

The background of the cover is a photograph of a wetland. In the foreground, numerous tall, thin green reeds stand vertically in shallow water. The water's surface is covered with many small, concentric ripples, indicating recent rainfall. The overall color palette is dominated by various shades of blue and green. A white, wavy graphic element is positioned above the title text.

Madison Metropolitan
Sewerage District

Resiliency

2018 Annual Report

TABLE OF CONTENTS

1	SECTION ONE: ABOUT THE DISTRICT
2	WHO WE ARE
8	WHAT WE DO
9	WHO WE SERVE
10	SECTION TWO: DEPARTMENT SUMMARIES
12	DISTRICT LEADERSHIP AND SUPPORT
	<ul style="list-style-type: none">• POLICY GOVERNANCE• RESOURCE/COMMUNICATIONS• HUMAN RESOURCES• SAFETY
15	ECOSYSTEM SERVICES
	<ul style="list-style-type: none">• CHLORIDE INITIATIVES• POLLUTION PREVENTION• PUBLIC EDUCATION• INDUSTRIAL PRETREATMENT PROGRAM• ACCEPTANCE OF SEPTAGE AND ATYPICAL WASTES• LAGOON SITE PROJECT• WATERSHED PROJECTS• LABORATORY ACTIVITIES• METROGRO
25	ENGINEERING
	<ul style="list-style-type: none">• ENGINEERING AND CONSTRUCTION
35	FINANCE
	<ul style="list-style-type: none">• PURCHASING• ACCOUNTING/FINANCE• USER-CHARGE MONITORING AND BILLING• SEWERAGE SERVICE CHARGES• CLEAN WATER FUND LOANS
40	MAINTENANCE
	<ul style="list-style-type: none">• MAINTENANCE WORKGROUPS• BUILDING AND GROUNDS• ELECTRICAL MAINTENANCE• MECHANICAL MAINTENANCE• MONITORING SERVICES/SEWER MAINTENANCE• MISCELLANEOUS WORK REPORTING
49	OPERATIONS
	<ul style="list-style-type: none">• OPERATIONS WORKGROUP• OPERATION OF WASTEWATER FACILITIES• RESEARCH• NINE SPRINGS ENERGY USE PROFILE

63

PLANNING AND STRATEGY

- ASSET MANAGEMENT
- CAPITAL IMPROVEMENTS PLANNING
- COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM
- COLLECTION SYSTEM
- GEOGRAPHIC INFORMATION PROGRAM
- INFORMATION TECHNOLOGY

67

SECTION THREE: FINANCIALS

68

FINANCIAL SUMMARY FOR THE YEAR ENDED DECEMBER 31, 2018

69

SUPPLEMENTAL DETAILED INFORMATION 2018

INTRODUCTION

Resilience – it's what we practice daily, and what shapes our planning and priorities here at the Madison Metropolitan Sewerage District. In 2018, we were given weather challenges that tested the resilience of our infrastructure, processes and staff. Not only did we come through it successfully by protecting public health and the environment, but we transformed from the challenges to become more capable and prepared for the future.

This vision to protect public health and the environment is enduring. It began in 1930, when the district was established by innovative leaders from Madison and four neighboring communities, who recognized the need for intergovernmental cooperation to protect area surface waters including Lake Mendota. It continues today with the support of our 26 customer communities, as we plan strategically for the future so we can continue to transform in order to meet complex new circumstances and achieve new possibilities.

During 2018 we continued to invest in our resilience through projects, initiatives and collaborations. Highlights include:

- a. Completion of significant infrastructure rehabilitation projects, including high flow capacity improvements throughout the district's collection system. Pumping station improvements included Pumping Station 15, which features sustainable attributes such as a green roof, solar panels and stormwater bio-retention areas, as well as public enhancements like a restroom, an aquatic invasive species control station (i.e., boat wash), a kiosk and a bike repair station.
- b. The district continues to strive to meet the chloride water quality standard through pollution prevention and source reduction initiatives, and in 2018 the district worked closely with WDNR and USEPA on a new variance with the upcoming permit reissuance to continue its successful source reduction program. This strategy not only seeks to meet the water quality standard in the short term, but to sustainably maintain compliance into the future. Through these innovative approaches, ratepayers continue to benefit by avoiding the cost associated with new and expensive treatment technology.
- c. In its second year of full operation, the district-led Yahara WINS adaptive management project helped implement successful urban and agricultural practices that kept 47,223 pounds of phosphorus out of area surface waters.
- d. Continued focus on costs and preventive maintenance helped maintain affordable rates; in 2018, the typical annual residential service charge of \$323 remained nearly 36 percent below the national average of \$504 for comparable utilities.

We thank you for your support and welcome your comments and feedback.

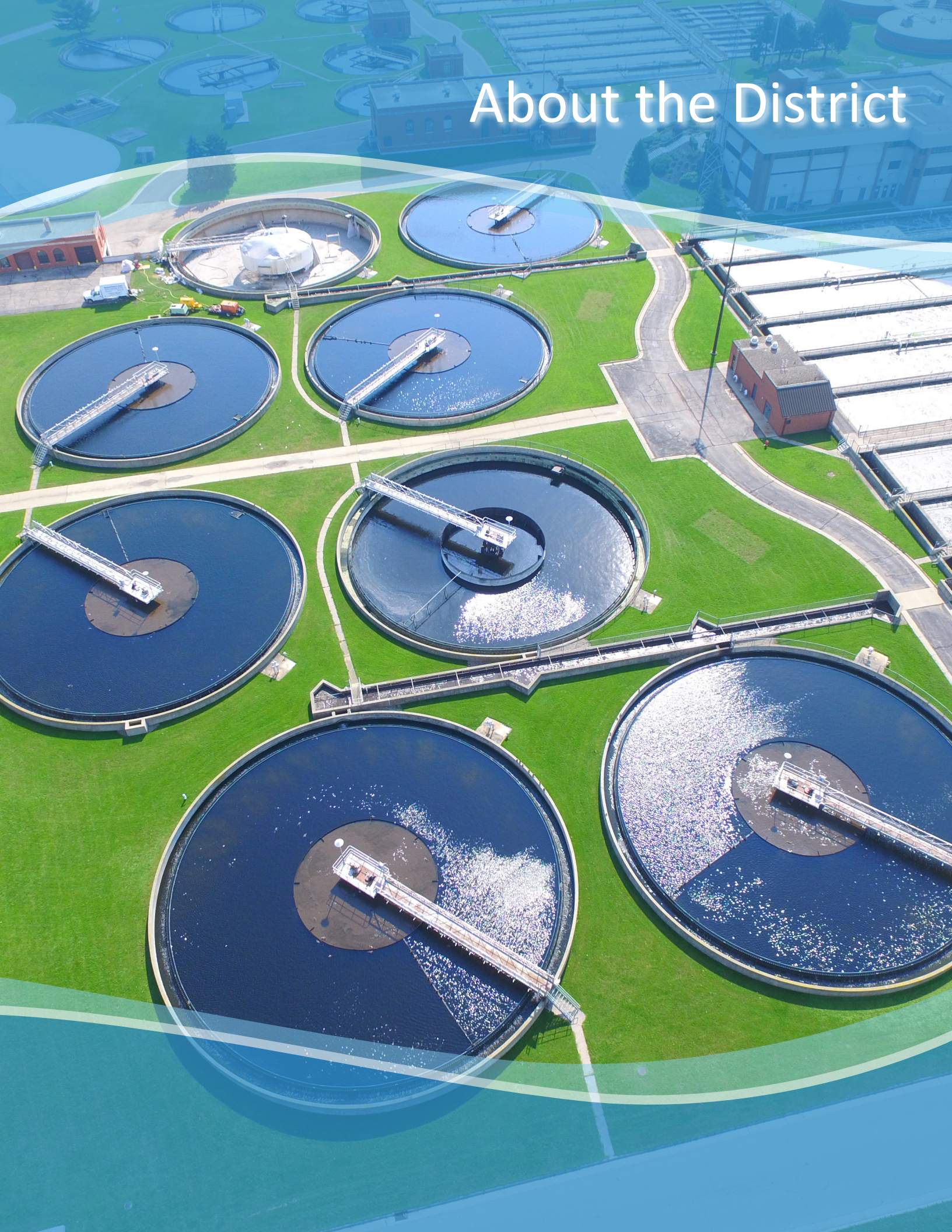
Sincerely,



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. As part of the 2015 budget bill, 2015 Wisconsin Act 118, the legislature revised the makeup of such commissions in areas including Dane County.

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, 2020)
- Ezra Meyer, Vice President (term ending June 30, 2019)
- Ken Clark (term ending June 30, 2019)
- Sara Eskrich (term ending June 30, 2020)
- Grant Foster (term ending June 30, 2020)
- Brad Murphy (term ending June 30, 2021)
- Mary Swanson (term ending June 30, 2021)
- Tom Wilson (term ending June 30, 2021)
- TBD

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, at the Maintenance Facility Training Center at 1610 Moorland Road, Madison, WI 53713. Special meetings are held upon call of any member of the commission.

Executive Team

The executive team consists of five directors, a human resources manager, a communications and public affairs manager, the chief engineer and director and the district's legal counsel. The team meets Wednesdays in the Operations Building.

The directors oversee the following departments:

- District Leadership and Support
- Ecosystem Services
- Engineering
- Finance
- Operations and Maintenance
- Planning and Strategy

DISTRICT LEADERSHIP & SUPPORT

The purpose of the district leadership and support team is to provide human resources, commission 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.

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.

FINANCE

This department provides financial services – procurement, accounting, financial process improvement and information technology – to internal and external customers so that the district can achieve its mission of protecting public health and the environment.

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.

PLANNING AND STRATEGY

Planning and 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, the computerized maintenance management system (CMMS) and the geographic information system (GIS), among others.

Personnel

In 2018, the district employed 102 full time employees (FTE). Table 1 represents the district’s overall staffing from 2017-2018.

Table 1 – FTE Employees

DEPARTMENT	2017 FTE COUNT	2018 FTE COUNT
Administration	15	7
District Leadership and Support	4	7
Ecosystem Services	17	17
Engineering	7	7
Operations and Maintenance	51	51
Planning and Strategy	6	13
TOTALS	100	102

2018 HIRES, RETIREMENTS AND PROMOTIONS OF DISTRICT EMPLOYEES



DEPARTMENT REORGANIZATION

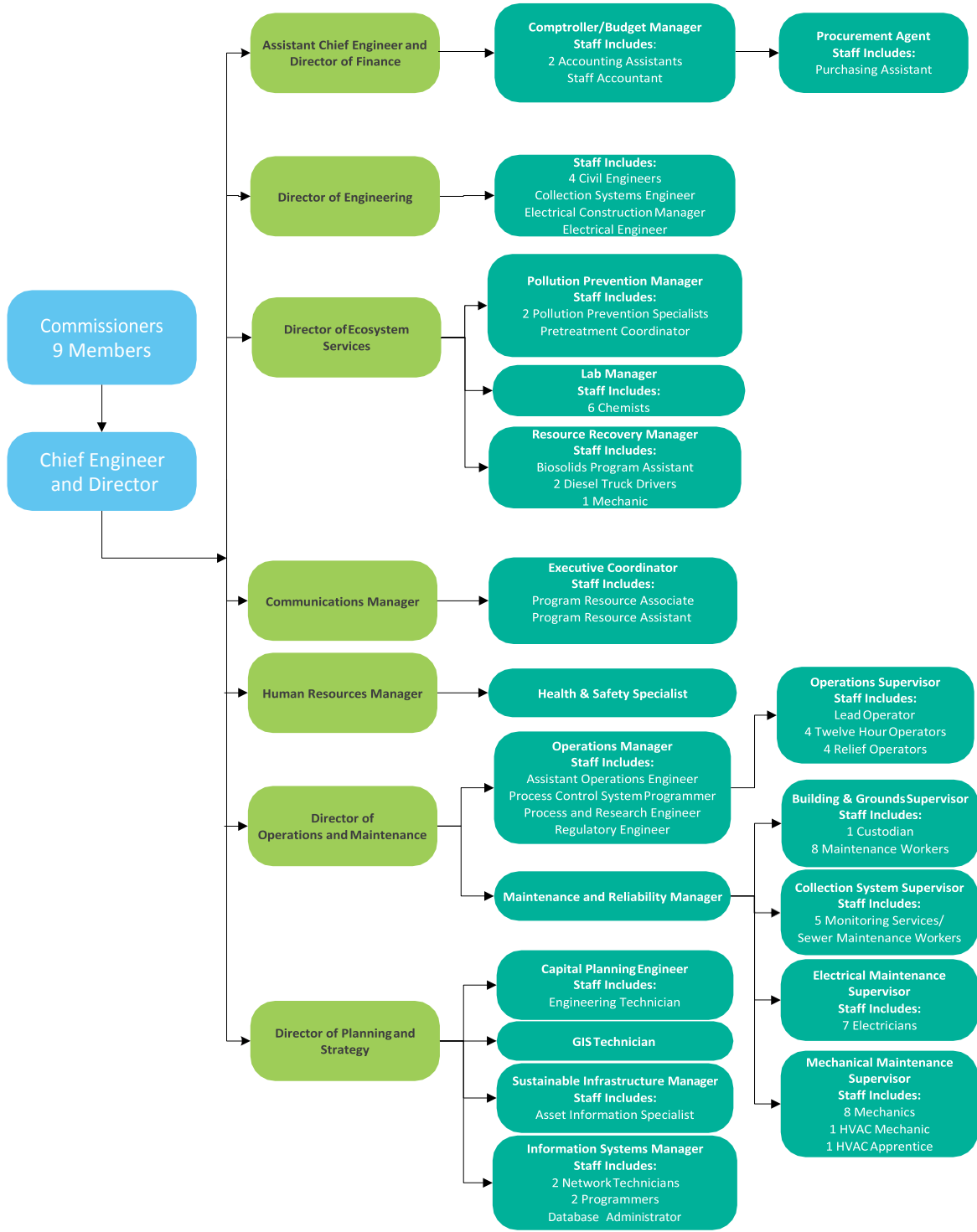
In 2018, several district departments underwent reorganization changes. The administration department became the finance department and the information technology group was moved to the planning and strategy department along with the business analyst position. The purchasing workgroup was realigned to report to the director of finance position. The reasons for these organizational changes were to:

- Create a department focused solely on the district's finances.
- Strengthen the role of strategic planning including an expanded emphasis on information technology and analytical business functions.

