2020 Asset Management Plan

ORANGE WATER AND SEWER AUTHORITY

OWASA is Carrboro-Chapel Hill's not-for-profit public service agency delivering high quality water, reclaimed water, and wastewater services.

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Acronyms

ADWF	Average Dry Weather Flow
ARV	Air Release Valve
AWIA	America's Water Infrastructure Act
AWT	Acoustic Wave Treatment
AWWA	American Water Works Association
BEM	Broadband Electromagnetic
BPS	Booster Pump Station
CCTV	Closed Circuit Television
CIP	Capital Improvements Program
CIPP	Cured In Place Pipe
CoF	Consequence of Failure
CM	Corrective Maintenance
CMMS	Computerized Maintenance Management System
CY	Calendar Year
DEQ	Department of Environmental Quality
ERP	Emergency Response Plan
FY	Fiscal Year
GIS	Geographic Information System
GPS	Global Position System
HDPE	High Density Polyethylene
HVAC	Heating Ventilation Air Conditioning
I/I	Inflow and Infiltration
KPI	Key Performance Indicator
LoF	Likelihood of Failure
M	Million
MGD	Million Gallons Per Day
NPDES	National Pollution Discharge Elimination System

O&M	Operation and Maintenance
OWASA	Orange Water and Sewer Authority
PM	Preventative Maintenance
PS	Pump Station
PVC	Polyvinyl Chloride
RDI/I	Rainfall Dependent Inflow and Infiltration
RFT	Remote Field Technology
R&R	Renewal and Replacement
RRA	Risk and Resiliency Assessment
SCADA	Supervisory Control and Data Acquisition
SEM/EDS	Scanning Electron Microscopy with Energy Dispersive X-Ray Spectroscopy
SUP	Special Use Permit
UNC	University of North Carolina
USEPA	United States Environmental Protection Agency
WO	Work Order
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

Executive Summary

Background

OWASA has a complex set of assets that provide essential water, wastewater and reclaimed water services to the Carrboro- Chapel Hill community. The asset management plan is the Authority's roadmap to protect its investment in water, wastewater and reclaimed water systems. Implementing the program will improve reliability, reduce risk, optimize operations and maintenance efforts and increase data tracking accuracy. OWASA's key performance indicators provide metrics to determine if the asset management program is successful. OWASA's mission, vision, and values along with the Water Environment Research Foundation's five core questions of asset management set the tone for the program:

- What is the current state of my assets?
- What is my required sustained level of service?
- Which of my assets are critical to sustained performance?
- What are my best minimum life-cycle cost capital improvements program (CIP) and operation and maintenance (O&M) strategies?
- What is my best long-term funding strategy?

Throughout the report, these five core questions are answered in the context of different asset classes but have been summarized below.

Asset Data

Accurate asset inventories are the basis for any asset management program. Some of OWASA's assets date back to the 1920s and have grown substantially today to serve over 83,000 customers in the Carrboro-Chapel Hill community. Today OWASA owns and operates one Water Treatment Plant, one Wastewater Treatment Plant (which also provides reclaimed water services), over 390 miles of water mains and associated valves, hydrants and appurtenances, over 335 miles of gravity wastewater mains and associated manholes and appurtenances, 14 miles of wastewater force mains, and five miles of reclaimed water mains and associated valves and appurtenances. Horizontal assets (all water, sewer, and reclaimed water mains) have spatial data and attributes associated with them stored in OWASA's GIS. Vertical assets at the treatment facilities and vehicle maintenance have attributes associated with them stored in OWASA's Computerized Maintenance Management Software System, MP2. OWASA has a well-defined asset registry for both horizontal and vertical assets but additional data cleanup in both GIS and MP2 is ongoing.

Level of Service

The goal of asset management is to achieve level of service targets at an acceptable level of risk. Level of service is defined by several of OWASA's Key Performance Indicators including the following:

- Accounted for Water as Percent of Water Pumped
- Water Pipe Breaks per 100 Miles of Pipe
- Primary and Secondary Drinking Water Violations
- Percent of Total Customer Hours with Water Service
- Water Quality Customer Inquiries

- Reportable Sewer Overflows per 100 Miles of Pipe
- Collection System Operating Permit Violations
- Water Treatment Plant and Wastewater Treatment Plant NPDES Permit Violations
- Wastewater Treatment Plant Odor Events
- Infiltration and Inflow Tracking
- Biosolids Operating Permit Violations
- Reclaimed Water System Operating Permit Violations

Additionally, OWASA's mission to provide customers high quality and reliable water, wastewater, and reclaimed water services through responsible and creative stewardship is at the forefront of the asset management plan and is supported by OWASA's vision and values.

Risk Criticality

Understanding risk and criticality are fundamental to the asset management program. No utility can eliminate the possibility of all failures so emphasis is places on minimizing failures and the consequences of asset failures. Risk and criticality are influenced by different factors depending on the type of asset. For horizontal assets risk is influences by pipe material, age, repair history, soil, installation, etc. For vertical assets risk is influenced by frequency of preventative maintenance activities, the environment in which is it used, age, material, installation, etc. Criticality for assets is primarily influenced by the consequence of the failure. Generally more critical assets have a higher consequence of failure and should be prioritized to receive maintenance and condition assessments. Within each asset class and at each of the treatment facilities, critical processes and infrastructure are identified along with any necessary spare parts to keep these assets functioning as intended.

Maintenance, Rehabilitation, and Replacement

Both maintenance and periodic capital improvement projects are needed to ensure that assets last their expected life and sustain the performance needed to meet the required service levels for the organization. Maintenance activities help to address infrastructure concerns before a failure occurs and provide information about the condition or status of asset. Additionally, maintenance activities can inform when capital projects for rehabilitation or replacement of assets are needed. OWASA also utilizes a renewal and replacement model that helps identify when different assets will need to be replaced based on their expected service life and condition scores noted by maintenance and other project activities and is further discussed in the funding section below.

Funding

The FY 2021 budget consists of projected revenues and other receipts of $37 million, capital project costs of $20.3 million, operating expenses of $23.2 million, debt service payments of $9.1 million, and capital equipment purchases of $704,500.

The value of OWASA's assets is documented in the fixed asset register, which is stored in the Great Plains database. The asset's cost or original purchase price is recorded in the fixed asset register for all new assets that are either purchased by or dedicated to OWASA. With the exception of land, the recorded cost of the assets is depreciated using the straight-line method, which is calculated as the original purchase price divided by the expected useful life, following generally accepted financial accounting guidance. The expected useful life ranges from 5-60 years depending on the type of asset.

The recorded cost for land is not depreciated. An asset's cost less the associated depreciation is known as net book value. Net book value by asset category as of February 2020 for Water and wastewater assets account for 37% ($102 million) and 52% ($144.3 million) of the total fixed asset register net book value of $277 million (M), respectively.

The Renewal and Replacement (R&R) Model also plays into OWASA's financial discussion. The R&R model was developed in 2014 and provides a first forecast model for 20-year capital and maintenance spending to renew and replace OWASA's assets. The model inputs are asset replacement value, asset life cycle (note that useful life is the duration of time than an asset is operable and it not inclusive of capacity of levels of service), asset age/condition, asset renewal condition and maintenance.

Implementation

The comprehensive asset management approach ensures the sustainable long-term operation, maintenance, replacement and expansion of OWASA's water, wastewater, and reclaimed water systems. The execution of the Asset Management Plan is a team effort with all departments within the organization playing a role in the success of the program. Prioritized goals have been identified for each of the operating departments and support departments (such as engineering) and are provided as appendices to this report. Overall the main goals of the plan are to prioritize projects that reduce risk, optimize maintenance and renewal opportunities, reinforce fiscal responsibility, utilize new technology when appropriate, and improve accurate data collection. Additionally, the asset management program is intended to be a continuous improvement process and the associated tools and practices, as well as goals, are frequently refined and improved.

Process

As with the execution of the asset management program, the creation of the asset management plan is a team effort. Staff from all departments were included in review of the plan and decisions associated with how the plan would be executed in the coming years. Overall organization buy-in is essential in the success of the asset management program.

Future Updates

The asset management plan will be updated annually at the start of each fiscal year. Based on reviewing implementation results of the planned asset management activities, any necessary adjustments will be made.

1 OWASA Background

1.1 Who is OWASA?

The Orange Water and Sewer Authority (OWASA) provides water, wastewater and reclaimed water services to approximately 83,000 people in the Town of Carrboro, Town of Chapel Hill, and the University of North Carolina at Chapel Hill. OWASA owns and operates a complex system of assets distributed primarily across southern Orange County.

OWASA's assets include three raw water reservoirs, 14 miles of raw water transmission mains, a drinking water treatment plant (WTP), 384 miles of drinking water distribution pipes (including emergency interconnects), six water storage tanks, four water booster pump stations, 335 miles of gravity sewer collection pipes, 14 miles of sewer force mains, 21 wastewater pump stations, five miles of reclaimed water pipes, a reclaimed water pumping station with an associated ground storage tank, a wastewater treatment plant (WWTP), support facilities, 150 vehicles/equipment, and over 4,000 acres of land. The net book value of OWASA's assets is approximately $276 million.

1.2 Assumptions for the Asset Management Plan

Key assumptions that underlie OWASA's asset management planning include:

- OWASA's utility service area boundary, as shown on Figure 1 and defined by the Water and Sewer Management, Planning and Boundary Agreement (WSMPBA) between Carrboro, Chapel Hill, Hillsborough and Orange County, will remain unchanged.

- No retail or wholesale water, wastewater or reclaimed water sales or service outside of the existing service area are anticipated.

- The cost of extending the OWASA water, sewer and/or reclaimed water system to unserved properties shall be borne by those parties benefitting from the extension.

- The regulatory environment will remain similar to current conditions. Changes in regulation will allow sufficient time to implement changes to our asset management program.

1.3 Guiding Asset Management Principles

Asset management is a process that guides the acquisition, operation, maintenance, renewal, replacement, and disposal of assets. OWASA's comprehensive asset management program is used to maintain a reliable of level of water, wastewater, and reclaimed water services to the community; protect human health and the environment; maximize the life of facilities, equipment and assets that OWASA is responsible for; and ensure that customer funds are wisely invested at the right time on the right assets. OWASA's Mission, Vision, and Values (as adopted by the Board of Directors in March 2014) and Key Performance Indicators (KPIs) help define the desired level of service and guide the asset management plan and are detailed below.

Mission – *Community-owned utility providing customers high quality and reliable water, wastewater, and reclaimed water services through responsible and creative stewardship of the resources they manage*

Vision – *Provide excellent service so that if customers could choose their water utility they would always select OWASA. They are a trusted steward of the community, environmental and financial resources they manage.*

Values

- ***Quality Drinking Water***
  We provide high quality drinking water through effective management and operation of our water supply, treatment, and distribution system.

- ***Environmental Responsibility***
  We protect the environment through effective management and operation of our wastewater collection, treatment, water reuse, and resource recovery systems. We manage our resources in an environmentally responsible manner.

- ***Excellence in Serving Customers***
  We provide excellent service to our customers. We are leaders in engaging our customers and stakeholders and provide them meaningful opportunities to participate in decisions that are important to them.

- ***Employees***
  We value our employees as our most important resource and we provide them competitive compensation and a safe and rewarding work environment which promotes diversity and equal opportunity for all.

- ***Affordability and Value***
  We provide affordable and high-value services and we are committed to continuous improvement.

- ***Sustainability***
  We embrace the principles of environmental, social, and economic sustainability. We strive to make the highest and best use of our local water resources and to promote conservation of water, energy, and other natural resources.

- ***Support for the Communities We Serve***
  We provide services consistent with the growth management and land use plans of the Town of Carrboro, the Town of Chapel Hill, and Orange County. We maintain open and positive communications with our governments and neighboring water utilities and cooperate in regional initiatives where appropriate and consistent with OWASA's commitment to our member governments.

- ***Innovation and Creativity***
  We seek innovation and creativity in accomplishing our mission and enhancing our services.

OWASA owns and operates a complex system of assets distributed primarily across southern Orange County (see Figure 1) and recognizes that comprehensive asset management is essential to the sustainable operation of the water, sewer, and reclaimed water systems serving the Carrboro-Chapel Hill community. Our asset management program is guided by the following principles:

- Maintain a reliable level of water, wastewater, and reclaimed water services to the community.
  - Protect human health and the environment
- Maximize the life of the facilities, equipment, and assets for which OWASA is responsible.
- Ensure that OWASA revenues are wisely invested at the right time on the right assets.

