience is an example of real-life structural barriers to pollution reduction and how these barriers can be removed to make it easier for people to take pollution prevention actions.

PUBLIC EDUCATION

The District prioritizes education to build awareness among the public about water quality issues and provide a solid foundation for actions that protect water. While COVID-19 disrupted the District's traditional education activities, the pollution prevention team used the opportunity to create remote educational tools and was able to advance planning work for educational programming in Shop One.

Tours

Tours remained discontinued through 2021 due to precautions and procedures for protecting staff through the COVID-19 pandemic. Small groups, for essential business purposes, were the only form of tour allowable throughout 2021. The virtual plant tour, however, remained available on the District's website. Opportunities for virtual talks and education, such as a live Q&A with wastewater treatment plant staff during the Monona Terrace's "Lakeside Kids" series, were the primary means of providing the content usually covered on plant tours.

Shop One and Community Outreach

Due to the ongoing pandemic, in-person community outreach continued on a somewhat limited basis in 2021. Outdoor, social-distanced opportunities to connect with the community, such as Science on the Square (part of the Wisconsin Science Festival), presentations in the Dane County Parks, the McFarland PTO Trunk or Treat, McFarland Public Works Open House Day, and hosting the monarch butterflies "dreamers" mural at Pumping Station 2, were the primary forms of direct outreach this year.

Throughout 2021, the District laid the groundwork for the next steps with Shop One, the former maintenance building at the plant whose next iteration is to engage and connect with the broader community on water topics. Work began by engaging with nine area artist/cultural leaders who serve as a team of creative collaboration advisors, as part of the US Water Alliance's inaugural Arts Accelerator Program. Over the course of the year, this group of advisors met a dozen times to help the District create a vision and plan for ongoing creative programming that engages the community and empowers water stewards. This work, which includes both guidance for first steps, as well as recommendations for how to work with artists in a transformative (vs. transactional) way over the long term, was synthesized in a final report. The final report includes details on the catalytic projects and was posted on the newly formed One Water Madison website, onewatermadison.org, a hub for Shop One-related information. The first catalytic project, a call for an Artist/Educator in Residence began in the late fall of 2021. The District's first Artist/Educator in Residence was chosen at the end of 2021 and will begin programming in 2022.

INDUSTRIAL PRETREATMENT PROGRAM

Certain substances, when added to sewage, can impact worker health and safety, the biology of the treatment plant, the quality of Metrogro biosolids, operation of sewers and pumping stations, and water quality in the receiving streams. The District's industrial pretreatment program helps to ensure that toxic substances are kept out of the sanitary sewer system. The program enforces the sewer use ordinance, operates a permitting program and implements pollution prevention and source reduction initiatives.

The core of the permitting program is maintaining relationships with the current 18 significant industrial users with categorical wastewater processes or with discharges affecting pollution prevention initiatives. All industrial permittees submitted self-monitoring reports and compliance monitoring of regulated wastewater discharges occurred in both semiannual periods. There were no instances of significant noncompliance by permittees or other users in 2021.

The industrial pretreatment program also maintains an additional 21 permits for non-typical organic industrial users, as well as permits with approximately 35 waste haulers. All waste haulers that use District facilities received annual permits in August. Staff members continued to perform waste acceptance reviews and respond to non-permitted industrial, hauled waste and other waste acceptance requests.

ACCEPTANCE OF SEPTAGE AND OTHER WASTEWATERS

Hauled wastes have been accepted at Nine Springs Wastewater Treatment Plant since 1986. In 2021, the District accepted waste from 35 permitted septage haulers. The haulers are charged a specific rate for each category of septage or type of hauled wastewater that reflects the District's cost of treating the material. In 2021, hauled wastewater treatment revenue exceeded $953,000. Approximately 41 million gallons of wastewater were received via truck in 2021.

The following table lists the five domestic septage categories, the number of gallons of septage received during 2021 and the percent of increase or decrease in volume from 2020 to 2021.

Table 4 – Domestic Septage Received (Gallon)

Septic Tank	Holding Tank	Grease Trap	Settling Basin	Portable Toilet
12,123,000	18,437,000	1,491,000	294,000	635,000
8% decrease	3% increase	20% increase	24% increase	5% increase

The hauled wastes receiving facility, and infrequently the whey well, are the discharge points for other wastewater not characterized by the five domestic septage categories. In 2021, other wastewater types and volumes that were received are listed in the Table 5.

Table 5 – Other Wastewater Types Received

Wastewater Received	Volume (gal)
Village of Belleville Biosolids	633,000
Refuse Hideaway Landfill Leachate	474,000
Middleton Landfill Leachate	9,000
Verona Landfill Leachate	483,000
Meat Processing Industries	881,000
Other Gray Water	435,000
Grocery Store Food Waste	49,000
Remediation Projects Groundwater	12,000
WVDL Tissue Digester Residue	21,000
Dairy Expo Milk Waste	50,000
Dane County Landfill RNG Tower Flush	494,500
Other Industrial Wastewater	56,000

LAGOON SITE PROJECT

Routine inspections, operations and maintenance activities continued on the lagoon site project in 2021. These activities included monthly visual inspections of capped areas and containment dikes, water management and vegetation control. Vegetation control in 2021 consisted of the removal of downed trees and mowing the dike roads and capped cells as ground conditions permitted. In the spring and fall of 2021, the District continued its nuisance-wildlife management program to remove muskrats and woodchucks and protect dike integrity from rodent burrows.

In response to the 2018 flooding that forced the District to repair a small dike leak that allowed river water from Nine Springs Creek to enter the lagoon area, Capital Improvement Project planning in 2019 identified Capital Project #A15 to survey and evaluate the lagoon dike system.

In late 2020, a request for proposal (RFP) was prepared to hire a consultant to begin work on Capital Project #A15, which will be a multiphase project. In March 2021, Golder Associates was hired to perform an engineering study, which included a topographic survey; wetland delineation; literature review; geotechnical investigation; and preparation of reports and technical memorandums including a hydraulic analysis, a geotechnical report and an alternatives analysis. Preliminary engineering is anticipated to continue in 2022, with further study needed to select the best alternative to effectively raise the dikes to the recommended elevation to make them more resilient during flood events.

WATERSHED PROJECTS

Yahara Watershed Improvement Network

In 2021, the District-led Yahara Watershed Improvement Network (Yahara WINS) adaptive management project completed its fifth year of the full-scale project aimed at reducing sources of phosphorus in the Yahara River watershed over the next 20 years. The Yahara WINS partnership has been able to successfully fund projects directly or indirectly that have resulted in hundreds of urban and agricultural practices like cover crop planting, strip tillage and leaf management. It is anticipated that 2021 will see even greater success than 2020 when more than 61,823 pounds of phosphorus was kept out of area surface waters.

Yahara WINS launched a new look for its website, yaharawins.org, in 2021 and all of the most up-to-date information on phosphorus reductions can be found there in the annual report published on or before June 30th each year.

Watershed Monitoring Program

The District conducts monitoring activities in both the Yahara and Sugar River watersheds to help assess the overall condition of select streams. Monitoring initiatives include the collection of water chemistry samples and evaluation of the fish and macroinvertebrate communities to determine the biological health of select streams. In 2021, District staff collected water chemistry samples and conducted fish and macroinvertebrate surveys. All water chemistry samples were analyzed at the District's laboratory. Fish identification and analysis were done with the help of a consultant. Macroinvertebrate samples were sent to UW–Stevens Point for sorting and classification.

In general, stream water quality as measured by water chemistry was like the previous year. The fish populations were not surveyed in 2020 due to the COVID-19 pandemic. The 2021 data showed modest reductions in fish species compared to 2019, due to the unusual 2021 climatic conditions including severe drought, heat and significantly lower stream flows.

The District also has joint funding agreements with the U.S. Geological Survey for two gauging stations in the Yahara River watershed and two gauging stations in the Sugar River watershed. The stations in the Yahara River watershed are used for traditional flow measurements. The

stations in the Sugar River watershed are used for flow, temperature, dissolved oxygen and conductivity measurements.

LABORATORY SERVICES

In 2021, the District laboratory performed 76,003 analyses on 18,565 samples.

Table 6 – Analyses Performed in 2021

PARAMETERS	QUANTITY
Nutrients (TKN, TP, NH3-N, PO4-P, WEP)	21,921
Solids (Suspended, Total, Dissolved)	27,275
Biochemical Oxygen Demand	5,103
Anions (Cl, NO3-N, NO3+NO2, NO2-N, SO4)	4,973
Field Measurements (pH, TEMP, COND, DO)	4,203
Metals	6,156
Bacteria (FCOLI, TCOLI, ECOLI, Salmonella)	1,512
Volatile Fatty Acids (VFA)	3,423
Misc. Testing (Alkalinity, Density, Chlorophyll, CH4, WET)	1,437

The District laboratory continued to support the following activities in 2021:

- The laboratory analyzed 688 samples in support of the Yahara WINS adaptive management project. Of these samples, 345 were collected by citizen volunteers.
- The laboratory provided analytical support for several District-sponsored research pilot projects being conducted with UW-Madison. These projects are investigating potential opportunities for the District to reduce energy demands while maintaining or increasing the level of treatment. The laboratory analyzed 5,067 samples and performed 14,869 analyses for these projects. Many of these analyses required same-day results so that the pilot could be monitored as quickly as possible. The lab values the importance of this partnership and strives to support these pilots.
- Chloride testing was completed daily on all five main pumping stations for the months of January, February, March and December. In addition, at Pumping Station 9, hourly

samples were taken for 5 days. These samples were tested for chloride and conductivity; then, these parameters were compared to see if a correlation could be drawn. Correlation was good and a regression was created. This testing was in support of pollution prevention efforts.

Other noteworthy activities in the laboratory during 2021 were the following:

- The lab continued to provide influent and pumping station samples for surveillance purposes to UW-Madison and the State Lab of Hygiene to test for SARS-CoV-2 in wastewater. This took place throughout 2021. The lab also provided samples for a national SARS-CoV-2 wastewater surveillance program.
- In September 2021, the lab was audited by the DNR Laboratory Certification program. This audit is performed approximately every three years. Also, DATCP audited the lab in its microbiology section in December 2021. DATCP performs their audits on a bi-annual basis. The lab passed both audits successfully.
- The lab purchased a simultaneous ICP, a SpectroGreen ICP, in March of 2021. This purchase moved the lab from sequential analysis, which measures one metal at a time, to a simultaneous analysis, which measures all metals at the same time. This gives the lab the ability to go back to look for additional metals after the analysis is complete and speeds up the analysis. The instrument was installed in June 2021 and method development began. With the completion of method development, the lab discontinued the use of its graphite furnace and began to use the ICP exclusively for metals analyses. This created efficiencies in the metals section.
- After more than 25 years of using BOD AutoEZ, the lab began to research new BOD analyzers. BOD AutoEZ was developed by former District lab manager Greg Zelinka and the lab in the 1990s and the District earned a patent for it. It served the lab well, but with newer technology and the age of the instrument, it was decided to replace BOD AutoEZ. Late in December 2021, the Skalar SP2000 was chosen. Installation will take place in 2022.
- After 35 years at the District, chemist Mark Anderson retired in February 2021. Some of Mark's many accomplishments were serving on several DNR technical advisory committees; helping to develop a statistical argument for quadratic and cubic regressions for the DNR; performing cutting-edge PCB analysis; and sampling for Whole Effluent Toxicity testing and macroinvertebrates. Chemist Jessica Schwark joined the lab team in March 2021 as his replacement.