The changes are meant to improve internal customer service, encourage interaction among departments and create new benefits for our customer communities. In addition to the larger-scale changes that occurred in 2018, the GIS position was aligned to report to the asset manager position.

Figure 1 is an organization chart that represents the district's hierarchy at the end of 2018 including the new approved positions for 2019.

Figure 1 Organization Chart



WHAT WE DO

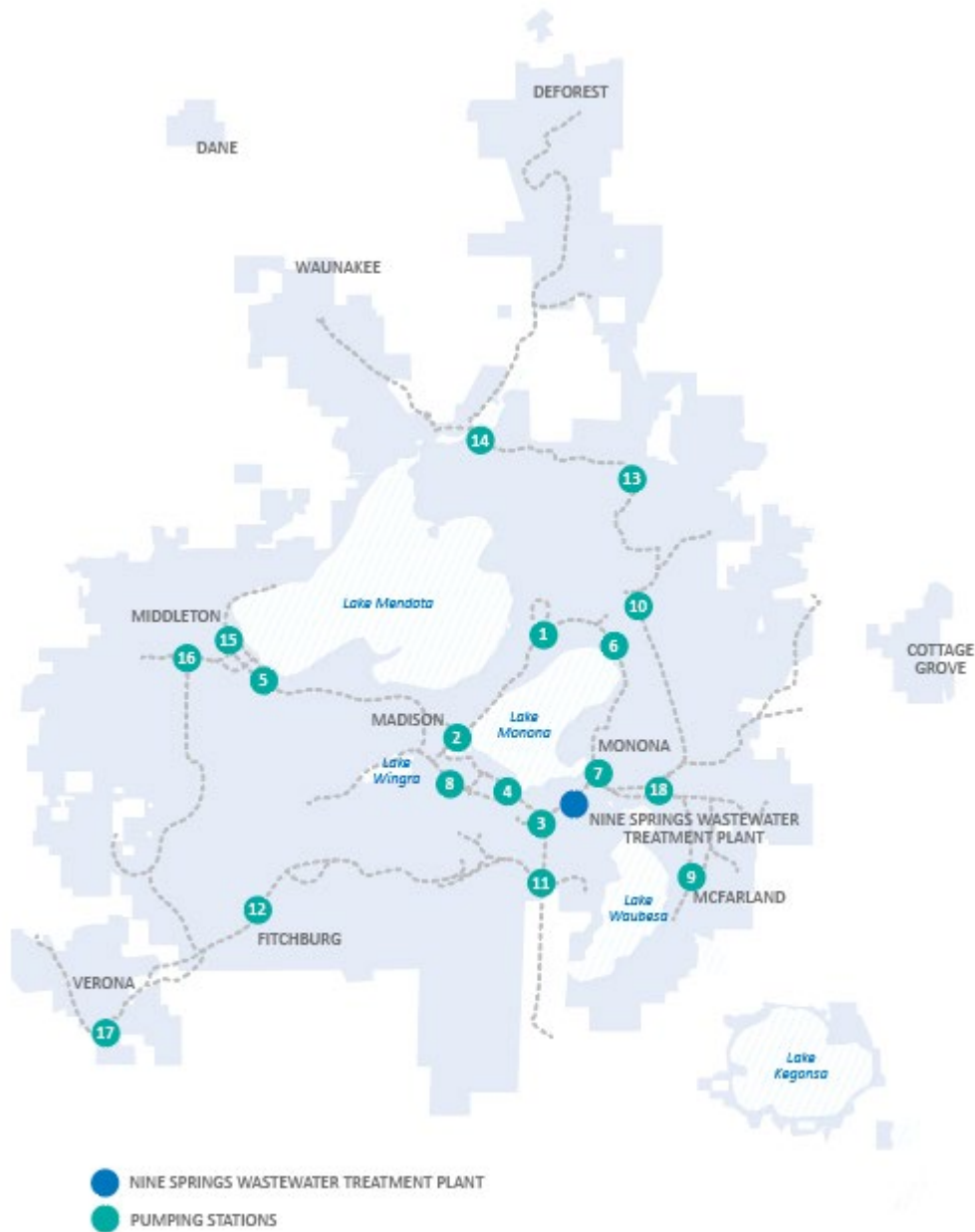
For over 88 years, the Madison Metropolitan Sewerage District has protected public health and the environment by monitoring, maintaining and operating the complex system of pipes and equipment that convey, treat and return wastewater to the environment.

To convey the wastewater generated from homes, businesses and industries throughout its service area, we operate and maintain approximately 96 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 47 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: 1) treated effluent, 2) energy and 3) biosolids. Treated effluent is pumped 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 2018, the district served over 380,000 people in the greater Madison area. Our 184 square-mile service area includes five cities, eight villages and 13 sanitary/utility districts. The district's service area stretches from Dane and Morrisonville in the north to Verona and Lake Kegonsa 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 2018, the district added 624.95 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
Dohm Attachment	2018-01	City of Madison	134.53
City Owned Lands - Lower Badger Mill Creek	2018-02	City of Madison	70.30
Schewe Limited Partnership	2018-03	City of Madison	81.87
Aldora Court	2018-05	Town of Westport	2.02
Malmquist/ Heinrichs/ Veridian Homes lands	2018-06	City of Madison	66.34
Francois and Jackie Luyet property	2018-07	City of Madison	1.95
Woodland West	2018-08	Village of Waunakee	135.07
Gaston Schoolhouse	2018-09	Village of Cottage Grove	0.72
McFarland School District Baseball Fields	2018-10	Village of McFarland	23.47
Schnaubelt Parcel	2018-11	Town of Westport	2.29
Verona Area School District	2018-12	City of Verona	106.39
		TOTAL	624.95

Department Summaries



DISTRICT LEADERSHIP AND SUPPORT

Staffing

The leadership and support workgroup has 7 full time employees and 2 part time employees:

- Chief Engineer and Director
- Communications Manager
- Executive Coordinator
- Health and Safety Specialist
- Human Resources Manager
- Multimedia Graphic Artist (part time)
- Program Resource Assistant
- Program Resource Associate (2 positions - one is part time)

Responsibilities of Workgroup

The workgroup's main responsibilities are as follows:

- Business Services
- Communications/Marketing
- Commission Management
- Executive Management
- Human Resources
- Public Affairs
- Safety

Programs, Initiatives and Work Reporting

POLICY GOVERNANCE

Advancing a policy driven strategic approach to governance, fostering relationships with customers and the public and building employee capacity to be effective leaders at fulfilling the district's mission, vision and values are the pillars for the work of the chief engineer and director. In 2018, the chief engineer and director led efforts to develop, review and prioritize commission outcome policies.

With clean water utilities starting to branch into new policy arenas that address the topics of infrastructure renewal, water equity, affordability and resiliency, a policy book was developed by the commission in 2017 and 2018. The policy book provides a blueprint for governing the district in this new climate of change by outlining district outcome policies, process policies and delegation policies.

RESOURCE/COMMUNICATIONS

Rising public interest in water quality and affordability issues is increasing overall attention to the business of the district. The resource and communications team address the increasing demands for public engagement, as well as develops materials to support Yahara WINS and pollution prevention programs. In 2018, a communications inventory was completed to help reflect the current status of the district's communication efforts and identify the channels, tools, staff capacity and processes needed to continue moving forward.

HUMAN RESOURCES

In 2018, the district continued to experience the effects of retirements and a tightening labor market. Almost half of the 100 full-time district employees have been with the district for six years or less. The executive team has also experienced significant change with half of the team members hired in the last two years. While this has been a challenge for the organization, the district continues to hire high quality employees who bring with them a variety of experience and perspectives.

Having a diverse and inclusive work environment has become a necessity, as the district's working environment must evolve to support diversity in order to recruit, retain and engage employees at the highest level. In 2018, the district's inclusion and diversity initiative moved forward with a number of strategies including developing a three year partnership with the YWCA, creating an inclusion and diversity scorecard and completing "Creating Equitable Organizations" training. The inclusion and diversity strategic plan was implemented and the intercultural development inventory was completed with all new employees. Inclusion and diversity is a commission priority that will continue to evolve in the years to come.

In 2018, members of the district's Employee Leadership Council (ELC) completed training on interest based problem solving and established council operating guidelines. The ELC also tackled a number of important issues for employees in 2018 including evaluating district paid time off policies, pay progression and participating in the 360 review of the chief engineer and director. The council is composed of elected district employees and provides a path for employees to participate in responsible governance of the district. The council is a valuable resource to the employees and the organization.

SAFETY

With workplace violence and security threats becoming more common, the district initiated a goal in 2018 to develop a process to take a comprehensive look at security on the Nine Springs campus. Goals include performing a safety and security needs assessment.

In 2018, the district saw an uptick in our Occupational Safety and Health Administration (OSHA) incident rate and days away restricted or transferred (DART) rate (Table 3). Although we had an uptick in Incident and the DART rate, we also experienced unusual events (local flooding) that demonstrated district employees commitment to safety and protecting the environment.

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

ECOSYSTEM SERVICES

Staffing

The operations workgroup has 17 full time employees:

- Chemist (6)
- Director of Ecosystem Services
- Lab Manager
- Metrogro Assistant
- Metrogro Driver
- Metrogro Mechanic (2)
- Pollution Prevention Manager
- Pollution Prevention Specialist (2)
- Pre-Treatment Coordinator
- Resource Recovery Manager

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 works 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

CHLORIDE INITIATIVES

The district continues to strive to meet the chloride water quality standard, which is included in district's WPDES permit, through pollution prevention and source reduction initiatives. In 2018, the district applied for a new variance with the upcoming permit reissuance to continue its successful source reduction program.

The chloride reduction strategy, developed in 2017, leverages nontraditional investment, incentive programs, outreach, research and collaborations/partnerships to drive behavior change that not only seeks to meet the water quality standard in the short term, but to sustainably maintain compliance into the future. Through these innovative approaches,

ratepayers continue to benefit by avoiding the cost associated with new and expensive treatment technology.

In 2018, action on the strategy focused on maintaining successful programs, and building capacity for the roll out of new programs in 2019. Incentive programs including, commercial & industrial rebates, innovation grants, road salt reduction equipment grants were updated, streamlined and continued. In addition, the district offered its third Salt Wise soft water training program. The 2018 class was titled, “Smart Salt Use for Businesses” and it was held in the format of an informational seminar about chloride pollution and incentive programs. A panel of water treatment businesses was present at the seminar, to help facility managers in attendance easily seek advice and service providers for salt reduction projects.

District staff leveraged relationships with partners, like the WI Salt Wise Partnership, to further chloride reductions as well. Through the Salt Wise Partnership, the district contributed to the development of Dane County’s winter salt application rates standards and City of Madison salt certification training course, as advisors. The development of rates and the certification training classes work synergistically with district programs to change norms around road salt use in both the public and private sector. District customer communities were encouraged to take action in their communities at a chloride-specific meeting on Pollution Prevention Week.

POLLUTION PREVENTION

In 2018, the district pollution prevention team focused on setting the stage for ongoing pollution prevention initiatives by developing strategic tools and partnerships. While the district has several staff members dedicated to pollution prevention, there are thousands of people and businesses in our area to reach with pollution prevention messages. The district is working to reach more people, more efficiently through technological tools and building partnerships.