OWASA's Asset Management program is based on the Water Environment Research Foundation's *Simple Infrastructure Management Program Learning Environment*'s five core questions of asset management:

- What is the current state of my assets?
- What is my required sustained level of service?
- Which of my assets are critical to sustained performance?
- What are my best minimum life-cycle cost capital improvements program (CIP) and operation and maintenance (O&M) strategies?
- What is my best long-term funding strategy?

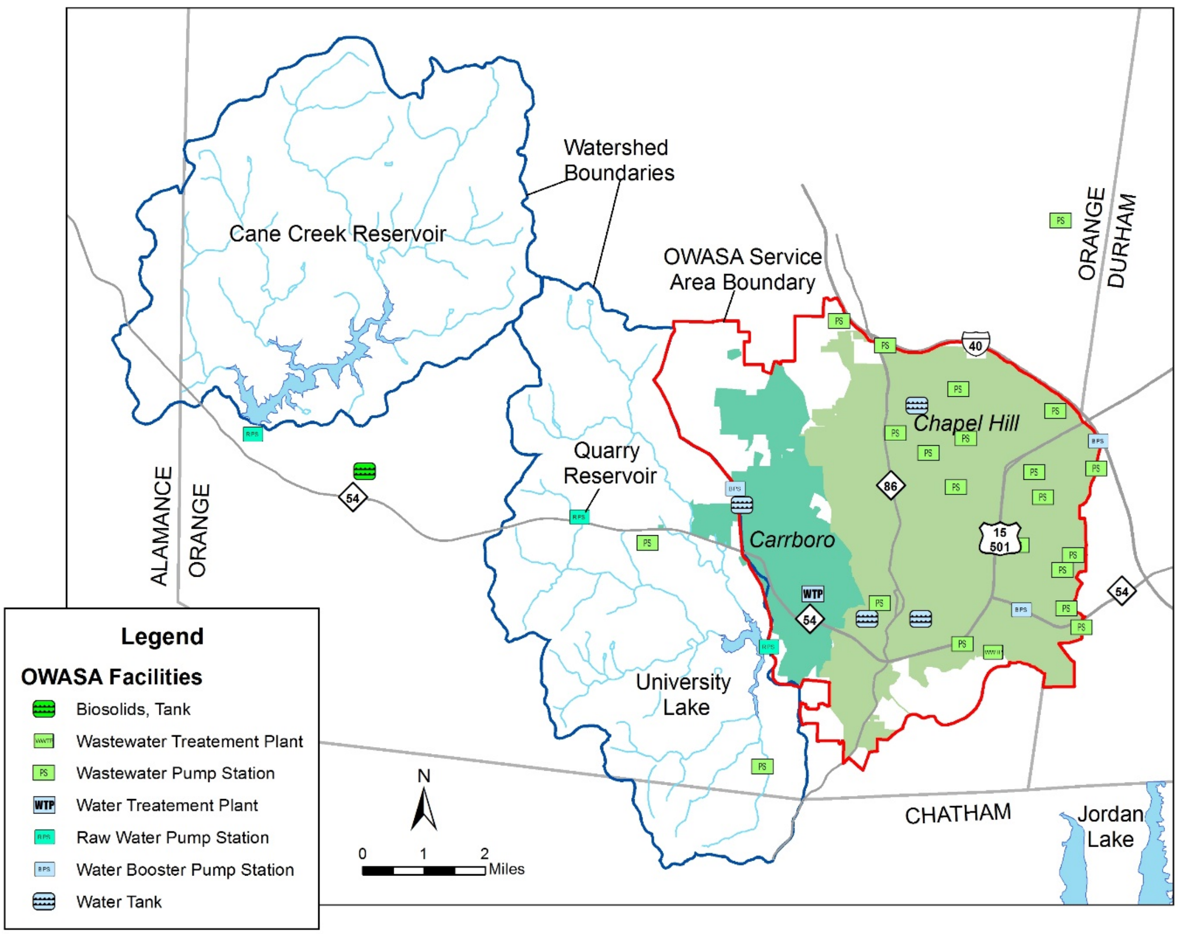

Figure 1: OWASA Water and Sewer Service Area and Watersheds

1.4 Risk framework

Risk framework is a tool used to calculate the nature and level of exposure that an organization is likely to confront through a potential failure of a specified asset or group of assets. OWASA's asset groups have different terminology and methods for quantifying risk; however, the goal of each process is to prioritize assets to develop effective funding strategies for optimum operation and maintenance strategies and overall risk reduction. OWASA has developed frameworks for calculating risk in four separate asset groups: water horizontal assets, wastewater horizontal assets, vertical assets, and vehicles. Horizontal assets consist of buried infrastructure such as water distribution pipes, sewer collection pipes and the valves and appurtenances that allow those pipes to function and our housed in OWASA's Distribution and Collection ~~System~~ Systems ~~Operations~~ Section. Vertical assets are typically assets above ground such as pumps, motors, chemical storage tanks, meters and the associated appurtenances that allow the treatment plants to function. Vertical assets are the assets at the Water Treatment Plant (WTP) and the Wastewater Treatment Plant (WWTP) and the associated pump stations, storage tanks, dams and support facilities. The four risk-assessment frameworks were customized to the unique characteristics of each asset group.

Regardless of the framework used, the risk being evaluated centers on the failure of an asset. Failure is defined as the inability of any asset to do what its users need it to do. Under this definition, an asset may be operating, but if it is not meeting intended performance standards it may be considered in a failed state. Asset failure modes include mortality, capacity, level of service, and financial efficiency.

The two primary inputs of the risk framework are likelihood of failure and consequence of failure. Likelihood of failure describes the quantification of uncertainty related to a failure actually occurring. Consequence of failure is typically associated with the severity of the outcome. A risk matrix schematic is shown in Figure 2. The first priority should be to focus on the high-risk assets in the red area (high likelihood and consequence of failure), then the yellow area, and finally the blue area.

Figure 2: Risk Framework

1.5 Guiding KPIs for OWASA/Level of Service

Once OWASA has an inventory of the assets they own, where they are located, their age, value, etc., they need to understand "What is their required sustained level of service?" Levels of service are driven by community and customer expectations and regulatory requirements. OWASA then compares actual performance to the desired level of service.

Service levels are a utility's stated commitment to deliver service to a customer at a specific level of quality and reliability. The long-term effectiveness of OWASA's asset management program can be assessed by comparing OWASA's historical performance to these service levels. The goal of asset management is to achieve level of service targets at an acceptable level of risk. Level of service is defined by several of OWASA's Key Performance Indicators including the following:

- Accounted for Water as Percent of Water Pumped
- Water Pipe Breaks per 100 Miles of Pipe
- Primary and Secondary Drinking Water Violations
- Percent of Total Customer Hours with Water Service
- Water Quality Customer Inquiries
- Reportable Sewer Overflows per 100 Miles of Pipe
- Collection System Operating Permit Violations
- Water Treatment Plant and Wastewater Treatment Plant NPDES Permit Violations
- Wastewater Treatment Plant Odor Events
- Infiltration and Inflow Tracking (not currently an external KPI but an internal tracking metric)
- Biosolids Operating Permit Violations
- Reclaimed Water System Operating Permit Violations

Our Key Performance Indicators are updated monthly and posted on the OWASA website, https://www.owasa.org/plans/key-performance-indicators/. The level of services and specific targets are discussed in the following section.

1.5.1 Water Treatment and Distribution

1.5.1.1 Accounted for Water as a Percentage of Water Pumped

Accounted for water as a percentage of water pumped is defined as the percentage of metered and billed water and unbilled but authorized water usage out of the total volume of water pumped into the water distribution system from the Jones Ferry Road WTP. Water loss is defined as the difference between water produced and authorized water usage, which includes metered and billed water use as well as the actual or estimated volume of water used for authorized purposes, such as our unidirectional flushing program, blow-off of water associated with the installation and testing of new lines, etc. Primary water loss sinks include unauthorized water usage, meter inaccuracies, and leaks. The accounted for water as a percentage of water can be used to gauge the overall condition of the distribution system. An excessive amount of leakage indicates that the distribution system may be deteriorating. OWASA's goal is for water sales as a percent of water pumped to be greater than 92%.

Based on system characteristics, the American Water Works Association (AWWA) Water Audit Methodology calculates the low limit of leakage that could be technically achieved if all of today's best technology could be successfully applied (referred to as the Unavoidable Annual Real Losses). In the Fiscal Year 2016 Water Audit conducted by OWASA, this amount equated to 92% of total water produced. This is the source of the goal set for this KPI. In essence, this means that it would be technically difficult and costly to account for more than 92% of the water pumped from the Jones Ferry Road Water Treatment Plant.

Historical values from Fiscal Year (FY) 2016-2020 are presented in Figure 3.

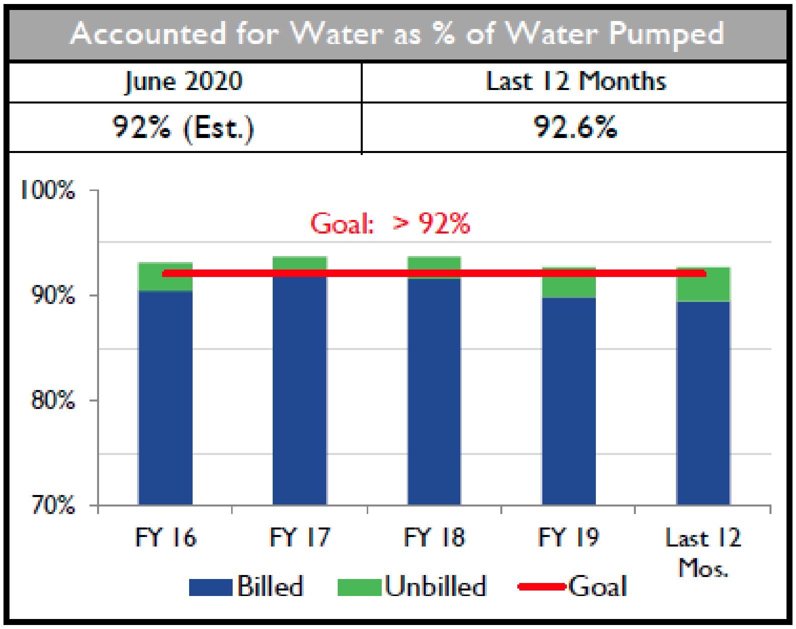

Figure 3: Fiscal Year 2016-2020 Accounted for Water

1.5.1.2 Water Pipe Breaks per 100 Miles of Pipe

The water pipe breaks per 100 miles of pipe level of service is defined as the number of breaks occurring on water distribution pipes per hundred miles of water distribution pipes, averaged over the entire distribution system. For this indicator, a water distribution pipe is a pipe owned by OWASA that is greater than 2 inches in diameter and conveys water from the Jones Ferry Road WTP to its their customers. The quantity of pipe breaks can be used to gauge the overall condition of the distribution system. An excessive amount of pipe breaks per 100 miles of pipe indicates that the overall integrity of the distribution system may be declining. OWASA's current goal is for water pipe breaks to be less than 8.7 breaks/100 miles based on the AWWA 2018 Benchmarking Survey. Historical values from FY 2016 through FY 2020 are presented in Figure 4. The number of water pipe breaks per 100 miles of pipe has been less than 15 breaks/100 miles for the last ten years. Currently the water main break per 100 miles of pipe is a fluctuating goal that is updated every year depending on the most recent AWWA Benchmarking Survey, however staff is currently evaluating an OWASA-specific goal based on recent water main prioritization work.