ENGINEERING

Staffing

In 2021, the Engineering department continued with nine full-time employees:

- Director of Engineering
- Project Engineer (4)
- Electrical Engineer (2)
- Collection System Engineer
- Project Coordinator

All of the engineering positions are filled with registered professional engineers and ISI-Envision credentialed sustainability professionals.

Responsibilities of Workgroup

The Engineering department oversees the planning, design, construction and commissioning of all major capital improvement projects at the District. This includes engineering functions encompassing civil, structural, mechanical, plumbing, electrical, controls and HVAC disciplines. These projects range in value from less than $50,000 to $50 million or more. Depending on the scope of the work, smaller capital projects are typically planned and designed in-house whereas consulting services are utilized for larger projects. These consulting services are retained and managed by department staff. Similarly, the Engineering department typically assumes the lead role during project construction, performing all construction management duties and utilizing consulting services for field support as needed.

The department also manages condition assessments and rehabilitation of the gravity and force main portions of the collection system. This includes the development of an inflow and infiltration (I/I) reduction program; annual televising and cleaning projects within the collection system; collection system maintenance projects; manhole rehabilitation projects; and condition assessment of the force mains. Other duties performed by the Engineering department include:

- Assistance with long-range asset management, capital planning and budgeting
- Assistance with large maintenance projects
- General assistance to the Operations and Maintenance (O&M) department
- Response to emergency and high flow events
- Utility coordination and administration
- Coordination with other municipalities (e.g., City of Madison) and agencies (e.g., Wisconsin Department of Transportation (WisDOT))

- Process control programming and HMI (i.e., computer control screen) design
- Real estate and property issues
- Facility transfers

Programs, Initiatives and Work Reporting

ENGINEERING AND CONSTRUCTION

Grass Lake Dike Restoration

In 1958, the District constructed a variety of improvements to discharge effluent to the Badfish Creek waterway, the most significant being an earthen dike approximately 5,000 feet in length, along the western edge of Grass Lake. The dike was constructed to provide a division between Grass Lake and the effluent discharge waterway.

In 1988, a permit to maintain the dike and effluent ditch was granted to the District. Conditions of the permit required perpetual maintenance of the bank slopes. Over the decades, portions of the dike banks have eroded. The rate of bank erosion is unknown, but bank subsidence has occurred in many locations. There is also minor damage from animal burrows.

A request for proposals for bank evaluation and design services was developed, and the work was awarded to Cardno in August of 2018. Due to issues associated with floodplain management, COVID-19 and permitting, the design phase of the work was still ongoing at the end of 2021. The project is expected to be bid out by mid-2022, with construction of the recommended improvements anticipated to occur in fall 2022.

Lagoon Dike Improvements

Until the early 1980s, the area of ponds (known as the lagoon area) immediately east of the Nine Springs Treatment Plant served as storage for biosolids produced at the plant through the treatment process. Following updates to the treatment plant process and biosolids storage, biosolids began to be cleaned out of the lagoons in the early 1990s. The western portion was reconstructed to provide habitat and recreational opportunities, while also serving as an overflow for treated effluent during high flow events. The eastern portion remained as a storage area for biosolids that contained PCB levels above the allowable reuse limit.

To date, current maintenance has included mowing and controlled burns to control invasive plants, tree and brush growth; nuisance animal control of geese and woodchucks; and building up of the low areas of the dike roads with a mixture of woodchips and soil, topped with a thin layer of road gravel.

During an extreme high flow event in August 2018, the Nine Springs Creek reached record levels (near the southern dike roads of the eastern lagoon area) and leaks formed on the southern dike road causing water from Nine-Springs Creek to enter the lagoon area. This event, which required emergency repairs, highlighted the need to consider the resilience of the dikes

during future high-water events. A request for proposals to conduct an engineering study was developed to evaluate the dikes surrounding the lagoon and provide recommendations to ensure the dikes have adequate freeboard and resilience from weather events in the future. The work was awarded to Golder Associates, Inc. in March of 2018, and the engineering study phase of the work was still ongoing at the end of 2021. The project is expected to move into the preliminary design phase in mid-2022, final design and permitting to occur throughout most of 2023, and construction of the recommended improvements anticipated to begin in later 2023.

Liquid Processing Improvements-Phase 1

The 2016 Liquid Processing Facility Plan recommended improvements to the liquid processing facilities that were to be implemented in phases over a 10+ year period. The first phase (Nine Springs Liquid Processing Improvements-Phase 1) consists of the following main elements:

- Peak flow management improvements: hydraulic capacity upgrades at the Nine Springs Wastewater Treatment Plant (NSWTP), as well as upgrades to allow the activated sludge process to operate in a biological contact process mode during high-flow events.
- Ultraviolet disinfection system replacement: replacement of the existing ultraviolet disinfection system.
- Process control system upgrades: replacement of the remaining Bristol Babcock distributed control units (DCUs).
- Electrical substation improvements: construction of one new unit substation to replace the existing substations U11, U12, and U13.
- East side blower control replacement: replacement of control panels that are unreliable, poorly documented and use legacy parts that are difficult to replace.
- Primary tanks 1 and 2 rehabilitation: restoration of 80-year-old tanks that are still serviceable but require repair of deteriorated concrete.
- Primary influent pipeline rehabilitation: rehabilitation of the 54-inch primary influent pipe from the east primary junction chamber to the east primary clarifiers.
- Plant flow metering improvements: installation of flow metering equipment to measure flows through the east and west plants.
- Secondary clarifier stress testing: testing to determine the maximum solids loading rate of the final clarifiers.

Planning and design phases were completed in the fall of 2019 and the project was bid in October 2019. The Commission awarded the contract to C.D. Smith Construction, Inc. for a bid price of $12,895,000. Construction activities began in early 2020 and were substantially complete by the end of 2021. Throughout construction there were 65 change orders, totaling $382,882 (+2.97%), resulting in a final construction cost of approximately $13,278,000.

West Interceptor Shorewood Relief

The District's West Interceptor system is a complex network of sewers that provide service to the near west side of the City of Madison, the City of Middleton, the Village of Shorewood and the Town of Westport. The system is generally comprised of two or three parallel sewers that extend westward from Pumping Stations 2 and 8.

The majority of the West Interceptor system has adequate long-term capacity. However, several areas of the system need additional capacity. These sections comprise approximately 11,500 feet of sewer near the Village of Shorewood Hills, located along University Avenue between Walnut Street and Whitney Way.

The West Interceptor Shorewood Relief project will provide additional capacity to convey projected future flows from the District's west side service area, including expected growth in the City of Middleton and Town of Westport. Due to the size and complexity of the project, the design and construction of the relief sewer will occur in three phases over a period of approximately three years.

Planning of the overall project, detailed design and bidding for the construction of Phase 1 was completed in late 2020. The Commission awarded the contract to Advance Construction, Inc. in January of 2021 at a bid price of approximately $3,410,500. Construction activities began in the spring of 2021 and carried on throughout the summer and into the fall. There were delays in construction as a result of Hobas pipe shortages, extending the substantial completion date into early 2022. The final construction cost is anticipated to be approx. $3,450,000 (+1.2%).

Phase 2 of this project was designed throughout 2021 and is being constructed as a part of a WisDOT project on University Avenue in 2022. Detailed design and bidding of Phase 3 are anticipated to take place in 2022, with construction beginning in 2023.

Pumping Station 17 and Relief Force Main

The original Pumping Station 17 (PS17) and associated force main was commissioned in 1995 as a cost-effective and regional solution to meet Verona's wastewater needs. As the City of Verona, the Town of Verona and the City of Madison continue to develop areas surrounding the current PS17 service area, increased capacity needs of PS17 are being realized.

In 2005, the District prepared the Lower Badger Mill Creek Sewer Service Report, which recommended a long-term solution of constructing a Lower Badger Mill Creek Interceptor (LBMCI) to serve the entire watershed and route sewage from these areas to PS17. Phases 1 through 4 of the LBMCI have been constructed to date, with the last section, Phase 5 and 6, scheduled for completion by the end of 2024.

The completion of the LBMCI will reroute a significant amount of current (and future) flow from Pumping Stations 12 and 16 to PS17. By 2040, the required capacity for PS17 is estimated to be 11.82 million gallons per day (MGD), far exceeding the current firm capacity of 4.6 MGD.

Therefore, a major capacity upgrade of PS17 is necessary, as well as an upgrade of the existing 16-inch diameter force main as it has a maximum capacity of approximately 8 MGD.

The Pumping Station 17 projects include rehabilitating PS17 and constructing a new PS17 relief force main (PS17 RFM), designed to work in combination with the existing force main to handle the estimated future flows from this area. The PS17 RFM is being designed and constructed in two phases, with Phase 1 being completed in conjunction with the City of Verona's Eastside Interceptor. With both of these utilities located in the same corridor, coordinating the design and construction of PS17 RFM Phase 1 with the City of Verona allowed for economies of scale and cost savings by sharing a common topographic survey, design, mobilization and administration with the City.

Design of PS17 RFM Phase 1 was completed in 2020 by Short Elliott Hendrickson Inc. and the construction was completed in the fall of 2021 by Minger Construction Co., Inc. PS17 RFM Phase 1 included nearly 7,000 lineal feet of 24-inch diameter force main, with an original bid price of approximately $2,952,000, and a final construction cost of approximately $3,001,000 (+1.6%).

The design of PS17 rehabilitation and the PS17 RFM Phase 2 began in October 2021 by MSA Professional Services, Inc. The second phase of the PS17 RFM is anticipated to consist of approximately 8,400 lineal feet of 24-inch force main and 3,000 lineal feet of 36-inch gravity interceptor to connect to the East Nine Springs Interceptor along HWY 18/151 near Goose Lake. This corridor has a variety of environmental and archeological challenges to consider when developing the final alignment. The design is anticipated to be completed by the end of 2022, with construction beginning in early 2023.