Technology is helping the district streamline data gathering related to pollution prevention. In 2018, the pollution prevention team piloted the Survey123 application through the ESRI ArcGIS software suite to more efficiently collect information from dental clinics. Historically, district staff inspected a number of dental clinics each year to ensure the proper management of dental amalgam, a source of mercury to the sewer. Using Survey123, the district developed a “virtual inspection” survey that allowed for remote collection of dental mercury management information, saving the time, logistics and fuel of visiting clinics in person. Encouraged by the results of this program, the pollution prevention team is planning for applications of this tool in tracking and minimizing other pollutants, such as chloride and wipes.

The district also worked to forge new relationships in the community and strengthen existing partnerships. During September’s Pollution Prevention Week, the district convened representatives of its customer communities to encourage them to be leaders on chloride

reduction, providing resources and guidance for municipal chloride reduction efforts. That same week, the district partnered with Dane County Clean Sweep to offer a voucher for free disposal of household hazardous waste, such as mercury. The district has also begun engaging area developers in potential strategies for minimizing the chloride loading from new home construction in the district service area. Between partnerships and strategic use of technology, the district aims to expand the reach and effectiveness of pollution prevention messages.

PUBLIC EDUCATION

Tours are an opportunity to interact with the public, share important wastewater messages, and exchange knowledge with other wastewater professionals. Approximately 1,860 people went on plant tours in 2018. Groups included school field trips, youth enrichment programs, adult professionals and groups with a general interest in wastewater.

As in previous years, the district offered some special tours as a way of bringing new audiences into the plant and focusing on different aspects of wastewater treatment. On World Water Day in March 2018, the district hosted an event relating to the United Nations designated 2018 World Water Day theme, “The Answer is in Nature.” The event showcased the connection of wastewater treatment and resource recovery to natural systems through an evening tour and lecture on the history of the district lagoons’ transformation from superfund site to wildlife area. A special hard-hat tour during Pollution Prevention Week in September provided the general public a unique peek into the solids-processing side of the plant. The district also participated in the Parks & Trails Unite festival in June 2018. Taking advantage of the treatment plant’s location on the Capital City bike trail, district staff led bike tours of the plant to bikers heading to the festival at Lake Farm Park.

The transition of the district’s Shop One building to a public space for fostering water stewardship was launched forward in 2018 with a “Scholarship Exchange Experience for Innovation & Technology” (SEE IT) scholarship from the Water Research Foundation, Water Environment Federation, National Association of Clean Water Agencies and Leaders Innovation Forum for Technology (LIFT). The scholarship enabled district staff to visit innovative peer organizations, and see first-hand how these wastewater agencies use public spaces to build partnership with the communities they serve. One of the many ideas that staff brought back from this trip was the use of purposeful, creative design for functional elements within the educational space. In late 2018, the district applied this concept in planning for improved acoustics in Shop One. The district engaged a firm to improve acoustics in the meeting space and tasked it with not only improving the functionality of the room, but also with including educational elements and communicating district brand in the design and materials. Construction and installation of these elements is anticipated to be completed in 2019.

Having seen successful existing models for wastewater educational programming, through the SEE IT program, staff began the ongoing and iterative processes of listening and learning from local stakeholders to conceptualize what an effective water education center at the district would look like. Conversations around possibilities will continue through 2019 to inform a strategy for Shop One and related programs.

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, the operation of sewers and pumping stations and the 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. An industrial permit was reissued for one facility in 2018. In addition, a new permit was issued at the end of 2018 for the Dane County Landfill renewable natural gas project. All industrial permittees received annual inspections, and compliance monitoring of regulated wastewater discharges occurred in both semi-annual periods. There were no instances of significant noncompliance by permittees or other users in 2018.

The industrial pretreatment program also maintains an additional 21 permits for non-typical organic industrial users, as well as permits with approximately 29 waste haulers. All waste haulers that use district facilities received annual permits in August, and two non-typical permits were reissued in 2018. Staff members continued to perform waste acceptance reviews and to respond frequently to non-permitted industrial, hauled waste and other waste acceptance requests.

ACCEPTANCE OF SEPTAGE AND ATYPICAL WASTES

Hauled wastes have been accepted at Nine Springs Wastewater Treatment Plant since 1986. In 2018, the district accepted waste from 28 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 2018, hauled wastewater treatment revenue exceeded \$702,000. Just less than 35 million gallons of wastewater were received via truck in 2018.

Table 10 lists the five domestic septage categories, the number of gallons of septage received during 2018, and the percent of increase or decrease in volume from 2017 to 2018.

Table 10 – Domestic Septage Received

Septic Tank	Holding Tank	Grease Trap	Settling Basin	Portable Toilet
12,478,000	18,197,000	694,000	221,000	533,000
13% increase	5% increase	45% increase	29% increase	5% increase

The hauled wastes receiving facility, and infrequently the whey well, are the discharge points for other wastewater not characterized by the five domestic septage categories. Table 11 shows the other wastewater types and volumes received in 2018.

Table 11 – Other Wastewater Received

Wastewater Received	Volume (gal)
Village of Belleville Biosolids (100 loads)	500,000
Refuse Hideaway Landfill Leachate	50,000
Middleton Landfill Leachate	16,000
Verona Landfill Leachate	35,000
Slaughterhouse Wastewater	874,000
Other Gray Water	185,000
Grocery Store Food Waste	42,000
Remediation Projects Groundwater	115,000
WVDL Tissue Digester Residue	29,000
Industrial precipitation/wash water	288,000
Other Industrial Wastewater	517,000
Total Other Wastewater Received	2,648,000

LAGOON SITE PROJECT

U.S. Environmental Protection Agency Region V conducted their annual site review of the lagoon site in spring of 2018, fulfilling a statutory requirement on the part of EPA and included both a site visit and inspection. Routine inspections, operations and maintenance activities continued in 2018. These activities included monthly visual inspections of capped areas and containment dikes, water management and vegetation control. In June of 2018, the district along with other partners hosted the Milwaukee Public Museum's BioBlitz. The district's Wildlife Observation Area (of which the lagoons are a part of) was included in 1,000 acres surveyed as part of the event. In August 2018, the region experienced widespread flooding, and as a result, the district was forced to repair a small dike breach that was allowing river water from Nine-Springs Creek to enter the lagoon area.

WATERSHED PROJECTS

Yahara Watershed Improvement Network

In 2018, the district-led Yahara WINS adaptive management project completed its second 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 2018, the partnership was able help implement successful urban and agricultural practices that kept 47,223 pounds of phosphorus 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 2018, district staff collected water chemistry and macroinvertebrate samples. 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 similar to the previous year. The district also has joint funding agreements with the U.S. Geological Survey for two gauging stations in the Yahara 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 2018, the district laboratory performed 78,018 analyses on 16,254 samples.

Table 12 – Analyses Performed in 2018

PARAMETERS	QUANTITY
Nutrients (TKN, TP, NH3-N, PO4-P, WEP)	23,181
Solids (Suspended and Total)	22,301
Biochemical Oxygen Demand	5,311
Anions (Cl, NO3-N, NO3+NO2, NO2-N, SO4)	5,110
Field Measurements (pH, TEMP, COND, DO)	5,004
Metals	9,622
Bacteria (FCOLI, TCOLI, ECOLI, Salmonella)	1,353
Volatile Fatty Acids (VFA)	4,165
Misc. Testing (Alkalinity, Density, Chlorophyll, CH4, CN, WET, TDS)	1,971

The district laboratory was also involved in the following activities:

- The laboratory analyzed 1,139 samples in support of the Yahara WINS adaptive management project. Of these samples, 266 were collected by citizen volunteers
- The City of Madison Engineering Department continued to bring the lab samples from its monitoring program. The City collects samples from various points throughout the collection system to use for billing purposes. The district analyzed 69 samples for TKN, TP, CBOD5, TSS and pH
- The district ran a digester retention time study to help understand future digester cleaning needs. The study involved adding a chemical tracer to a digester and periodically measuring the decrease in tracer concentration over time. The lab analyzed 69 samples for this effort
- The laboratory continued to provide 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 also analyzed several influent samples for a UW-Madison study investigating fate of titanium in wastewater. The laboratory analyzed 810 samples from these projects

- The district ran a comprehensive source separated organics digestion study to understand the potential impacts on energy generation and additional treatment needs. The laboratory analyzed 973 samples covering 37 different parameters as part of this effort
- During the winter months, the lab analyzed 449 samples for chloride to provide data for the chloride minimization efforts

Other noteworthy activities in the laboratory during 2018 were the following:

- 100 percent of the results reported on the proficiency testing samples required for certification were acceptable
- A gas membrane was installed on the Astoria2 ammonia auto-analyzer. Data comparisons were performed to determine if the membrane could be used in place of distillation. WDNR lab certification approval is anticipated for 2019
- The lab successfully passed the WDNR laboratory audit for certification under NR 149. The audit is performed every three years
- Knowledge transfer was a priority in 2018. Lab members shared knowledge on a variety of subjects and lab cross training was ongoing

METROGRO

Metrogro Operation

The district recycles biosolids to agricultural land through its Metrogro program. Summary hauling and cost information for the last two years is given in Table 13.

Table 13 – Metrogro Program Details for Past Two Years

Year	2017	2018
Gallons Recycled (MG)	34.6	33.5
Dry Tons Recycled	6,424	6,477
Acres Applied	4,560	4,396
*Program Cost (\$000)	\$1,930	2,096
\$/1000 Gallons	\$55.78	\$62.56
\$/Capita (375,000 residents)	\$5.14	\$5.58
\$/Dry Ton	\$300	\$323

The district continues to produce a high quality biosolids product. Metal concentrations in 2018 were below the concentrations used by EPA to define an exceptional quality biosolid, as shown in Table 14 (Note: Wisconsin Department of Natural Resources uses the term “high quality” in NR 204).

Table 14 - Metrogro Biosolids Quality 2018 Average Values

Parameter	Concentration	EPA EQ Limit*	EPA Ceiling Limit	Units (Dry Weight)
Total Solids	5.2	NA	NA	%
TKN	8.8	NA	NA	%
NH3-N	3.8	NA	NA	%
Total-K	0.5	NA	NA	%
Total-P	3.0	NA	NA	%
Arsenic	6.1	41	75	mg/kg
Cadmium	1.4	39	85	mg/kg
Chromium	44.8	NA	NA	mg/kg
Copper	571	1,500	4,300	mg/kg
Lead	29.0	300	840	mg/kg
Mercury	0.7	17	57	mg/kg
Molybdenum	19.5	NA	75	mg/kg
Nickel	27.2	420	420	mg/kg
Selenium	6.3	100	100	mg/kg
Zinc	897	2,800	7,500	mg/kg
PCB	<0.0310	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 2018. Approximately 648 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.

The district administers a yield guarantee program to secure land during the spring hauling season. The payment structure for the yield guarantee program is based on the date at which application to a given field is completed. Weather conditions in 2018 made the spring hauling season a challenge, but with extended hours and weekend work, all applications were completed by the beginning of June.

Each year the district contracts with a number of companies to provide semi tractor-trailers with drivers to pull the district's Metrogro trailers. Several of the companies also provide individuals to operate the district's Metrogro applicators. The district requested submittals from contractors to supply owner-operator semi tractors and equipment operators for 2018.

Metrogro Dry Product

The district's long-term goal of diversifying its overall biosolids management has led to the production of a Class A biosolids cake material. In previous years, the cake material was mixed with sand and sawdust to create a material that represented soil in appearance and texture. A new approach was taken in 2017 with a small scale composting trial at the district. Due to the small scale success, composting was trialed a second time in 2018 in partnership with Berryridge Farms and their existing on farm composting facility. This has led collaboration with a larger work group on collectively exploring possibilities to transport watershed produced phosphorus with a more targeted approach. Air-drying of the cake material is also being explored. Additional composting, as well as air drying trials, will continue into 2019.

ENGINEERING

Staffing

During 2018, the engineering department had 7 full time employees and 1 part time employee:

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

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 \$40 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.

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
- PLC programming and HMI (i.e., computer control screen) design
- Assistance with large maintenance projects
- Utility location and coordination
- 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 will extend sanitary sewer service to undeveloped land near the intersection of Highways PD and M. The interceptor will serve 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 that will extend approximately 3,230 linear feet from the district's Nine Springs Valley Interceptor-Midtown Extension to the southwest corner of Highways PD and M.

Planning and design work for the interceptor were completed in conjunction with Wisconsin Department of Transportation reconstruction of Highway M and were performed by MSA Professional Services. The project was bid as part of the Wisconsin Department of Transportation 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. Final acceptance and closeout is anticipated to occur in 2019.