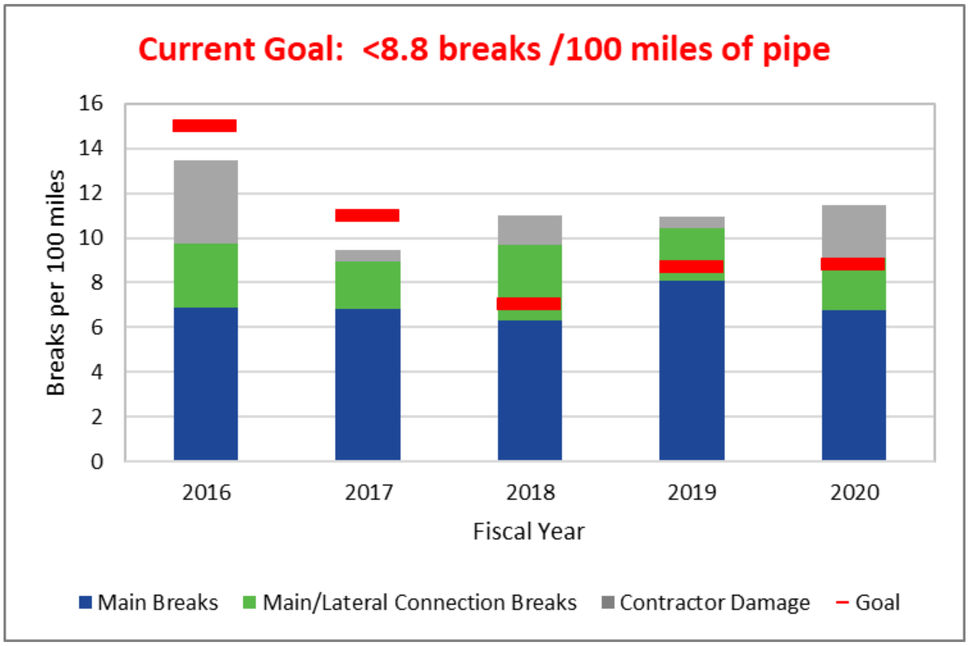

Figure 4: Fiscal Year 2016 - 2020 Number of Water Main Breaks per 100 Miles of Pipe

1.5.1.3 Primary and Secondary Drinking Water Violations

National Primary Drinking Water Regulations are limits set for substances that are thought to pose a threat to health when present in drinking water above certain levels. Secondary Drinking Water Regulations are non-enforceable federal guidelines regarding taste, odor, color and in addition to certain non-aesthetic effects of drinking water. These contaminants normally do not have any health effects and normally do not affect the safety of our water. Primary and Secondary Drinking Water Regulation violations may indicate that the water plant or distribution system is not operating as intended due to capacity limitations, aging equipment, inadequate operations and maintenance activities, etc. OWASA's goal is to be in full compliance with the Primary and Secondary Drinking Water Regulations. Throughout FY 2020, OWASA has been in full compliance with the Primary and Secondary Drinking Water Regulations

1.5.1.4 Percent of Total Customer Hours with Water Service

The percent of total customer hours with water service is defined as the time unplanned water outages affects a number of customers over a given time period. The goal for OWASA is to achieve at least five 9's of service equating to customers having reliable water service 99.999% of the time. Historical values from FY 2016 through FY 2020 are presented in Figure 5. Being able to achieve the five 9's illustrates OWASA's reliable water distribution network.

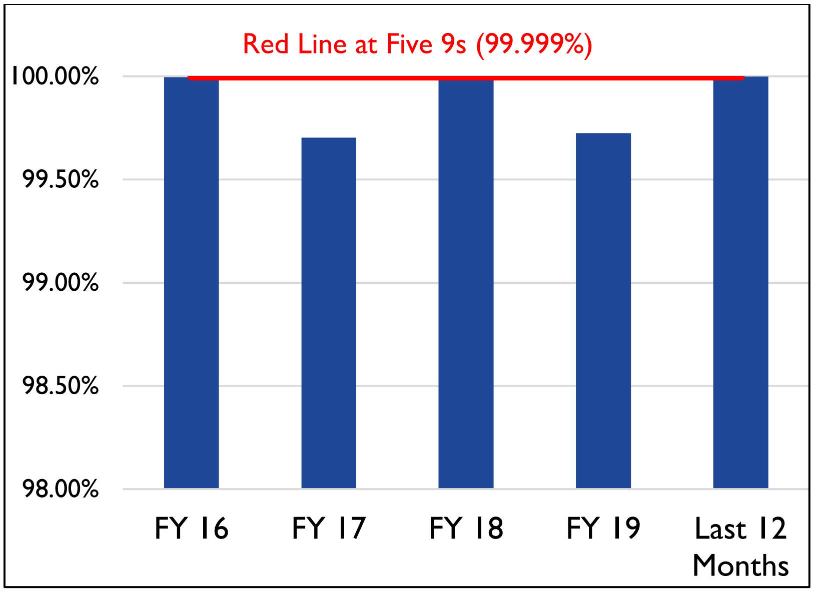

Figure 5: Percent of Total Customer Hours with Water Service

1.5.1.5 Water Quality Customer Inquiries

Every month OWASA tracks the number of water quality customer inquiries. These inquiries are broken down into two main categories: inquiries that result in sampling events and inquiries that do not require sampling. The details of each inquiry are broken out based on topic and recorded and tracked within a database spreadsheet by the Water Treatment Plant Laboratory Supervisor. While there is not a particular goal for the number of customer inquiries OWASA aims to have each year, customers are encouraged to call the Water Treatment Plant if they have any questions or concerns about their water quality. Historical values from calendar year (CY) 2016 through FY 2020 are presented in Figure 6. However, note that during the COVID-19 pandemic, the Water Treatment Plant laboratory was not completing any customer requested sampling due to social distancing requirements, so the last 12 months of data may look different than normal years.

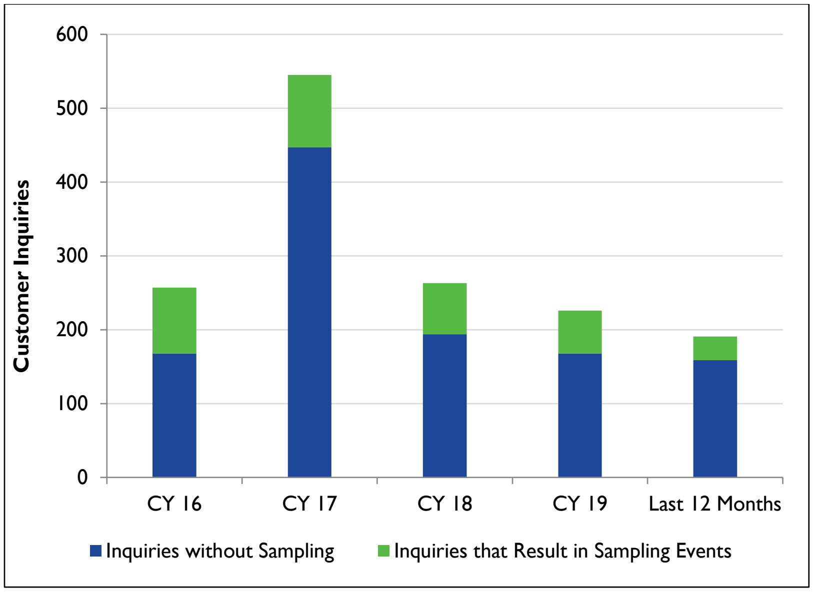

Figure 6: Calendar Year 2016- Fiscal Year 2020 Water Quality Customer Inquiries

1.5.2 Wastewater Collection and Treatment

1.5.2.1 Reportable Sewer Overflows per 100 Miles of Pipe

The reportable sewer overflows per 100 miles of pipe level of service is defined as the number of reportable sewer overflows that occur per hundred miles of gravity sewer and pressurized sewer pipes. A sewer overflow is reportable if the volume of sewage is equal to or greater than 1,000 gallons or any amount of sewage reaches the surface waters of the State (including through ditches, storm drains, etc.). Overflows are typically caused by pipe breaks, pipe blockages, excessive inflow and infiltration, malfunctioning pump stations, and electrical power failure. The quantity of overflows can be used to gauge the overall condition of the collection system and the effectiveness of the collection system maintenance program. An excessive amount of reportable sewer overflows per 100 miles of pipe indicates that the integrity of the collection system may be declining and/or maintenance activities may be inadequate. Additionally, reportable sewer overflows could be caused by capacity shortfalls due to growth and development in the service area. Historical values from FY 2016 through FY 2020 are presented in Figure 7. Per North Carolina Division of Water Resources guidance, OWASA's goal is to have zero sewer overflows. The national median per the American Water Works Association (AWWA) 2019 Benchmarking Report is 2.1 sewer overflows/100 miles of pipe (this includes sewer overflows due to both non-capacity and capacity issues).

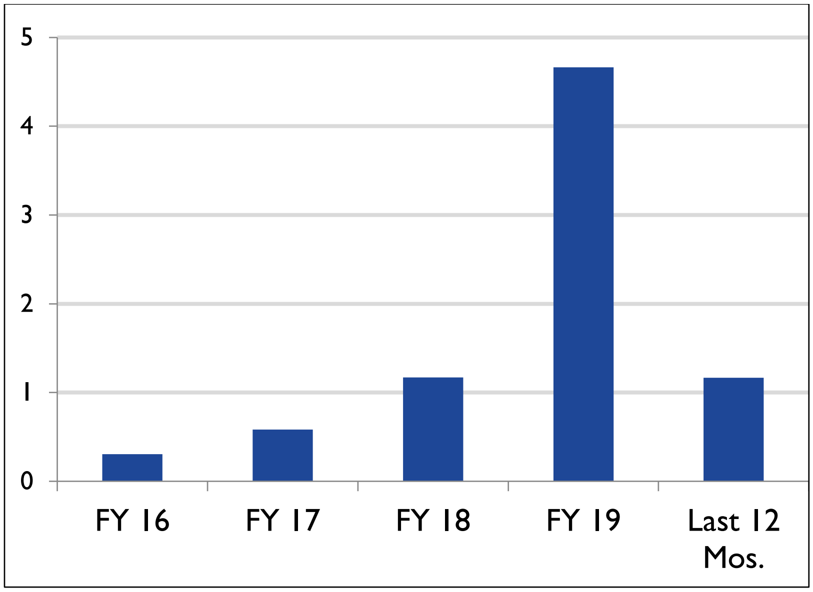

Figure 7: Fiscal Year 2016-2020 Number of Reportable Sewer Overflows per 100 Miles of Pipe

1.5.2.2 Collection System Operating Permit Violations

Requirements for the wastewater collection system's design and construction, operation and maintenance, and overflow reporting are included in the Wastewater Collection System Operating Permit. Collection System Operating Permit violations indicate that the collection system may be deteriorating or that maintenance, renewal and replacement activities may be inadequate. OWASA's goal is to be in full compliance with these requirements. Over FY 2020, OWASA has had 3 operating permit violations due to sewer overflows resulting from a broken force main, debris in a sewer main, and contractor failure to maintain power to sewer bypass pumps.

1.5.2.3 NPDES Permit Violations

The National Pollution Discharge Elimination System (NPDES) is a permit system for regulating point sources of pollution. The goal of the NPDES program is to reduce pollution by establishing effluent discharge limits and monitoring requirements.

OWASA's NPDES permitted discharges are located at the Jones Ferry Road WTP and Mason Farm WWTP. The Jones Ferry Road WTP is permitted to discharge wastewater associated with backwash clarifier effluent into Rocky Branch Creek. The Mason Farm WWTP is permitted to discharge treated wastewater effluent into Morgan Creek. NPDES Permit violations may indicate that either the WTP or WWTP is not operating as intended due to issues such as capacity limitations, aging equipment, or inadequate operations and maintenance activities. OWASA's goal is to be in full compliance with the requirements in both NPDES permits. Throughout FY 2020, OWASA has been in full compliance with the requirements of the NDPES permits of both the WTP and the WWTP.

1.5.2.4 Wastewater Treatment Plant Odor Events

On March 1, 2004, the Chapel Hill Town Council approved a Special Use Permit (SUP) for OWASA to upgrade and expand the Mason Farm WWTP, which was completed in 2007. The SUP included a provision that OWASA eliminate odor from the Mason Farm WWTP to the satisfaction of the Town Council and that OWASA regularly report to the Council on the progress of its off-site odor elimination program. Wastewater treatment plant odor events indicate that the odor control equipment may not be operating as intended due to issues such as capacity limitations, aging equipment, equipment malfunction, or inadequate operations and maintenance activities. Odor events are reported by neighboring property owners and documented by OWASA staff. A summary of system compliance for FY 2016 through FY 2020 is presented in Figure 8. There have been relatively few odor events in the past several years due to capital improvement projects that were completed as part of the WWTP's Odor Elimination Program in the past and ongoing efforts to coordinate additional construction work at the WWTP to mitigate odors.