Headworks Building Flow Metering Improvements

The Headworks Building was constructed as part of the Tenth Addition to the Nine Springs Wastewater Treatment Plant (NSWTP) in 2005. This component of the wastewater processing system includes influent flow metering, fine screen solids removal, vortex grit removal and disposal of screenings and grit.

The influent venturi flow meters for the NSWTP are located immediately upstream of the fine screens. The meters were installed at an elevation such that the downstream fine screens must be operated in a manner to maintain meter submergence, which is critical for meter accuracy. Influent flow rates to the Headworks Building can (and do) change quickly and using the screening operations to maintain meter submergence has proven difficult. In addition, this submergence requirement resulted in several other issues associated with the operation and maintenance of the screening system including higher energy use, higher wash water volumes, more rags and solids, as well as more frequent maintenance than expected.

The Nine Springs Treatment Plant-Headworks Flow Metering Improvements project began in early 2019 with Short Elliott Hendrickson Inc. to address these issues and improve the

reliability of plant flow metering accuracy for customer billing. The intent of this project is to alter conditions to facilitate operating the fine screens as initially intended, with intermittent cleaning cycles based on screenings accumulation, independent of flow meter submergence requirements. To accomplish this, the existing venturi flow meters in the Headworks Building have been repositioned at a lower elevation.

The design work was completed at the end of 2019 and the construction contract was awarded to Staab Construction Corp. in February 2020 for a bid price of $1,833,000. Construction was substantially complete in October 2021 and had a final construction cost of approximately $1,913,400 (+4.4%).

Nine Springs Valley Interceptor Rehabilitation – Dunn's Marsh to McKee Road

The District's Nine Springs Valley Interceptor (NSVI) provides service to the west side of the City of Madison, the City of Fitchburg and the City of Verona. The NSVI system stretches from Pumping Station 11 to McKee Road. Approximately 4,200 lineal feet of pipe along the Cannonball/Military Ridge bike path between McKee Road and Dunn's Marsh were identified as needing additional capacity and in corroded condition.

To meet future capacity needs, either a larger pipe (a replacement sewer) or a second pipe (a relief sewer) working in parallel with the existing pipe were deemed the most viable options. During initial planning, a replacement sewer alternative was selected as the preferred option and the design of this option was completed in the fall of 2020. The construction contract was awarded to R.G. Huston Company, Inc. in October 2020 for a bid price of approximately $3,319,700. Construction was conducted throughout 2021 and was substantially complete in October 2021, with a final construction cost of approximately $3,415,800 (+2.9%).

Operations Building 1st Floor Remodel

A portion of the first floor (approximately 5,000 sq. ft.) of the Operations Building was identified as being underutilized and inefficient during a 2013 space needs study conducted by Bray Architects. Other issues such as public/disabled access and building security were also identified as concerns. To solve these issues, a remodel of the area was added to the 2021 Capital Improvements Plan. Major goals of the project included:

- Better security for the lab and operator area
- Better functionality of the operator area
- Increased safety of the lab, including limiting entrance to only those who need to be in the lab
- More efficient use of space. Currently, some of the lab space is underutilized, while a larger and more cohesive area for the Ecosystem Services department is needed.
- A more inclusive workplace. Currently, the building entrance for people with mobility issues is separate from the main entrance. This creates two public entrances to the

building and requires those with accessibility issues to traverse through hallways and staff areas to reach the front desk. A single, revitalized and welcoming public entrance for everyone is desired.

- Improved working conditions and a healthy workplace that promotes employee engagement and satisfaction, including a common cafeteria area separate from work areas and conference rooms. A cafeteria will be a healthier place to eat as well as a place for informal meetings and collaboration.

In September 2019, Engberg Anderson Architects were retained to assist with planning and design of the Operations Building 1st Floor Remodel project. This included a space-needs study, adjacency investigation, evaluation of alternatives, conceptual design and detailed design. This planning and design work was completed in the summer of 2020, and the construction project was bid out and awarded to Kenneth F. Sullivan Co. in August 2020 for a construction price of approximately $1,566,500. Construction activities began in the fall of 2020, continued through 2021 and were nearly substantially complete by the end of 2021, with a final construction cost of approximately $1,632,000 (+4.2%).

Pumping Station Rehabilitations

In 2011, the District updated its Collection System Facilities Plan, which included a condition assessment of all District pumping stations across six major categories: peak flow capacity; firm flow capacity; power system redundancy; mechanical condition; structural integrity; and electrical condition. Across the six categories, Pumping Stations 4, 13, and 14 received the highest priority for improvements among the District's pumping stations, indicating the need to prioritize the rehabilitation of these stations in the near term.

Pumping Station 4 (PS4) is part of the South Interceptor system and provides service to the City of Madison and the Town of Madison. The station was placed into service in 1967 and pumps flow directly to the NSWTP through a parallel system with Pumping Stations 2 and 3. The current firm capacity of PS4 is 4.2 MGD; following rehabilitation the firm capacity will be 5.5 MGD.

Pumping Station 13 (PS13) and Pumping Station 14 (PS14) are located along the Northeast Interceptor (Waunakee/DeForest Extension), which serves the northerly portions of the collection system, including the north side of the City of Madison and the villages of Waunakee and DeForest. PS13 and PS14 were placed into service in 1970 and 1971, respectively, and PS14 pumps its flows to PS13. The current firm capacity of PS13 and PS14 is 20.0 MGD and 15.0 MGD, respectively, and following rehabilitation the firm capacity will be 29.4 MGD and 20.2 MGD, respectively.

Typical of District pumping station rehabilitation projects, the PS4, PS13 and PS14 projects will include installation of new pumps; enhancement of power system redundancy; replacement of major electrical and control equipment; installation of new HVAC systems; replacement of manual valves and gates; installation of new flow metering equipment; installation of

generators; and wet well repairs. Due to their proximity and interconnectedness, PS13 and PS14 were selected to be designed and rehabilitated together.

Planning and design for PS13 and PS14 were completed in the summer of 2020 by Strand Associates, Inc. and the construction project was awarded to C.D. Smith Construction Inc. in August 2020 for a bid price of approximately $9,277,000. Construction activities began in late 2020, continued through 2021, and are expected to be completed in the third quarter of 2022.

Planning and design for PS4 began in April 2021 by Applied Technologies, Inc. and is expected to be completed and ready for bidding in the fall of 2022.

MAINTENANCE OF DISTRICT FACILITIES

Staffing

The Maintenance workgroup has 42 full-time employees:

- Maintenance and Reliability Manager
- Collection System Supervisor
- Collection System Services Worker (6)
- Electrical Maintenance Supervisor
- Electrician (7)
- HVAC Technician (2)
- Facilities Maintenance Supervisor
- Facilities Maintenance Worker (7)
- Custodian (2)
- Mechanical Maintenance Supervisor
- Mechanic (9)
- Metrogro Operations Supervisor
- Metrogro Mechanic (2)
- Biosolids Program Assistant

Responsibilities of Workgroup

The workgroup's main responsibilities are as follows:

- Conducting preventative, predictive and reactive maintenance activities at the treatment plant, pumping stations and within the collection system
- Monitoring and sampling collection system wastewater for customer billing
- Locating District utilities as part of Digger's Hotline program
- Facilities management of District properties and buildings
- Biosolids processing, handling, disposal

Programs, Initiatives and Work Reporting

MAINTENANCE WORKGROUPS

The Maintenance workgroups of the Operations and Maintenance department are responsible for the maintenance of the Nine Springs Wastewater Treatment Plant (NSWWTP), the District pumping stations, the non-District pumping stations, the District's interceptor system and the District's rental properties. This work is performed by the Facilities Maintenance section, the

Electrical Maintenance section, the Mechanical Maintenance section and the Collection System Services section. Additionally, the workgroup includes the Metrogro Operations section which is responsible for the resource recovery disposal of biosolids.

FACILITIES MAINTENANCE

The Facilities Maintenance section spends the majority of the year maintaining the District and non-District pumping stations, NSWWTP facilities and grounds, odor control equipment, roads and small equipment. Routine work includes landscaping projects; cleaning plant buildings and galleries; maintaining lagoon and dike roads; painting, plumbing and carpentry projects; lawn mowing and maintenance; and snow plowing. This section also performs preventive maintenance work on the District's electrical manholes, process tanks, roofs and floors.

This section completed several projects in 2021:

- Removal and replacement of H2S media in the plant's biogas treatment system
- Removal and replacement of siloxane media in the plant's biogas treatment system
- Lead-based paint abatement of process and air piping in the east half of Primary Gallery 1

The Facilities Maintenance section continued improving snow removal operations and reduced salt use by applying knowledge acquired from attendance at winter roadway maintenance trainings and utilizing innovations in equipment and techniques.

In 2021, the Facilities Maintenance crew assisted operations and engineering staff with projects including preventative maintenance on plant primary settling tanks, aeration tanks, final clarifiers, sump pumps and pits, as well as inspection of plant and pumping station roofs and cleaning wet wells of District-owned pumping stations (in conjunction with the City of Madison).

The crew also contracted services for repairing the plant perimeter fence following damage from multiple downed trees and vehicle accidents.

In 2021, the Facilities Maintenance crew continued working on Reliability Centered Maintenance (RCM) objectives through:

- Implementing a dedicated planner position within the section to increase the efficiency of the department and technicians performing the work
- Continued development of standard operating procedures for routine tasks to promote consistency and efficiency in work
- Continued work with the Strategy department on the District's asset management plan and redefining workflow processes to aid the selection of a new computerized maintenance management system (CMMS)

ELECTRICAL MAINTENANCE

The Electrical Maintenance section devoted a majority of the year to providing the knowledge and skills necessary to assure a high level of electrical reliability to District facilities and the facilities owned by others yet maintained by the District. This was accomplished through a mix of preventive and reactive maintenance, standard operating procedures, electrical staff training, planned improvements, construction projects and daily maintenance. Examples of preventive maintenance tasks performed by the section include calibration, inspection and testing/cleaning of electrical and instrumentation equipment, and thermographic imaging of electrical devices.

The continued use of the District's CMMS has allowed the section to identify problems by tracking equipment data, scheduling maintenance and creating daily and preventive maintenance work orders. The section continued to lend its expertise to other departments to facilitate District projects and improve the treatment process, including providing electrical cross-training to District mechanics, operators and HVAC personnel; assisting the Engineering department with submittal reviews and the evaluation of the Liquid Process Facility Plan; collecting data on electrical assets for the CMMS; and operating District portable generators during planned and unplanned power outages.