Pumping Station 15 Rehabilitation

The district's collection system facilities plan update (2011) identified Pumping Station 15 as requiring a firm capacity upgrade and replacement of electrical and control equipment. The Pumping Station 15 rehabilitation project included replacement of existing pumps and valves, enhancement of the power system, replacement of major electrical and control equipment, installation of new heating, ventilation and air conditioning systems, installation of a flow meter within an exterior valve vault and construction of a building superstructure that will allow new electrical equipment to be located above grade. It also included sustainable features such as a green roof, solar panels, stormwater bio-retention areas, permeable pavers and low-maintenance landscaping. Public enhancements include a restroom, an aquatic invasive species control station (i.e., boat wash), a kiosk and a bike repair station.

Planning and design began in 2015 and were completed in early 2016. This work was performed by Baxter & Woodman and district staff members. The project was bid on Thursday, April 7, 2016. The commissioners awarded the contract to Miron Construction Co. on April 14, 2016, at their low bid price of \$3,085,728. Construction activities began in mid-2016 and were complete in early 2018. An open house was held in May, 2018, to celebrate completion of the project. Work was formally accepted by the commissioners on March 15, 2018. The final contract amount, including all change orders, was \$3,154,426.

2016 Liquid Processing Facilities Plan

In 2016, the district's asset management program identified a number of treatment plant liquid-processing needs. It had been more than 20 years since the district completed a study of the treatment plant liquid processing system and staff members believed that a single facility planning effort would best address the needs in a holistic way. The basic purpose of a facility planning effort is to assess the condition of a sewerage system, establish a need for improvements, evaluate options to address system needs and to identify the cost effective alternatives. The project was meant to:

- Evaluate future loading conditions and regulatory constraints
- Conduct condition assessments for structures, equipment, controls and instrumentation associated with the project
- Evaluate current and future peak flow conditions, as well as potential schemes for managing peak wet weather flows, to ensure the plant's hydraulic capacity is capable of handling incoming peak flows
- Evaluate aeration systems for treatment performance, energy efficiency, facility impacts and costs to meet future process and nutrient removal requirements
- Develop an overall plan to meet the future hydraulic requirements of the influent screening, grit removal and screenings/grit management systems
- Develop an overall plan to meet the future hydraulic requirements of the ultraviolet disinfection system
- Assess the electrical systems and power reliability for the liquid processing facilities and identify required electrical upgrades
- Address other miscellaneous plant improvements

Strand Associates was chosen to perform the facilities planning work and the plan was developed over the course of approximately 18 months. The "2016 Liquid Processing Facilities Plan" (and recommendations from the plan) was presented to the commission on Aug. 31, 2017. The recommendations included future improvements to the Nine Springs Treatment Plant liquid processing system totaling approximately \$57.1 million (in 2017 dollars) over a period of 10-plus years. Design for the first set of projects from the plan, called "Liquid Processing Improvements-Phase 1" began in 2018, with subsequent phases occurring in later years.

At the Aug. 31, 2017 meeting, the commission adopted a resolution accepting the liquid processing facilities plan, subject to conducting a public hearing and receiving DNR approval. These were completed in late 2017, and on Jan. 25, 2018, the plan was formally accepted by the commission.

West Interceptor MH02-003 to MH02-014A Rehabilitation

The West Interceptor is one of the district's oldest facilities in the collection system. It was constructed in 1916 and extends from Pumping Station 2 to the intersection of University Avenue and Farley Avenue. The section in Regent and Randall streets, which extends from manhole MH02-003 to manhole MH02-014A, consists of approximately 4,575 feet of 24 inch cast iron pipe.

The West Interceptor was televised in 2011 to assess its condition. The primary defect in the cast iron sewer was tuberculation, or the buildup of deposits on the inside walls of the pipe due to chemical reactions between the wastewater and the cast iron pipe. The deposits generally form above the normal waterline and decrease the capacity of the sewer by reducing the effective diameter of the pipe and increasing the surface roughness. The tuberculation may also compromise the structural integrity of the pipe. Cleaning and cured-in-place lining of the sewer were recommended to rehabilitate the sewer and extend its useful life.

Planning and design for rehabilitating the interceptor were completed in 2016. In April 2016, the project was bid as a joint project with City of Madison. Due to bidding problems, the project was not awarded and was delayed until 2017. At that time, the district work was separated from the City of Madison work and was bid as a district-only project on Jan. 31, 2017. The commissioners awarded the contract to Michels Pipe Services on Feb. 9, 2017, at the low bid price of \$1,219,783. Construction activities were completed in 2017 and the work was formally accepted by the commissioners on April 12, 2018. The final contract amount, including all change orders, was \$1,196,087.

Lower Badger Mill Creek Interceptor-Phase IV

The Lower Badger Mill Creek watershed is located along the district's west boundary and includes land in the Town of Middleton, Town of Verona, City of Madison and City of Verona. Starting in approximately 2004, the district began working with the cities to design a regional interceptor to serve the entire basin. In 2006, the district and City of Verona built phase I of the Lower Badger Mill Creek Interceptor, which extended from Pumping Station 17 to Edwards Street. Phase II of the interceptor was installed in 2008, and extended service to the Epic Systems Corp. campus. Phase III of the Lower Badger Mill Creek Interceptor was constructed in 2013 to facilitate roadway and infrastructure improvements at Epic Systems.

Phase IV of the Lower Badger Mill Creek Interceptor extended the interceptor from Hubble Road to Highway PD and will accommodate further expansion of the Epic campus and future development near Highway PD. Phase IV of the Lower Badger Mill Creek Interceptor included approximately 3,870 feet of 30-inch diameter sewer and nine manholes. Planning and design started in late 2016, with MSA Professional Services assisting with this work. Design was

completed in mid-2017 and the project was bid on June 29, 2017. The commission awarded the contract to S.J. Louis Construction on July 13, 2017, at the low bid price of \$911,656. Construction activities began in late 2017 and were completed in the summer of 2018. The work was formally accepted by the commissioners on Nov. 15, 2018. The final contract amount, including all change orders, was \$907,128.

Monona Waterfront Redevelopment/Southeast Interceptor Relocation

As part of a redevelopment project in Monona in a triangular area bounded by Broadway Avenue on the south, the Yahara River on the northeast and Bridge Road on the northwest, several buildings and structures were proposed to be located over the district's 60 inch Southeast Interceptor. Locating these facilities over the interceptor is not in the best long-term interest of the district, as the risk associated with limiting access for future interceptor maintenance is very high.

During 2017, district staff members, the City of Monona and the commission discussed alternatives to alleviate this concern. In the end, it was decided to relocate the interceptor to a proposed roadway, where it would be accessible and not located under any future buildings. Due to additional length of sewer required, the pipe needed to be increased from 60 inch to 63 inch diameter. The cost for relocating approximately 700 feet of the interceptor was approximately \$1 million, with the district contributing \$250,000 towards the relocation. The project was designed to meet district standards and was bid and inspected by the City of Monona. The work was completed in late 2017 and the relocated interceptor was in service by the end of the year. Final payment of \$250,000 was made to the City of Monona in 2018.

Nine Springs Fuel Tank Relocation

The existing unleaded fuel tank located on the district campus was a 4,000 gallon buried tank that was installed approximately 20 years ago. The pumping/dispensing system had reached the end of its useful life and the tank was in an area where future site improvements to Shop One were being considered. In addition to this, it was more efficient and economical if the tank would be sited closer to the Maintenance Facility, where most of the daily users are located.

In late 2017, district staff members developed plans to relocate the unleaded gasoline system to an area just north of the Maintenance Facility. To reduce costs and provide easier maintenance, the tank was designed to be above ground, with a capacity of 6,000 gallons. The work was bid in late 2017 and was awarded to Walt's Petroleum on Dec. 28, 2017, at their low bid price of \$79,883. Work was completed in 2018. The final contract amount, including all change orders, was \$82,383.

Southeast Interceptor Rehabilitation Upstream of Pumping Station 9

The Southeast Interceptor was constructed in 1961 as part of the Southeast Interceptor Project, which began at Pumping Station 7 and ended at the Yahara River in the Village of McFarland. The section upstream of Pumping Station 9 consists of approximately 3,360 feet of 24" and 27" reinforced concrete pipe which runs parallel to the west side of U.S. Highway 51 and crosses the highway just north of the Yahara River. Annual televising revealed that portions of this sewer were suffering from corrosion above the normal water-line.

The 2018 CIP assumed that all of the interceptor pipe upstream of Pumping Station 9 required rehabilitation with a cured-in-place pipe (CIPP). Upon detailed review by district staff, much of the pipe was determined to be in good structural condition, but many of the joints were leaking. Staff determined that the leaking joints could be fixed by injecting grout at the joints and CIPP was not required, which provided significant cost savings.

District staff completed design in early 2018 and the project was bid on Jan. 31, 2018. The commissioners awarded the contract to Visu-Sewer Inc., on Feb. 22, 2018, at their low bid price of \$215,780. Construction activities began in late 2018 and were approximately 50 percent complete at the end of the year.

West Interceptor Rehabilitation: Pumping Station 5 to the Gammon Extension

This section of the West Interceptor was constructed in 1931 and consists of approximately 3,560 feet of 18-inch cast iron sewer. The sewer was inspected by closed-circuit television, which revealed moderate tuberculation along the entire length. Tuberculation is the buildup of deposits on the inside walls of the pipe due to chemical reactions between the wastewater and the cast iron pipe. The deposits decrease the capacity of the sewer and may also compromise the structural integrity of the pipe. District staff recommended that the entire length be cleaned and rehabilitated with cured-in-place pipe (CIPP).

District staff completed design in mid-2018 and the project was bid on Aug. 2, 2018. The commissioners awarded the contract to Visu-Sewer Inc., on Aug. 16, 2018, at their low bid price of \$465,320. Construction activities had not started as of the end of 2018

Pumping Station 10 Force Main Rehabilitation

The Pumping Station 10 Force Main consists of a 36-inch diameter pre-stressed concrete pipe originally installed in 1963. No improvements have been made to the force main since original installation. The last 2,000 feet of the force main are relatively flat and the pipe is not full at all times, which leads to concrete corrosion in the upper portion of the pipe (similar to what occurs in concrete gravity sewers).

District staff completed design in the summer of 2018 and recommended the force main be rehabilitated by either tite-fit HDPE pipe or CIPP (cured-in-place pipe) methods. The project was advertised in July and bids were opened on Aug. 7, 2018. The commissioners awarded the contract to Murphy Pipeline Contractors, Inc., on Aug. 16, 2018, at their low bid price of \$1,247,934. Construction activities began in late 2018 and were approximately 92 percent complete at the end of the year.

Pumping Station 7 Improvements

Pumping Station 7, one of the most critical assets in the district's collection system, was originally built in 1950 and pumps roughly 11 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.

Pumping Station 7 is nearly 70 years old and 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 a number of improvements at Pumping Station 7. Improvements and key objectives associated with the project include 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 improvement identified during the design process

A scope of work associated with design of these improvements was developed and requests for proposals were sent to consulting firms. The design work was awarded to Strand Associates in early 2018, and was essentially complete at the end of 2018. Bidding will occur in early 2019, with construction anticipated from the spring of 2019 through the summer of 2020.

Southwest Interceptor: Haywood Drive Replacement

The Southwest Interceptor – Haywood Drive Replacement is located in the City of Madison along Haywood Drive, between N. Wingra Drive and W. Shore Drive. This section of the Southwest Interceptor was constructed in 1936 and consists of 24" cast iron sewer. As with other district interceptors made of cast iron sewer and in excess of 50 years old, this pipeline is suffering from the effects of tuberculation. This section of the Southwest Interceptor also

serves as an important intertie between Pumping Station 2 and Pumping Station 8 and has been used on numerous occasions to avoid sewer backups during high flows and other emergency events.

This project will replace the deteriorating Southwest Interceptor on Haywood Drive. It will also provide additional capacity so that flow can be better diverted between Pumping Station 2 and Pumping Station 8 during high flow and/or emergency situations. Approximately 1,500 feet of 24" cast iron sewer will be replaced with a 36" sewer as part of the improvements.

A scope of work associated with design of these improvements was developed and requests for proposals were sent to consulting firms. The design work was awarded to Baxter & Woodman, and was essentially complete at the end of 2018. Bidding will occur in early 2019, with construction anticipated from April through July of 2019.

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 Madison Metropolitan Sewerage 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. The design work was on-going at the end of 2018 and is expected to be complete by mid-2019. Construction of any recommended improvements is not anticipated until 2020.

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" concrete sewer that was constructed in 1969. Television inspection of this 11,000' 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 will be needed sometime

between 2017 and 2031. To verify this, the district measured current flows, which revealed that the current pipe is at 95 percent of capacity and relief is required in the next decade.

District staff evaluated preliminary alternatives for the Truax Extension Relief and Rehabilitation projects as part of the 2018 CIP 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 and eliminates the need for expensive and risky bypassing pumping.

A request for proposals for NEI-Truax Extension Relief design services was developed and the work was awarded to Strand Associates in early 2018. The design work was approximately 90 percent complete at the end of 2018. Bidding will occur in early 2019, with construction anticipated from June of 2019 through the summer of 2020.