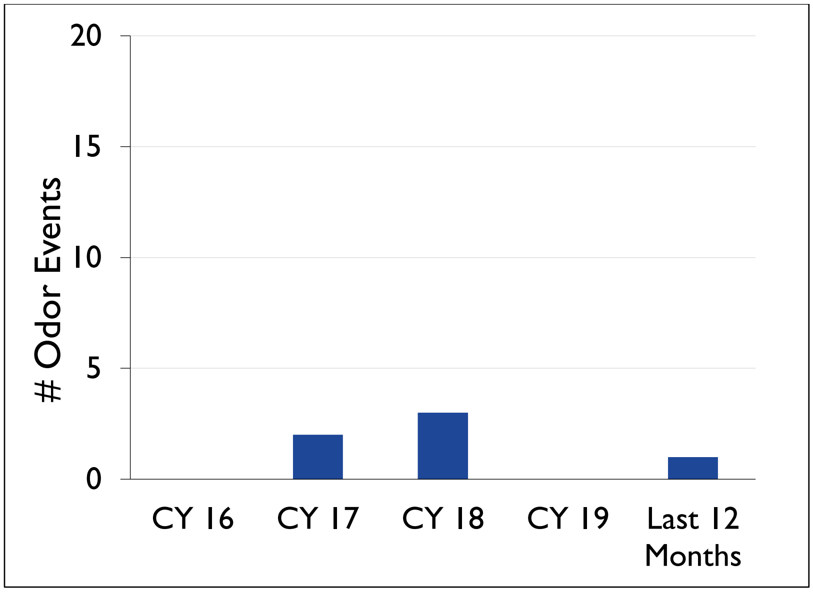

Figure 8:Calendar Year 2016 through Fiscal Year 2020 Number of Odor Events at the Wastewater Treatment Plant

1.5.2.5 Biosolids Operating Permit Violations

OWASA is permitted for both Class A – Exceptional Quality and Class B land application of biosolids. The biosolids permits include treatment requirements, metal concentration limits, testing and monitoring requirements, land application restrictions, and operation and maintenance requirements. Biosolids operating permit violations may indicate that the treatment process may not be operating as intended due to issues such as capacity limitations, aging equipment, equipment malfunctions, inadequate operations and maintenance activities. OWASA's goal is to be in full compliance with the requirements in both permits. Through the reporting period represented in this report, OWASA was in full compliance with the requirements in both permits.

Additionally, OWASA has a goal to land apply at least 75% of the biosolids produced. A summary of OWASA's land application program for calendar year (CY) 2016 through FY 2020 is presented in Figure 9. The operation and maintenance of the wastewater treatment plant solids handling facilities and treatment impacts OWASA's ability to meet the biosolids recycling goals. Well maintained and operated equipment provides more assurance of regulatory compliance for biosolids that can be land applied. Please note, however, that wet weather negatively impacts OWASA's ability to consistently land apply biosolids.

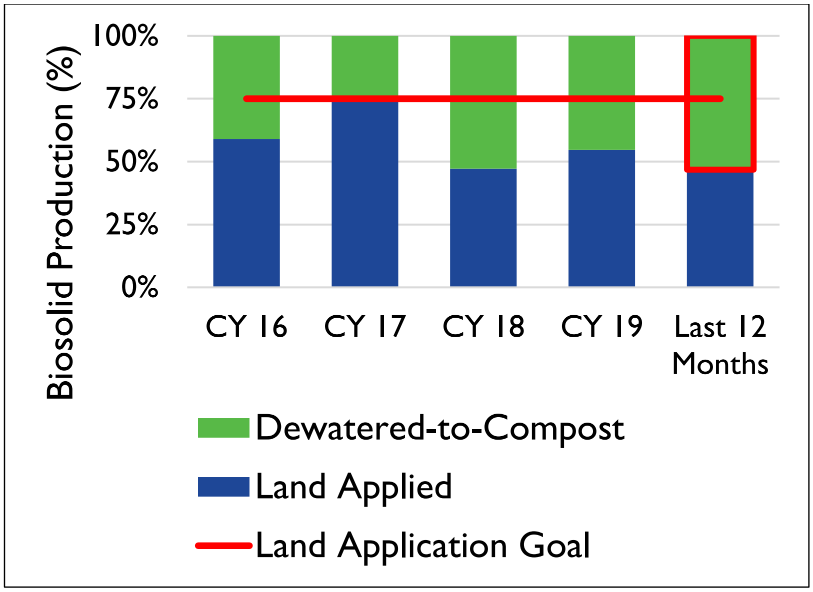

Figure 9: Calendar Year 2016 -FY 2020 Biosolids Recycling

1.5.2.6 Infiltration and Inflow (I/I) Tracking

Infiltration and Inflow is the excess water that flows into sewer pipes from groundwater. Infiltration is water that seeps into sewer pipes through holes, crack, joint failures and faulty connections. Inflow is water that flows into sewers via illegal connections (such as roof drain downspouts, foundation drains, broken cleanout caps, and cross connections as well as overland flow that can enter into holes and voids in manholes. Most I/I is caused by aging infrastructure that needs repair/maintenance or replacement. As such, OWASA is committed to removing and reducing I/I from the collection system through internal staff efforts as well as coordinated capital projects to line and replace aging sewer pipes. A dashboard has been developed during FY 2020 to aid in this effort and to track the overall progress of I/I reduction though the collection system. A screenshot of the output of the I/I tracking dashboard is shown in Figure 10. The general slope of the average R-Value, which is the relative percentage of I/I within the overall flow, shown in as the red dots in Figure 10 is a good indication of how well I/I is being removed from the system – a positive slope indicates increasing I/I over time and a negative slope indicates decreasing I/I entering the system over time.

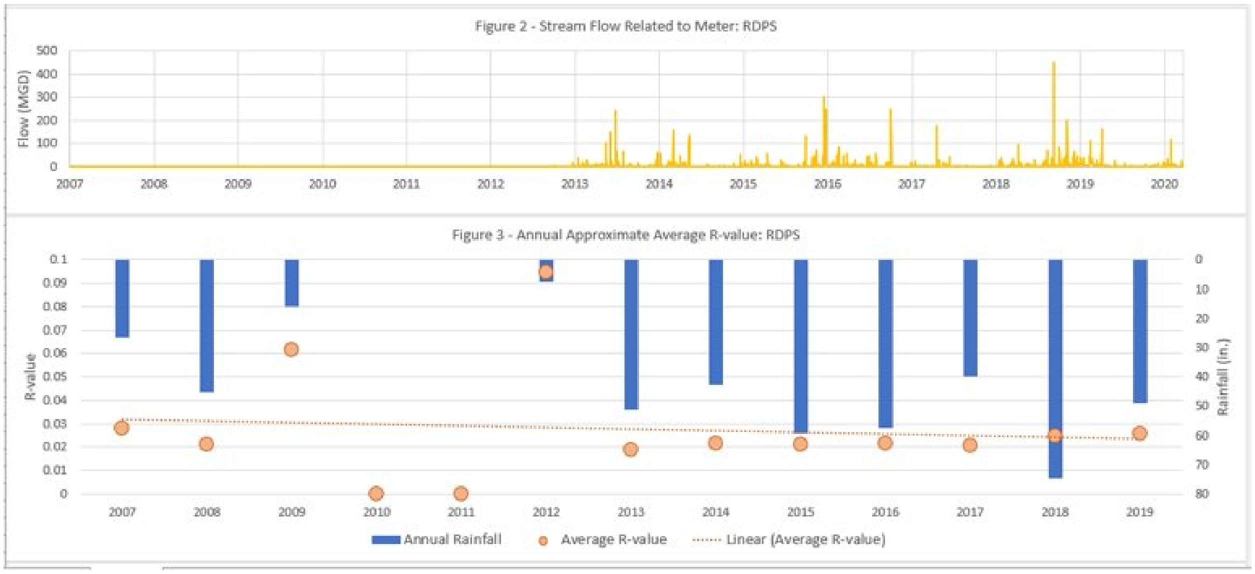

Figure 10: I/I Dashboard Outputs

1.5.3 Reclaimed Water System

1.5.3.1Reclaimed Water Utilization System Operating Permit Violations

The Reclaimed Water Utilization System Permit includes design and construction, operation and maintenance, and effluent monitoring and reporting requirements for the reclaimed water system. Reclaimed Water Distribution System Operating Permit violations may indicate that the treatment, storage, pumping or distribution system may not be operating as intended due to issues such as capacity limitations, aging equipment, equipment malfunctions, or inadequate operations and maintenance activities. OWASA's goal is to be in full compliance with the permit's requirements. OWASA has been in full compliance with the permit requirements throughout FY 2020.

1.6 Financial Overview

In order to sustainably manage our infrastructure, OWASA must have the financial resources and capacity to operate, maintain, repair and replace assets when needed. OWASA has a formal Financial Management Policy that ensures a comprehensive and systematic approach to strategic financial planning and related policy decisions. The Policy includes performance measures and targets that collectively guide ongoing efforts to provide customers with high quality water, wastewater and reclaimed water services through responsible, sustainable and creative stewardship of the resources and assets that OWASA manages. Table 1 summarizes the primary financial performance measurements and objectives specified in the Financial Management Policy.

Table 1: Financial Performance Objectives

Measurement	Objective
Working Capital Reserves	The greater of 4 months of O&M budget or 20% of the succeeding 3 years of CIP budget
Capital Improvements Reserve Fund	Minimum fund balance target of 2% of annual depreciated capital costs
Debt Service Coverage Ratio	≥ 2.0
Debt Burden to Asset Value	≤ 50%
Sufficiency of Revenues Above Debt Requirements	Annual Debt service shall not exceed 35% of annual gross revenues
Credit Ratings	Aa2 – Moody's; AA+ - Standard & Poor's; AA+ - Fitch
Cash Financing of Capital	Annual revenues and cash reserves shall provide not less than 30% of CIP funding
Rate/Revenue Stabilization Fund	Minimum fund balance target of 5% of projected water and sewer revenue
Service Affordability	Average annual residential bill divided by real median household income shall be ≤ 1.5%

OWASA maintains a comprehensive 15-year financial plan to evaluate projected revenues, operating and capital expenditures, debt service, future borrowing needs, and rate adjustment scenarios to ensure it can meet the financial goals and objectives over the long-term. The plan is updated annually, and annual rate adjustments are made as needed to ensure financial performance.

OWASA updates the financial plan's assumptions annually regarding projected water sales, growth trends, increases in number of customers, projected operating and maintenance costs (including trends in energy, chemical, personnel, and other expense categories), projected capital equipment and capital improvements needs, desired ratio of net income to debt service, cost of borrowing, and other factors. Based on the input assumptions, the plan is used to determine the level of rates required to achieve OWASA's financial goals and objectives.

OWASA's rates and fees are based on comprehensive cost-of-service rate studies that are prepared about once every five years. The Board of Directors sets and adopts rates and fees annually.

The FY 2021 budget consists of projected revenues and other receipts of $37 million, capital project costs of $20.3 million, operating expenses of $23.2 million, debt service payments of $9.1 million, and capital equipment purchases of $704,500. Figure 11 provides a breakdown of FY 2021 budget expenditures. COVID-19 has adversely impacted OWASA's current and projected revenue. Accounting for the reduction in revenue, capital expenditures and operating expenses in the FY 2021 budget were reduced including the deferral of asset management projects such as the Computerized Maintenance Management Software system and Distribution Condition Assessment Pilots (to be discussed in subsequent section).

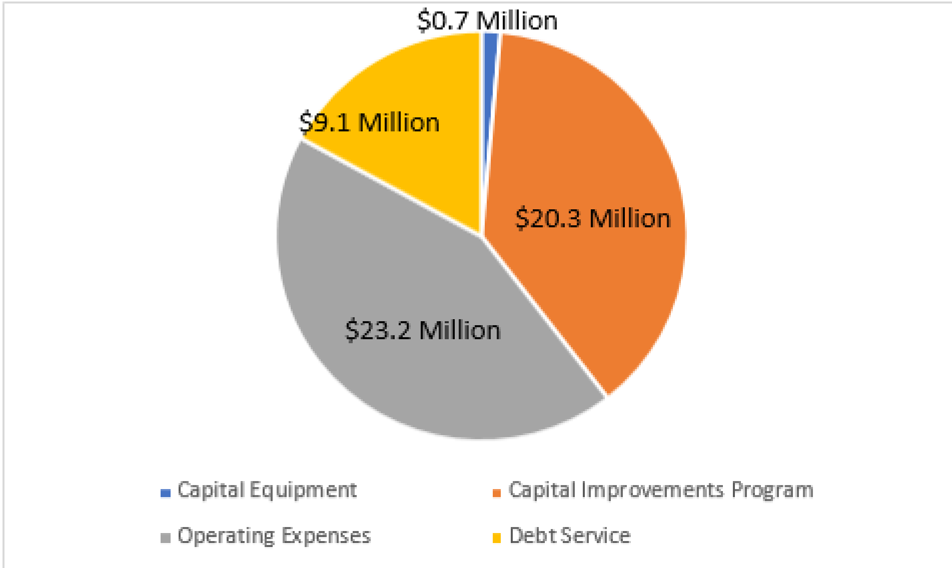

Figure 11: FY2021 Budget

The value of OWASA's assets is documented in the fixed asset register. The asset's cost or original purchase price is recorded in the fixed asset register for all new assets that are either purchased by or dedicated to OWASA. With the exception of land, the recorded cost of the assets is depreciated using the straight-line method, which is calculated as the original purchase price divided by the expected useful life, following generally accepted financial accounting guidance. The expected useful life ranges from 5-60 years depending on the type of asset. The recorded cost for land is not depreciated. An asset's cost less the associated depreciation is known as net book value. Net book value by asset category as of February 2020 for water and wastewater assets account for 37% ($102 million) and 52% ($144.3 million) of the total fixed asset register net book value of $277 million (M), respectively.