The following additional improvements and projects were completed or continued in 2021:

- Continued to upgrade and modify existing electrical equipment at the District and non-District facilities to accommodate the requirements of NFPA 70E (Arc Flash)
- Completed design, fabrication and installation of new controls and telemetry for the City of Madison Carroll pumping station. Also started the design, fabrication and installation of new controls and telemetry for the City of Madison's Arbor Hills and Veith pumping stations.
- Continued the communications/PLC upgrade at Pumping Station 5
- Completed installation of cell phone signal boosters at District pumping stations to improve the safety of District personnel
- Completed installation of new variable frequency drives for final clarifiers 1 and 2 flocculator drives
- Worked with a contractor to replace the lights on the tower by Aeration Control Building 4 with LED fixtures for better light and reduced energy costs
- Started the dissolved oxygen meter replacement project on the aeration tanks
- Designed and started the process for the installation of a remote I/O control panel in the Effluent Building
- Oversaw contracted electrical maintenance work performed on plant and pumping station electrical utility service and substation equipment

- Removed electrical generator #2 and sent in for reconditioning; then reinstalled, tested and put back in service.
- Replaced the antennas and antenna cables on the Pumping Station 17 radio tower
- Started the Plant PLC Replacement project
- Assisted Engineering department with the Liquid Processing Improvements project and Headworks Building venturi move project
- Began implementation of the new RCM workflows that have been developed with the help of all the O&M workgroups

HVAC MAINTENANCE

The HVAC Maintenance section devoted a majority of the year to providing the knowledge and skills necessary to increase the HVAC reliability of District facilities and the facilities owned by others yet maintained by the District. This was accomplished through a mix of preventive and reactive maintenance, standard operating procedures, HVAC staff training, planned improvements and daily maintenance. Examples of preventive maintenance tasks performed by the section include inspection, testing and cleaning of HVAC equipment and daily steam boiler checks.

The continued use of the District's CMMS has allowed the section to identify issues by tracking equipment data, scheduling maintenance and creating daily and preventive maintenance work orders. The section continued to lend its expertise to other departments to facilitate District projects and environmentally protect process equipment, including assisting the Engineering department with submittal reviews and the evaluation of the Liquid Process Facility Plan and collecting data on HVAC assets for the CMMS.

The following improvements and projects were started or completed in 2021:

- Continued the reorganization and enhancement of the HVAC preventive maintenance program. Work is being clarified, added and organized by season.
- Assisted with the yearly contracted maintenance of the boilers and steam boilers at the NSWWTP
- Assisted with the initial design and review for the Plant HVAC Improvement project
- Began implementation of the new RCM workflows that have been developed with the help of all the O&M workgroups

MECHANICAL MAINTENANCE

The Mechanical Maintenance section maintains mechanical equipment through preventative and reactive maintenance of NSWWTP equipment and District and non-District pumping stations. The section verifies proper operation of equipment and ensures that all collected wastewater is conveyed to the plant, with the support of operations and other maintenance

sections. The section also maintains the District's vehicle fleet and develops the skills of section staff members through the District's apprenticeship program and other training.

In addition to many scheduled and unscheduled maintenance activities, major accomplishments completed in 2021 included:

- RCM implementation:
    - Established a dedicated planner position within the section. The planner has created nearly 78 job plans that have increased the efficiency of the department and technicians performing the work.
    - Continued developing standard operating procedures for routine mechanical tasks to promote consistency and efficiency in work
    - Continued working with the Strategy department on the District's asset management plan and redefining workflow processes to aid in the selection of a new CMMS. Classifying stock codes and working with the purchasing department to set critical levels of inventory to have the parts needed.
    - Continued improving lubrication department equipment and work practices
- On a weekly basis, removed rags and other debris from plugged collection system pumps to keep them functioning at required capacities. Responded to 281 emergency work orders in 2021.
- Replaced a total of 18 pumps at the treatment plant and pumping stations where the cost-benefit analysis dictated the purchase of a new pump was most beneficial
- Rebuilt seven pumps at District pumping stations and one pump at a non-District station
- Rebuilt 21 pumps at the treatment plant that serve various treatment plant functions
- Continued replacement of unreliable rotary lobe pumps to a more reliable brand
- Replaced obsolete flocculator drives on final clarifiers 1 and 2 with a newer style that is more reliable and energy-efficient, setting a new standard for the future
- Responded to Waukesha engine failures and repaired in a timely manner, maintaining a key gas biogas utilization and energy resource to the treatment plant
- Facilitated the Blower Engine Overhaul project, completely overhauling Waukesha engine to ensure reliability in the future
- Replaced the Operations Building vacuum compressor for the lab
- Began the west blower condition assessment project to gather information and make the decision of repair or replacement of the blowers
- Assisted the Engineering department staff on necessary shutdowns and tie-ins for the Pumping Station 13 & 14 Rehabilitation project

COLLECTION SYSTEM SERVICES

This workgroup devotes its time to three major functions for the District. The first is the collection of wastewater samples and flow information from the communities and sanitary districts that are served by the District. The analyses results measured by the District's laboratory on these samples and the flow data recorded by the crew are used to bill the District's municipal customers for treatment services. The crew also collects samples at companies with discharge permits issued by the District's industrial pretreatment program.

The second major function is the inspection and maintenance of the District's collection system each year. This work includes the identification and repair of assets by the crew or contractors and working with contractors for the District's annual cleaning and televising of portions of the interceptor system. The third major function is locating. This work includes locating utilities, mapping, monitoring projects, construction meetings and repairing locating posts.

During 2021, the following activities were performed by the crew:

- Conducted preventive maintenance work, including all work on air release valves; exercising valves; replacing three air release valves with new prototype stainless valves; inspecting stop logs and flap gate structures; and inspecting where force mains meet gravity manholes.
- Monitored and recorded all lateral connections
- Implemented and utilized a new GIS editing program
- Viewed and coded interceptor televised videos
- Monitored numerous construction projects involving utility crossings of District interceptors and force mains
- Investigated odor complaints
- User charge program repair and construction of manhole weirs
- Collected "First of Month" readings from pumping stations and other municipality lift station pumps for billing

User-Charge Monitoring and Billing

User-charge billing of the District's municipal customers is performed quarterly using data collected at the Nine Springs Wastewater Treatment Plant and within the collection system. The Collection System Services crew supports quarterly billing by providing sampling and flow measurement at key points in the collection system. The Collection System Services crew and plant staff collected data and samples at 85 sampling points in 2021. The sampling points generated 4,256 samples throughout the year.

2021 Manhole Inspections

The crew inspected the manholes and surrounding areas for the following interceptors:

- NEI-Waun/Defo Ext Waun Leg (27) manholes, Waun union (3) manholes
- NEI-Waun-Defo Ext/Waun Leg (34) manholes
- NEI-Waun-Defo Ext/Defo Leg (34) manholes
- NEI-Waun-Defo Ext Defo Leg (34) manholes
- NEI-Waun-Defo Ext Defo Leg (14) manholes Hwy 19 Ext (17) manholes
- NEI-Waun-Defo Ext Defo Leg (33) manholes
- NEI-Waun-Defo Ext (26) manholes
- NSVI-Mendota Ext (5) manholes
- West Int/West Int Relief (35) manholes
- FEI/FEI-Far East Ext/EI-East Monona Int (37) manholes

Other Projects

- Siphon cleaning
- Spark tested the coating of 15 manholes on the Nine Springs Valley Interceptor
- Spark tested the coating of 9 manholes on the Shorewood Hills Relief Interceptor
- Spark tested the coating of 20 manholes on the NEI Truax Extension Relief
- Spark tested the coating of two pipes in the Headworks Building
- Sampled and took H2s readings from Dane County Landfill on HWY 12 to Marsh Road in McFarland
- Repaired 60 manholes

METROGRO OPERATIONS

The District recycles biosolids to agricultural land through its Metrogro program. This program provides valuable crop nutrient resources to local agricultural production systems and allows the District to meet biosolids storage and disposal goals.

The dry weather in 2021 made for an exceptional hauling season and set up biosolids storage to be in great shape heading into 2022. With the dry and mild start to 2021, all spring applications were able to be completed before the end of April and the good fortune continued once the summer/fall season began in mid-July. The 2021 hauling season ended on Dec. 6 with storage tank levels at zero.

Summary hauling and cost information for the last three years is provided in Table 7.

Table 7 – Metrogro Program Details for Past Three Years

Year	**2019**[2]	**2020**[1]	**2021**
Gallons Recycled (MG)	25.8	37.6	40.2
Dry Tons Recycled	4,890	7,182	7,894
Acres Applied	3,771	5,030	5,508

[1] Numbers shown for 2020 do not include the 1.3MG of additional Class B liquid biosolids that were stored at an off-site manure pit and land applied by a contractor. Numbers shown for 2020 do not include the 2,600 dry tons of additional dewatered material that was recycled at the landfill. Combined costs of these additional activities were around $290,000.

[2] Hauling season ended early in 2019 due to extremely wet weather and an early snowfall. This caused the additional storage needs for the winter of 2020 and increased volume needed to haul in 2020.

The District continues to produce a high-quality biosolids product. Metal concentrations in 2021 were below the concentrations used by EPA to define an exceptional quality biosolid, as shown in Table 8 (Note: Wisconsin Department of Natural Resources uses the term “high quality" in NR 204).

Table 8 - Metrogro Biosolids Quality 2021 Average Values

Parameter	Concentration	EPA EQ Limit*	EPA Ceiling Limit	Units (Dry Weight)
Total Solids	4.98	NA	NA	%
TKN	8.4	NA	NA	%
NH3-N	4.08	NA	NA	%
Total-K	0.56	NA	NA	%
Total-P	3.27	NA	NA	%
Arsenic	4.9	41	75	mg/kg
Cadmium	1.0	39	85	mg/kg
Chromium	43.7	NA	NA	mg/kg
Copper	544	1,500	4,300	mg/kg
Lead	17.9	300	840	mg/kg
Mercury	0.3	17	57	mg/kg
Molybdenum	25.8	NA	75	mg/kg
Nickel	25.1	420	420	mg/kg
Selenium*	6.2	100	100	mg/kg
Zinc	782	2,800	7,500	mg/kg
PCB	<0.017	NA	NA	mg/kg

*EQ means "exceptional quality"
NA means not applicable
< data qualifier is used if one or more of the monthly values used to calculate the yearly average is reported as below the analytical limit of detection.

Environmental monitoring to support the Metrogro program continued in 2021. Approximately 577 water samples were collected from private wells, with samples being analyzed for nitrate nitrogen and coliform bacteria. Soil samples were collected through the District, as well as through the farmer's crop consultants.

Equipment Upgrades

The District is continually looking for ways to increase efficiencies and improve biosolid

applications and nutrient management. In 2021, a second Oxbo applicator was added along with a Zimmerman low disturbance toolbar. The Oxbo applicator's advanced technology and increased capacity allowed for more acres to get covered in a timely manner. The addition of another Zimmerman toolbar also prevented runoff of approximately 0.67 lbs. of phosphorus per acre.

