Thriving Through Change

2020 Annual Report

Madison Metropolitan Sewerage District

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Introduction

Thriving Through Change

The pandemic brought significant changes to the District in 2020. While we continued to fulfill our mission, we made efforts early on to reduce spending and critically review or delay projects in recognition of the financial hardships the pandemic may have caused our owner communities. The budgetary measures were done in balance with important investments needed to ensure operational continuity. For instance, the Commission graciously approved hazard pay for those staff reporting to the plant at the start of the pandemic. In addition, the quick move to remote work meant increased investments in technology for staff to work from home. While this came with a cost, the lessons learned from this shift have allowed us the opportunity to find tools and technologies and to work toward establishing policies and support systems for a more flexible workforce in the future.

Despite the shift in how we did our work, it didn't change the work we were committed to doing. For instance, the District continued to engage in long-term, ongoing collaboration with our owner communities; two such examples are our inflow and infiltration (I/I) program and the Salt Savers water softener rebate program we are working on with the Village of McFarland and Town of Dunn.

2020 was a building year for the I/I program, working with an advisory committee of six owner community representatives to explore options and set a framework for moving the program forward. For Salt Savers, the Pollution Prevention team worked closely with these communities to format and roll-out rebate programs, and then adapt them to the restrictions of the pandemic. Both programs are examples of capitalizing on new opportunities that address challenges facing the District in collaborative ways that add value for our communities.

2020 was also a building year at the Nine Springs treatment plant. Of particular note, liquid processing improvements, which included a replacement of the UV disinfection system, upgrades to Headworks and repairs to tanks and channels, are underway. During 2020, $9.7 million was spent on construction for this project, which equated to approximately 155 jobs, a win for the local economy during the pandemic.

This annual report demonstrates that even with the pandemic, shifting restrictions, a significant change in work, and fiscal challenges and constraints, the District thrived and embraced change in 2020. 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 during a truly global public health crisis.

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 ending June 30, 2021
- 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
- Brad Murphy; term ending June 30, 2021
- Tom Wilson; term ending June 30, 2024

Note: D. Michael Mucha serves as the Chief Engineer and Director of the District. Dave Gawenda, 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; due to the pandemic, Executive Team meetings moved to a virtual platform in 2020.

The directors oversee the following departments:

- District Leadership and Support (Chief Engineer and Director)
- Ecosystem Services
- Engineering
- Operations and Maintenance
- Planning & Strategy (which was renamed to Strategy in late 2020)

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 coworkers, 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 (formerly "Planning & Strategy") 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 2020.

Figure 1 Organization Chart

Personnel

In 2020, the District employed 109 full-time employees (FTE). Table 1 represents the District's overall staffing from end of year 2019 to end of year 2020.

Table 1 – FTE Employees

DEPARTMENT	2019 FTE COUNT	2020 FTE COUNT
District Leadership and Support	14	14
Ecosystem Services	17	18
Engineering	8	8
Operations and Maintenance	51	55
Planning and Strategy	14	14
TOTALS	104	109

2020 NEW POSITIONS, RETIREMENTS AND PROMOTIONS OF DISTRICT EMPLOYEES

WHAT WE DO

For 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 41 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 2020, 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 2020, the District added 945.7 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
Monona Grove Elementary School	2020-01	Village of Cottage Grove	42.0
Pioneer Pointe	2020-02	Town of Middleton	127.7
Welton Family LP	2020-03	City of Madison	0.6
DeForest Area School District	2020-04	Village of Windsor	60.3
Whispering Coves	2020-05	City of Verona	198.2
Gust Lands	2020-06	City of Verona	68.3
North Annexation	2020-07	Village of Cottage Grove	184.9
Theis Trust Property	2020-08	City of Madison	35.4
East Side Growth Area	2020-09	Village of McFarland	218.2
Edison, LLC Property	2020-10	City of Madison	2.2
Epic 2020	2020-11	City of Verona	7.9
		TOTAL	945.7

Department Summaries

DISTRICT LEADERSHIP AND SUPPORT

Staffing

The District Leadership and Support workgroup has 13 full-time employees and 4 part-time employees:

- Chief Engineer and Director
- Budget Manager/Comptroller
- Communications and Public Affairs Manager
- Human Resources Manager
- Health, Safety and Security Leader
- HR Generalist (part time)
- Executive Coordinator
- Program Resource Assistant
- Program Resource Associate (2 positions - one is part time)
- Multimedia Graphic Artist (part time, unfilled for most of 2020)
- Accountant (2)
- Accounting Assistant (1)
- Procurement Agent
- Purchasing and Inventory Assistant
- Purchasing Assistant (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 and security
- Budget, accounting, payroll and procurement support for all District departments

- Clean Water Fund loans administration, including loan applications and disbursements
- Annual service charge rates preparation
- Accounting services for the Yahara Watershed Improvement Networks (Yahara WINS)
- Purchases parts, materials and services and maintain parts inventories

Programs, Initiatives and Work Reporting

GOVERNANCE

The Commission and District are organized according to the policy governance model. In this model, the Commission represents the District's owners, sets overall policy according to the needs of those owners and delegates management of the District to the Chief Engineer and Director.

In 2020, the Commission amended its policy book to redefine District owners as such: "District owners are each municipality which jointly or separately owns or operates a sewerage collection and disposal system which has territory included in the District boundary."

RESOURCE/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. In 2020, the Resource and Communications team promoted the District's 90th anniversary; supported Pollution Prevention team initiatives, including a flushables social media toolkit for owner communities; and were essential to helping the District adopt virtual platforms for meetings. The team also launched two microsites, which are small websites that support District initiatives; one site is for Shop One and the other supports the District's PFAS initiative. The PFAS website provides a single source of information and education about PFAS in wastewater and biosolids and the District's PFAS work. The team also completed the District's strategic marketing and communications plan.

Two other major accomplishments for the team were the build-out and roll-out of agenda management to streamline administration of Commission meeting materials and the completion of a project to scan in historical documents related to the District's Superfund site.

HUMAN RESOURCES

2020 saw significant change in the District's Human Resources (HR) department. On a positive note, the department was approved to hire a part-time HR Assistant to help support District HR functions. Ileana Rodriguez was hired in March for that position and worked in the office just four days before COVID-19 forced the closure of District offices. However, Ileana worked from home for the remainder of the year and has been a positive addition to the team. At the end of September 2020, longtime HR Manager Jenni Peters left the District for a new position, and Ileana managed HR functions for the remainder of the year. As a result, this position was reclassified to an HR Generalist, and we allocated funds to make it a full-time position in 2021.

COVID-19 affected the District greatly, and HR was involved in shaping the District's response to the pandemic. HR led 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 and took over leadership of the team when the former HR Manager left. The District created emergency pay and leave policies to address the pandemic and pivoted to a work-from-home model for as many employees as possible. Keeping the District's status as critical infrastructure in mind 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.

Because of COVID-19 and working at home, many HR projects that had been identified for 2020 were put on hold or modified. Even with the pandemic, the Inclusion & Diversity Committee was able to successfully complete a culture walk audit of facility spaces. The results of the audit were reported to the Executive Team and action items will be implemented in 2021. In addition, the Employee Leadership Council (ELC) completed its Employee Morale report and presented results to the Executive Team in December. Action items from that report will also be implemented in 2021.

SAFETY

The District has now fully installed a state-of-the-art camera system that provides physical security but also oversight of operation processes. The cameras have proven themselves to be very beneficial during 2020, their first full year of operation.

Through a new Fall Protection program created and implemented by Kayce Board, Health, Safety and Security Leader, the District saved upwards of $10,000 on repairs and replacement equipment. 2020 incident rates remain at an all-time low with no lost time or job transfers from work related injuries as shown below in Table 3.

Table 3 – Incident and DART Rate Comparison

Year	Incident Rate	DART Rate
2011	5.50	5.50
2012	2.14	1.07
2013	4.18	4.18
2014	9.20	4.60
2015	5.70	2.30
2016	3.4	1.1
2017	3.5	3.5
2018	6.5	4.3
2019	0.88	0
2020	2.40	0

BUDGET AND ACCOUNTING

Significant achievements and work advanced in 2020 include:

- Obtained an audit for the District and Yahara Watershed Improvement Networks (Yahara WINS) for fiscal year 2020 that found no material weaknesses or significant deficiencies (a "clean" audit)
- Received the Government Finance Officers Association (GFOA) budget presentation award for the District's 2020 budget document, the District's eighth year receiving the award
- Developed the first strategic plan for the department identifying short- and long-term goals for modernizing systems; creating efficiencies; increasing customer satisfaction; and focusing on staff development.

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 2020 include:

- Supported Reliability Centered Maintenance (RCM) project implementation of new workflows that have impacted purchasing, receiving and inventory management. New documented 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
- Advanced the reassignment of buyer duties from the procurement agent to the purchasing and inventory assistant.

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 91 sampling points in 2020. The sampling points generated 4,478 samples throughout the year. The analysis of the user-charge field samples and Nine Springs Wastewater Treatment Plant influent samples by the District lab yielded 16,201 sample results for use in the user-charge billing process.

SEWERAGE SERVICE CHARGES

Prior to the beginning of each calendar year, the District furnishes a written estimate of the cost of sewerage service for the ensuing year to each municipality in the district. This estimate is based on the previous year's wastewater contributions, any anticipated changes that may alter the municipality's prevailing volume and loadings trends, and the service charge rates for the ensuing year.