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, the Nine Springs Liquid Processing Improvements-Phase 1, consists of the following main elements:

- Peak flow management improvements: hydraulic capacity upgrades at the NSWWTP, as well as upgrades to allow the activated sludge process to operate in a biological contact process mode during high flow events
- Ultra-violet disinfection system replacement: replacement of the existing ultra-violet 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 in serviceable condition, 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

- Effluent force main standpipe improvements: design improvements to eliminate intermittent effluent wastewater discharges

A scope of work and a Request for Proposal concerning these improvements was developed. The design work was awarded to Strand Associates (teaming with Brown & Caldwell) in early 2018, and was approximately 50 percent complete at the end of 2018. Bidding will occur in the summer of 2019, with construction anticipated from late 2019 through the summer of 2021.

FINANCE DEPARTMENT

Staffing

The finance department has 7 full time employees:

- Accountant
- Accounting Assistants (2)
- Assistant Chief Engineer/Director of Finance
- Comptroller/Budget Manager
- Procurement Agent
- Purchasing and Inventory Assistant

Responsibilities of Workgroup

- Provides, accounting, budgeting and procurement support for all district departments
- Provides payroll support for all district departments in collaboration with the human resources manager
- Administers Clean Water Fund loans including loan applications and disbursements
- Prepares the annual service charge rates
- Provides accounting services for the Yahara Watershed Improvement Networks (Yahara WINS)
- The procurement group, staffed by the procurement agent and the purchasing and inventory assistant, focuses on the purchasing of parts, materials and services for the operations and maintenance department while also maintaining the parts inventories
- The procurement agent provides support for procurements by groups outside of the operations and maintenance department

Programs, Initiatives and Work Reporting

PURCHASING

Significant achievements and work advanced in 2018 include:

- Implemented more centralized purchasing at the district through the use of work group specific buyers for the finance, information technology, laboratory, Metrogro, resource team and operations and maintenance groups. Centralized department purchasing funnels district purchases to properly trained buyers capable of completing the purchasing process while adhering to the district's procurement code. The procurement agent continually works with all of the district buyers to facilitate compliance with district policy, workflows and best practices

- Supported O&M by working with IT to develop a weekly purchase order status report. This reporting supports planning and scheduling around confirmed material deliveries
- Reorganized the inventoried materials in storage building #1 which stores larger items that don't require humidity control
- Made improvements to the Maintenance Facility storeroom including relocating inventoried electrical motors from Shop One to the Maintenance Facility, reorganizing the air filters storage locations in the Maintenance Facility and continued work on the physical relocation of inventoried parts into the Vidmar cabinets

ACCOUNTING/FINANCE

Significant achievements and work advanced in 2018 include:

- Obtained an audit for the district for fiscal year 2017 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 2018 budget document, the district's sixth year receiving the award
- Continued to implement the 2017 organizational assessment for the accounting group structure that assigns duties to the lowest level that can support the work and maintain a proper level of segregation of duties and internal controls
- Incorporated three new persons into the four person accounting group
- Obtained a fiscal year 2017 audit for Yahara WINS which found no material weaknesses or significant deficiencies (a "clean" audit). This was the first year an audit of Yahara WINS was conducted

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 monitoring services/sewer maintenance (MS/SM) crew supports quarterly billing by providing sampling and flow measurement at key points in the collection system. The MS/SM crew and plant staff collected data and samples at 89 sampling points in 2018. The sampling points generated 4,400 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 15,083 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 2018 service charge rates, shown in the Table 15, were adopted on Oct. 26, 2017.

Table 15 - Service Charge Rate Summary Information

Parameter	Rate	Units
Volume	\$648.61	per million gallons
CBOD	\$0.15573	per pound
Suspended Solids	\$0.25196	per pound
TKN-Nitrogen	\$0.38193	per pound
Total Phosphorus	\$4.25832	per pound
Actual Customers	\$34.98	per year
Equivalent Meters	\$38.56	per year

The 2018 rates included a 0.69 percent surcharge to recover the DNR NR101 effluent fees.

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 twenty gallons per minute and is defined as one equivalent meter. The capacities of larger water meters are divided by the twenty-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 2018, the average annual residential service charge in the district was about \$323. This amount includes \$184 for services provided by the district and \$139 for services provided by

the municipality (e.g. the City of Madison). A survey of 174 of the nation’s largest municipalities indicated that the typical residential service charge in the district in 2018 of \$323 is 64 percent of the national average of \$504.

Operating costs per million gallons of treated wastewater for the years 2014 through 2018 are shown in Table 15. The cost per million gallons decreased in 2018 to \$2,185 per million gallons. This 2.4 percent decrease compared to 2017 was due to an overall cost increase of 4.0 percent and a volume increase of 6.5 percent. Operating costs per million gallons increased by 4.7 percent in 2017 compared to 2016 due to an overall cost increase of 7.9 percent and a volume increase of 3.1 percent.

Table 16 - Costs per Million Gallons of Wastewater Treated

District Function	2014	2015	2016	2017	2018
Administration	\$270	\$297	\$357	\$369	\$368
Collection	138	150	142	169	154
Treatment	809	828	774	810	777
Debt Service	771	847	866	891	887
TOTAL	\$1,988	\$2,122	\$2,139	\$2,239	\$2,185

In comparison with the 2017 costs, 2018 overall operating costs increased 4.0 percent. Administration costs increased 6.1 percent, collection costs decreased 2.8 percent, treatment costs increased 2.2 percent and debt service costs increased 6.0 percent. The increase in administration costs was largely due to two added positions, overall salary increases for all employees and additional engineering department salaries charged to the operating budget. The decrease in collection costs was primarily due to reduced replacement parts and services. The increase in treatment costs was due to increased electric power and salary costs. Debt service costs increased to support the district’s capital improvement plan.

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. The total amount financed through these Clean Water Fund loans is \$233.2 million.

No new Clean Water Funds loans were obtained in 2018. The district had three Clean Water Fund loans for which the final disbursement had not been received by the end of 2017. The status of those loans is as follows:

Pumping Stations 11 and 12 Rehabilitation

The district issued General Obligation Sewerage System Promissory Notes, Series 2015A, on Feb. 25, 2015, to the State of Wisconsin Clean Water Fund (CWF Project 4010-42). These bonds are for an aggregate amount not to exceed \$10,663,025 and are to be repaid at an annualized interest rate of 2.262 percent. The first interest payment on the loan was made on May 1, 2015. The first principal payment was made on May 1, 2016. The final payment will be made on May 1, 2034. The district received the final disbursement for this loan in 2018, bringing the final total for the loan to \$10,016,605.

Pumping Station 15 Rehabilitation, Pumping Station 12 Force Main Relocation, Rimrock Interceptor Rehabilitation/Replacement

The district issued General Obligation Sewerage System Promissory Notes, Series 2016A, on Nov. 9, 2016, to the State of Wisconsin Clean Water Fund (CWF Project 4010-46). These bonds are for an aggregate amount not to exceed \$7,196,557 and are to be repaid at an annualized interest rate of 1.96 percent. The first interest payment on the loan was made on May 1, 2017. The first principal payment was made on May 1, 2018. The final payment will be made on May 1, 2036. The district received the final disbursement for this loan in 2018 bringing the final total for the loan to \$6,897,393.

West Interceptor - Randall Street to near Pumping Station 2 Rehabilitation

The district issued General Obligation Sewerage System Promissory Notes, Series 2017A, on Dec. 27, 2017, to the State of Wisconsin Clean Water Fund (CWF Project 4010-44). These bonds are for an aggregate amount not to exceed \$1,439,043 and are to be repaid at an annualized interest rate of 1.76 percent. The first interest payment on the loan was made on May 1, 2018. The first principal payment was made on May 1, 2018. The final payment will be made on May 1, 2037. The district had received the final disbursement for this loan in 2018, bringing the final total for the loan to \$1,367,289.

MAINTENANCE OF DISTRICT FACILITIES

Staffing

The maintenance workgroup has 35 full time employees:

- Buildings & Grounds
- Buildings & Grounds Supervisor
- Custodian
- Electrician (7)
- Electrical Maintenance
- Electrical Maintenance Supervisor
- HVAC Technician(2)
- Maintenance and Reliability Manager
- Maintenance Worker (7)
- Mechanic (9)
- Mechanical Maintenance
- Mechanical Maintenance Supervisor
- Monitoring Services and Sewer Maintenance
- Monitoring Services and Sewer Maintenance Supervisor
- Monitoring Services and Sewer Maintenance Worker (4)

Responsibilities of Workgroup

The workgroup's main responsibilities are as follows:

- Conducting preventative and reactive maintenance activities at the treatment plant, pumping stations and the collection system
- Monitoring and sampling collection system wastewater for customer billing
- 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 covered, the district's interceptor system and the district's rental properties. This work is performed by the mechanical maintenance section, the electrical maintenance section, the buildings and grounds section and the monitoring services/sewer maintenance section.

The following information contains a more detailed listing of the activities performed by each of the maintenance sections.

BUILDING AND GROUNDS

The section spent the majority of the year maintaining the district and non-district pumping stations, the Nine Springs Wastewater Treatment Plant buildings 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 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.

The buildings and grounds section continued improving snow removal operations and reduced salt use by applying knowledge acquired from attendance at winter roadway maintenance and Dane County "Saltwise" training courses. The section also purchased and used a sweeper attachment for the skidsteer to remove snow more effectively to the ground surface, resulting in less salt use.

In 2018, buildings and grounds crew assisted the operations and engineering staff with projects including:

- Continued working jointly with the City of Madison on a non-intrusive wet well cleaning procedure. The procedure generally has eliminated entering a confined space, and the grease removed is taken directly to the landfill
- Performed preventive maintenance on primary settling tanks 05, 09 and 10
- Performed preventive maintenance on aeration tanks 25 through 30
- Performed preventive maintenance on final clarifiers 01, 02, 03 & 04
- Changed the media in the hydrogen sulfide removal vessel
- Assisted with the clean-up and repair of the failed digester 4 sludge piping
- Weekly safety testing of emergency/exit lighting & emergency eyewash/shower stations
- Responded to high flow event by sandbagging lagoon dike roads, auxiliary pumping at James Street station and cleanup of an overflow of the West Interceptor
- Painted and landscaped at the wastewater treatment plant
- Performed plumbing repairs in district buildings
- Performed preventative maintenance exercising of valves at the treatment plant and pumping stations
- Maintained and repaired snow removal and lawn care equipment
- Removed brush and trees along Badfish Creek
- Inspected treatment plant and pumping station roofs

- Performed repairs and updates to the Upper Yahara property prior occupation by the new tenant
- Assisted by the City of Madison, cleaned the wet wells of district owned Pumping Stations 07, 11, 12 and 17
- Assisted the district lab in stream sampling on the Badfish Creek and Sugar River Watershed
- Assisted in the relocation of the pilot plant to the east sludge gallery

The buildings and grounds crew contracted for the following services:

- Media blasting and recoating of final clarifiers 12 and 14
- Removal and replacement of approximately 20,000 square feet of low volume roadway at the plant
- Weed spraying of the plant perimeter fence
- Repairing of 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 maintenance, 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 testing of electrical devices. The section continued to lend its expertise to other departments to facilitate district projects and improve the treatment process. The continued use of the district's computerized maintenance management system has allowed the section to identify problems by tracking equipment data, scheduling maintenance and creating daily and preventive maintenance work orders.

In addition to normal maintenance tasks connected with the operation of the district's wastewater collection and treatment facilities, the following planned improvements or projects were completed or continued in 2018:

- Continued to upgrade documentation of electrical drawings for the district and non- district facilities
- Provided electrical cross-training to the district's mechanics, operators and HVAC personnel

- Operated district portable generators to provide power to various pumping stations during planned and unplanned power outages
- Continued to upgrade and modify existing electrical equipment at district and non-district facilities to accommodate the requirements of NFPA 70E (Arc Flash)
- Continued collection of data for the Pumping Stations 11, 12 and 15 electrical assets so that specifications, bills of materials and preventive maintenance work orders could be entered in the computerized maintenance management system
- Assisted with the evaluation of the liquid process facility plan
- Assisted with the evaluation of the current Thurber Avenue pumping station and the design of a replacement station
- Assisted the engineering department with submittal review for Pumping Station 7 and James Street and other upgrade projects
- Designed, fabricated and installed new controls and telemetry for Air National Guard pumping station 1
- Designed, fabricated and installed new controls and telemetry for Diemer pumping station
- Designed, fabricated and installed electrical and controls for the new pilot plants at the district
- Designed, fabricated and started installation of Pumping Station 16 control room supply fan automated controls to pressurize the dry well side of the station
- Completed installation of new HVAC controls for the Metrogro pumping station building
- Completed an electrical review and electrical repairs to the Yahara property
- Assistance provided to the City of Madison with an on-site generator installation at Fremont pumping station
- Created standard operating procedures for annual maintenance at several of the pump stations owned by others but maintained by the district. Standard operating procedures were also created for buildings and equipment at the treatment plant
- Used condition assessment forms for electrical assets and rated the condition of most electrical assets for the asset management program
- Changed direct radio frequency. This eliminated the cross talk between the Direct and Larkin communications allowing for faster and more reliable communication for both communication paths
- Coordinated 800KW generator at PS 1 with City of Madison during high flow conditions
- Installed Opti-Float system at Westport which was the first of its kind for the district

MECHANICAL MAINTENANCE

The mechanical maintenance section verifies proper operation and effectively maintains the pumping stations of the district and its contract customers, ensures that all collected wastewater is conveyed to the treatment plant and maintains and supports operation of the treatment plant equipment and facilities. The section works with operations personnel to achieve permit compliance, maintains the district's vehicle fleet and develops the skills of section staff members through the district's apprenticeship program and other training and wellness opportunities.