The District also added an additional Metrogro trailer to the fleet and rebuilt one of the older trailers. The increase in the number of trailers available helped support and maintain the efficiency gained by using the larger capacity application equipment.

MISCELLANEOUS WORK REPORTING

Reliability Centered Maintenance (RCM)

In 2021, District staff continued to develop RCM best practices in a continual effort to shift the maintenance culture. Workflow standardization and improvement was one focus for the maintenance department. Current workflows were updated and improved to meet the changing needs of the maintenance departments and follow CMMS standard processes. This included identification and requesting of work, planning of work, execution of work and stock code creation. All relevant staff were given development plans for the process changes through the District's documentation software to train on the processes and bring accountability to that training.

Another 2021 RCM priority for the maintenance groups was CMMS data cleanup. This was done to promote efficiency in the work planning and purchasing processes. In particular, staff in each workgroup assigned active assets to nearly 2,000 unassigned stock codes. By associating the stock code to the asset, the ordering process is streamlined, allowing planners to directly pick the parts from an asset's bill of materials and the purchasing team to order the parts from a known low-cost vendor. This not only saves staff time but ultimately lowers the amount of time to receive the parts, allowing work orders to be completed on time or closer to their required date.

Also in 2021, the Collection System Services section continued work done in 2020 on implementing work order planning with a dedicated planner within the group. Work order planning has been shown to increase the accuracy of work being performed and overall efficiency of the purchasing and maintenance teams. The planner's role is to triage individual work orders, and based on the work needed, create job plans to perform the work and order the necessary part for completion. Centralizing this work with one technician eliminates the inefficiencies and inconsistencies of each technician performing this work on their own and allows technicians to focus on completing work that is planned with the proper parts. Collection System Services has joined the other four maintenance teams in making work order planning a success at the District.

Finally, maintenance staff at all levels participated in the audit conducted by Reliability X to

assess where the District is in terms of RCM and where gains can be made. That audit resulted in several goals for the RCM program for 2022 and beyond. Specifically, in 2022, maintenance staff will continue with RCM work by starting a root cause analysis program and updating/refining the lubrication management policies and procedures.

OPERATIONS

Staffing

The Operations workgroup has 19 full-time employees:

- Director of Wastewater Operations & Reliability
- Operations Manager
- Senior Automation Systems Integrator
- Automation Systems Integrator
- Process and Research Engineer
- Regulatory Performance and Process Engineer
- Process and Project Specialist
- Operations Supervisor
- Lead Operator
- Operators (10)

Responsibilities of Workgroup

The workgroup's main responsibilities are as follows:

- Operation of the Nine Springs Wastewater Treatment Plant (NSWWTP)
- Resource recovery of clean water, biosolids, biogas and phosphorous fertilizer
- Regulatory compliance reporting
- Maintaining the District supervisory control and data acquisition (SCADA) system for collection system and treatment plant monitoring
- Researching, monitoring and testing process efficiencies for greater plant performance

Programs, Initiatives and Work Reporting

OPERATIONS WORKGROUP

The Operations workgroup is primarily responsible for operation of the treatment facility at the Nine Springs Wastewater Treatment Plant and the Process Control System (PCS). Significant projects the group worked on in 2021 included:

- Plant operations assistance with the Liquid Processing Improvements Phase 1 construction project completion
- Completed the Energy Master Plan study
- Installed grit basin improvements and examined results for further implementation
- Process Control System Phase 2 project completion

OPERATION OF WASTEWATER FACILITIES

Sources of Wastewater

The District receives and treats wastewater from the cities of Fitchburg, Madison, Middleton, Monona and Verona; the villages of Cottage Grove, Dane, DeForest, Maple Bluff, McFarland, Shorewood Hills, Waunakee and Windsor; and from sanitary and utility districts and other areas in the towns of Dunn, Madison, Pleasant Springs, Verona, Vienna and Westport. The District served a total of 26 municipal customers in 2021. The District also accepts septic tank wastes and similar wastes from unsewered areas located primarily in rural Dane County. In 2021, 47.9 acres of land was annexed by the District. The total area of the District at the end of 2021 was 187.32 square miles.

Interceptor Service

Interceptor sewer service is provided within the District through the District's main and intercepting sewers. The District operated and maintained 97.70 miles of gravity sewers and siphons and 31.79 miles of raw wastewater force mains at the end of 2021. Wastewater collecting systems are owned and operated by the cities, villages and town sanitary and utility districts and are connected to the metropolitan interceptor system.

All wastewater generated in the District is treated at the Nine Springs Wastewater Treatment Plant located at 1610 Moorland Road, Madison, Wisconsin, approximately one mile south of Lake Monona. The easterly part of the District is served by the East Interceptor, the Southeast Interceptor, the Northeast Interceptor and the Far East Interceptor. The westerly part of the District is served by the Lower Badger Mill Creek Interceptor, the West Interceptor, the Southwest Interceptor, the South Interceptor and the Nine Springs Valley Interceptor.

The transmission of wastewater from the metropolitan area to the NSWWTP requires the operation of 135 pumping stations, not including 447 small grinder pump installations. Table 9 and Table 10 list the number of pumping stations operated and maintained by individual communities and the District.

Table 9 – Pumping Stations Operated and Maintained by Communities

Owner	Number of Pumping Stations	Number of Grinder Stations
City of Fitchburg	1	
City of Middleton	8	
City of Monona	7	
Village of Cottage Grove	5	
Village of Dane	1	
Village of DeForest	1	1
Village of McFarland	5	1
Village of Shorewood Hills	1	
Village of Waunakee	3	1
Village of Windsor	4	11
Town of Dunn Kegonsa Sanitary District	5	355
Town of Pleasant Springs Sanitary District No. 1	9	55
Town of Vienna Utility District No. 1	1	
Town of Vienna Utility District No. 2	1	5
Town of Westport Utility Districts	10	14
State of Wisconsin:		4
University of Wisconsin Campus	6	
University of Wisconsin Arboretum	1	
Dane County - Rodefeld Landfill	1	
Total	**70**	**447**

Table 10 – Pumping Stations Operated and Maintained by the District

Owner	Number of Pumping Stations
Madison Metropolitan Sewerage District	18
City of Madison	31
City of Verona	2
Village of Maple Bluff	3
Town of Dunn Sanitary District No. 1	4
Town of Dunn Sanitary District No. 3	3
Town of Madison	3
Dane County Lake Farm Park	1
Total	**65**

Quantity of Wastewater

The District received 13,300,360,000 gallons of wastewater at the NSWWTP in 2021. This was a 13.4% decrease from 2020. The average daily quantities of wastewater received from each municipality and through infiltration into the District's intercepting sewers in 2021 are shown in Table 11.

Table 11 – Average Daily Quantities of Wastewater

Municipality	2021(GPD)	% of Total
City of Fitchburg	1,902,000	5.22
City of Madison	22,403,000	61.48
City of Middleton	2,013,000	5.52
City of Monona	825,000	2.26
City of Verona	1,145,000	3.14
Village of Cottage Grove	681,000	1.87
Village of Dane	50,000	0.14
Village of DeForest	933,000	2.56
Village of Maple Bluff	121,000	0.33
Village of McFarland	582,000	1.60
Village of Shorewood Hills	136,000	0.37
Village of Waunakee	1,561,000	4.28
Village of Windsor	519,000	1.42
Town of Dunn San. Dist. No. 1	141,000	0.39
Town of Dunn San. Dist. No. 3	66,000	0.18
Town of Dunn San. Dist. No. 4	14,000	0.04
Town of Dunn Kegonsa San. Dist.	121,000	0.33
Town of Madison	570,000	1.57
Town of Pleasant Springs San. Dist. No. 1	68,000	0.19
Town of Verona	600	<0.01
Town of Verona Util. Dist. No. 1	28,000	0.08
Town of Vienna - Wyst59 LLC	100	<0.01
Town of Vienna Util. Dist. No. 1	64,000	0.17
Town of Vienna Util. Dist. No. 2	32,000	0.09
Town of Westport Sewer Utility District	448,000	1.23
Town of Westport - Cherokee Golf & Tennis	3,100	0.01
Total Wastewater	**34,427,000**	**94.48**
Infiltration into District Interceptors	1,996,000	5.48
Groundwater to District Interceptors from MMSD Construction Projects	17,000	0.05
Total Received at the Treatment Plant	**36,439,000**	**100**

Wastewater Treatment

The District has a single treatment plant, the Nine Springs Wastewater Treatment Plant. In 2021, the Nine Springs Wastewater Treatment Plant met all Wisconsin Department of Natural Resources (DNR) discharge limitations. This level of compliance qualifies the District for a gold

level Peak Performance Award from the National Association of Clean Water Agencies (NACWA).

Preliminary treatment includes influent wastewater fine screening and grit removal. Fine screening is accomplished by three rotating band screens with six-millimeter openings followed by a vortex grit system for grit removal. Variable speed drives for the band screens are used to control the influent well level. Grit is removed continuously from three vortex grit chambers. The dewatered grit and screenings are conveyed to dumpsters and hauled by a contractor to the landfill three to five times per week.

All material removed by the fine screens is conveyed to a screening processing well. Pumps macerate the screenings and pump them to compactors which squeeze water out of the screenings before they are placed in a dumpster. Two to four times a day, the grit is removed from this well. The grit and accompanying rags are pumped to a separate settling basin, termed a “snail.” The material settled in the snail is conveyed to the grit and screenings dumpster.

Following preliminary treatment, 19 primary settling tanks are used to remove floatable and settleable material from the wastewater. After primary settling, the wastewater is biologically treated in the activated sludge system. The activated sludge system consists of tanks with anaerobic, anoxic, and aerobic zones configured for biological phosphorus removal, ammonia removal and decomposition of organic material. The material flowing out of the aeration tanks is a mixture of cleaned water and microorganisms. It flows to secondary clarifiers for separation. The secondary clarifiers are a combination of center feed/peripheral draw off and peripheral feed/peripheral draw off configurations that efficiently remove the suspended bacterial solids to meet advanced secondary standards. Most of the solids, which contain the microbial culture, are pumped back to the aeration tanks. A certain percentage of solids are removed from the activated sludge process and pumped to the solids handling processes every day to maintain a desired bacterial population; these removed solids are referred to as waste activated sludge (WAS). An eight-to-ten-day solids retention time is normally maintained in the process.

During 2021, the secondary portion of the NSWWTP was operated as four separate treatment units. Effluent from the individual plants was monitored to ensure adequate process control and to provide information on differing operating modes.

The treated water is disinfected by ultraviolet irradiation from April 15 through Oct. 15 and pumped to surface outfalls on Badfish Creek and Badger Mill Creek. In 2021, approximately 34.67 million gallons per day (MGD) on average were pumped to Badfish Creek and 3.08 MGD were pumped to Badger Mill Creek.