The District's 2019 service charge rates, shown in the Table 4, were adopted on Oct. 25, 2018. The 2019 rates included a 0.66% surcharge to recover the DNR NR101 effluent fees.

Table 4 - Service Charge Rate Summary Information

Parameter	Rate	Units
Volume	$655.36	per million gallons
CBOD	$0.15905	per pound
Suspended Solids	$0.26775	per pound
TKN-Nitrogen	$0.40279	per pound
Total Phosphorus	$4.18724	per pound
Actual Customers	$36.45	per year
Equivalent Meters	$36.38	per year

Wastewater volumes, CBOD loadings, suspended solids loadings, total Kjeldahl nitrogen (TKN) loadings and total phosphorus loadings are determined each quarter for each community.

These determinations are based on a minimum of seven consecutive days of monitoring data for the current quarter and previous quarter's discharge data for each community.

Meter equivalencies are based on the capacities of the different sizes of water meters used throughout the District. A 5/8-inch water meter has a capacity of 20 gallons per minute and is defined as one equivalent meter. The capacities of larger water meters are divided by the 20 gallon per minute capacity of a 5/8-inch water meter to determine their meter equivalencies. An actual customer is defined as one water meter without regard to size. The numbers of equivalent meters and actual customers in each municipality are set by counting the number of each size of water meter in service in each municipality where water meters are used. In municipalities where water meters are not used, the number of each size water meter that would be required is estimated.

In 2019, the average annual residential service charge in the District was about $343. This amount includes $195 for services provided by the District and $148 for services provided by the municipality (e.g. the City of Madison). A survey of 176 of the nation's largest municipalities indicated that the typical residential service charge in the District in 2019 of $343 is 67% of the national average of $512.

Operating costs per million gallons of treated wastewater for the years 2016 through 2020 are shown in Table 5. The cost per million gallons increased in 2019 to $2,259 per million gallons.

This 3.3% increase compared to 2018 was due to an overall cost increase of 6.1% and a volume increase of 2.7%. Operating costs per million gallons decreased by 2.4% in 2018 compared to 2017 due to an overall cost increase of 4.0% and a volume increase of 6.5%.

Table 5 - Costs per Million Gallons of Wastewater Treated

District Function	2016	2017	2018	2019	2020
Administration	$357	$369	$368	$403	$375
Collection	$142	$169	$154	$171	$184
Treatment	$774	$810	$777	$782	$911
Debt Service	$866	$891	$887	$903	$1,034
TOTAL	**$2,139**	**$2,239**	**$2,185**	**$2,259**	**$2,504**

The increase in costs was largely due to increased salary, contracted services, electricity, replacement parts and services costs.

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 26 loans under this program. A total amount of $268.4 million has been financed through these Clean Water Fund loans. Two new Clean Water Fund loans were obtained in 2020. The District had no other Clean Water Fund loans for which the final disbursement had not been received by the end of 2019. 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 November 1, 2020. The first principal payment will be made on May 1, 2021. The final payment will be made on May 1, 2040. The District had received $9,582,563 for this project as of December 31, 2020.

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 August 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 November 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 $14,550,746 for this project as of December 31, 2020.

ECOSYSTEM SERVICES

Staffing

The Ecosystem Services department has 18 full-time employees:

- Director of Ecosystem Services
- Lab Manager
- Pollution Prevention Manager
- Resource Recovery Manager
- Metrogro Operations Supervisor
- Pretreatment Coordinator
- Watershed Programs Coordinator
- Biosolids Program Assistant
- Chemist (6)
- Metrogro Mechanic (2)
- Pollution Prevention Specialist (2)

Responsibilities of Workgroup

The purpose for the Ecosystem Services department is to envision and execute next generation water quality and resource recovery solutions. It is responsible for the 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. While the team transitioned to a virtual work environment in March 2020, they were able to sustain and improve their initiatives partially because of their foresight to leverage GIS and develop virtual tools over the past few years. Major pollution prevention activities in 2020 included continued

efforts to reduce chloride and mercury. The addition of a grant-funded staff member at mid-year helped accelerate our chloride reduction program and move Wisconsin Salt Wise ahead.

Chloride Reduction

Much of the District's chloride reduction efforts in 2020 related to empowering more people to take action to reduce the amount of salt entering the sewer system. The District launched the Salt Savers pilot program in the Town of Dunn in late 2019. The pilot was designed to reduce barriers, incentivize and give residents clear recommendations on how to improve their water softeners. The District planned to launch a second iteration of this pilot in McFarland in early 2020 but paused both programs with the onset of COVID-19.

During the program pause, District staff took the opportunity to enhance the technological tools that are integral to the administration of the program. Working with ESRI consultants hired under a yearlong contract, the program's reporting app, review dashboard and job summary reports underwent substantial improvements, ultimately resulting in making the program easier for service providers, reviewers and participating residents.

Another part of the Salt Savers program that pivoted due to the pandemic was service provider training. Service providers participating in the program are required to complete a training in order to ensure consistent information about the District's chloride goals is given and consistent recommendations about softener efficiencies are applied. Before 2020, the District had delivered these trainings in person, but in August 2020 the first online softener training was held to accommodate the District's gathering rules. Like other lessons learned through the necessities of the pandemic era, the relative ease and flexibility of offering online training is a lesson that will likely inform post-pandemic programming.

Following local health department guidance about permitted service activities, the District restarted the Town of Dunn program in summer 2020 and launched the McFarland version in November 2020. To evaluate effectiveness of the pilot, along with program participation, monitoring equipment was installed in Pumping Station 9 to track change against baseline chloride levels.

Efforts to impact chloride source reduction through partnership continued in 2020 through Wisconsin Salt Wise. Notably, this year's partners funded a coordinator position for the organization. The addition of a dedicated staff person allowed Salt Wise to make significant strides in 2020. The coordinator conducted several outreach events and built key connections statewide to begin transitioning Salt Wise from a localized, informal partnership into a statewide presence that is a leading resource on salt reduction in Wisconsin.

Mercury Minimization

Remote tools also helped the District adapt its mercury minimization activities to the changed circumstances in 2020. The District had already created an online version of its annual dental amalgam certification form in previous years, and so in 2020 it was relatively simple to update

the form and carry out the annual certification entirely online. A large majority of clinics returned their forms online, and there were few reported issues, so the District felt that the online reporting system was a successful method of gathering data from dental clinics to verify proper mercury management. In addition to making data collection more efficient and paper-free, using the ArcGIS form helped improve data organization and analysis due to the consolidation of submitted data in one online database. This structure helps District staff monitor dental data as it is submitted and easily identify practices that need correction to maintain low mercury levels.

In 2020, District staff also laid groundwork for innovative mercury source reduction. It can be challenging to determine the remaining sources of mercury to the plant due to a limited data set. To effectively target sources of mercury, it is crucial to know where mercury is coming from. The District's Pollution Prevention team got in contact with a research team at the U.S. Geological Survey's Mercury Research Laboratory that uses an innovative process to trace mercury in a water sample to specific sources based on the forms of mercury in the sample. The team has used this process in surface waters, but never before in wastewater. Connecting with this team paved the way for a special sampling project to start in 2021 that has the potential to shed new light on where mercury is coming from in the sewer system and help the District better understand how best to prevent it.

Non-Flushable Materials

As headlines of national toilet paper shortages swept the nation in 2020, and more people than ever before expanded their use of digital platforms, the Pollution Prevention team took the opportunity to test the efficacy of online platforms to capture information about public sentiment, attitudes and barriers around the issue of flushing wipes. Information gained was compared to the 2019 Community Values Survey and provided useful insight that will inform messaging and conscious, proper use of injunctive and descriptive norms in future efforts.

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

While tours have historically been the District's primary education activity, COVID-19 obligated the District to suspend tours starting in March 2020. During the shutdown, the Pollution Prevention team created an alternative, online way for people to learn about the plant and how it fits into the water cycle. Using StoryMaps, an application within the District's ArcGIS suite, a virtual plant tour was created that is available on the District's tours webpage. A Pollution Prevention specialist used this tool as a basis for a "live tour" webinar presentation to

students at Glacial Drumlin Middle School in June 2020.

In addition to providing a remote alternative to plant tours during COVID-19, this tool can help supplement in-person tours in the post-pandemic future by supplying an overview of plant processes that anyone can access regardless of where they are.

Shop One

Shop One, the former maintenance building at the District, is an opportunity for the District to engage and connect with the broader community on water topics. In the future, the District intends to make major improvements to this building to support its educational purpose. Despite the pandemic, the District was able to take initial steps towards this vision in 2020. A panel of artists and cultural practitioners convened to guide the formation of catalytic projects. These projects are to be designed in a way that kickstarts programming and builds capacity. This work was supported by the US Water Alliance's inaugural Arts Accelerator program.

Community Outreach

Prior to pandemic shutdowns, District staff appeared at in-person community outreach events. In January 2020, the Pollution Prevention team designed an interactive game for elementary school-aged and younger kids. It was built in-house with materials on hand and used for outreach at the Madison Children's Museum's annual "National Poop Day," at Marquette Elementary School's Science Night and at plant tours in early 2020.

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 19 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 2020.