In addition to many scheduled maintenance activities, major accomplishments completed in 2018 included:

- Oversaw the rebuild of engine and generator 1 by outside contractors
- Responded to multiple generator and blower engine failures, keeping them running to utilize the digester gas supply and reduce energy consumption from the utility
- Repaired many deaerator system pump failures. Worked with outside contractor to determine the root cause of the pump failures and devised a permanent solution
- Installed two new pumps at the City of Madison's Redan Drive station
- Replaced and repaired suction and discharge valves at the City of Madison Atlas station
- Replaced several critical process related pumps and mixers
- Assisted with the clean-up and repair of the failed digester 4 sludge piping
- Replaced gaskets and adjusted weights on the digester 4 and 5 emergency relief hatches
- Coordinated and repaired a failed flow splitter gate valve with contractor assistance
- Worked with vendor to find a solution to multiple Lipactor gearbox failures
- Installed a trial rotary lobe pump to take the place of a high cost and highly maintenance intensive progressive cavity pump on the acid digester system
- On a weekly basis, removed rags and other debris from plugged collection system pumps to keep them functioning at required capacities
- Rebuilt and replaced many smaller pumps and sump pumps
- Performed a complete rebuild of the final clarifier drive 10 primary and flocculator drives
- Assisted the contractor with the removal and reinstallation of blower 5 during its rebuild
- Worked with outside contractors to maintain hot water and steam boilers to state standards
- Identified the air quality in the WAS thickening building was the root cause of air compressor failures and devised a plan to move them to an area with better air quality
- Rebuilt the majority of the Metrogro storage tank isolation valves in the Metrogro pumping station that would not set properly

- Began working with the manufacturer to start the process of replacement for our obsolete Sterling drives on the final clarifiers
- Troubleshoot and assisted during the high flow event with crews responding around the clock
- Continued developing standard operating procedures for routine mechanical tasks to promote consistency and efficiency in work
- Worked with the planning department and GHD on the asset management plan on the goal of working toward reliability centered maintenance

MONITORING SERVICES/SEWER MAINTENANCE

A major portion of the work performed by this section involves 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. In addition, the crew inspects portions of the district's collection system each year. Repair needs found by the crew are either made by the crew members or by contractors. In addition to the inspections performed by the crew, crewmembers work with contractors to televise and clean portions of the interceptor system.

During 2018, the following activities were performed by the crew:

- Conducted preventive maintenance work on all air release valves
- Monitored and recorded all lateral connections
- Implemented and tested laser and flow monitoring equipment
- Inspected stop log and flap gate structures
- Exercised valves in the collection system
- Assisted United States Infrastructure Corp. with the location of force mains
- Viewed and coded interceptor televised videos
- Monitored numerous construction projects involving utility crossings of district interceptors and force mains
- Investigated odor complaints

2018 Special Projects

- Inspected the manholes and surrounding areas for the following interceptors:
 - West Int/Randall Relief(24) & West Int Ext(11)
 - West Int/West Point Ext(6) & Nine Springs Valley/Waubesa Ext(26)
 - East Int/North End Int(7) & Far East Int/Cottage Grove Ext(4)/Truax Ext(10 of 43)
 - North East Int/Truax Ext(33 of 43)
 - West Int/Spring Street Relief(31 of 31)
 - West Int/Gammon Ext(42 of 42)
 - NS Valley Int/Esser Pond Ext(18), Fortune Dr Rep(9), Gammon Ext PS16(2)
 - NE Int-Pflaum Road Replacement 2005(24)/FE Int-Gaston Road Ext(6)
 - Rimrock Int(4), Rimrock Int Rehab- Replacement(5)/NE Int-FEI to SEI relief Replacement(19)
- Replaced 24 castings and 24 covers as part of infiltration and inflow reduction
- Performed a flow assessment with laser units on Monroe Street in February and did 12 laser flow comparisons at various monitoring points
- Continued to work on standard operating procedures for the sewer maintenance/monitoring department included a priority standard operating procedure for pre-treatment, which was completed in coordination with the lab
- Inspected wet wells at Pumping Stations 7, 11, 12 and 17 for H₂S corrosion
- Started coding the condition of manholes using manhole assessment and certification program
- Assisted several municipalities with trying to reduce fats, oils and grease issues
- Conducted manhole coating inspections on 2 manholes in the SEI coated by Visu-Sewer, 3 manholes and 6 benches coated by Red Horse, 4 new manholes coated by Pumping Station 7, Pumping Station 16 wet wells, 8 manholes on lower Badger Mill Creek Int, 1 manhole in Shorewood Hills, and 7 manholes on Pflaum Road Replacement Interceptor
- Assisted Village of Deforest with sampling issues associated with Sanimax
- During the high flow event of August of 2018 we raised and monitored 8 stop log sites due to the flooding
- Sand bagged 1 manhole by Dunn 3 lift station because of high flows
- Repaired manhole 11-166C behind Thermo-Scientific that was damaged during the high flow event
- Installed two bolt-down covers in the Monroe Street area due to high flows and rain event
- Monitored flows and sulfide for the Dane County landfill by installing laser units and order loggers, and recording data and samples for the lab/pre-treatment coordinator

- Assisted mechanics in installing a sewer plug in the lagoon intake so the lagoon pump could be accessed and repaired
- Assisted in the removal of the Bedford Street stoplogs and Pumping Station 5 stoplogs

MISCELLANEOUS WORK REPORTING

Training

Training of craftspeople continued to be an important function in 2018. Maintenance department personnel serve on the Joint Apprenticeship Training Committee, which oversees the activities of the apprenticeship programs for electricians, mechanics and heating, ventilation and air conditioning (HVAC) technicians. Several employees are in the apprentice program and are seeking journeyman credentials.

Additional training topics attended by maintenance department supervisors and craftspeople included:

- Ultimate Culture Conference
- General winter maintenance training
- Salt application equipment calibration training
- Electrical code training and updates
- Update & clarification of the 2017 NEC & SPS 316 changes
- Logix 5000 Foundation and advanced classes
- University of Wisconsin training on wastewater pumping systems and lift stations
- Oracle WAM conference and training
- John Crane Seal School training
- HVAC pneumatic controls training
- MACP and PACP training
- University Of Wisconsin training on failure mode and effects analysis and root cause analysis in maintenance management
- Ethics training for professional engineers
- ArcMap training
- Diversity and inclusiveness training

Pilot Asset Management Program

The district's maintenance and reliability manager, maintenance supervisors and lead workers continued to aid the district's planning department and consulting engineer in the completion of the first pilot asset management program at the district, in preparation for full scale implementation of the program. The work continued with additional condition assessments, development of key performance indicators (KPIs) that will be tracked, and training on work order planning. KPI's are necessary to judge the performance of the entire maintenance management system. Two categories of KPI's will be tracked by the district which are strategic and tactical. Each KPI has a specific driver and will provide information to staff at various levels within the district. Work order planning was also emphasized in 2018 by the consulting engineer. Several training sessions and meetings were held on transitioning toward this concept. In 2019, KPIs will be tracked, work order planning will be a priority and the same staff.

Fleet Management Plan

The district's first fleet management policy and plan was created and approved by the chief engineer and director and commission. Within the fleet management policy was the establishment of the fleet management fund that provides a stable source of revenue for fleet investments. Immediately, the fleet management plan was implemented for vehicle purchases in 2018.

OPERATIONS

Staffing

The operations workgroup has 16 full time employees:

- Assistant Operations Engineer
- Automation Systems Integrator
- Director of Wastewater Operations & Reliability
- Lead Operator
- Operations Manager
- Operations Supervisor
- Process and Research Engineer
- Regulatory Performance and Process Engineer
- Relief Operator (4)
- 12 Hour Operator (4)

Responsibilities of Workgroup

The workgroup's main responsibilities are as follows:

- Operation for 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 plant and the Process Control System (PCS). Significant projects the group worked on in 2018 included:

- Digester #4 leak response
- Extended high flow event (managing plant flows)
- Repair of a hole in the lagoon dike
- Relocation and start-up of the research pilot plant
- Assisting with pilot projects from a variety of outside vendors
- Resumption of Class A cake biosolids production

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 2018. The district also accepts septic tank wastes and similar wastes from unsewered areas located primarily in rural Dane County. In 2018, 624.95 acres of land was annexed by the district. The total area of the district at the end of 2018 was 184.97 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 95.05 miles of gravity sewers and 31.69 miles of raw wastewater force main at the end of 2018. 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 Nine Springs Wastewater Treatment Plant requires the operation of 134 pumping stations, not including 435 small grinder pump installations. Table 4 and Table 5 list the number of pumping stations operated and maintained by individual communities and the district.

Table 4 – Pumping Stations Operated and Maintained by Communities

Owner	Number of Pumping Stations	Number of Grinder Stations
City of Middleton	8	
City of Monona	8	
Village of Cottage Grove	4	
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	
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:		
University of Wisconsin Campus	6	4
University of Wisconsin Arboretum	1	
Dane County - Rodefild Landfill	1	
Total	69	435

Table 5 – 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 16,370,289,000 gallons of wastewater at the Nine Springs Wastewater Treatment Plant in 2018. This was a 6.53 percent increase from 2017. The average daily quantities of wastewater received from each municipality and through infiltration into the district’s intercepting sewers in 2018 are shown in Table 6.

Table 6 – Average Daily Quantities of Wastewater

Municipality	2018 (GPD)	Percent of Total
City of Fitchburg	1,804,000	4.02
City of Madison	29,754,000	66.34
City of Middleton	2,208,000	4.92
City of Monona	990,000	2.21
City of Verona	1,225,000	2.73
Village of Cottage Grove	659,000	1.47
Village of Dane	55,000	0.12
Village of DeForest	928,000	2.07
Village of Maple Bluff	205,000	0.46
Village of McFarland	742,000	1.66
Village of Shorewood Hills	155,000	0.35
Village of Waunakee	1,819,000	4.06
Village of Windsor	508,000	1.13
Town of Dunn San. Dist. No. 1	300,000	0.67
Town of Dunn San. Dist. No. 3	83,000	0.19
Town of Dunn San. Dist. No. 4	18,000	0.04
Town of Dunn Kegonsa San. Dist.	134,000	0.30
Town of Madison	600,000	1.34
Town of Pleasant Springs San. Dist. No. 1	67,000	0.15
Town of Verona	600	<0.01
Town of Verona Util. Dist. No. 1	22,000	0.05
Town of Vienna - WYST59 LLC	100	<0.01
Town of Vienna Util. Dist. No. 1	80,000	0.18
Town of Vienna Util. Dist. No. 2	38,000	0.08
Town of Westport Sewer Utility District	531,000	1.18
Town of Westport - Cherokee Golf & Tennis	3,500	0.01
Total Wastewater	42,929,000	95.72
Infiltration into District Interceptors	1,921,000	4.28
Total Received at the Treatment Plant	44,850,000	100.00

Wastewater Treatment

The district has a single treatment plant, the Nine Springs Wastewater Treatment Plant. In 2018, the Nine Springs Wastewater Treatment Plant met all Wisconsin Department of Natural Resources discharge limitations. This level of compliance should qualify the district for a gold award from the National Association of Clean Water Agencies.

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 2018, 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 2018, approximately 42.86 million gallons per day on average were pumped to Badfish Creek and 3.22 MGD were pumped to Badger Mill Creek.

The open-channel ultraviolet disinfection system has met the effluent fecal coliform concentration standard since starting in 1997. All lamp banks are cleaned with citric acid in the winter months when disinfection is not required. Lamp and ballast replacement is also accomplished during this period.

Primary sludge is pumped from the 19 primary settling tanks on a rotating basis and is pumped to three gravity thickener tanks. The solids concentration from the gravity thickeners averaged 5.8 percent in 2018.

The waste-activated sludge is thickened on three gravity belt thickeners. Generally, two of the three units are in service with one unit as standby. The thickened solids concentration off the gravity belt thickeners averaged 6.5 percent in 2018.