The open-channel ultraviolet disinfection system has met the effluent fecal coliform concentration standard since it started operation in 1997. At the conclusion of the 2020 disinfection season (Oct. 16, 2020), this system was shut down for the last time, removed from

service, and replaced with a new and modern disinfection system. This new system was successfully operated throughout the 2021 disinfection season.

Primary sludge is pumped from the 19 primary settling tanks on a sequential basis and is pumped to three gravity thickener tanks. The solids concentration from the gravity thickeners averaged 5.3% in 2021.

The waste activated sludge is thickened on three gravity belt thickeners. Generally, two of the three units are in service with one unit as standby. The thickened solids concentration off the gravity belt thickeners averaged 6.5% in 2021.

The anaerobic digestion process was operated as a phased system throughout 2021. The sludge treatment flow train is normally run as follows:

- Gravity-thickened primary sludge is directly fed unheated to acid phase digestion.
- Thickened waste activated sludge is heated with steam injection and fed to acid phase digestion.
- One acid phase digester is heated to approximately 93 degrees Fahrenheit with an approximately 1.26-day (30-hour) detention time.
- Acid phase sludge is fed to east digesters 4-9 and the temperature is maintained at 95 to 98 degrees Fahrenheit. The detention time in the east digesters averaged approximately 34 days.
- Digested sludge from east digester 7 is normally pre-heated to approximately 120 degrees Fahrenheit through a Lackeby tube and shell heat exchanger and transferred to west digesters 1-3 for time/temperature Class A batching at 134 degrees Fahrenheit.
- The required batching time at that temperature is approximately 14 hours. In 2021, approximately 8% of the total biosolids mesophilically digested underwent additional time-temperature batch treatment to meet Class A liquid criteria.

Digested sludge from the east digesters is normally thickened on gravity belt thickeners. The thickened sludge is land applied as part of the Metrogro liquid land application program. Class A digested biosolids production started in November 2014. Most of the production has remained in the liquid form and is thickened on gravity belt thickeners in combination with the Class B biosolids and the resulting combination is handled as Class B liquid biosolids. After receiving approval by the DNR on Oct. 18, 2016, for the plan to produce and distribute Class A equivalent biosolids, the limiting factor in production has been demand for the product. In 2021, the centrifuge was only operated once in August to make Class A cake biosolids.

The digested biosolids concentration averaged 2.9% for 2021 from the east digesters and 1.7% from the west digesters after the time and temperature batching operation. The digested biosolids were thickened to an average concentration of 5.38% in 2021 through the addition of polymer on a gravity belt thickener. An average of 22.6 tons per day of digested biosolids was

thickened in 2021. Anaerobic digester foaming was kept under control through operational measures (such as feed time, liquid levels, and temperature adjustments) and limited use of chemical defoamant.

Filtrates from the digested sludge gravity belt thickening, centrifuge dewatering and the WAS thickening processes are combined and sent to the Ostara struvite harvesting process for nutrient recovery (as magnesium ammonium phosphate). The purpose of the struvite harvesting process is to remove phosphorus before anaerobic digestion where nuisance struvite is formed and to reduce phosphorus in the biosolids that will be land applied.

The District utilizes biological phosphorus removal in its secondary process. In this process, anaerobic/aerobic cycling is used to alternately release and take up phosphorus in excess of metabolic requirements. In the anaerobic section, with the availability of organic material in the form of volatile fatty acids, the bacteria release phosphorus. This aspect of biological phosphorus removal is also used in the anaerobic WAS treatment tanks before the WAS gravity belt thickeners. A low flow stream of acid phase sludge is recycled to the treatment tanks and contains significant concentrations of volatile fatty acids, more than 5,000 milligrams per liter. The volatile fatty acids in the acid phase sludge are utilized to affect release of phosphorus from the waste-activated sludge.

A significant amount of soluble phosphorus is also released in the acid phase digestion process. The filtrate from the WAS thickeners is thus rich in soluble phosphorus and is combined with the filtrate from the digested sludge thickener, which has a high ammonia concentration. These streams are fed to the struvite harvesting reactors, which were purchased from Ostara. Magnesium chloride and sodium hydroxide are added to enhance struvite formation. The process forms spheroidal struvite pellets.

By contract, the product is sold to Ostara in 1-ton bags. Ostara picks up the product and markets it as a slow-release fertilizer for applications where high phosphorus content is required. Performance optimization efforts in close association with Ostara are ongoing. For 2021, the total production was 563.1 tons being shipped off site.

The digested liquid biosolids produced by the District are marketed under the name “Metrogro.” The thickened biosolids from the gravity belt thickeners are either pumped directly to truck loading facilities or to the Metrogro storage tanks. During the winter, all biosolids are stored in the Metrogro storage tanks. The tanks have a storage capacity of 19.5 million gallons. The biosolids are hauled and applied to cropland as a soil conditioner and fertilizer.

As a byproduct of the anaerobic digestion process, gas is produced that is approximately 60% methane. Digester gas production averaged around 808,000 cubic feet per day in 2021. Part of the digester gas was used to fuel boilers for plant heating and to fuel a 650-horsepower blower engine, which provides air to aeration tanks. The remainder of the gas is used to fuel two

generator engines in Sludge Control Building #2. Before use in the engines and boilers, the gas is treated by a gas treatment system which removes moisture, hydrogen sulfide and siloxanes from the gas. An average of 15,903 kilowatt-hour of electricity was generated each day in 2021. In addition, the blower engine saved the purchase of approximately 7,060 kilowatt-hours per day of electrical energy. The District supplements digester gas production with natural gas purchased from Madison Gas and Electric.

The District takes advantage of the heat recovered from the engines to heat anaerobic digesters and most plant buildings as well as heating air in the struvite dryers. Jacket water heat and engine exhaust heat are recovered from all three engines when available. Lube oil heat is recovered from the generator engines, but not from the blower engine. If plant heating demands cannot be satisfied with recovered heat, there are three sets of three boilers available for satisfying the heating load.

The section in this report entitled “Nine Springs Energy Use Profile” describes in detail the electrical and thermal demands at the treatment plant. Table 14, “Annual Energy Use Summary” shows a complete breakdown of the thermal and electrical savings from the use of digester gas.

The 2021 wastewater treatment data are reported in accordance with the District’s Wisconsin Pollutant Discharge Elimination System Permit (WPDES) and a summary of this information is shown in Table 12. Monitoring data for effluent metals are reported in Table 13.

Table 12 – Yearly Log of Plant Operations 2021

Madison Metropolitan Sewerage District

Nine Springs Wastewater Treatment Plant

YEARLY LOG - PLANT OPERATIONS
2021

Month	Influent Flow (MGD)	BFC Effluent Flow (MGD)	BMC Effluent Flow (MGD)	BOD RAW CBOD (MG/L)	BOD Effluent CBOD (MG/L)	TSS RAW TSS (MG/L)	TSS Effluent TSS (MG/L)	Nitrogen RAW TKN (MG/L)	Nitrogen Effluent Ammonia (MG/L)	Phosphorus RAW TP (MG/L)	Phosphorus Effluent TP (MG/L)	Effluent FCOLI MPN/100 Mean(1)	Min Hr Effluent D.O. (MG/L)
Jan – 21	36.70	33.71	3.01	280	3.4	255	5.1	49.0	0.28	5.70	0.26		5.12
Feb – 21	37.40	34.54	2.85	309	3.6	256	4.9	53.6	0.33	6.21	0.26		4.51
Mar – 21	39.10	36.48	2.96	302	3.0	263	4.4	50.4	0.77	5.98	0.21		5.24
Apr – 21	37.94	36.27	3.02	315	3.4	283	5.3	52.0	0.64	6.18	0.32	67	5.22
May – 21	35.81	36.03	1.62	301	3.4	305	5.1	52.2	0.49	6.25	0.31	25	5.22
Jun – 21	35.64	35.72	2.59	320	2.0	320	4.1	52.4	0.11	6.69	0.29	28	2.21
Jul – 21	36.20	33.82	3.56	306	2.6	290	5.2	50.4	0.30	6.23	0.39	59	5.63
Aug – 21	36.68	34.30	3.51	288	3.3	285	6.5	50.7	0.54	6.27	0.55	118	4.98
Sep – 21	35.86	33.28	3.58	322	1.8	305	3.7	54.2	0.32	6.77	0.36	91	5.11
Oct – 21	36.22	32.95	3.58	325	1.8	297	3.8	53.2	0.40	6.74	0.32	57	5.23
Nov – 21	35.25	31.10	3.57	331	3.7	290	7.1	57.7	0.08	7.28	0.41		5.25
Dec – 21	34.50	31.08	3.06	335	3.4	272	5.0	57.2	0.16	6.86	0.32		5.48
Average	36.44	34.11	3.08	311	3.0	285	5.0	52.8	0.37	6.43	0.33	64	4.93

BFC is to Badfish Creek Outfall

BMC is to Badger Mill Creek Outfall

(1) Geometric mean

Table 13 – Influent and Effluent Metal Concentrations 2021

Date of Sample	Effluent MGD	Cadmium (T) (PPB) Inf	Cadmium (T) (PPB) Eff	Chromium (T) (PPB) Inf	Chromium (T) (PPB) Eff	Copper (T) (PPB) Inf	Copper (T) (PPB) Eff	Lead (T) (PPB) Inf	Lead (T) (PPB) Eff	Mercury (T) (PPT) Inf	Mercury (T) (PPT) Eff	Nickel (T) (PPB) Inf	Nickel (T) (PPB) Eff	Zinc (T) (PPB) Inf	Zinc (T) (PPB) Eff
Jan-21	36.72	0.13 b	0.13 b	2.10 q	1.6 q	61.8	7.03 q	1.92 b	1.92 b	118	0.63	2.77 b	2.77 b	117	51.1
Feb-21	37.39	0.13 b	0.13 b	3.63	1.0 b	64.3	11.10	2.04 q	1.92 b	51.6	0.94	2.98 q	2.77 b	129	41.5
Mar-21	39.44	0.13 b	0.13 b	5.31	1.5 q	84.3	10.90	3.04 q	1.92 b	43.2	0.74	4.90 q	2.77 b	168	48.4
Apr-21	39.29	0.13 b	0.13 b	4.04	1.0 b	82.9	9.59	1.92 b	2.42 q	93.9	0.83	3.79 q	2.77 b	152	44.9
May-21	37.65	0.13 b	0.13 b	3.89	1.0 q	76.4	11.20	2.04 q	1.92 b	50.2	0.80	3.11 q	2.77 b	128	40.6
Jun-21	38.30	0.13 b	0.13 b	4.67	1.4 q	92.5	7.06 q	4.47 q	1.92 b	71.3	0.68	3.52 q	2.77 b	181	45.7
Jul-21	37.38	0.13 b	0.13 b	3.31 q	1.0 b	86.1	4.35 q	1.92 b	1.92 b	52.6	0.73	3.38 q	2.77 b	147	55.8
Aug-21	37.81	0.13 b	0.13 b	2.54 q	1.0 b	86.6	11.80	1.92 b	1.92 b	89.9	0.83	2.77 b	2.77 b	152	35.6
Sep-21	36.85	0.13 b	0.13 b	2.92 q	1.0 b	83.2	10.20	1.92 b	1.92 b	134	0.55	2.87 q	2.77 b	180	65.8
Oct-21	36.53	0.26 b	0.26 b	3.16	0.6 b	152	5.34 q	7.03 q	3.15 b	32.4	0.73	4.66	2.11 q	143	39.8
Nov-21	34.67	0.26 b	0.26 b	3.38	0.6 q	257	11.50	10.5	3.15 b	75.0	0.55	5.22	1.95 q	147	50.6
Dec-21	34.15	0.26 b	0.26 b	5.22	0.8 q	189	11.70	8.58 q	3.15 b	165	0.85	5.57	1.86 q	214	39.1