The Renewal and Replacement (R&R) Model also plays into OWASA's financial discussion. The R&R model was developed in 2014 and provides a first forecast model for 20-year capital and maintenance spending to renew and replace OWASA's assets. The model inputs are asset replacement value, asset life cycle (note that useful life is the duration of time than an asset is operable and it not inclusive of capacity of levels of service), asset age/condition, asset renewal condition and maintenance. The inputs are run through a deterministic model and then a probabilistic model taking into account a sensitivity analysis due to the range of uncertainty in the model. The R&R model was updated in 2015 to incorporate new asset inventory data collected by OWASA staff, update the asset class subdivisions, and update specific asset life cycle assumptions. An example of the 2015 R&R 20-year forecast charts for water vertical assets is shown in Figure 12.

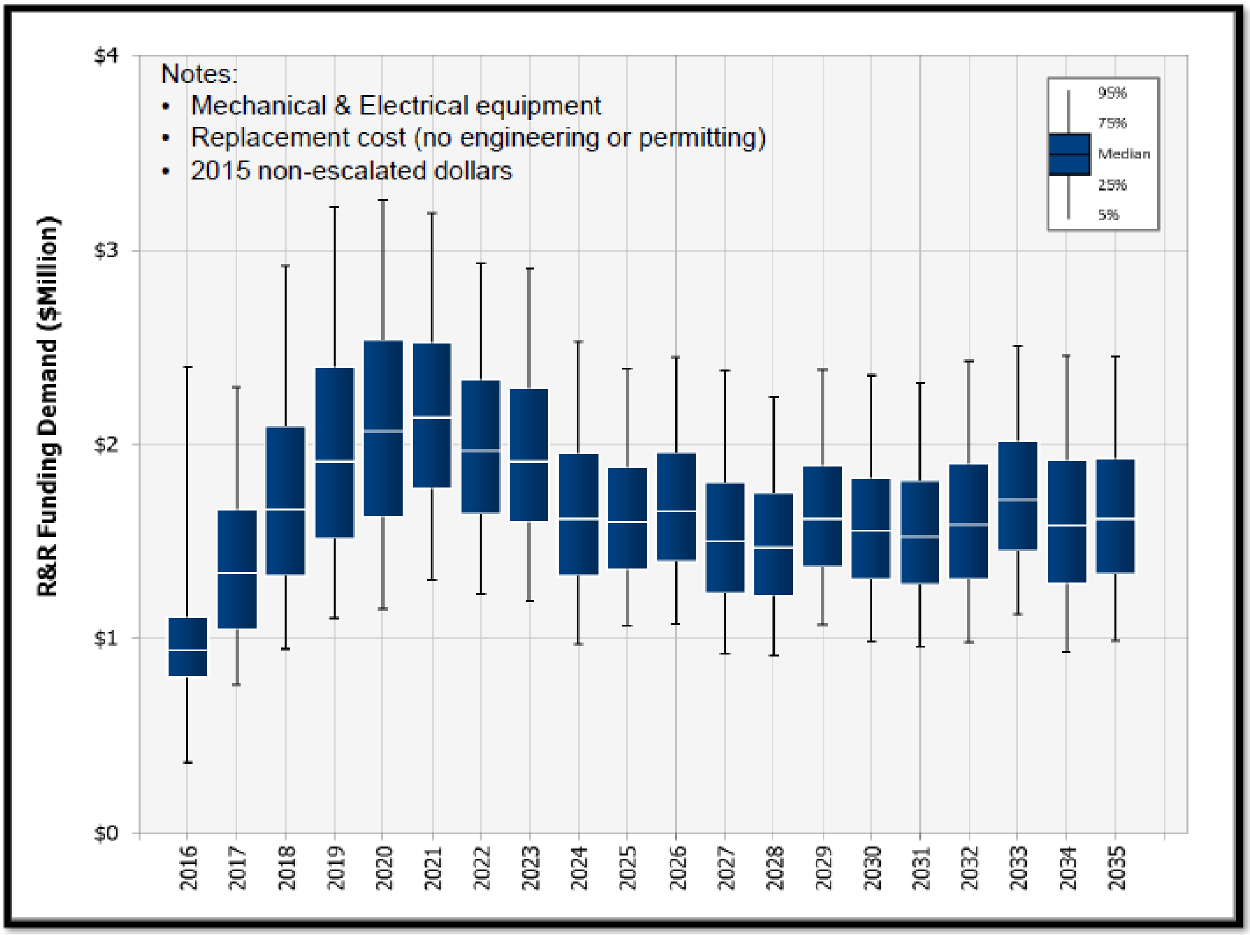

Figure 12: Water Vertical Asset R&R Funding Demand 2016-2035

The current R&R model focused on the major assets and systems that were existing in the CMMS and the GIS in 2015. The model is intended to be used for financial forecasting and planning, not a tool for specific asset failure prediction. During the 2015 upgrade, it was recommended that the R&R forecast model be updated on a 3 to 5year interval so a new version of the forecast model should be forthcoming in the next year or two.

1.7 CIP Overview

Assets identified for renewal, replacement, and/or expansion by models, studies, ~~or~~ performance or other factors are developed into capital improvements program (CIP) projects. Asset renewal, replacement and expansion is key to sustaining the levels of service discussed in Section 1.5. CIP projects are defined as any major (greater than $10,000), non-recurring (greater than 5 years) capital expenditures for the construction, expansion, improvement, repair, or replacement of a building, utility system, or other physical structure or property.

Annually OWASA publishes the Board-approved long-range Capital Improvements Program and Budget for a 5-year period along with the Annual Budget. Its objective is to help guide OWASA's efforts to meet the community's evolving needs for sustainable, reliable, and high-quality water, wastewater, and reclaimed water services. The capital improvements program is extended out 15-years to include projects outside of the five-year window to ensure adequate lead time for evaluation of alternatives, advance studies, and to inform long-term financial planning. The 15-year CIP is a key part of the 15-year financial plan previously mentioned.

Capital project needs are identified by staff observation, regulatory or contractual requirements, work order evaluation, hydraulic models, risk/prioritization models, coordination with other projects (e.g. street resurfacing, greenways, etc.), and master planning studies. Utilization of the geographic information system (GIS) and computerized maintenance management systems (CMMS) also inform the CIP needs and allow OWASA to focus on the assets that pose the greatest risk based on the risk framework described in Section 1.4 : Risk Framework.

After CIP projects are identified, OWASA uses a project prioritization model developed for OWASA by CH2M HILL as part of the 2013 Asset Management Project Implementation project. The decision criteria address triple bottom line (social, environmental, and economic) considerations, and include:

- Regulatory Compliance and Safety
- Customer Service/Level of Service
- Finance and Operating Risk
- O&M Efficiency
- Environmental Enhancement

The results of the FY 2021-2025 CIP project prioritization are presented in Figure 13. Each column in the graph represents a CIP project. The colors in each column indicate the decision criteria that comprise the project's total benefit score

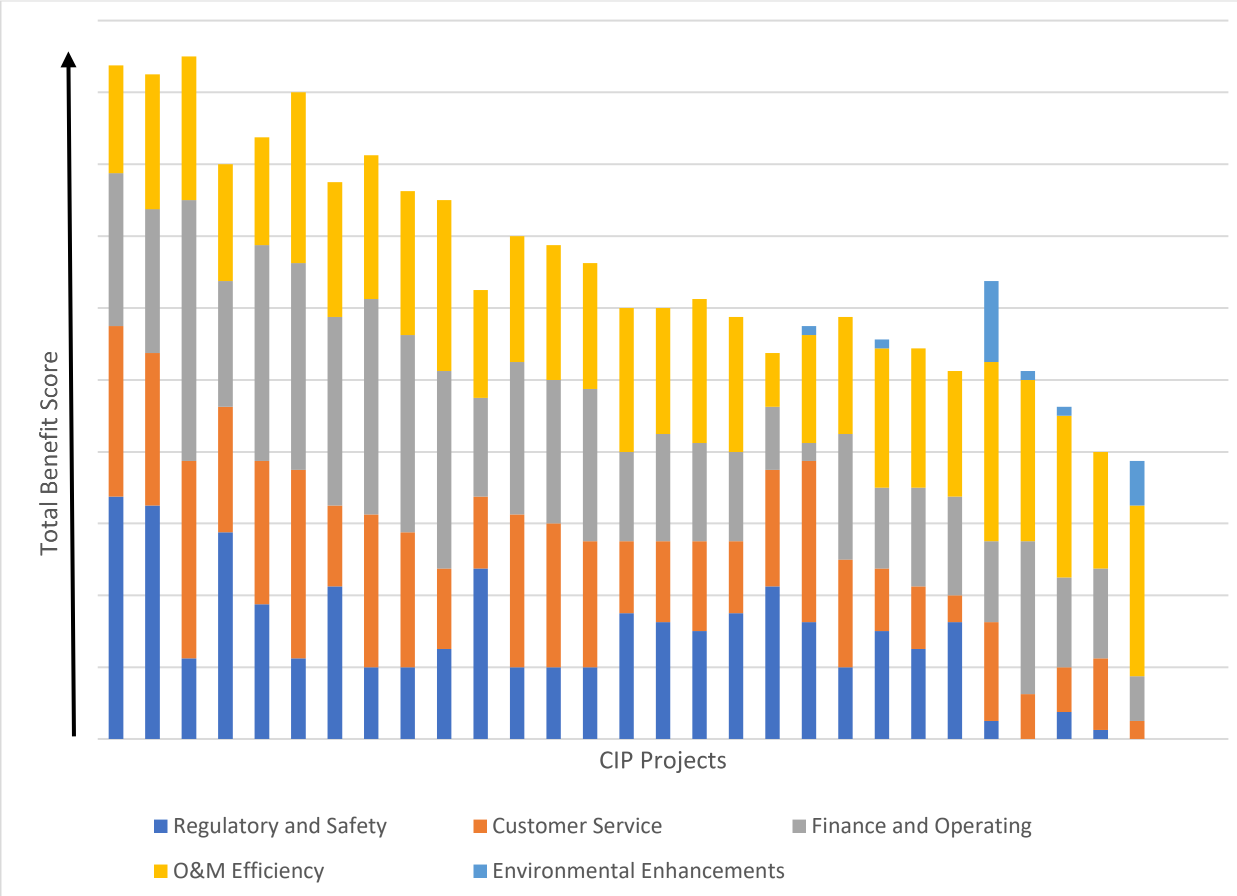

Figure 13: FY2021-2025 CIP Prioritization

The CIP project prioritization model allows staff to evaluate projects against one another. Water, wastewater, pipeline, and facility projects are rated using the decision criteria listed above. Projects with higher scores are typically scheduled to occur earlier in the CIP. In addition to the results of the project prioritization model, staff accounts for project interrelationships, project implementation considerations, and other external schedule constraints when programming projects into the CIP.

The current 5-year, $113 million dollar Capital Improvements Program for fiscal years 2020-2024 was developed using these the previous tools and procedure and is shown in Table 2.

Table 2: OWASA Capital Improvements Program Five Year Overview for FY2020-2024[1]

	Annual Totals					5-Year Total
Project Category:	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2020-24
Raw Water Supply Sources	$1,051,000	$3,152,000	$1,665,000	$1,370,000	$170,000	$7,408,000
Raw Water Transmission	50,000	50,000	0	0	0	100,000
Water Treatment Facilities	2,785,000	6,186,000	5,267,000	2,939,000	2,514,000	19,691,000
Drinking Water Pumping	0	0	0	0	0	0
Drinking Water Storage	0	0	100,000	0	0	100,000
Drinking Water Transmission and Distribution	9,701,000	9,491,000	3,781,000	6,877,000	6,363,000	36,213,000
Wastewater Collection Lines	4,601,000	3,737,000	3,115,000	6,798,000	4,540,000	22,791,000
Wastewater Pump Stations and Force Mains	2,204,000	275,000	0	300,000	0	2,779,000
Wastewater Treatment and Recycling	6,031,000	5,048,000	2,250,000	5,703,000	4,561,000	23,593,000
Reclaimed Water	0	0	0	0	0	0
Central Office and Operations	0	0	0	0	0	0
FY 2020 - 2024 CIP	$26,423,000	$27,939,000	$16,178,000	$23,987,000	$18,148,000	$112,675,000

[1] Budget amounts are escalated at 5% annually (with some exceptions)

A breakdown of CIP spending for system rehabilitation, enhancement, and growth is presented in Figure 14. More than 78% of the projected funding for the FY 2020-2024 CIP is for rehabilitation or replacement of existing infrastructure. The need for additional system capacity is limited as determined by the various hydraulic models and capacity studies.