The industrial pretreatment program also maintains an additional 21 permits for non-typical organic industrial users, as well as permits with approximately 42 waste haulers. All waste haulers that use District facilities received annual permits in August. Staff members continued to perform waste acceptance reviews and to 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 2020, the District accepted waste from 37 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 2020, hauled wastewater treatment revenue exceeded $816,000. Approximately 36 million gallons of wastewater were received via truck in 2020.

The following table lists the five domestic septage categories, the number of gallons of septage received during 2020 and the percent of increase or decrease in volume from 2019 to 2020.

Table 6 – Domestic Septage Received (Gallon)

Septic Tank	Holding Tank	Grease Trap	Settling Basin	Portable Toilet
13,109,000	17,938,000	1,243,000	238,000	608,000
1% increase	4% decrease	28% increase	11% increase	5% decrease

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 2020, other wastewater types and volumes that were received are listed in the table below.

Table 7 – Other Wastewater Types Received

Wastewater Received	Volume (gal)
Village of Belleville Biosolids	575,000
Refuse Hideaway Landfill Leachate	40,000
Middleton Landfill Leachate	11,000
Verona Landfill Leachate	800,000
Meat Processing Industries	960,500
Other Gray Water	357,000
Grocery Store Food Waste	72,000

Remediation Projects Groundwater	79,042
WVDL Tissue Digester Residue	9,000
Laboratories Wastewater	43,000
Other Industrial Wastewater	143,000

LAGOON SITE PROJECT

Routine inspections, operations and maintenance activities continued in 2020. These activities included monthly visual inspections of capped areas and containment dikes, water management and vegetation control. Vegetation control in 2020 consisted of tree removal and mowing the dike roads and capped cells as ground conditions permitted. Trees along the northeast corner were damaged by a colony of beavers and were subsequently removed to avoid potential disturbance to the dike roads in the event the trees would fall. In spring and fall 2020, the District continued its nuisance-wildlife management program to remove the beavers and protect dike integrity from rodent burrows.

Capital Improvement Project planning in 2019 identified Capital Project #A15 to survey and evaluate the lagoon dike system as part of an engineering and maintenance prioritization plan. This was done in response to the 2018 flooding that forced the District to repair a small dike breach that was allowing river water from Nine Springs Creek to enter the lagoon area. In late 2020, an RFP was prepared in order to hire a consultant to begin work on Capital Project #A15. The RFP will be used to select a consultant in early 2021 to begin work on this multi-phase project. The first phase of the project, to be completed in 2021, includes survey, wetland delineation and a geotechnical investigation. Collected data will be used to evaluate the dikes and recommend and prioritize any repairs or maintenance.

WATERSHED PROJECTS

Yahara Watershed Improvement Network

In 2020, the District-led Yahara WINS adaptive management project completed its fourth 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. In 2020, the partnership was able help implement successful urban and agricultural practices. It is anticipated that 2020 will see the same success as 2019, when more than 55,000 pounds of phosphorus was kept out of area surface waters.

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 2020, District staff collected water chemistry samples and conducted macroinvertebrate surveys. All water chemistry samples were analyzed at the District's laboratory. 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 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 are used for traditional flow measurements. The stations in the Sugar River watershed are used for flow, temperature, dissolved oxygen and conductivity measurements.

LABORATORY ACTIVITIES

During 2020 the District laboratory performed 72,739 analyses on 16,895 samples.

Table 8 – Analyses Performed in 2020

PARAMETERS	QUANTITY
Nutrients (TKN, TP, NH3-N, PO4-P, WEP)	20,703
Solids (Suspended and Total)	24,647
Biochemical Oxygen Demand	4,996
Anions (Cl, NO3-N, NO3+NO2, NO2-N, SO4)	4,272
Field Measurements (pH, TEMP, COND, DO)	5,328
Metals	6,067
Bacteria (FCOLI, TCOLI, ECOLI, Salmonella)	1,587
Volatile Fatty Acids (VFA)	3,549
Misc. Testing (Alkalinity, Density, Chlorophyll, CH4, CN, WET, TDS)	1,590

The District laboratory continued to support the following activities:

- The laboratory analyzed 716 samples in support of the Yahara WINS adaptive management project. Of these samples, 197 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 3,365 samples and performed 10,423 analyses for these projects. The lab values the importance of this partnership and strives to support these pilots.
- Additional mercury testing was done on Pumping Station 11 and on targeted manholes. Chloride testing was completed on all pumping stations for the month of December. This testing was in support of pollution prevention efforts.

Other noteworthy activities in the laboratory during 2020 were the following:

- Beginning in May 2020, the lab provided influent to UW-Madison and State Lab of Hygiene for method validation to test for SARS-CoV-2 in wastewater. Once method validation was complete, the lab continued to provide both influent and pumping station samples for surveillance purposes throughout 2020.
- For 12 weeks, the lab provided pumping station samples to UW-Milwaukee for opioid testing. District samples were part of a study to understand how best to distribute community support resources.
- With the issuance of a new permit in May 2020, the lab coordinated WET testing in the second and fourth quarters.
- The first-floor remodel of the Operations building began in September 2020. Reorganization of lab space was required to make accommodations for this project. Included in this was the replacement of the BOD incubator. The lab researched standalone incubators and recommended the one purchased. During construction, the lab coordinated with the Engineering department and contractors to continue lab duties while construction continued.
- In order to maintain social distancing, the lab adapted new training and sampling protocols, and sample acceptance procedures. This continued throughout 2020. Also, due to COVID concerns, the annual fish survey was cancelled.
- The lab put into service two new autosamplers for nutrient analyses and narrowed the field for purchasing a new ICP in 2021.

METROGRO

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.

In 2019, extended wet fall weather coupled with an early winter created a need for additional solutions to meet 2020 storage needs. An off-site manure pit was contracted to secure additional storage, and a contractor was hired to apply this material into nearby fields using a dragline. In addition, biosolids were dewatered and hauled to the landfill.

Overall weather conditions and field availability were ideal for land application in 2020. Metrogro was able to apply a record quantity of Class B liquid biosolids to fields in the spring. Summer and fall hauling were also highly successful. This allowed the program to overcome the setbacks created by 2019 weather conditions and end the hauling season in late November 2020 with an excellent storage position.

Summary hauling and cost information for the last three years is provided in Table 9.

Table 9 – Metrogro Program Details for Past Three Years

Year	**2018**	**2019**	**2020**[1]
Gallons Recycled (MG)	33.5	25.8	37.6
Dry Tons Recycled	6,477	4,890	7182
Acres Applied	4,396	3,771	5,030

[1] Numbers shown for 2020 do not include the 1.3MG of additional Class B liquid biosolids that was stored at an off-site manure pit and land applied by a contractor. Numbers shown for 2020 do not include the 2600 dry tons of additional dewatered material that was recycled at the landfill. Combined costs of these additional activities was around $290,000.

The District continues to produce a high-quality biosolids product. Metal concentrations in 2020 were below the concentrations used by EPA to define an exceptional quality biosolid, as shown in Table 10 (Note: Wisconsin Department of Natural Resources uses the term “high quality" in NR 204).

Table 10 - Metrogro Biosolids Quality 2020 Average Values

Parameter	Concentration	EPA EQ Limit*	EPA Ceiling Limit	Units (Dry Weight)
Total Solids	5.30	NA	NA	%
TKN	8.25	NA	NA	%
NH3-N	3.80	NA	NA	%
Total-K	0.52	NA	NA	%
Total-P	2.88	NA	NA	%
Arsenic	5.3	41	75	mg/kg
Cadmium	1.0	39	85	mg/kg
Chromium	42.6	NA	NA	mg/kg
Copper	576	1,500	4,300	mg/kg
Lead	22.9	300	840	mg/kg
Mercury	0.5	17	57	mg/kg
Molybdenum	21.7	NA	75	mg/kg
Nickel	25.7	420	420	mg/kg
Selenium*	6.0	100	100	mg/kg
Zinc	800	2,800	7,500	mg/kg
PCB	<0.0075	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 2020. Approximately 583 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

After multiple years of research, experimentation and equipment demonstrations, a promising low-disturbance liquid injection solution was identified. The Zimmerman Red Viper liquid injection system was trialed on several farm fields under varying conditions in the fall of 2020. It was well received by crop producers. This low disturbance tillage aligns well with producers' increasing adoption of reduced and no-tillage farming systems in the region, as well as District goals around adaptive management.

Biosolids Study

The District is facing several factors which have created an interest in exploring options to diversify biosolids management. Some of these factors are:

- Increasing quantities of biosolids generated by the District due to population growth.
- Decreasing availability of land for application, and greater distances to travel to available land, as urban and suburban areas expand.
- Increasing variability of weather leading to decreasing windows of time for land application.

These factors led to hiring a consultant in 2020 to perform a detailed analysis of the District's current biosolids recycling strategies and compare them to various possible alternatives, including Class A liquid as well as several dewatered products and composts. The consultants also analyzed current data management systems and provided suggestions for future improvements.

ENGINEERING

Staffing

In 2020, the Engineering department continued with eight full-time employees and one part-time project coordinator. The department includes six registered professional engineers, six ISI-Envision credentialed professionals and one master electrician construction manager:

- Director of Engineering
- Electrical Construction Manager
- Electrical Project Engineer
- Project Engineer I (1)
- Project Engineer II (3)
- Collection System Engineer
- Project Coordinator (part time)

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 $100,000 to $50 million or more. Depending on the scope of the work, smaller capital projects are typically planned and designed in-house.