"b" validation code indicates that sample concentration is less than the method detection limit

"q" validation code indicates that sample concentration is less than the limit of quantitation and above the method detection limit

Effluent MGD is monthly average of BFC outfall plus BMC outfall

RESEARCH

Pilot-scale study to evaluate total nutrient removal with low dissolved oxygen

To address energy demands and constantly strive to provide better treatment, the District continued a research project that was initiated in 2013 with Dr. Daniel Noguera (Civil and Environmental Engineering department, University of Wisconsin–Madison) to explore the possibility of removing both nitrogen and phosphorus at low dissolved oxygen concentrations. This work has continued for several years due to the relatively slow growth rate of the microorganisms involved and the novel nature of the research. The initial phases of work were aimed at reducing input oxygen levels to establish the practical boundaries of treatment. Early results suggested a potential to save approximately 30% on aeration energy costs for treatment while achieving the same or slightly better overall effluent quality. These initial results indicated that full-scale implementation in some form may be possible.

While early results have demonstrated an ability to achieve desired nutrient removal with reduced energy demand, negative impacts on sludge settleability were observed. Work in 2021 focused on understanding factors that may impact sludge settling characteristics, including the relationship between dissolved oxygen concentration and sludge settleability, and utilizing novel sludge wasting techniques to help enrich desired microorganisms. The work also introduced sampling for nitrous oxide to better understand biological nitrogen removal mechanisms. This work will be extended into 2022 in order to further evaluate process stability, factors impacting sludge settleability, and nitrous oxide. Results from this work will be utilized for future liquid process facilities improvements projects.

NINE SPRINGS ENERGY USE PROFILE

Table 16 shows an estimate of the total amount of electric and thermal energy used at the NSWWTP and the division between purchased and renewable (primarily self-produced) power. From 2017 to 2021, renewable energy used at NSWWTP provided roughly 36.6% of the plant's total energy needs and had an estimated total value just under $6.3 million.

Notes:

- The District fuels three large gas-driven engines from biogas produced in its anaerobic digestion process. Two of these engines drive electric generators while one powers an aeration system blower.
- In March 2016, it was discovered that the catalyst elements on the two generators were failing due to overheating resulting in damage to one catalyst housing. After discussions with the DNR, in January 2017 an agreement was reached with respect to the air permit allowing the District to operate both generators without catalysts under best available control technologies. The exhaust catalyst on the engine-driven blower continues to function in place.

- In early 2018, a generator engine experienced mechanical failure (thought to be attributable to excess temperature operations stemming from catalyst use) and required an off-site rebuild to correct, removing it from service for 3 months in all. The other engine generator was scheduled for rework in 2018 and started that process in December. Both events reduced the amounts of power generated as well as thermal energy to recover.
- A sustained high flow event in summer 2018 resulted in high power demands from the plant to maintain operations, specifically related to pumping. This also had the impact of increasing overall electric demand which, combined with less generation, reduced the percentages of renewable energy used.
- In 2021 the engine generators experienced downtime for maintenance and repairs, and in late 2021 the engine blower was removed from service for overhaul and repair. These events contributed to greater thermal energy generation from digester gas as well as decreased energy generation/avoided purchase.

Table 14 – Annual Energy Use Summary

Electric Energy	**2017**		**2018**		**2019**		**2020**		**2021**	
	kWh/ Day	% of Total	kWh/ day	% of Total	kWh/ day	% of Total	kWh/ day	% of Total	kWh/ Day	% of Total
Commercial Service Purchased from MG&E	60,646	67.0%	67,335	72.6%	65,918	70.9%	62,809	69.1%	64,571	73.7%
Wind Power Purchased from MG&E	40	0.0%	41	0.0%	40	0.0%	40	0.0%	40	0.0%
Generated from Digester Gas	20,160	22.3%	16,057	17.3%	17,627	19.0%	18,838	20.7%	15,903	18.2%
Avoided Purchase Due to Blower Gas Engine	9,605	10.6%	9,335	10.1%	9,378	10.1%	9,185	10.1%	7,060	8.1%
Total Used & Avoided	**90,451**		**92,768**		**92,963**		**90,873**		**87,574**	
Average cost of purchased power ($/kWh)	$0.0889		$0.0869		$0.0844		$0.0881		$0.0873	
Estimated total monthly value of energy used	$244,503		$245,140		$238,677		$244,135		$232,468	
Estimated monthly value of renewable energy	$80,568	33.0%	$67,206	27.4%	$69,436	29.1%	$75,396	30.9%	$61,062	26.3%
Thermal Energy	**2017**		**2018**		**2019**		**2020**		**2021**	
	therms/ Day	% of Total	therms/ day	% of Total	therms/ day	% of Total	therms/ day	% of Total	therms/ Day	% of Total
Generated from Natural Gas	593	25.2%	523	24.2%	533	22.7%	757	30.2%	580	25.2%
Generated from Digester Gas	157	6.7%	280	13.0%	356	15.2%	201	8.0%	387	16.8%
Recovered from Gas Engines	1,607	68.2%	1,359	62.9%	1,457	62.1%	1,545	61.7%	1,332	57.9%
Total hot water energy used	**2,357**		**2,163**		**2,346**		**2,503**		**2,299**	
Average cost of purchased gas ($/therm)	$0.5169		$0.5057		$0.4876		$0.3591		$0.5451	
Estimated total monthly value of gas used*	$49,408		$44,348		$46,391		$36,552		$50,830	
Estimated monthly value of renewable energy	$36,981	74.8%	$33,621	75.8%	$35,847	77.3%	$25,498	69.8%	$37,999	74.8%
Total Energy Use	**2017**		**2018**		**2019**		**2020**		**2021**	
	$ per Month	% of Total	$ per month	% of Total	$ per month	% of Total	$ per month	% of Total	$ per month	% of Total
Total Estimated Value of Energy Used	$293,912		$289,488		$285,068		$280,687		$283,297	
Estimated Value of Renewable Energy Used	$117,549	40.0%	$100,827	34.8%	$105,283	36.9%	$100,893	35.9%	$99,060	35.0%

* Conversion of natural gas to heat is assumed to be 75% efficient and heat recovered from the gas engines is assumed to be 40%.
Note – due to rounding, numbers may not add exactly.

STRATEGY

Staffing

The Strategy department was formed in 2016 by combining some staff from Engineering and Operations. In the fall of 2018, the information technology (IT) workgroup was transferred from the Administration department. Effective the end of 2020, the vacant Assistant Chief Engineer and Director position was reclassified to Capital Investment Policy Advisor and transferred to the department.

The Strategy department has 15 full-time employees:

- Senior Director of Strategy
- Capital Investment Policy Advisor
- Capital Planning Engineer
- Engineering Technician
- Strategic Performance and Policy Advisor
- Asset and Maintenance Management System Administrator
- Asset Management Specialist
- GIS Analyst
- District Technology Manager
- Records Program Administrator
- Programmer/Analyst (2)
- Network Administrator (2)
- Database Administrator

Responsibilities of Department

The department's main responsibilities are as follows:

- Asset management
- Business needs and technology systems analysis
- Capital finance
- Capital improvements planning
- Customer community requests for sewer extensions and annexations
- Data management
- Geographic information systems
- IT infrastructure administration and design

- Maintenance and replacement of the Oracle WAM system
- Quarterly service charges
- Software and systems support
- Software needs assessment and design
- Strategic financial planning
- Technology advising for workgroups and staff
- Technology planning and strategy

Programs, Initiatives and Work Reporting

ASSET MANAGEMENT

The department is responsible for the overall direction of the District's asset management efforts. The goals of asset management are to maximize the productive life of assets, minimize asset lifecycle cost, maintain needed service levels and manage risk. The department sets standards, monitors performance and helps other work groups succeed in their asset management duties.

Since the completion of the Nine Springs Asset Management Plan in early 2020, the District has begun the process of creating a Reliability Centered Maintenance (RCM) program at the District. This has included implementing a planning and scheduling process for the maintenance group and improving how the District's spare parts inventory is managed. This work has been supported by the expertise of the RCM firm ReliabilityX.

CAPITAL IMPROVEMENTS PLANNING

Each year the department prepares the District's Capital Improvements Plan. This plan includes the major capital projects that will be undertaken by the District in the next six years and the intended funding sources. Also included in the plan is a listing of revenue sources and expenditures for the capital fund and the status of the debt service fund. A draft of the Capital Improvements Plan is introduced to the Commission in July of each year and is accepted by them for planning purposes. Any changes to the plan are incorporated into the document and the plan is then used to prepare the annual capital budget. These documents are available on the District's website at madsewer.org/news-resources/plans-reports.

MAINTENANCE MANAGEMENT AND FINANCE SYSTEMS

The department is responsible for the District's Oracle Work And Management (WAM) system. It supports several important functions at the District, including maintenance management, some financial functions and some human resources functions. The system is one of the District's most important, along with the plant process control system. However, WAM needs to be replaced because Oracle support for the District's version of the product is ending and other systems will better suit the District's future needs.

The District is replacing WAM with separate maintenance management and financial systems. Depending on the market, systems or additional modules to support human resources functions and IT asset management are also likely to be added. The effort is supported by a project in the Capital Improvements Plan. Work in 2021 focused on helping the accounting team prepare a request for proposals for work on updating the chart of accounts, a first step in the project.

COLLECTION SYSTEM

The department is responsible for the review and approval of any proposed connections to, or alterations of, the public sewerage system within the District's service area. District staff ensure that plans for new public sewers are in conformance with the District's sewer use ordinance and determine the amount of connection charges that are due prior to connection to the system.