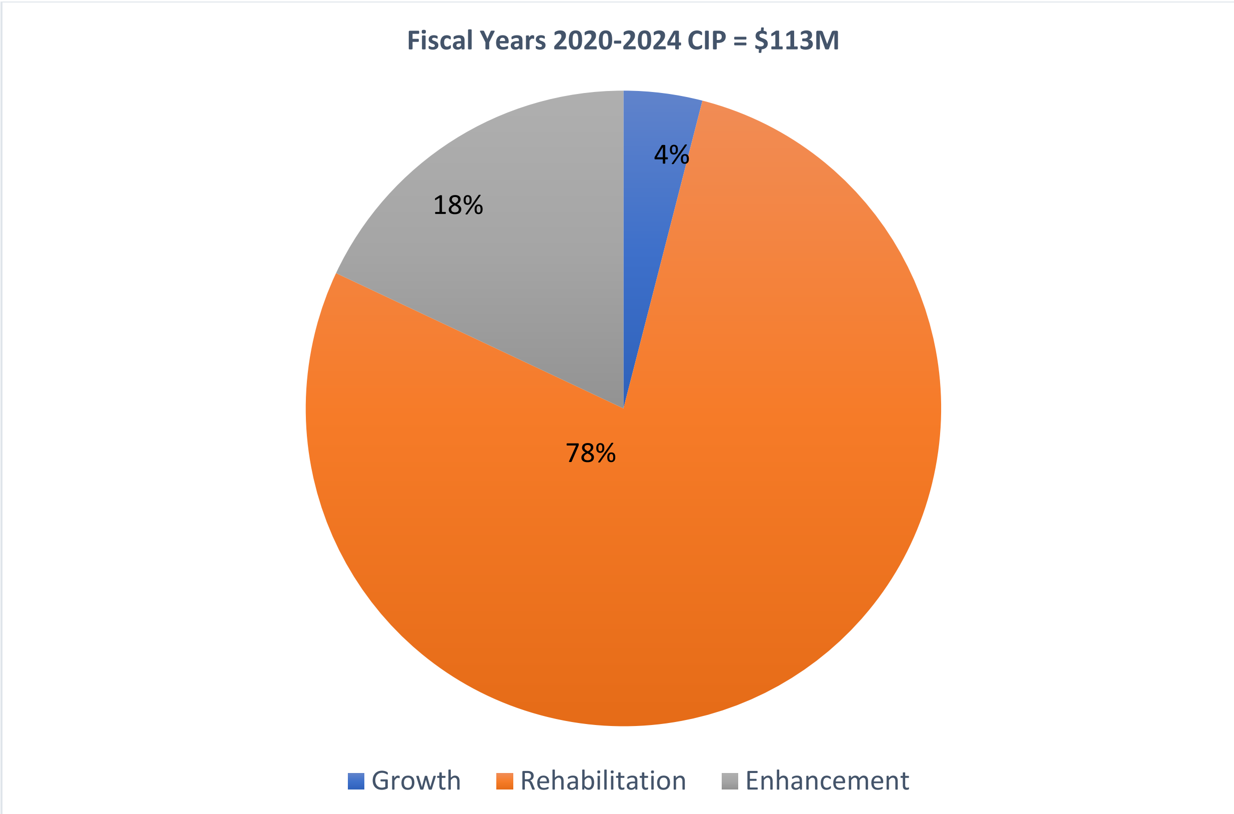

Figure 14: CIP Funding by Project Type

1.8 Rehabilitation and Replacement Benchmarking

Comparing OWASA's rehabilitation and replacement funding rate to other utilities is informative because this funding accounts for a majority of CIP spending. AWWA's 2019 (FY 2018) Benchmarking Report included system renewal and replacement performance indicators for the following four asset groups:

- water treatment and pumping facilities
- water pipelines and distribution
- wastewater treatment and pumping facilities
- wastewater pipelines and collection.

The performance indicator is calculated by dividing the amount of funds reserved for renewal and replacement of an asset group by the total present worth of renewal and replacement needs for that asset group. Table 3 compares OWASA's FY 2018 CIP renewal and replacement rate against the 25th percentile (bottom quartile), median and 75th percentile (top quartile) of the 2019 (FY 2018) AWWA benchmark survey results.

Table 3:Comparison of OWASA FY 2018 System Renewal/Replacement Rates with the AWWA 2019 (FY 18) Benchmarking Performance Indicators

Asset Class	OWASA	75th Percentile	Median	25th Percentile
Water Supply	0.7%	3.1%	1.0%	0.1%
Water Treatment Facilities	2.0%	4.9%	2.3%	0.9%
Water Pump Stations	0.5%	11.4%	2.4%	0.5%
Water Transmission and Distribution Pipe Networks	1.6%	1.7%	1.1%	0.6%
Wastewater Collection	1.2%	3.2%	1.2%	0.5%
Wastewater Pump Stations	10.3%	7.7%	2.8%	1.3%
Wastewater Treatment Facilities	4.1%	3.7%	2.5%	1.3%

OWASA's renewal and replacement rate is at or above the 25th percentile for all of the asset classes. During this reporting period, the wastewater assets were being renewed at or above the median.

Using performance indicators to compare dissimilar utilities can be challenging due to utility-specific factors such as water sources, treatment requirements, system age/materials, regulations, etc. The AWWA report notes that several large-scale phenomena including economies of scale, economies of scope and economies of density can influence observed levels of performance and make utility-to-utility comparison difficult.

1.9 Energy Management Program Overview

To improve our environmental impact, reduce a significant operating cost, and increase the resiliency of our organization, the OWASA Board of Directors has established the following energy management goals and objectives:

- Reduce the use of purchased electricity by 35% by the end of calendar year 2022 compared to the calendar year 2010 baseline.
- Reduce the use of purchased natural gas by 5% by the end of calendar year 2020 compared to the calendar year 2010 baseline.

Beneficially use all wastewater treatment plant (WWTP) biogas by 2022, provided the preferred strategy is projected to have a positive payback within the expected useful life of the required equipment. Formally engage local governments and partners in discussion about potential development of a biogas-to-energy project at the Mason Farm WWTP

These objectives are being met through a wide variety of investment in energy efficiency projects that span operations and maintenance activities and capital projects.

Significant strides have been made towards meeting the energy management program objectives to date since the 2010 baseline. Figure 15 illustrates the energy management program achievements through the end of 2018.

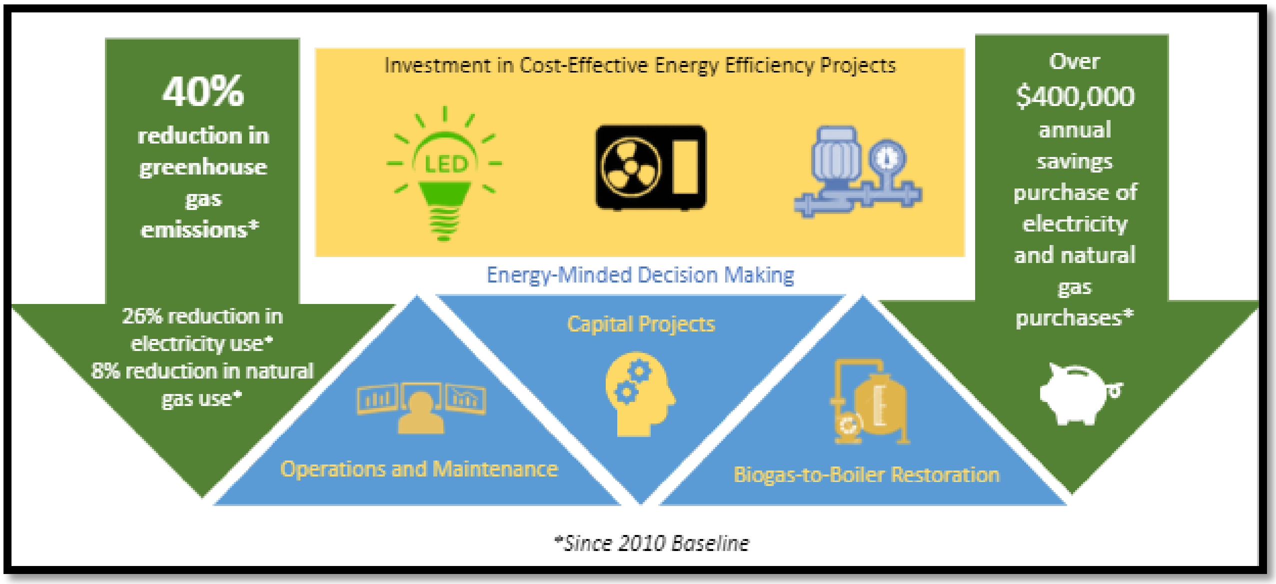

Figure 15: Energy Management Program Achievements

2 Raw Water Reservoirs and Managed Land

2.1 Overview

2.1.1 Reservoirs

OWASA's water supply originates as rain in the Cane Creek and University Lake Watersheds. Within these two watersheds, water is stored in three reservoirs:

Reservoir	Location	Capacity*	Area
Cane Creek Reservoir	Orange County, 9 miles west of Carrboro	Can store about 3 billion gallons	Surface Area = 540 acres Watershed = 32 square miles
University Lake	Within Carrboro	Can store about 450 million gallons	Surface area = 200 acres Watershed = 30 square miles
Quarry Reservoir	Within the University Lake Watershed about 3 miles west of Carrboro	Can store about 200 million gallons now and in 2030 is should be capable of storing 2.2 billion gallons	Surface area = To be determined when blasting and reservoir is filled. Watershed = N/A

*Based on 2010 long range water supply plan yield calculations – future sedimentation rate studies would further refine the overall capacity number in the coming years

University Lake was created by University of North Carolina (UNC) in 1932. The lake and about 500 acres of surrounding lands are owned by UNC but OWASA controls all land within 100 feet of the shoreline and is entitled to use University Lake as a water supply source through a contractual agreement with UNC. University Lake is impounded by a concrete gravity dam founded on bedrock connected to an earthen embankment that extends along the left side of the concrete dam. The dam is classified as a large hazard structure according to the North Carolina Dam Safety Regulations and is inspected reguarly. The University Lake Pump Station is located directly below the non-overflow gravity section of the dam. Wooden flashboards were added to the service spillway in 1965 to raise the normal elevation, the original flashboards were replaced in 2002 with new timbers and a support system and then replaced again in 2018 with new timbers and a membrane cover to extend the life of the flashboards.

Cane Creek Reservoir was created by OWASA and filled in 1989. Cane Creek Reservoir is impounded by a zoned earthfill embankment that was constructed of native materials excavated primarily from the auxiliary spillway section. The service spillway is a gated ogee crest provided with vertical roller gates for control of major flood events. The auxiliary spillway is located at the right abutment of the dam to provide additional hydraulic capacity for peak inflows in excess of the 200-year storm event. The spillway is provided with an erodible fuse plug designed to fail during major events. The dam is classified as a large hazard structure according to the North Carolina Dam Safety Regulations and is inspected annually. The Cane Creek pump station is located directly downstream of the Cane Creek Dam.

OWASA also has an allocation of 5 percent of Jordan Lake’s water supply storage capacity which can yield about 5-6 million gallons per day (MGD). OWASA’s land in Chatham County is also being proposed for a potential regional water treatment plant as part of the Triangle Water Supply Partnership that could potentially serve the City of Durham, Town of Pittsboro and Chatham County along with OWASA in the future. OWASA currently participates in the Triangle Water Supply Partnership planning efforts and Jordan Lake may become increasingly important to OWASA in the event of prolonged droughts or emergency. Retaining this allocation and access to Jordan Lake is essential to meeting long-term customer demands today and in the future.