The anaerobic digestion process was operated as a phased system throughout 2018. 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 90 degrees Fahrenheit with an approximately 1.25 day (30 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 24 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 2018, approximately 13 percent of the total biosolids mesophilically digested underwent additional time-temperature batch treatment to meet Class A 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 2018, the centrifuge was operated regularly in January, then starting in October began regular runs to decrease input to liquid biosolids storage.

The digested biosolids concentration averaged 3.0 percent for 2018 from the east digesters and 2.0 percent from the west digesters after the time and temperature batching operation. The digested biosolids were thickened to an average concentration of 5.87 percent in 2018 through the addition of polymer on a gravity belt thickener. An average of 23.8 tons per day of digested biosolids was thickened in 2018.

Anaerobic digester foaming was a minor issue in early 2018. The foaming was kept under control through operational measures (such as feed time adjustments) and eventually the 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 2018 a new total annual production record for the district was set, with 719.4 tons being shipped off-site (just short of 2 tons per day). The capture of particulate phosphorus in the reactors continued to improve in 2018 and was accompanied by a noticeable downward shift in average product size.

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 percent methane. Digester gas production averaged around 792,000 cubic feet per day in 2018. 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 16,057 kilowatt-hour of electricity was generated each day in 2018. In addition, the blower engine saved the purchase of approximately 9,335 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 8, “Annual Energy Use Summary” shows a complete breakdown of the thermal and electrical savings from the use of digester gas.

The 2018 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 7. Monitoring data for effluent metals are reported in Table 8.

Table 7 – Yearly log of Plant Operations 2018

Month	Influent Flow (MGD)	BFC Effluent Flow (MGD)	BMC Effluent Flow (MGD)	BOD		TSS		Nitrogen		Phosphorus		Effluent FCOLI MPN/100 Mean(1)	Min Hr Effluent D.O. (MG/L)
				RAW BOD (MG/L)	Effluent BOD (MG/L)	RAW TSS (MG/L)	Effluent TSS (MG/L)	RAW TKN (MG/L)	Effluent Ammonia (MG/L)	RAW TP (MG/L)	Effluent TP (MG/L)		
				Jan – 18	37.38	34.94	3.04	283	9.0	223	5.7		
Feb – 18	38.96	36.42	3.03	294	8.3	215	4.8	52.3	0.57	6.20	0.25		5.66
Mar – 18	36.71	34.83	2.94	305	6.4	226	3.9	53.7	0.24	6.48	0.21		7.06
Apr – 18	37.86	36.80	2.68	297	5.0	229	3.9	52.2	0.49	6.31	0.21	57	5.38
May – 18	46.47	44.91	2.99	239	5.4	204	5.5	42.5	0.42	5.31	0.31	63	5.35
Jun – 18	48.72	47.10	3.54	246	5.1	223	6.0	40.6	0.21	5.24	0.31	85	3.33
Jul – 18	42.90	41.31	3.59	243	4.5	213	5.3	42.9	0.24	5.35	0.35	101	5.32
Aug – 18	51.02	48.05	3.52	230	3.5	211	4.3	39.9	0.21	4.93	0.32	90	1.63
Sep – 18	55.88	54.36	3.18	189	3.6	173	4.1	34.4	0.10	4.23	0.36	118	5.36
Oct – 18	54.70	53.70	3.50	186	4.7	161	4.1	35.8	0.12	4.28	0.36	81	6.22
Nov – 18	45.13	43.71	3.52	220	6.5	206	5.6	39.9	0.16	4.88	0.37		7.81
Dec – 18	42.22	40.63	3.10	245	6.7	207	4.8	43.2	0.26	5.24	0.28		6.62
Average	44.83	43.06	3.22	248	5.7	208	4.8	44.1	0.31	5.38	0.30	85	5.50

BFC is to Badfish Creek Outfall
 BMC is to Badger Mill Creek Outfall
 (1) Geometric mean

Table 8 – Influent and Effluent Metal Concentrations 2018

Date of Sample	Effluent MGD	Cadmium (T) (PPB)		Chromium (T) (PPB)		Copper (T) (PPB)		Lead (T) (PPB)		Mercury (T) (PPT)		Nickel (T) (PPB)		Zinc (T) (PPB)	
		Inf	Eff	Inf	Eff	Inf	Eff	Inf	Eff	Inf	Eff	Inf	Eff	Inf	Eff
		Jan-18	37.98	0.40 q	0.16 q	5.71	1.58 q	90.5	8.93 q	2.12 q	1.20 b	65.0	0.926	3.86 q	1.60 b
Feb-18	39.46	0.16 b	0.16 b	3.81	0.87 q	75.6	9.00 q	3.80	2.06 q	52.6	0.945	4.16 q	1.60 b	170	91.4
Mar-18	37.77	0.16 b	0.16 b	3.98 q	0.60 b	80.5	10.80	3.67 q	1.20 b	985.0	0.875	3.41 q	1.60 b	162	68.8
Apr-18	39.48	0.21 q	0.16 b	4.96	1.07 q	81.2	10.00	3.41 q	1.20 b	53.0	0.891	4.29 q	1.60 b	191	58.4
May-18	47.90	0.16 b	0.16 b	5.12	0.86 q	84.3	8.39 q	2.44 q	1.20 b	44.1	1.26	5.56	3.02 q	153	63.8
Jun-18	50.64	0.16 b	0.16 b	4.55	0.80 q	78.4	7.66 q	3.20 q	1.20 b	113.0	1.38	3.48 q	2.16 q	138	52.5
Jul-18	44.90	0.16 b	0.16 b	4.75	0.90 q	81.1	9.65	3.80	1.20 b	56.9	0.796	2.91 q	1.60 b	156	51.4
Aug-18	51.57	0.16 b	0.16 b	3.40	1.16 q	83.3	10.40	2.84 q	1.20 b	93.5	2.78	2.77 q	1.63 q	146	51.2
Sep-18	57.54	0.60	0.16 b	3.63	1.19 q	51.6	6.33 q	2.55 q	1.20 b	64.1	1.94	2.45 q	1.60 b	95	47.3
Oct-18	57.21	0.20 b	0.20 b	3.02 q	1.00 b	46.9	5.24 q	3.47 q	1.20 b	32.8	0.533	3.48 q	1.86 q	121	47.4
Nov-18	47.23	0.40 b	0.40 b	2.19 q	1.00 b	60.0	5.84 q	4.53	1.20 b	43.7	1.08	4.44 q	2.10 q	115	41.9
Dec-18	43.73	0.20 b	0.20 b	2.41 q	1.16 q	71.6	6.72 q	3.31 q	1.20 b	49.3	1.10	2.21 q	1.60 b	101	37.8

"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

RESEARCH

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

To address energy independence 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. The removal of nitrogen at low dissolved oxygen is established, but the combined removal of both nitrogen and phosphorus at low dissolved oxygen concentrations is a relatively new concept, with full-scale attainment only at a few specialized types of facilities. The purpose of this study is to see if this technology could be implemented at a conventional activated sludge type facility such as the Nine Springs Wastewater Treatment Plant.

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 percent 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, but several equipment failures occurred, clouding results.

In 2018, several upgrades were made to the pilot to improve equipment reliability and to allow operation at lower temperatures. Additional sensors and control equipment were also added to allow the pilot to be operated in a manner more similar to what would be expected if implemented at full scale. Work in 2018 focused on monitoring process stability and matching aeration demands to pollutant removal requirements. This work will be extended through 2019 in order to evaluate process stability through an entire winter and summer to validate models that may be utilized for future liquid process facilities improvements projects.

Bench-scale organic waste co-digestion research

The district completed an investigation involving co-digestion of source separated organic wastes aimed at understanding the potential impacts that may result from implementing such processes at the Nine Springs Wastewater Treatment Plant. The study sought to answer questions that have emerged as the district investigates opportunities to co-digest food waste or other source separated organics to increase renewable energy production. In particular, the study focused on characterizing the impact that additional organic wastes may have on the digestion process in terms of digester health as well as quality of the residuals remaining after digestion. Overall, the study concluded that co-digestion of source separated organics did increase biogas production and did not result in a deterioration of biosolids quality. However,

the study also revealed that overall biosolids production would increase, and biogas methane content was not improved. These results indicate that co-digestion of source separated organics is feasible, but that other feedstock sources such as fats/oils/grease and waste with a high soluble organic fraction should be prioritized over the type of source separate organics that were considered, which had a relatively high fraction of inert material.

Pilot-scale study to evaluate nitrite shunt activated sludge process for total nitrogen removal

The “2016 Liquid Process Facilities Plan” recommended an alternative to the current modified University of Cape Town activated sludge process at Nine Springs that can reduce the total nitrogen content in the plant effluent. This recommendation was put forward in anticipation of possible stricter permit limits for total nitrogen in the future, as a means to reduce energy demands, and to advance the district’s environmental stewardship. The process, known as “nitrite shunt”, has been shown to improve nitrogen removal while also achieving energy savings with minimal modifications to existing activated sludge infrastructure. However, this process has only been implemented at two facilities in the U.S. and the viability in cold regions such as Madison has not been demonstrated.

This project was initiated in 2016, with Dr. Daniel Noguera (civil and environmental engineering department, University of Wisconsin–Madison). The project seeks to evaluate the viability of adapting biomass from the full-scale University of Cape Town process at Nine Springs to the nitrite shunt process under cold weather conditions. The project originally involved the operation of a sequencing batch reactor that was fed primary effluent from the treatment plant. In 2017, the pilot was upgraded to a continuous flow process that approximates the design proposed in the facility plan. The project was intended to last until the end of 2017, but encountered several challenges with process controls, which slowed project progress. The project was extended through 2018, with additional improvements being made to improve process control and allow the system to operate at lower temperatures. Because of the relatively slow growth rate of the microorganisms involved and the novel nature of the research, this study has been extended through 2019 in order to allow more time for data collection.

Project findings are intended to help inform decisions with future liquid process facilities improvements efforts. Results will be used to inform staff of the viability and operability of the process, provide data to validate models used for future design efforts, as well as give district staff members experience and insight with several advanced sensors and control methods required for many newer biological nutrient removal processes such as nitrite shunt.

Lab-scale partial nitrification study to evaluate side-stream ammonia removal

The district initiated a research project with Daniel Noguera (civil and environmental engineering department, University of Wisconsin–Madison) in 2016 to explore the possibility of removing ammonia from struvite harvester effluent as a means to address challenges associated with side-stream nutrient loads. The study included the operation of a lab-scale single-stage partial nitrification and anammox reactor similar to the Demon process. The reactor was located at UW–Madison and was fed struvite harvester effluent from the Nine Springs Wastewater Treatment Plant. The goal of the study was to evaluate operational and control requirements for an ammonia/nitrogen removal technology for the struvite harvester effluent with the aim of minimizing energy requirements for treatment of side-stream flows. This study was completed in 2018 and results indicate approximately 90 percent total nitrogen removal can be achieved. Additionally, microbial community analysis has shown that the anammox organisms predicted to drive this result have not been found to be a significant contributor to the results. Rather, other organisms predicted to perform microbial functions similar to anammox organisms have been found. This work concluded that biological side-stream nutrient removal is achievable and that more groups of microorganisms may be capable of producing the desired results compared to previous knowledge.

NINE SPRINGS ENERGY USE PROFILE

Table 9 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 2014 to 2018, renewable energy used at the Nine Springs Wastewater Treatment Plant provided roughly 36 percent of the plant’s energy needs and had an estimated total value just below \$6.2 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.
- Air permitting issues were resolved between the district and the Wisconsin Department of Natural Resources in 2012. Based upon permit requirements, the district increased exhaust stack heights and installed an oxidation catalyst on one of its gas engines. The catalyst was determined to be effective and thus in late 2014, DNR directed installation of catalyst equipment on the remaining two engines. This installation was completed in February 2015.
- Overhaul work on one of the engine generators in early 2014 removed an engine for service for a brief period and decreased the overall amount of generation from digester gas for the year.