Consulting services are utilized for larger projects. These services are retained and managed by department staff. The Engineering department typically assumes the lead role during project construction, performing all construction management, inspection and resident engineering.

The department also manages long-term issues associated with the collection system. This includes the development of an inflow and infiltration (I/I) reduction program, which is anticipated to take several years to plan and implement. Other duties performed by the Engineering department include:

- General assistance to the O&M department
- Response to emergency and high flow events
- Management of the force main inspection program
- Administration of locating services
- Assistance with long-range asset management, capital planning and budgeting
- Process control programming and HMI (i.e., computer control screen) design

- Assistance with large maintenance projects
- Utility coordination and administration
- Real estate and property issues
- Facility transfers
- Coordination with other municipalities (especially the City of Madison)
- Committee (ELC, I&D, etc.) participation

Programs, Initiatives and Work Reporting

ENGINEERING AND CONSTRUCTION

Nine Springs Valley Interceptor-Morse Pond Extension

The Nine Springs Valley Interceptor-Morse Pond Extension project extends sanitary sewer service to undeveloped land near the intersection of Highways PD and M. The interceptor serves City of Verona lands south of Highway PD and City of Madison lands north of Highway PD. The new interceptor is a 20-inch diameter sewer located along Raymond Road and extends approximately 3,230 feet from the District's Nine Springs Valley Interceptor-Midtown Extension.

Planning and design work for the interceptor were completed in conjunction with Wisconsin Department of Transportation's (WisDOT) reconstruction of Highway M. The project was bid as part of the WisDOT County Highway M reconstruction project on Aug. 8, 2017. Commissioners approved the District portion and increased the overall total project budget estimate to $2.3 million on Aug. 31, 2017. Construction activities began in late 2017 and were completed in the summer of 2018. Due to delays in final acceptance of work by WisDOT, final closeout did not occur until 2020. The final District construction amount was $2,113,604.

Pumping Station 7 Improvements

Pumping Station 7, a critical asset in the District's collection system, was originally built in 1950 and pumps 5 to 6 million gallons of wastewater to the treatment plant each day. The station works in tandem with Pumping Station 18, and the two stations provide critical redundancy and resiliency to the District's overall conveyance system.

The 70-year-old station was last rehabilitated in 1992. Given the age of the station, the time that has elapsed since the last rehabilitation, and the complexities of operating Pumping Station 7 in tandem with Pumping Station 18, District staff recommended several improvements at Pumping Station 7. Key objectives associated with the project included the following:

- Replacement of existing controllers and control system
- Replacement of electrical switchgear (including outdoor transformers and utility equipment)

- Installation of an odor control system
- Replacement or modifications to the HVAC system
- Separation of control room space from garage and screen room
- Installation of variable speed drive(s) to optimize pumping operations
- Replacement of manual valves with electrically actuated valves
- Other miscellaneous improvements identified during the design process

Planning and design were completed in late 2018 and the project was bid on Dec. 18, 2018. The Commissioners awarded the contract to C.D. Smith Construction Inc. on Jan. 17, 2019 at their low bid price of $3,348,000. Construction activities began in the summer of 2019 and were completed in late 2020. The work was formally accepted by the Commission on Jan. 14, 2021. The final contract amount, including all change orders, was $3,266,397.81

Grass Lake Dike Restoration

In 1958, the District constructed facilities to discharge effluent to the Badfish Creek waterway. Improvements to the waterway included an earthen dike along the western edge of Grass Lake. The dike was constructed to provide a division between Grass Lake and the effluent discharge waterway. The dike is approximately 5,000 feet in length.

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. The work was awarded to Cardno in August of 2018. Due to issues associated with floodplain management, COVID-19 and permitting, the design work was still ongoing at the end of 2020. Design is expected to be complete by mid-2021, with construction of any recommended improvements not anticipated to occur until late 2021 or early 2022.

Northeast Interceptor: Truax Extension Relief

The Northeast Interceptor – Truax Extension, between Lien Road and the intersection of U.S. Highway 51 and Rieder Road, is a 48-inch concrete sewer that was constructed in 1969. Television inspection of this 11,000-foot section of pipe revealed a number of structural defects, including corrosion of the interior pipe surface. In addition to this, the Collection System Facilities Plan Update (2011) indicated that capacity relief for the Truax Extension was needed sometime between 2017 and 2031. To verify this, the District measured current flows, which revealed that the pipe was at 95% of capacity and relief was required in the next decade.

District staff evaluated preliminary alternatives for the Truax Extension Relief and Rehabilitation projects and recommended construction of a relief sewer prior to rehabilitation of the existing Truax Extension. This reduces the overall risks and total cost of both projects, as

the relief sewer can be used during typical days to bypass flows during the rehabilitation (i.e., lining) process. It also eliminates the need for expensive and risky bypassing pumping.

The Northeast Interceptor – Truax Extension Relief project consists of 7,800 lineal feet of 42-inch diameter interceptor sewer using open-cut and trenchless techniques. The project also includes construction of a paved path in Reindahl Park that will enhance the park's path network and also provides periodic access for District staff to perform maintenance activities. Planning and design were completed in early 2019 and the project was bid on March 28, 2019. The Commission awarded the contract to Speedway Sand & Gravel, Inc. on April 11, 2019 at their low bid price of $7,034,426. Construction activities began in the summer of 2019 and were substantially complete in October of 2020. Final completion is expected to occur in the spring of 2021.

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, 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 were completed in the fall of 2019 and the project was bid on Oct. 31, 2019. The Commission awarded the contract to C.D. Smith Construction, Inc. on Nov. 14, 2019

at their low bid price of $12,895,000. Construction activities began in early 2020 and were 72% complete at the end of the 2020.

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, it is anticipated that construction will occur in three phases over a period of approximately three years.

Planning of the overall project and detailed design for construction of Phase 1 were completed in the fall of 2020 and the project was bid on December 17, 2020. The Commission is expected to award the contract to Advance Construction, Inc., in January of 2021, at their low bid price of $3,410,465.50. Construction activities are anticipated to start in the spring of 2021.

Headworks Building Flow Metering Improvements

The Headworks Building was constructed as part of the Tenth Addition to the Nine Springs Wastewater Treatment Plant in 2005. Headworks wastewater processing systems include influent flow metering, fine screen solids removal, vortex grit removal and disposal of screenings and grit.

The influent venturi flow meters 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 resulted in several other issues associated with operation and maintenance of the screening system:

- The volume of screen wash water required has exceeded expectations.
- The energy required to operate the screens and screenings handling equipment has exceeded design estimates.
- Maintenance of screening equipment has been higher than anticipated due to additional operating hours.
- Rags and solids have been found in downstream processes, which indicates that higher water levels required for meter submergence result in bypasses of the fine screens.

The Nine Springs Treatment Plant-Headworks Flow Metering Improvements project will 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 and independent of flow meter submergence requirements. To accomplish this, the existing venturi flow meters in the Headworks Building will be repositioned at a lower elevation.

The design work was completed at the end of 2019 and the project was bid on Feb. 6, 2020. The Commission awarded the contract to Staab Construction Corp. on Feb. 27, 2020 at their low bid price of $1,833,000. Construction was 73% complete at the end of 2020 and is anticipated to be complete by the summer of 2021.

Northeast Interceptor Joint Grouting MH10-112 to MH10-106

The Northeast Interceptor was constructed in 1964 and consists of 48-inch reinforced concrete pipe. Routine inspection of the sewer upstream of Pumping Station 10 revealed that the pipe was in good structural condition, but numerous joints were suffering from inflow/infiltration. Staff determined that the leaking joints should be fixed by injecting grout at the joints.

In 2017, the District included funds in the operating budget to seal 37 of the leakiest joints in the section of sewer from MH10-112 to Pumping Station 10. Bids for the work were opened in December of 2017 but were significantly higher than the budgeted amount. The contract was not awarded and the project was shifted to the Capital Improvements Plan.

For budgeting and timing reasons, the project was split into two phases with this project being the first phase. The section of the Northeast Interceptor sewer to receive joint grouting during this project is located between MH10-112 and MH10-106. This includes testing approximately 326 joints for leaks and grouting approximately 310 joints.

Design of the joint-grouting project was completed by District staff in early 2020 and the project was bid on Jan. 30, 2020. The Commission awarded the contract to Michels Corporation on Feb. 13, 2020, at their low bid price of $208,186. Construction activities were substantially complete at the end of 2020, with only punch-list items remaining to be completed.

2019 Treatment Plant Piping Improvements

Potable water, also known as W1 piping, and hot water piping are both critical to treatment plant function. Sections of both W1 and hot water piping were identified for replacement based on their poor condition. These are described in detail as follows:

- W1 Piping Improvements: This includes upgrades and repairs to the 1960s-era potable water main (W1) system located inside the east piping galleries.
- Hot Water Piping Improvements**:** This includes hot water piping in the solids gallery between the Boiler Building and Sludge Control Building 1 (SCB 1), which was installed as part of the Fourth Addition in 1961.

The 2019 Treatment Plant Piping Improvements project involves the removal and replacement

of the two piping systems. Approximately 1,200 feet of 4-inch galvanized W1 water pipe will be replaced with 4-inch stainless steel pipe and approximately 550 feet of 6-, 8- and 10-inch carbon steel hot water piping will be replaced with 6-inch carbon steel piping. The project will also involve replacement of seven 4-inch isolation valves on the W1 piping and insulation of both new piping systems.