Currently the Cane Creek Reservoir/University Lake/Quarry Reservoir system can support an average yield of about 10.5 MGD during severe drought conditions. When the Quarry Reservoir is expanded in the future, the entire water reservoir system will be able to support an average yield of 12.6 MGD. Current annual average day raw water demand is around 7 MGD.

A 24-inch diameter raw water main is used to transport water from the Cane Creek Reservoir to a junction with the raw water main from the Quarry Reservoir. The Quarry Reservoir currently acts as an emergency water supply for OWASA. The 24-inch raw water main begins at the raw water pump station located at the Cane Creek Reservoir. From there, the raw water main runs south until it reaches NC-54 where it turns east traveling along NC-54 to the pump station located at the Quarry Reservoir. This raw water line was installed in the mid to late-1980s. The Quarry Reservoir Pump Station pumps into the 24-inch raw water line and the line increases in size to a 30-inch line. There is a high point of the line near this upsized line section and a combined Air-Release Vacuum-Relief Valve is located near the high point. From this valve, the line flows downhill to the plant where a sleeve valve is used to maintain sufficient backpressure to prevent vacuum in the line. From the sleeve valve the line enters the plant and combines with water pumped from University Lake.

University Lake water is pumped from the adjacent University Lake pump station through a 20-inch concrete raw water transmission main that travels along Jones Ferry Road to the WTP that was installed in the 1960s or through a 42-inch ductile iron pipe that travels overland to the WTP that was installed in 2002. There is also an abandoned 12-inch cast iron main that follows a similar path as the ductile iron pipe that is currently in use.

2.1.2 OWASA-Managed Land

OWASA owns 4,010 acres of land that is used for a variety of purposes including facilities, biosolids management, reservoirs, and watershed protection, and potential future facility sites (such as water supply facilities at Jordan Lake and future elevated water storage tanks). OWASA's land inventory is stored in the GIS. Each feature includes the land asset's spatial location and a variety of attribute information including the parcel identification number, area, physical address, date of purchase, deed reference, and expected use. Table 6 provides a summary of OWASA-owned land.

As part of OWASA's current Strategic Plan (adopted in 2014 and updated in 2016) and in alignment with the Board of Directors developed policies concerning land management with regard to protecting our water supplies, OWASA has maintained practices that encourage watershed protection, biosolids management, planning for future facilities, energy management, educational opportunities, and forest stewardship.

Table 4: OWASA Owned Land

Category	Acres
Biosolids	710
Cane Creek Reservoir & Watershed	2,540
Jordan Lake	130
OWASA Facilities	110
Quarry Reservoir	250
University Lake & Watershed[1]	0
Total	3740

1. University Lake and about 500 acres of adjacent lands are owned by University of North Carolina (UNC). OWASA is entitled to use University Lake as a water supply source and controls all land within 100 feet of the shoreline through a contractual agreement with UNC.

As previously mentioned, OWASA also currently owns 125 acres in Chatham County for a potential future intake and new regional water treatment plant (WTP) on the west side of Jordan Lake.

OWASA's lands are shown in Figure 16.

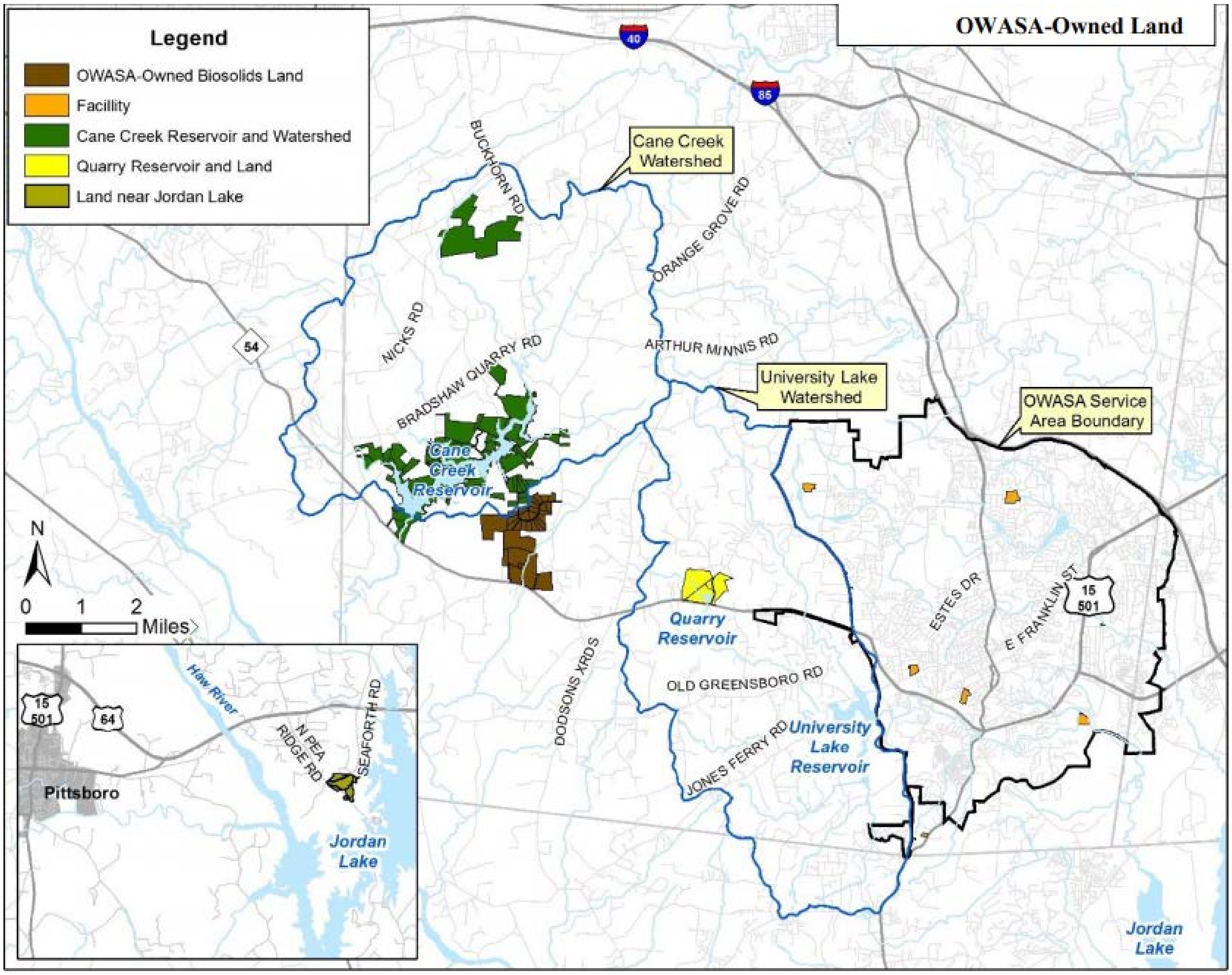

Figure 16: OWASA Owned Land

2.2 Current Activities

2.2.1 Reservoirs

OWASA currently collects a large amount of data on the water quality of our reservoirs. As our two primary reservoirs, University Lake and Cane Creek Reservoir are the focus of the regular sampling. The parameters of analysis, location of analysis and frequency are illustrated in Table 7. The water treatment plant staff use this data to track overall water quality trends and make treatment decisions.

Table 5: Reservoir Water Quality Testing Parameters

Parameter	**Where/What**	**Frequency**
Temperature	University Lake: 0.1, 1, 2, 3, 4, 5, 6, & 7 meters from surface Cane Creek: 0.1, 1, 2, 3, 4, 5, 6, 7, 8, 9, & 10 meters from surface, and bottom	Weekly
Specific Conductance		
Conductivity		
Dissolved Oxygen, Percent Saturation		
Dissolved Oxygen, concentration		
pH		
Chlorophyll		
Phycocyanin		
Algal enumeration	Photic zone (2x secchi depth) off intake structures	
Secchi depth	Off intake structures	
Total Organic Carbon	Intakes	Minimum 1x/month, often weekly
Dissolved Organic Carbon		
UV_{254}		
SUVA		
Inorganic Compounds		Annually
Volatile Organic Compounds		
Cyanotoxins (microcystins, cylinderospermopsin, anatoxin-a)	Intakes	Weekly spring - fall

In addition to the water quality parameters listed in Table 7, the laboratory at the Water Treatment Plant also tests the raw water for two taste and odor compounds: geosmin and MIB (2-methylisoborneol). The taste and odor compounds are tested daily at the two primary reservoirs – University Lake and Cane Creek Reservoir internally using gas chromatography-mass spectrometry.

OWASA also annually tests the Quarry Reservoir for inorganic compounds, volatile organic compounds (including MTBE), and total organic carbon. The Quarry Reservoir is tested at a different time interval than the Cane Creek Reservoir and University Lake because the Quarry is currently listed as an Inactive Emergency Source with the Department of Environmental Quality (DEQ). DEQ has approved this water supply even though the Quarry Reservoir is still under construction. Once the Quarry Reservoir is completely constructed and filled, the sampling for this reservoir will match that of Cane Creek Reservoir and University Lake.

This work currently supports the following KPIs:

- Water Quality Customer Inquiries
- Primary and Secondary Drinking Water Violations = 0

2.2.2 OWASA Owned Lands

OWASA currently manages more than 3,000 acres of watershed land that is either directly owned by OWASA or protected through conservation easements. The land is managed to protect water quality, establish and maintain adequate riparian forest buffers to serve as an effective filter for runoff and to prevent sedimentation of streams and other surface waters. Additionally, land management activities are completed to enhance forest condition for wildlife health and species diversity through long-range programs of managing forests in accordance with sound, science-based silvicultural practices. As part of these activities OWASA has also engaged the use of drone technology to take pictures of the land they own before and after land management activities.

OWASA currently uses GIS to store available information about the land and forests that we own. The data include information about land and forest management as well as data from local, state, and federal public databases.

In September 2019 the Board of Directors approved guiding principles for OWASA's Forest Management Program:

- Protect Water Quality (OWASA's highest priority)
- Improve Ecological Health of Forested Land
- Reduce the risk of Wildfire
- Improve Wildlife Habitat and Species Diversity
- Sustainably Manage OWASA's Resources
- Engage the Community and Partner Agencies
- Minimize Adverse Impacts on Neighbors and Surrounding Community

2.3 Next Steps

OWASA will continue to complete all required and suggested sampling at the raw water sources to ensure it understands our water quality. Additionally, OWASA plans to conduct a study of the Cane Creek raw water transmission main in order to better locate the line, evaluate the limited access for cleaning and inspections, evaluate requirements for near continuous operation, and provide insight and design for the current lack of redundancy. Furthermore, the condition of existing valves and blow-off assemblies and condition of the Cane Creek raw water main (i.e., presence of cracks, leaks, blockages, etc.) will also be evaluated. The information gained during the Cane Creek raw water main evaluations will be used for future planning of the Cane Creek Raw Water Pump Station Improvements. Additional work is also planned for locating and determining the condition of the 1960's 20-inch concrete raw water main at University Lake. The University Lake 20-inch raw water main will be evaluated during the upcoming Permanganate Facility Project at that location prior to construction of the new chemical facility.

OWASA will also continue to complete all required dam inspections annually as required by the state and update any safety, operation, and or emergency management plans as needed.

In the future additional land management activities are expected. OWASA plans to complete a prescribed burn on the OWASA-owned mitigation track to improve the health of the managed land.

Lastly, for land management activities additional drone technology applications are being considered. Some of these applications include using drones during the prescribed burn to observe the before and after results of the burn as well as to observe the burn as it progresses. See Section 5.3.4 (on drones).

Staff and our forest management consultant developed a method to prioritize OWASA's forested lands for management. The initial prioritization was based on field work completed by our consultant from

2010 and data available in GIS and then field verified. Our forestry consultant has drafted Forest Stewardship plans for the top two priority sites, and these have been shared with partner agencies with expertise in land management. OWASA provided the plans for public comment and following the community engagement process, the stewardship plans will be implemented, monitored, and adapted as they learn more.

These efforts support the following KPIs:

- Water Quality Customer Inquiries
- Primary and Secondary Drinking Water Violations = 0

3 Water Treatment and Administrative Offices/Operations Center

3.1 Water Treatment Overview

The water system vertical assets include OWASA's reservoirs, raw water pump stations, Jones Ferry Road Water Treatment Plant (WTP), booster pump stations (BPS), and storage tanks. These assets are essential for treating, storing, and pumping drinking water to meet customer demands and to ensure adequate flow and pressure for firefighting purposes. Table 6 provides a summary of these assets. OWASA's inventory of individual assets located at these facilities is stored in the CMMS database. The database contains 1,534 mechanical, electrical, and structural assets for the water system. Figure 17 illustrates where these assets are located relative to OWASA's service area.