- 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 past 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 and required an off-site rebuild to correct, removing it from service for 3 months in all. The other engine generator was scheduled for rework in 2018 and started that process in December. Both 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 9 – Annual Energy Use Summary

Electric Energy	2014		2015		2016		2017		2018	
	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	62,201	70.8%	58,536	66.6%	67,775	75.9%	60,442	67.0%	66,867	72.4
Wind Power Purchased from MG&E	25	0.0%	40	0.0%	40	0.0%	40	0.0%	40	0.0%
Generated from Digester Gas	16,478	18.7%	19,968	22.7%	12,291	13.8%	20,160	22.3%	16,057	17.4%
Avoided Purchase Due to Blower Gas Engine	9,194	10.5%	9,406	10.7%	9,177	10.3%	9,605	10.6%	9,335	10.1%
Total Used & Avoided	87,898		87,951		89,284		90,247		92,299	
Average cost of purchased power (\$/kWh)	\$0.0843		\$0.0921		\$0.0837		\$0.0892		\$0.0875	
Estimated total monthly value of energy used	\$225,302		\$246,277		\$228,011		\$244,962		\$245,730	
Estimated monthly value of renewable energy	\$65,866	29.2%	\$82,365	33.4%	\$54,929	24.1%	\$80,902	33.0%	\$67,710	27.6%
Thermal Energy	2014		2015		2016		2017		2018	
	therms/ Day	% of Total	therms/ day	% of Total	therms/ day	% of Total	therms/ day	% of Total	therms/ Day	% of Total
Generated from Natural Gas	665	28.8%	834	43.0%	361	20.0%	593	25.2%	523	24.2%
Generated from Digester Gas	292	12.6%	111	5.8%	333	18.4%	157	6.7%	280	13.0%
Recovered from Gas Engines	1,352	58.6%	992	51.2%	1,111	61.6%	1,607	68.2%	1,359	62.9%
Total hot water energy used	2,309		1,938		1,806		2,357		2,163	
Average cost of purchased gas (\$/therm)	\$0.6674		\$0.4793		\$0.4828		\$0.5169		\$0.5057	
Estimated total monthly value of gas used*	\$62,507		\$37,668		\$35,454		\$49,408		\$44,348	
Estimated monthly value of renewable energy	\$44,513	71.2%	\$21,455	57.0%	\$28,357	80.0%	\$36,981	74.8%	\$33,621	75.8%
Total Energy Use	2014		2015		2016		2017		2018	
	\$ 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	\$287,809		\$283,945		\$263,464		\$294,370		\$290,078	
Estimated Value of Renewable Energy Used	\$110,378	38.4%	\$103,820	36.6%	\$83,286	31.6%	\$117,883	40.0%	\$101,330	34.9%

* 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.

PLANNING AND STRATEGY

Staffing

The planning and strategy department was formed in 2016 by combining some staff from engineering and operations. In the fall of 2018, the information technology (IT) workgroup was transferred to planning and strategy from the administration department.

The planning and strategy department has 13 full time employees:

- Asset Management Specialist
- Capital Planning Engineer
- Database Administrator
- Director
- Engineering Technician
- GIS Analyst
- Information Systems Manager
- Network Technician (2)
- Programmer/Analyst (2)
- Records Program Administrator
- Sustainable Infrastructure Manager

Responsibilities of Workgroup

The workgroup's main responsibilities are as follows:

- Asset management
- Capital improvement planning
- Computerized maintenance management system
- Customer community requests for sewer extensions and annexations
- Data management
- Geographic information systems
- IT infrastructure administration and design
- Long-term financial strategy
- Quarterly service charges
- Software needs assessment and design
- Software and systems support
- Technology advising for workgroups and staff
- Business needs and technology systems analysis
- Technology planning and strategy

Programs, Initiatives and Work Reporting

ASSET MANAGEMENT

The department is responsible for the development of a district-wide asset management program with the goal of lowering the life-cycle cost of assets while maintaining service levels and managing risk.

The district is finalizing an asset management plan for assets at the treatment plant. Based on the recommendations of the plan, the next steps will include implementing aspects of reliability centered maintenance and supporting the design and implementation of a new computerized maintenance management system. In addition, in 2018, the department began work to update the collection system facilities and asset management plan. That project will proceed for approximately two years.

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>.

COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

The department is responsible for the district's computerized maintenance management system (CMMS). The CMMS is one of the district's most important systems, along with the plant process control system. The CMMS contains information on district assets, including their age, condition and criticality; is used by the maintenance group to plan, schedule and closeout work orders; contains data used in analyzing asset performance, maintenance needs and investment needs; and integrates with the district's financial systems.

The district is in the early stages of replacing its current system, because of pricing and suitability issues. A new position was added in the 2019 budget to oversee the transition to a new system and to administer the program once implemented.

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 2018, the district processed over 150 sewer extensions and 11 annexations, adding nearly one square mile to the district territory.

GEOGRAPHIC INFORMATION PROGRAM

The geographic information program supports the district's need for the management, analysis and mapping of spatial information. The district is in the last stages of migrating to a new geographic information system. With the data clean-up and migration complete, the next phase will focus on developing applications for staff and other stakeholders.

INFORMATION TECHNOLOGY

The district's information systems workgroup provides infrastructure support, software support, system administration, design services, data management 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 and the rate-setting database and applications.

Ecosystem Services

Our ecosystem services team is supported by information systems staff in the management of the Metrogro hauling and land application database, the laboratory's Ethosoft X-LIMS laboratory information system and the pretreatment database and applications.

Engineering

Systems supported for the work of our 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 and the manhole inspection database and applications.

Planning and Strategy

Supported technology for the planning and strategy department include: the Geographical Information System (GIS) geodatabase and applications, collection system applications, Oracle Work and Asset Management (WAM) system (especially asset-related functions and applications) and the user charge billing system.

Leadership and Support

Services provided to the district's leadership and support department include the development and management of the internal and external websites, support for meeting and event related software and commission related technology support.

District-Wide

The IT group supports these district-wide programs and systems: infrastructure administration, data and information storage and administration, server virtualization, desktop virtualization, virtual private network administration, network security, email administration and security, network administration and security, printers and scanning equipment, database management, business analysis, computer and device programming, smartphone management, technology project management, technology planning and strategy, phone system administration, software upgrades, software testing, software customization and configuration, license management and network disaster recovery plans.

Notable additions in this area for 2018 were the administration of records management program and WAM system administration. These new areas add the following responsibilities: system upgrades, system security, data management, records administration, workflow design, system planning and user support.

Financials

FIGURE 2 EU REVENUE 1997-2006



Other revenue (including surplus from the previous years)
 NP/GNI-based own resource
 GNI-based own resource
 Additional own resources

CONTRIBUTION BY MEMBER STATE AND TOR COLLECTED ON BEHALF OF THE EU, IN 2006

SECTION II

ANNEX 2

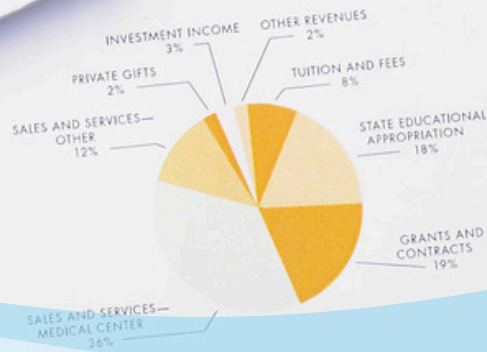
1997-2006 by heading

(Outturn in payments)

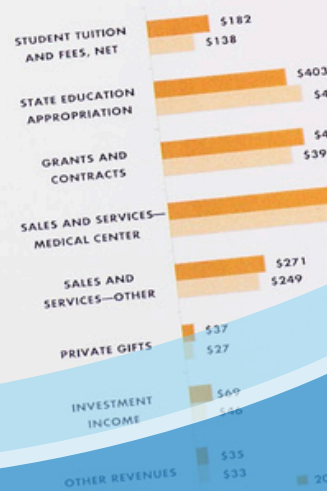
	2004	2005	2006
	million EUR	million EUR	million EUR
13 612.0	42.6%	48 346.8	45.4%
34 498.7	33.7%	32 843.2	30.8%
2 742.9	2.7%	2 943.3	2.8%
16 070.1	15.7%	15 512.3	14.6%
7 160.8	7.0%	8 639.8	8.1%
2 775.9	2.7%	2 095.5	2.0%
517.7	0.5%	472.3	0.4%
2 824.8	2.8%	594.1	0.6%
4 135.1	4.0%	4 376.6	4.1%
4 532.6	4.4%	4 860.2	4.6%
5 847.7	5.7%	6 109.6	5.7%
4 391.9	4.3%	4 196.5	3.9%
2 916.1	2.8%	3 266.7	3.1%
99 934.2	97.6%	103 999.6	97.8%
2 464.2	2.4%	2 544.2	2.4%
102 398.4	100%	106 543.8	100%
108 734.2	100%	108 734.2	100%

REVENUES SUPPORTING CORE ACTIVITIES

The following chart provides a breakdown of revenues supporting core activities for the fiscal year ended June



REVENUES SUPPORTING CORE ACTIVITIES (DOLLARS IN MILLIONS)



The following chart provides a breakdown of revenues supporting core activities for the fiscal year ended June 30, 2003.

Revenues to support UC Davis' cost of over \$2 billion, including those nonoperating revenues, increased from 2003 to 2004. UC Davis has

FINANCIAL SUMMARY FOR THE YEAR ENDED DECEMBER 31, 2018

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, 2018 and 2017

	2018	RESTATED 2017
OPERATING REVENUES		
Charges for services:		
Transmission and treatment of sewage	\$ 36,585,585	\$ 33,368,233
Servicing pumping stations	338,817	398,875
Septage disposal	703,861	555,299
Pretreatment monitoring	21,238	23,801
Struvite Harvesting	257,574	205,570
Total operating revenues	<u>37,907,075</u>	<u>34,551,778</u>
OPERATING EXPENSES		
Administration	6,019,680	5,676,030
Treatment	12,717,863	12,448,173
Collection	2,865,879	2,999,333
Depreciation	8,328,156	8,284,730
Total operating expenses	<u>29,931,578</u>	<u>29,408,266</u>
Operating income	<u>7,975,497</u>	<u>5,143,512</u>
NONOPERATING REVENUES (EXPENSES)		
Investment income (losses)	562,051	199,482
Rent	70,907	71,309
Other	271,032	204,628
Construction Expenses	(375,065)	(681,706)
Disposal of property and equipment	(50,372)	(569,487)
Interest expense	(3,270,113)	(3,411,009)
Total non-operating revenues (expenses)	<u>(2,791,560)</u>	<u>(4,186,783)</u>
Income(loss) before capital contributions	5,186,937	956,729
CAPITAL CONTRIBUTIONS		
Contributed assets	-	798,301
Conveyance Facilities Connection/Treatment charges	2,932,675	2,765,972
Total capital contributions	<u>2,932,675</u>	<u>3,564,273</u>
CHANGE IN NET POSITION	8,116,612	4,521,002
NET POSITION		
BEGINNING OF YEAR, AS PREVIOUSLY REPORTED	133,473,125	130,056,666
RESTATEMENT	<u>(412,990)</u>	<u>(1,104,543)</u>
BEGINNING OF YEAR, RESTATED	<u>133,060,135</u>	<u>128,952,123</u>
END OF YEAR	<u>\$ 141,176,747</u>	<u>\$ 133,473,125</u>

SUPPLEMENTAL DETAILED INFORMATION

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

MADISON METROPOLITAN SEWERAGE DISTRICT GENERAL FUND

Year Ended December 31, 2017
(with comparative amounts for 2016)

Repair and Replacement Expenditures	2017	2016
Engineering & Administration	128,106	144,597
Nine Springs Treatment Plant	1,159,578	897,225
Nine Springs Treatment Plant Vehicles	24,492	89,854
Collection System	98,325	16,819
Collection System Vehicles	14,977	8,183
Interceptors		
Pumping Station #1	3,196	7,200
Pumping Station #2	2,542	8,087
Pumping Station #3	757	
Pumping Station #4	40	333
Pumping Station #5	681	722
Pumping Station #6	2,953	1,510
Pumping Station #7	24,091	2,862
Pumping Station #8	25,548	2,717
Pumping Station #9	138	92
Pumping Station #10	2,245	2,074
Pumping Station #11	3,061	
Pumping Station #12	2,400	47
Pumping Station #13	49,808	8,868
Pumping Station #14	2,294	1,761
Pumping Station #15	28	2,034
Pumping Station #16	134,996	29,134
Pumping Station #17	22,808	9,470
Pumping Station #18	4,023	5,425
East Interceptor	0	21,521
Far East Interceptor	0	-
Nine Springs Valley Interceptor	10,960	1,142
Lower Badger Mill Creek Interceptor	0	-
Northeast Interceptor	4,003	3,960
South Interceptor	28	518
Southeast Interceptor	224	1,128
Southwest Interceptor	273	-
West Interceptor	580	5,033
City of Madison Pumping Stations	39,408	20,954
City of Verona Pumping Stations	2,500	1,124
Village of Maple Bluff Pumping Stations	3,874	274
Town of Dunn SD#1 Pumping Stations	3,091	340
Town of Dunn SD#3 Pumping Stations	25,960	1,684
Town of Madison Pumping Stations	2,177	161
Dane County Parks	297	

Total Repair & Replacement	1,800,462.00	\$1,296,853
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Capital Outlay Expenditures	2017	2016
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Concrete Sewer		-
Electrical Equipment		1,217
Heavy Mechanical Equipment		
Light Mechanical Equipment	38,571	21,685
General Equipment		7,032
Office Equipment	129,443	89,711
Lab Equipment	26,883	5,850
Fixed Improvements	16,963	-
Vehicles	65,046	57,523
Total Capital Outlay	276,906	\$183,018
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Protect public health and the environment.

Madison Metropolitan Sewerage District
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