Design was completed by District staff in mid-2019. On Oct. 22, 2019, bids were opened and at the Oct. 31, 2019 Commission meeting the work was awarded to 1901, Inc. at their low bid price of $418,551. Construction activities began in late 2019 and were completed in the summer of 2020. The work was formally accepted by the Commission on Oct. 14, 2020. The final contract amount, including all change orders, was $432,328.36.

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

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 is corroded and needs additional capacity.

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 is required. During initial planning, the replacement sewer alternative was selected as the preferred option and design of this option was completed in the fall of 2020. The project was bid on Oct. 15, 2020 and the Commission awarded the contract to R.G. Huston Company, Inc., on Oct. 29, 2020 at their low bid price of $3,319,665.00. Construction was 23% complete at the end of 2020 and is anticipated to finish by the fall of 2021.

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 studies of the non-process areas of the treatment plant. 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 Capital Improvements Plan. Major goals of the project include:

- 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 group 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.

Engberg Anderson Architects were retained to assist with planning and design of the project. This included a space-needs study, adjacency investigation, evaluation of alternatives, conceptual design and detailed design. This work was completed in the summer of 2020 and the project was bid on July 30, 2020. The Commission awarded the contract to Kenneth F. Sullivan Co., on Aug. 13, 2020, at their low bid price of $1,566,525. Construction activities began in the fall of 2020 and were 14% complete at the end of the year, with construction expected to continue to the fall of 2021.

Pumping Station 17 Force Main Relief-Phase 1

The Pumping Station 17 force main was built in 1995 and is 16-inch diameter ductile iron pipe. Upgrades to Pumping Station 17 and the force main will be required in approximately 2024 to accommodate additional flows expected after the completion of the Lower Badger Mill Creek Interceptor. The Pumping Station 17 relief force main, working in combination with the existing force main, will be sized to handle the estimated future flows from this area.

Phase 1 of the Pumping Station 17 Force Main Relief project was designed in conjunction with the City of Verona Eastside Interceptor, which is in the same corridor. Cost savings include sharing common survey, design, mobilization, administration, etc., with the City. The District entered into a Memorandum of Understanding with the City to issue a joint request for proposals, hire a design consultant and construct the project.

Design of the Pumping Station 17 Force Main Relief-Phase 1 and City of Verona Eastside Interceptor Replacement project was completed in the summer of 2020 and the work was bid as a City of Verona contract on Sept. 17, 2020. The Commission approved the District's $2,951,963.50 portion of the overall $7,761,804.60 contract amount to Minger Construction Co., Inc., on Sept. 24, 2020. Construction activities began in late 2020 and were 10% complete at the end of the year, with construction expected to continue to the fall of 2021.

Pumping Stations 13 & 14 Rehabilitation

The District's Collection System Facilities Plan Update (2011) identified Pumping Stations 13 and 14 as requiring firm capacity upgrades and replacement of major equipment. The District's Collection System Facilities Plan Update also included a condition assessment of all District pumping stations across six categories. These categories included peak flow capacity, firm flow capacity, power system redundancy, mechanical condition, structural integrity and electrical

condition. Compiling scores across all the six categories, Pumping Station 13 and Pumping Station 14 received the first and third highest point totals, respectively, indicating the need for rehabilitation for these stations in the near term.

The Pumping Stations 13 & 14 Rehabilitation project 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 major wet well repairs. Both stations will be rehabilitated at the same time and bid as one project due to their proximity and similar needs.

Planning and design were completed in the summer of 2020 and the project was bid on Aug. 13, 2020. The Commissioners awarded the contract to C.D. Smith Construction Inc. on Aug. 27, 2020 at their low bid price of $9,276,979. Construction activities began in late 2020 and were 1% complete at the end of the year, with construction expected to continue into early 2022.

2020 Interceptor Rehabilitation

The 2020 Interceptor Rehabilitation project improved two District sewer systems. The first portion rehabilitated 600 feet of the West Interceptor built in 1916 and 3,950 feet of the West Interceptor Spring Street Relief built in 1940. Both interceptors are 24-inch diameter cast iron pipe. Televised inspection of the interceptors showed tuberculation along the entire length. The deposits decrease the capacity of the sewer and compromise the structural integrity of the pipe.

The second portion of the project rehabilitated 190 feet of the Northeast Interceptor Relief, which is 30-inch diameter cast iron pipe built in 1937, and 700 feet of the East Johnson Street Relief, which is 36-inch diameter concrete pipe built in 1979. These interceptors are located near the intersection of First Street and East Johnson Street.

The project was planned and designed by District Engineering department staff and the project was bid on May 14, 2020. The Commissioners awarded the contract to Visu-Sewer, Inc., on May 28, 2020, at their low bid price of $971,896.50. Construction activities began in the summer of 2020 and were complete by the end of the year. Formal acceptance of the work by the Commissioners is expected in early 2021.

Auto Switching of 3rd Power Feeds to Pumping Stations 10 and 11

Pumping Stations 10 and 11 have two separate power sources from the utility company, Madison Gas and Electric (MGE). In the event of a loss of power from one source, the stations are equipped to automatically transfer power to the second source. This is done via electrical switch gear located inside the pumping stations that is owned and operated by the District. The switching is done at 480 volts.

Both stations also have a third utility power source available, but the current configuration requires manual intervention by MGE to transfer power to this source. In emergency situations, there is not enough time for the MGE to respond and manually transfer the power. This can result in overflows

in the collection system.

To provide added resilience and redundancy to the power system, automatic transfer capabilities were added to the third power feed. The transfer equipment is owned, operated and maintained by MGE, which alleviates the District of any future maintenance and operational responsibilities. Continuous monitoring by MGE allows them to quickly detect a power failure and automatically transfer to the other source with no manual intervention required, greatly increasing station reliability.

The automatic transfer equipment was purchased and installed by MGE at the request of the District. The District reimbursed MGE for these costs. The final total for these were $74,300.00 at Pumping Station 10 and $84,342.86 at Pumping Station 11.

Operations Building 800 Mechanical Room Refrigerant Alarm System

In approximately 2012, the District made improvements to the HVAC system in the Operations Building on the Nine Springs Wastewater Treatment Plant campus. These included replacing an existing absorption chiller with an electric chiller in the 800 Mechanical Room, located in the basement of the building. The electric chiller contains a large amount of refrigerant. A subsequent inspection of the chillers noted that the 800 Mechanical Room did not meet ASHRAE and state code requirements regarding a refrigerant leak monitoring and alarm system.

Design of a refrigerant monitoring and alarm system was completed in the fall of 2020. Bids were opened on Nov. 12, 2020, and the work was awarded to Kenneth F. Sullivan, at their low bid price of $78,146.00. Work had not started as of the end of 2020.

MAINTENANCE OF DISTRICT FACILITIES

Staffing

The Maintenance workgroup has 38 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)

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

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, 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.

FACILITIES MAINTENANCE

The Facilities Maintenance section spends the majority of the year maintaining the District and non-District pumping stations, the Nine Springs Wastewater Treatment Plant 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 2020:

- Constructed new office space at the Vehicle Loading Building
- 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
- Removal and replacement of media in the odor control system at Pumping Station 16

Three new employees were hired in 2020 to fill vacancies that were created by the departure of three Facilities Maintenance Utility Workers.

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 obtaining certification for all employees through Dane County "Saltwise" training courses in 2020.

In 2020, 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 several major projects in 2020:

- Removal and replacement of 600 feet of deficient internal process fencing
- Repairing the plant perimeter fence following damage from multiple downed trees and vehicle accidents

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; testing/cleaning of electrical and instrumentation equipment; and thermographic imaging of

electrical devices. The continued use of the District's computerized maintenance management system (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 system; and operating District portable generators during planned and unplanned power outages.

The following additional improvements and projects were completed or continued in 2020:

- 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 City of Madison Woodley, Fayette and Debs Road pumping stations. Also completed the same for Dane County's Lake Farm Park pumping station.
- Started the communications/PLC upgrade at Pumping Station 5
- Completed the Engineering light replacement project in the Operations Building IT area by installing, programming and testing the lights.
- Completed a survey of District pumping stations for the need of cell phone signal booster installation to improve the safety of District personnel, and ordered the equipment needed.
- Completed installation of VFDs for Final Clarifiers 15 and 16 flocculators
- Completed replacement of the florescent light fixtures in the basement of SCB2 with LED light fixtures
- Assisted Engineering department with the Liquid Processing Improvements project and Headworks venturi move project
- Assisted Engineering department with the City of Madison's James Street pumping station replacement
- Installed a UPS unit for the Operations Building to replace a failed power conditioner
- Our new Electrical Apprentice, Tom Berg, started apprenticeship school.
- Jeff Kroning has taken on the job of being a planner for the Electrical Department.

HVAC MAINTENANCE

In 2020, the HVAC Maintenance section was moved under the supervision of the Electrical department to help even out the work load between crew supervisors. 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 computerized maintenance management system (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 system.