The department also is charged with adding new lands to the District's service area through the annexation process. Requests for annexation to the District are submitted by the District's customer communities and are reviewed by staff for conformance to District policies and to regional planning standards of the Capital Area Regional Planning Commission. In 2021, the District processed 68 sewer extensions and four annexations, adding 48 acres to the District's territory.

GEOGRAPHIC INFORMATION PROGRAM

The geographic information program supports the District's need for the management, analysis and mapping of spatial information. Treatment plant maintenance, engineering projects and sewer maintenance are supported by having District asset information accessible on an interactive map both in the office and in the field.

Additionally, the geographic information program has developed applications to improve workflows and distribute information more efficiently. Examples of this include the publicly available Paid Areas Viewer to track District connection charge payment status; the MMSD Collection System Viewer used to provide collection system asset information both internally and externally; the Nine Springs Asset Viewer to inform users about plant assets and utilities; and the new GPS data collection workflow to improve accuracy of the District collection system GIS.

INFORMATION TECHNOLOGY

The District's information systems (IT) workgroup provides infrastructure support, software support, system administration, cybersecurity services, design services, data management, database administration, records administration and technological consulting services for all departments at the District. Services and systems of note are listed by department in the following summary.

Finance

Supported services and applications for the function and productivity of the Finance workgroup include Sage accounting system; budgeting database system; pumping station billing database and applications; custom maintenance management system reports; Optimas reporting system; and the rate-setting database and applications.

Ecosystem Services

The Ecosystem Services team is supported by IT staff in the management of the Metrogro hauling and land application database; septage receiving database and applications; the laboratory's Ethosoft X-LIMS laboratory information system; laboratory software integration applications; the home well-sampling application; the application to create eDMR submissions; and the pretreatment database and applications.

Engineering

Systems supported for the work of the Engineering department include the construction administration database, construction plan holders application and the easements database.

Operations and Maintenance

These applications and programs are supported for the work of the Operations and Maintenance department: Data Access and Reporting Center (DARC) process reporting system; process control data transfer and analysis; process control system reporting; lock-out/tag-out database and applications; work scheduler application; Optimus reports; Citrix virtual desktop and applications; and the manhole inspection database and applications.

Strategy

Supported technology for the Strategy department includes the Geographical Information System (GIS) geodatabase and applications; connection charges database and applications; collection system applications; Oracle Work and Asset Management (WAM) system (especially CRM and asset-related functions); and the user charge billing system.

Leadership and Support

Services provided to the District's Leadership and Support department include the administration of technology for the internal websites; security camera technology support and administration; support for meeting and event-related software; administration services for Agenda Management; and general Commission-related technology support.

District-Wide

The IT group supports and administers these District-wide programs and systems: network infrastructure; digital information storage; server virtualization; desktop virtualization; virtual private network; network security; Cybersecurity Awareness Training (CAT) program; records

management and administration; cybersecurity tools and systems; email systems; printers, scanners, and plotters; enterprise and workgroup databases; business analysis; computer and device programming; smartphones and cellular devices; technology project management; technology planning and strategy; desk phone system; software upgrades and testing; software customization and configuration; license management; technology asset management; and network disaster recovery planning.

Notable work and changes in 2021 include new processes to obtain and configure a variety of technology for remote workers; expanded Microsoft Teams tools, SharePoint site functions and new Office 365 applications; upgraded network hardware and software to increase performance; expansion of the records program to support more workflows for onboarding and agenda management; and planning and strategy development for the future migration of the Oracle WAM system.

SERVICE CHARGES

Service charges are the District's primary source of revenue and are paid by the District's 26 owner communities. Each year, the District calculates service charge rates that are expected to provide the revenue requirement approved by the Commission in the annual budgeting process. These rates are then multiplied by sampled flows and loadings to calculate quarterly service charge bill amounts for each of the District's 26 owner communities.

In 2021, the District collected $45 million in service charge revenues, which exceeded the budgeted amount by $1.7 million. This surplus was driven by higher-than-expected levels of two of the seven rate parameters, Carbonaceous Biochemical Oxygen Demand (CBOD) and Total Suspended Solids (TSS), as measured at the Nine Springs Wastewater Treatment Plant.

The District's 2021 service charge rates, shown in Table 15, were adopted by the Commission on Oct. 29, 2020.

Table 15 – 2021 Service Charge Rates

Parameter	Rate	Units
Volume	$919.30	per million gallons
CBOD	$0.19579	per pound
Suspended Solids	$0.31950	per pound
TKN-Nitrogen	$0.50093	per pound
Total Phosphorus	$5.55236	per pound
Actual Customers	$41.03	per year
Equivalent Meters	$37.00	per year

While service charges are billed to municipalities and not directly to residents, average residential charges can be estimated based on typical wastewater volume and strength. In 2021, the District's service charge for an average home was $237 per year or $19.75 per

month.

These charges are in addition to what the District's owner communities charge for their own sewer infrastructure and services. For example, in 2021, the average annual charge for a home in the City of Madison, the District's largest owner community, was $385, including both the District's service charges and the City's own charges. The national average for annual sewer service charges in 2021 was $518 per year, according to the National Association of Clean Water Agencies.

Table 16 - Costs per Million Gallons of Wastewater Treated

District Function	2017	2018	2019	2020	2021
Administration	$369	$368	$403	$375	$435
Collection	$169	$154	$171	$184	$271
Treatment	$810	$777	$782	$911	$1,101
Debt Service	$891	$887	$903	$1,034	$1,244
TOTAL	**$2,239**	**$2,185**	**$2,259**	**$2,504**	**$3,051**

The District's costs are largely fixed in nature. In 2021, the District experienced a decrease in wastewater flow to the Nine Springs Wastewater Treatment Plant, while the District's largely fixed costs increased. As a result, the cost per million gallons of wastewater treated increased from $2,504 in 2020 to $3,051 per million gallons in 2021, as shown in Table 16.

Financials

FINANCIAL SUMMARY FOR THE YEAR ENDED DECEMBER 31, 2021

This statement is for informational purposes only and is not intended to represent full financial disclosure. Complete financial statements and related footnotes are available on our website at madsewer.org or available upon request.

STATEMENTS OF REVENUES, EXPENSES, AND CHANGES IN NET POSITION
Years Ended December 31, 2021, and 2020

	2021	2020
OPERATING REVENUES		
Charges for services:		
Transmission and treatment of sewage	45,152,382	$39,520,330
Servicing pumping stations	514,389	489,646
Septage disposal	967,427	829,125
Pretreatment monitoring	29,922	29,150
Struvite Harvesting	212,279	245,382
Total operating revenues	**46,876,399**	**41,113,633**
OPERATING EXPENSES		
Administration	5,783,541	6,516,650
Treatment	14,651,050	13,962,474
Collection	3,597,821	3,299,880
Depreciation	9,302,596	8,557,312
Total operating expenses	**33,335,008**	**32,336,318**
Operating income	**13,541,391**	**8,777,315**
NONOPERATING REVENUES (EXPENSES)		
Investment income (losses)	19,244	245,763
Rent	83,534	86,084
Other	247,642	263,099
Capital assets contributed to other governments		
Construction expenses	(2,120,504)	(2,010,225)
Disposal of property and equipment	(483,043)	(2,668)
Interest expense	(3,104,684)	(2,947,661)
Total nonoperating revenues (expenses)	**(5,357,811)**	**(4,365,609)**
Income (loss) before capital contributions	8,183,580	4,411,706
CAPITAL CONTRIBUTIONS		
Contributed assets	-	-
Conveyance Facilities Connection/Treatment charges	3,814,145	3,898,368
Total capital contributions	**3,814,145**	**3,898,368**
CHANGE IN NET POSITION	11,997,725	8,310,074
NET POSITION		
BEGINNING OF YEAR, AS PREVIOUSLY REPORTED	156,934,036	148,623,962
RESTATEMENT		
BEGINNING OF YEAR, RESTATED	**156,934,036**	**148,623,962**
END OF YEAR	$168,931,761	$156,934,036

SUPPLEMENTAL DETAILED INFORMATION

The following information was prepared by staff members of the Madison Metropolitan Sewerage District and is not part of the independent auditor's financial report.

MADISON METROPOLITAN SEWERAGE DISTRICT

GENERAL FUND

Year Ended December 31, 2021

(with comparative amounts for 2020)

Repair and Replacement Expenditures	2021	2020
City of Madison Pumping Stations	161,295	86,646
City of Verona PS	(1,187)	12,469
Collection System Base	49,617	68,047
Dane County Parks	936	56
East Interceptor	512	443
Engineering & Administration	243,250	200,489
Far East Interceptor	341	
Lower Badger Mill Creek	51	
Nine Springs Treatment Plant	941,907	1,032,808
Nine Springs Treatment Plant Vehicles	147,281	205,317
Nine Springs Valley Interceptor	63,018	1,156
Northeast Interceptor	27,143	2,958
Pumping Station No. 1	16,170	8,267
Pumping Station No. 10	10,072	62,645
Pumping Station No. 11	1,490	3,516
Pumping Station No. 12	8,235	9,159
Pumping Station No. 13	5,424	4,712
Pumping Station No. 14	139	2,501
Pumping Station No. 15	5,330	2,622
Pumping Station No. 16	13,404	3,574
Pumping Station No. 17	22,887	21,666
Pumping Station No. 18	14,044	13,756
Pumping Station No. 2	48,819	49,709
Pumping Station No. 3	13,002	621
Pumping Station No. 4	622	1,853
Pumping Station No. 5	8,660	19,455
Pumping Station No. 6	327	15,683
Pumping Station No. 7	69,826	17,456
Pumping Station No. 8	14,824	47,413
Pumping Station No. 9	1,098	1,198
Southeast Interceptor	-	831
Southwest Interceptor	3,062	153
Town of Dunn #3	574	1,953
Town of Dunn SD #1 Pumping Stations	1,264	1,174
Town of Madison Pumping Stations	1,717	6,122
Village of Maple Bluff Pumping Stations	663	202
West Interceptor	432	2,655
Total Repair & Replacement	1,896,249	1,909,285

Capital Outlay Expenditures	2021	2020
CIP	257,887	4,149
Concrete Sewer	-	-
Communication Equipment	-	5,076
Office Furniture	-	17,277
Electrical Equipment	31,895	8,121
Heavy Mechanical Equipment	62,489	9,124
Instrumental & Control Equipment	116,193	9,370
Light Mechanical Equipment	42,709	222,927
General Equipment	60,035	30,786
Office Equipment	47,707	250,601
Lab Equipment	104,691	30,063
Fixed Improvements	-	
Structure	16,357	-
Vehicles	167,757	197,042
Total Capital Outlay	907,720	784,535

Protecting public health and the environment

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