The following improvements and projects were started or completed in 2020:

- The reorganization and enhancement of the HVAC preventive maintenance program was started. Work is being clarified, added and organized by season.
- Completed the replacement of a failed glycol chiller compressor.
- An analysis of the Deaerator system in the WAS Thickening Building was done. Improvements to the system were made and the preventative maintenance was modified. This has greatly decreased the failures of the system.
- Completed installation of a new air conditioner unit in the Operations Building 800 Electrical Room, caused by increased cooling needs with the install of the new UPS unit in that room.
- Completed a VFD replacement at Pumping Station 6 for the roof top unit
- Made a major repair to the heating coil for the air handler unit that feeds the lab in the Operations Building
- Assisted with the Boiler Building boilers controls replacement project

MECHANICAL MAINTENANCE

The Mechanical Maintenance section maintains mechanical equipment through preventative and reactive maintenance of Nine Springs Wastewater Treatment Plant 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 2020 included:

- Reliability Centered Maintenance implementation:

  - Implemented a dedicated planner position within the section. The planner has created nearly 100 jobs 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 aide in the selection of a new CMMS.
- On a weekly basis, removed rags and other debris from plugged collection system pumps to keep them functioning at required capacities.
- Replaced a total of seven pumps at the treatment plant and pumping stations where the cost-benefit analysis dictated the purchase of a new pump was most beneficial.
- Rebuilt eight pumps at District pumping stations and one pump at a non-District station
- Rebuilt 16 pumps at the treatment plant that serve various treatment plant functions
- Began a series of replacements of unreliable rotary lobe pumps to a more reliable brand
- Replaced obsolete flocculator drives on Final Clarifiers 15 and 16 with a newer style that is more reliable and energy efficient, setting a new standard for the future.
- Removed and recycled failed mixers from the Metrogro storage tanks that were no longer necessary for the process
- Responded to Waukesha engine failures and repaired in a timely manner, maintaining a key gas biogas utilization and energy resource to the treatment plant.
- Assisted the Engineering department staff on necessary shutdowns and tie-ins for the Pumping Station 7 Improvements project, the Liquid Processing Improvements project and the Headworks Flow Metering 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 2020, the following activities were performed by the crew:

- Conducted preventive maintenance work, including: all work on air release valves; exercising valves; replacing three Dezurik 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 tested laser and flow monitoring equipment
- 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

2020 Manhole Inspections

- Inspected the manholes and surrounding areas for the following interceptors:
    - East Interceptor/North Basin (21 manholes) & upstream of PS06 (25 manholes)
    - Far East Interceptor/Door Creek Ext (36 manholes)
    - Lower Badger Mill Creek Interceptor (57 manholes)
    - Southeast Interceptor/Blooming Grove Ext (27 manholes) & Dutch Mill Ext (4 manholes)
    - West Interceptor (40 of 79 manholes)
    - Southwest Interceptor (39 of 79 manholes)
- West Interceptor Midvale Relief/South Interceptor Baird St Ext, Southwest Interceptor (44 manholes)
- Southeast Interceptor (MH07-801 to MH07-823 & MH09-101 to MH09-108), Nine Springs Valley/Syene Ext (39 manholes)

2020 Special Projects

- Grouting of the North East Interceptor
- Spark tested the coating of 27 manholes
- Inspected Morse Pond extension manholes for leaning and tilting deficiencies related to City of Madison new storm sewer filling with soil adjacent to the District's pipe
- Investigated, learned and began using Korterra software for Digger's Hotline system to

field locate District force mains, gravity sewers and abandoned lines

- Siphon cleaning

MISCELLANEOUS WORK REPORTING

Reliability Centered Maintenance (RCM)

In 2020, District staff continued to develop RCM best practices in a continual effort to shift our maintenance culture. Development and refinement of work order planning processes was the top focus for the maintenance department. Industry best practice has proven that implementing work order planning with dedicated planners increases accuracy of work being performed and overall efficiency of the purchasing and maintenance teams. Three maintenance teams, Facilities Maintenance, Electrical Maintenance and Mechanical Maintenance each assigned one team member to be the dedicated work group planner. 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. Planning thus far has been a success with the creation of 200 job plans, updated bills of materials for dozens of assets and the increased efficiency seen on individual work orders.

Also, in 2020, the RCM team implemented a weekly planning and scheduling meeting. The team includes key members of Maintenance, Operations, Purchasing and Strategy department staff members. The purpose of this meeting is to prioritize and track work orders for planning, purchasing and execution on a weekly basis. This meeting serves as a focused discussion to promote alignment on work orders making their way through the system and to ask any questions on lingering issues. The meeting also allows for tracking the completion of work in each category which provides necessary data for the calculation of key performance indicators that show the health of our processes. Data tracking was done on a small scale in 2020 to promote learning of the processes. In 2021, maintenance staff will continue with RCM work by building dedicated weekly schedules and further developing KPI’s that will be used to track progress.

2020 Treatment Plant HVAC Improvements Study

In 2019, District staff identified this project to review and evaluate current treatment plant HVAC systems, and based on need, develop a plan to upgrade and replace aging HVAC systems in various buildings. HVAC systems are vital at the treatment plant to provide a safe environment for staff, meet building codes and protect equipment from damage due to excessive heat and cold, harsh atmospheres and condensation. Due to the harsh environments many of the HVAC systems in the treatment plant see, they have deteriorated beyond reasonable repair and need to be replaced. Also, buildings may need an HVAC system redesign

to increase ventilation needs and to meet current codes. Planned replacement of these systems will ensure proper plant operations, reduce the safety risk to staff who work in these buildings and protect equipment within the buildings.

The best approach for this evaluation was to hire a consultant to perform a holistic treatment plant HVAC improvements study as part of the Capital Improvements Plan (CIP). The goal of the study is to evaluate building HVAC systems (that were updated prior to 2015) for condition and code requirements, which will guide future HVAC improvement projects. In the fall of 2020, Strand Associates was retained as the consultant and began work on the study. The study will be completed in the spring of 2021 and projects resulting from the study will be prioritized in the CIP in 2022 and beyond.

OPERATIONS

Staffing

The Operations workgroup has 17 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 Plant Specialist
- Operations Supervisor
- Lead Operator
- Operators (8)

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 2020 included:

- Plant operations assistance with the Liquid Processing Improvements construction project
- Continued work on the district's on-going energy master plan study
- Updated the operator progression path
- Completed DNR air compliance inspection with full compliance evaluation

- Process Control System Phase 2 work
- Implemented operator workgroup schedule and structure
- Managed the contract and plant operations for excess Class B biosolids dewatering and removal

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 2020. The District also accepts septic tank wastes and similar wastes from unsewered areas located primarily in rural Dane County. In 2020, 945.75 acres of land was annexed by the District. The total area of the District at the end of 2020 was 187.25 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 97.81 miles of gravity sewers and siphons and 32.12 miles of raw wastewater force mains at the end of 2020. 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 136 pumping stations, not including 446 small grinder pump installations. Table 11 and Table 12 list the number of pumping stations operated and maintained by individual communities and the District.

Table 11 – 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	8	
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	13
State of Wisconsin:		4
University of Wisconsin Campus	6	
University of Wisconsin Arboretum	1	
Dane County - Rodefeld Landfill	1	
Total	**71**	**446**

Table 12 – 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 15,355,471,000 gallons of wastewater at the NSWWTP in 2020. This was an 8.64% decrease from 2019. The average daily quantities of wastewater received from each municipality and through infiltration into the District's intercepting sewers in 2020 are shown in Table 13.

Table 13 – Average Daily Quantities of Wastewater

Municipality	2020 (GPD)	% of Total
City of Fitchburg	1,942,000	4.63
City of Madison	26,446,000	63.04
City of Middleton	2,087,000	4.97
City of Monona	1,186,000	2.83
City of Verona	1,118,000	2.66
Village of Cottage Grove	686,000	1.63
Village of Dane	53,000	0.13
Village of DeForest	1,069,000	2.55
Village of Maple Bluff	186,000	0.44
Village of McFarland	720,000	1.72
Village of Shorewood Hills	144,000	0.34
Village of Waunakee	1,839,000	4.38
Village of Windsor	639,000	1.52
Town of Dunn San. Dist. No. 1	193,000	0.46
Town of Dunn San. Dist. No. 3	77,000	0.18
Town of Dunn San. Dist. No. 4	22,000	0.05
Town of Dunn Kegonsa San. Dist.	127,000	0.30
Town of Madison	615,000	1.47
Town of Pleasant Springs San. Dist. No. 1	70,000	0.17
Town of Verona	600	<0.01
Town of Verona Util. Dist. No. 1	27,000	0.06
Town of Vienna - Wyst59 LLC	100	<0.01
Town of Vienna Util. Dist. No. 1	82,000	0.20
Town of Vienna Util. Dist. No. 2	37,000	0.09
Town of Westport Sewer Utility District	568,000	1.35
Town of Westport - Cherokee Golf & Tennis	2,700	0.01
Total Wastewater	**39,937,000**	**95.19**
Infiltration into District Interceptors	2,017,000	4.81
Groundwater to District Interceptors from MMSD Construction Projects	1,100	0.00
Total Received at the Treatment Plant	**41,955,000**	**100**

Wastewater Treatment

The District has a single treatment plant, the Nine Springs Wastewater Treatment Plant. In 2020, the Nine Springs Wastewater Treatment Plant met all Wisconsin Department of Natural Resources discharge limitations with the exception of an exceedance of the monthly ammonia limit for the Badger Mill Creek outfall in August due to complications in process treatment resulting from construction upgrades. This level of compliance should qualify the District for a

silver 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 and to maintain a minimum level above the influent flow meters. 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 screenings 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 2020, the secondary portion of the Nine Springs Wastewater Treatment Plant 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 2020, approximately 39.38 million gallons per day on average were pumped to Badfish Creek and 3.36 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. 16th), this system was shut down for the last time. It was removed from service, and the process of replacing with a new and modern system started. This new

system is expected to be online for the start of 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 5.4% in 2020.

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 6.4% in 2020.

The anaerobic digestion process was operated as a phased system throughout 2020. 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 92 degrees Fahrenheit with an approximately 1.38-day (33-hour) detention time.
- Acid phase sludge is fed to the east digesters 4-9 and the temperature is maintained at 95 to 98 degrees Fahrenheit. The detention time in the east digesters averaged approximately 29 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 2020, approximately 10% 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 Wisconsin Department of Natural Resources 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 2020, the centrifuge was operated regularly in January making Class A biosolids. Then, from Feb. through mid-April it ran nearly continuously, processing Class B liquid into Class B cake on an emergency basis to alleviate storage issues due to a wet fall and an early freeze in 2019 which stopped full haul out before winter. The Class B cake thus produced was diverted to landfill.

The digested biosolids concentration averaged 2.9% for 2020 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 5.69% in 2020 through the addition of polymer on a gravity belt thickener. An average of 22.4 tons per day of digested biosolids was thickened in 2020.

Anaerobic digester foaming was kept under control through operational measures (such as feed time 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 (magnesium ammonium phosphate) harvesting process for nutrient recovery. 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, in excess of 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 2020, the total production was 656.9 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 805,000 cubic feet per day in 2020. 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 18,838 kilowatt-hour of electricity was generated each day in 2020. In addition, the blower engine saved the purchase of approximately 9,185 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 16, “Annual Energy Use Summary” shows a complete breakdown of the thermal and electrical savings from the use of digester gas.

The 2020 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 14. Monitoring data for effluent metals are reported in Table 15.

Table 14 – Yearly Log of Plant Operations 2020

Month	Influent Flow (MGD)	BFC Effluent Flow (MGD)	BMC Effluent Flow (MGD)	BOD RAW BOD (MG/L)	BOD Effluent BOD/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 – 20	41.13	38.90	3.07	257	9.7	206	5.5	43.3	0.85	5.33	0.26		5.19
Feb – 20	41.15	39.20	3.09	286	9.7	192	4.2	44.9	0.74	5.37	0.20		5.18
Mar – 20	43.93	43.52	3.09	239	7.0	197	4.4	40.8	0.34	4.77	0.20		5.08
Apr – 20	40.71	40.32	3.08	235	5.1	195	4.0	43.5	0.19	5.11	0.24	29	6.03
May – 20	43.17	40.72	3.44	228	2.3*	199	4.5	41.8	0.20	4.96	0.29	28	5.05
Jun – 20	45.32	42.78	3.57	221	2.2*	192	3.8	40.6	0.15	4.91	0.26	75	5.18
Jul – 20	47.38	44.79	3.59	204	2.1*	191	5.4	36.7	0.53	4.34	0.34	61	5.20
Aug – 20	42.00	39.23	3.55	220	2.5*	182	4.3	41.2	1.34	5.02	0.31	103	5.47
Sep – 20	41.89	38.15	3.58	244	2.0*	216	4.6	43.5	0.74	5.15	0.29	85	5.25
Oct – 20	39.90	36.40	3.59	273	1.7*	231	3.7	48.3	0.13	5.74	0.26	73	5.33
Nov – 20	38.62	34.82	3.58	266	2.5*	257	4.5	48.6	0.40	5.83	0.26		5.72
Dec – 20	37.14	33.71	3.09	279	3.7*	247	5.5	48.6	0.35	5.66	0.37		5.29
Average	41.86	39.38	3.36	246		209	4.5	43.5	0.50	5.18	0.27	65	5.33

BFC is to Badfish Creek Outfall

BMC is to Badger Mill Creek Outfall
(1)Geometric mean
*CBOD required in new permit

Table 15 – Influent and Effluent Metal Concentrations 2020

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-20	41.97	0.13 b	0.13 b	3.41	1.0 b	67.2	9.77	3.15 q	1.92 b	52.2	0.83	3.79 q	2.77 b	108	51.0
Feb-20	42.29	0.13 b	0.13 b	3.13 q	1.0 b	59.1	6.87 q	1.92 b	1.92 b	30.6	0.75	2.77 b	2.77 b	97	50.6
Mar-20	46.61	0.13 b	0.13 b	4.33	1.2 q	62.5	5.27 q	1.92 b	1.92 b	108.0	0.72	3.02 q	2.77 b	124	42.3
Apr-20	43.40	0.13 b	0.13 b	2.35 q	1.0 b	57.5	8.38 q	2.63 q	1.92 b	25.8	0.93	2.77 b	2.77 b	108	62.9
May-20	44.15	0.13 b	0.13 b	2.02 q	1.0 b	53.4	5.91 q	1.92 b	1.92 b	32.7	1.07	2.77 b	2.77 b	119	35.0
Jun-20	46.34	0.13 b	0.13 b	2.54 q	1.0 b	54.8	3.83 q	2.96 q	1.92 b	49.4	1.40	2.77 b	2.77 b	111	47.7
Jul-20	48.37	0.13 b	0.13 b	2.86 q	1.0 b	74.6	7.12 q	1.92 b	1.92 b	51.9	1.30	2.77 b	2.77 b	134	31.5
Aug-20	42.78	0.13 b	0.13 b	2.32 q	1.0 b	57.5	4.16 q	2.98 q	1.92 b	36.4	0.85	2.77 b	2.77 b	110	30.8
Sep-20	41.73	0.13 b	0.13 b	4.23	1.0 b	110.0	8.20 q	7.03	1.92 b	89.8	1.22	4.03 q	2.77 b	188	32.0
Oct-20	39.98	0.15 q	0.13 b	3.52	1.0 b	87.2	5.58 q	3.02 q	1.92 b	238.0	0.91	2.77 b	2.77 b	145	32.8
Nov-20	38.40	0.13 b	0.13 b	2.69 q	1.0 b	68.0	7.16 q	3.08 q	1.92 b	71.5	0.83	3.01 q	2.77 b	119	34.9
Dec-20	36.80	0.13 b	0.13 b	3.53	1.0 q	92.3	7.92 q	3.65 q	1.92 b	48.3	0.75	3.78 q	2.77 b	119	36.9

"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 2020 focused on understanding factors that may impact sludge settling characteristics including influent waste constituents, physical reactor configuration and operational setpoints. This work will be extended into 2022 in order to further evaluate process stability as well as understand impacts to sludge settleability after additional operating and physical modifications have been implemented. Results from this work will be utilized for future liquid process facilities improvements projects.

Pilot-scale study to evaluate total nutrient removal with intermittent aeration

The use of intermittent aeration to increase nitrogen removal is established, but this effort seeks to achieve nitrogen and phosphorus removal at low dissolved oxygen concentrations while employing a demand-based intermittent aeration control strategy. The purpose of this study is to see if this novel control strategy can be employed to reduce energy demands and improve nutrient removal with minimal modifications to the current full-scale infrastructure at the Nine Springs Wastewater Treatment Plant. This pilot scale study was initiated in 2019 and is supported by Dr. Daniel Noguera (Civil and Environmental Engineering department, University of Wisconsin–Madison).

Early work focused on establishing process stability and developing best operational practices for operating in winter conditions. Initial results have been promising, with the pilot demonstrating an ability to achieve desired nitrogen and phosphorus removal rates at low dissolved oxygen concentrations. However, sludge settleability has degraded over time, which is believed to be due to a combination of operating procedures as well as pilot plant tank design. Work in 2020 focused on understanding sludge settleability characteristics and making physical and operational changes aimed at improving settleability. This work will be extended into 2022 in order to further evaluate process stability as well as understand impacts to sludge settleability after additional operating and physical modifications have been implemented.

Results from this pilot 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 Nine Springs Wastewater Treatment Plant and the division between purchased and renewable (primarily self-produced) power. From 2016 to 2020, renewable energy used at the Nine Springs Wastewater Treatment Plant provided roughly 36% of the plant's energy needs and had an estimated total value just over $6.1 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 discussion with DNR, the District was able to restore one generator to operation but for most of 2016 the second generator was idle until determination of the long-term viability of catalysts was determined before committing to the high cost to repair the catalyst housing. This is reflected in a higher purchase of electricity from Madison Gas and Electric compared to other years.
- 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 three months in all. The other engine generator was scheduled for rework in 2018 and started that process in December. Both of these 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.

Table 16 – Annual Energy Use Summary

Electric Energy	2016		2017		2018		2019		2020	
	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	67,775	75.9%	60,442	67.0%	66,867	72.4%	65,943	70.9%	62,809	69.1%
Wind Power Purchased from MG&E	40	0.0%	40	0.0%	40	0.0%	40	0.0%	40	0.0%
Generated from Digester Gas	12,291	13.8%	20,160	22.3%	16,057	17.4%	17,627	19.0%	18,838	20.7%
Avoided Purchase Due to Blower Gas Engine	9,177	10.3%	9,605	10.6%	9,335	10.1%	9,378	10.1%	9,185	10.1%
Total Used & Avoided	**89,284**		**90,247**		**92,299**		**92,988**		**90,873**	
Average cost of purchased power ($/kWh)	$0.0837		$0.0892		$0.0875		$0.0844		$0.0881	
Estimated total monthly value of energy used	$228,011		$244,962		$245,730		$238,733		$244,135	
Estimated monthly value of renewable energy	$54,929	24.1%	$80,902	33.0%	$67,710	27.6%	$69,434	29.1%	$75,396	30.9%
Thermal Energy	**2016**		**2017**		**2018**		**2019**		**2020**	
	therms/ Day	% of Total	therms/ day	% of Total	therms/ day	% of Total	therms/ day	% of Total	therms/ Day	% of Total
Generated from Natural Gas	361	20.0%	593	25.2%	523	24.2%	533	22.7%	757	30.2%
Generated from Digester Gas	333	18.4%	157	6.7%	280	13.0%	356	15.2%	201	8.0%
Recovered from Gas Engines	1,111	61.6%	1,607	68.2%	1,359	62.9%	1,457	62.1%	1,545	61.7%
Total hot water energy used	**1,806**		**2,357**		**2,163**		**2,163**		**2,503**	
Average cost of purchased gas ($/therm)	$0.4828		$0.5169		$0.5057		$0.4876		$0.3591	
Estimated total monthly value of gas used*	$35,454		$49,408		$44,348		$46,391		$36,552	
Estimated monthly value of renewable energy	$28,357	80.0%	$36,981	74.8%	$33,621	75.8%	$35,847	77.3%	$25,498	69.8%
Total Energy Use	**2016**		**2017**		**2018**		**2019**		**2020**	
	$ 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	$263,464		$294,370		$290,078		$285,125		$280,687	
Estimated Value of Renewable Energy Used	$83,286	31.6%	$117,883	40.0%	$101,330	34.9%	$105,281	36.9%	$100,893	35.9%

* 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 (formerly "Planning & Strategy") 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. In fall of 2020, the department's name was shorted to "Strategy." 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 14 full-time employees:

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

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.

In parallel, the department has begun to investigate new computerized maintenance management systems (CMMS) to replace the outdated Oracle WAM system. To make the eventual shift to new software requires a revision of the asset hierarchy which, in turn, requires the revision of data and data sharing procedures among work groups. Work in 2020 included reviewing the CMMS market, learning about data issues facing the project and supporting the finance workgroup in asset accounting related changes.

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 https://www.madsewer.org/Planning/Budget-Finance.

MAINTENANCE MANAGEMENT AND FINANCE SYSTEMS

The department is responsible for the District's Oracle WAM system. It supports several important functions at the District, including maintenance management, some financial functions and some human resources functions. The EAP is one of the District's most important systems, 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 in the early stages of 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.

In addition to acquiring new software, the project also addresses directly related work processes. Many District maintenance and finance work processes are outdated and need to be changed before new systems are implemented. In 2020, the department did preliminary work to understand these work processes, as well as overall data and software issues facing the project. The next step is planned to be a focused effort to address financial work processes, a prerequisite to next steps in the project.

In addition, the department worked on developing reliability centered maintenance processes, as discussed in the asset management section of this report. Those processes will be key to this project. In 2020, the department revised several key maintenance processes in the areas of work planning, work scheduling and spare parts management. This was part of the District's broader reliability-centered maintenance program that seeks to revise and strengthen processes that are supported by our software. The department feels that software is only as strong as the work process that underlie it. In 2021, the department will continue this work by performing preliminary investigations to understand work process and data requirements of the finance and engineering groups.

In 2020, the department held multiple training sessions for the core members of the WAM replacement team. These sessions included history and foundational information on the data, services and functions supplied by our WAM installation and its related integrations. Building this kind of knowledge in the WAM team will help to make the future system migration go more smoothly and reduce the chance of errors. This training included staff from both the Strategy department and the Finance department.

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 2020, the District processed 58 sewer extensions and 11 annexations, adding 946 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. The geographic information system (GIS) has been successfully migrated to the ESRI ArcGIS platform, allowing for District-wide access to District GIS data via interactive web maps. 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.

The current publicly available mapping applications are the Paid Areas Viewer, the MMSD Viewer Public (District Collection System GIS), and the MMSD Salt Savers Pilot Eligibility Viewer, which shows eligible parcels within the Salt Savers pilot project area. A "Virtual Plant Tour" story map for the public was introduced in 2020 as well as a revised manhole inspection workflow and data collection system.

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 department 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; the home well-sampling system; 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; Citrix virtual desktop and applications; and the manhole inspection database and applications.

Strategy

Supported technology for the Strategy department include: 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 and external 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; records management and administration; cyber security; 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; 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 2020 include: new processes to obtain and configure a variety of technology for remote workers; implementation and configuration of Microsoft Teams,

SharePoint and Office 365 for all District staff; upgraded network hardware and software to increase performance, implement additional redundancy and provide more storage; expansion of the records program to support more workflows for onboarding, agenda management, Metrogro data management and computer deployments; and analysis, document creation and training to support the team responsible for the future migration of the Oracle WAM system.

Financials

FINANCIAL SUMMARY FOR THE YEAR ENDED DECEMBER 31, 2020

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 www.madsewer.org or available upon request.

STATEMENTS OF REVENUES, EXPENSES, AND CHANGES IN NET POSITION
Years Ended December 31, 2020 and 2019

	2020	2019
OPERATING REVENUES		
Charges for services:		
Transmission and treatment of sewage	$39,520,330	$37,683,788
Servicing pumping stations	489,646	580,300
Septage disposal	829,125	826,433
Pretreatment monitoring	29,150	29,413
Struvite Harvesting	245,382	253,163
Total operating revenues	**41,113,633**	**39,373,097**
OPERATING EXPENSES		
Administration	6,516,831	6,768,878
Treatment	13,962,477	13,149,173
Collection	3,299,880	3,446,909
Depreciation	8,516,459	8,409,797
Total operating expenses	**32,295,647**	**31,774,757**
Operating income	**8,817,986**	**7,598,340**
NONOPERATING REVENUES (EXPENSES)		
Investment income (losses)	245,763	805,271
Rent	86,084	82,289
Other	263,099	286,040
Capital assets contributed to other governments		
Construction expenses	(1,608,924)	(477,281)
Disposal of property and equipment	(2,668)	(68,930)
Interest expense	(2,947,661)	(3,041,096)
Total nonoperating revenues (expenses)	**(3,964,307)**	**(2,413,707)**
Income (loss) before capital contributions	4,853,679	5,184,633
CAPITAL CONTRIBUTIONS		
Contributed assets	-	-
Conveyance Facilities Connection/Treatment charges	3,898,368	2,262,579
Total capital contributions	**3,898,368**	**2,262,579**
CHANGE IN NET POSITION	8,752,047	7,447,212
NET POSITION		
BEGINNING OF YEAR, AS PREVIOUSLY REPORTED	148,623,959	141,176,747
RESTATEMENT		
BEGINNING OF YEAR, RESTATED	**148,623,959**	**141,176,747**
END OF YEAR	$157,376,006	$148,623,959

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, 2020
(with comparative amounts for 2019)

Repair and Replacement Expenditures	2019	2020
City of Madison Pumping Stations	123,903	86,646
City of Verona Pumping Stations	2,185	12,469
Collection System	62,853	60,454
Collection System Vehicles	9,539	7,593
Dane County Parks	6,546	56
East Interceptor	898	443
Engineering & Administration	250,822	200,489
Far East Interceptor	-	-
Nine Springs Treatment Plant	1,129,508	1,035,528
Nine Springs Treatment Plant Vehicles	185,431	202,597
Nine Springs Valley Interceptor	-	1,156
Northeast Interceptor	110	2,958
Pumping Station #1	2,375	8,267
Pumping Station #10	2,963	62,645
Pumping Station #11	2,897	3,516
Pumping Station #12	962	9,159
Pumping Station #13	4,293	4,712
Pumping Station #14	516	2,501
Pumping Station #15	4,202	2,622
Pumping Station #16	3,014	3,574
Pumping Station #17	14,575	21,666
Pumping Station #18	8,211	13,756
Pumping Station #2	32,977	49,709
Pumping Station #3	11,643	621
Pumping Station #4	1,275	1,853
Pumping Station #5	1,759	19,455
Pumping Station #6	5,470	15,683
Pumping Station #7	920	17,456
Pumping Station #8	29,258	47,413
Pumping Station #9	10,070	1,198
South Interceptor	585	-
Southeast Interceptor	449	831
Southwest Interceptor	667	153
Town of Dunn SD#1 Pumping Stations	2,745	1,174
Town of Dunn SD#3 Pumping Stations	2,180	1,953
Town of Madison Pumping Stations	16,378	6,122
Village of Maple Bluff Pumping Stations	3,409	202
West Interceptor	575	2,655
Total Repair & Replacement	1,936,163	1,909,285

Capital Outlay Expenditures	2019	2020
CIP	177,450	4,149
Concrete Sewer	-	-
Communication Equipment	-	5,076
Office Furniture	64,897	17,277
Electrical Equipment	49,683	8,121
Heavy Mechanical Equipment	234,067	9,124
Instrumental & Control Equipment	-	9,370
Light Mechanical Equipment		222,927
General Equipment	39,550	30,786
Office Equipment	42,112	250,601
Lab Equipment	30,802	30,063
Fixed Improvements		
Vehicles	45,262	197,042
Total Capital Outlay	683,823	784,535

Protecting public health and the environment

Madison Metropolitan Sewerage District
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