Table 6: Water System Vertical Assets

Asset Type	Purpose	Count	Capacity
Raw Water Pump Stations	Pump raw water from the reservoirs to the water treatment plant (Cane Creek, University Lake, and the Quarry Reservoir)	3	4-18 million gallons per day (MGD)
Water Treatment Plant (WTP)	Remove impurities from raw water using chemical and physical processes. Treated drinking water is then pumped into the distribution system.	1	20 MGD
Booster Pump Stations (BPS)	Transfer drinking water from lower pressure zones to higher pressure zones in the distribution system. Also used during emergencies to convey water to and from neighboring water systems.	4	2-7 MGD
Storage Tanks	Store drinking water in order to maintain adequate flow and pressure throughout the system.	6	0.5-3.0 MG

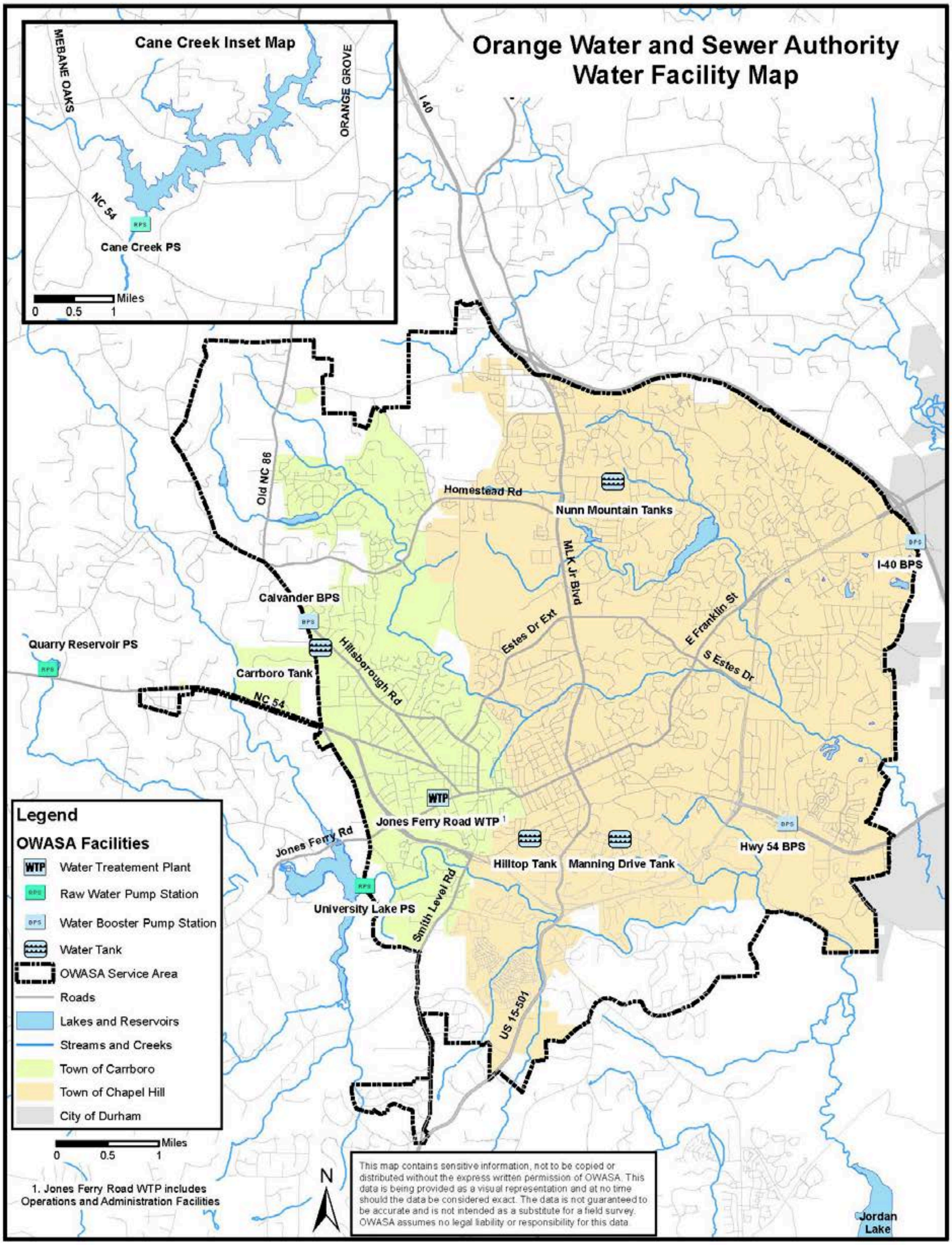

Figure 17: Water System Vertical Assets

3.2 Administrative Offices and Operations Center Overview

OWASA's Administrative Offices and Operations Center are co-located with the Jones Ferry Road WTP at OWASA’s 17-acre site in Carrboro. The Administration Building was built in 1990 and houses OWASA’s administrative office, finance, human resources, customer service, information technology, safety, and engineering and planning. The Operations Center was built in 2004 and houses the Distribution and Collection department, warehouse operations, fleet maintenance, material and equipment storage, and a vehicle wash facility. OWASA’s inventory of individual assets located at these facilities is stored in the CMMS database. The database contains 354 mechanical, electrical, and structural assets.

3.2 Water Treatment Current Activities

3.2.1 Surveying

OWASA staff began reviewing as-builts of the Water Treatment Plant (WTP) in 2018. This as-built review, in conjunction with staff knowledge, is being transferred into a GIS mapping effort for all underground utilities at the WTP. During construction in late 2019, additional portions of OWASA’s underground fiber loop were surveyed. The fiber loop provides connectivity for the supervisory control and data acquisition (SCADA) system and other communications between the water treatment plant and the main OWASA administration building. The fiber loop section is one of the first sections of underground utilities to be mapped into GIS. Additional assets at the WTP will continue to be mapped in 2020 and into the future. Given the current schedule and work load, it is anticipated that OWASA-led activities for survey at the WTP will take several years to complete.

It is important to note that OWASA is planning a transition from their current ESRI GIS to the ESRI Utility Network platform by 2024 which may impact overall mapping projects and overall GIS master planning efforts.

3.2.2 Computerized Maintenance Management System

OWASA has recognized the need to assess their current maintenance management practices at the water treatment plant for a potential new Computerized Maintenance Management System (CMMS). OWASA has used Infor’s MP2 CMMS for WTP and WWTP facility maintenance functions for upwards of 20 years. Work is planned for the upcoming years to assess OWASA’s Current Business Process for Maintenance management at the WTP and WWTP, develop a business case for procuring a new software system, and implement and train on a new CMMS system. Some of the additional asset management items that will investigated during the new CMMS project include the following:

- Condition scores on equipment
- Tracking PM:CM ratio
- Inventory
- Vibration analysis on equipment
- Predictive maintenance

As part of the interim solution until a new work order (WO) system/CMMS system can be implemented, staff is working on improving WO management and data accuracy and collection on WOs.

3.2.3 Risk Assessments

In 2018 CH2MHill completed a Reliability and Risk Assessment at the Water Treatment Plant. That work was the result of an after-action review from a water emergency in February 2017 which identified the need for a reliability and risk assessment to be performed on OWASA's water, wastewater, and reclaimed water systems. This project analyzed the most critical plant subsystems (as identified by OWASA staff) through a formal reliability and risk-analysis process. The main objective of the assessment was to develop and implement a plan following best practices that focused on operations and maintenance (O&M) strategies and the identification of potential capital projects to mitigate and manage risk of a system failure. A detailed risk register, a project management tool that identifies potential risks in an organization, came out of that report and the items and projects within that register have and will continue to be incorporated into the O&M and CIP programs at the WTP as appropriate. The risk register includes information about each identified risk, such as the nature of the risk, level of risk, who owns it and what the possible mitigation measures are. An example of the output from the risk register is shown below in Figure 18.

Risk No.	System	System Function	Risk Description	Treatment Plan	Risk Treatment Owner
W-R3	Electrical Distribution System	To feed electrical power to plant.	WTP electrical system - Configuration of the electrical power distribution system is complex due to 2300 and 480 voltage systems.	Phased capital project to eliminate 2300 voltage system, which would involve converting finished water pump 5 to 480 voltage.	Capital
W-R4	Electrical Distribution System	To feed electrical power to plant.	WTP electrical system - Various single-points of failure	Conduct component level PM identified in FMEA (gas in oil testing, thermographic survey, insulation test, turns ratio test, etc.)	O&M

Figure 18: Example of OWASA's Risk Register

Additionally, in 2020, OWASA staff started working on the requirements of the US Environmental Protection Agency's (USEPA) America's Water Infrastructure Act (AWIA) of 2018. This act requires all utilities serving over 3,300 people to conduct a risk and resilience assessment (RRA) and prepare subsequent emergency response plans (ERPs). Both the RRA and the ERPs will need to be reviewed, updated, and revised as necessary on a 5-year basis. OWASA shall submit its certification to the USEPA that the RRA and ERPs are complete by December 31, 2020 and June 30, 2021, respectively.

Furthermore, OWASA is planning to evaluate additional software that will help track assets and risks, such as the Innovyze InfoAsset Planner suite.

3.2.4 Critical Spare Parts

Staff is currently preparing a critical spare parts list for maintenance of essential equipment at the WTP. This process is driven by the current CMMS system and breaks down the treatment plant, pump stations, and tanks separately. The treatment plant is broken into sub-location of the treatment process, the major equipment is listed and then staff works with the Water Supply and Treatment Manager to determine the criticality of the different equipment and whether there are currently spares, enough spares, or if repair parts can be ordered quickly when needed. If equipment is deemed critical, the reason for the criticality is listed. Cost tracking is also included in this process. Critical spare costs are identified in the list so the Water Supply and Treatment Manager can adequately budget for critical spares in upcoming budget seasons. Additionally, contractors and vendors who are best suited to supply spares are also noted. This work is assisting with the overall risk and resiliency improvement initiatives and CIP projects going on at the Water Treatment Plant

All of these current activities support the following KPIs:

- Zero Primary and Secondary Drinking Water Violations
- Percent of Total Customer Hours with Water Service at 99.999%

3.3 Administrative Office and Operations Center Current Activities

3.3.1 Administrative Office Building and Operations Center

In 2020 improvements to the Administrative Office roof, pyramid skylight, and front entry skylight are all planned. The improvements consist of metal roof panels and interior ceiling panels. This new roof material is planned to be of sufficient strength for planned solar panels that will be added to the administrative building in late 2020. It is expected that the new roof will have at least a 25-year warranty. Solar panels are also expected to be constructed on the Operations Center Roof in late October 2020.

Additionally, there had been recent LED lighting improvements completed throughout the both buildings – Administrative Office and the Operations Center.

3.3.2 HVAC System Optimization

Since its installation in 2018, the Administrative Office HVAC system has undergone some significant optimization efforts to reduce energy consumption as well as optimize comfort for office staff. There have been changes in the control and maintenance items along with the preventative maintenance frequency.

3.3 Water Treatment Next Steps

3.3.1 Bulk Chemical Tank Inspection Checklist

In order to better predict future failures of tanks, a checklist and SOP to better inspect bulk chemical tanks will be implemented in the future.

3.3.2 Facility-wide valve maintenance program

OWASA is currently exploring a facility wide valve maintenance program at their treatment facilities. Staff is looking for best in class examples of other facility valve maintenance program but it is expected that the program will include identifying the critical valves for the treatment facilities. The critical valve inventory for the treatment facilities will be maintained in either the CMMS system or within GIS.

Information about the maintenance needed for proper operation, vendor information, as well as information about how the valve affects the overall treatment process would be collected and stored.

3.3.3 Updating Equipment Condition Scores

In the early 2010s, OWASA had completed an initial equipment inventory that included condition scores. However, since that time, many of the original condition scores have not been updated within the CMMS system. As such, OWASA is looking at opportunities to integrate updating condition scores within their current processes – such as during regular preventative maintenance activities or when corrective maintenance work orders are completed. A focus on updating condition scores could be prioritized based on critical equipment within the facility.

All of these future activities support the following KPIs:

- Zero Primary and Secondary Drinking Water Violations
- Percent of Total Customer Hours with Water Service at 99.999%

3.3.3 Monitoring Raw Water Pump Stations

OWASA currently utilizes the Specific Energy Software pumping analysis to track energy usage and optimization at the finished water pump station at the WTP, and in the future additional work is being completed to assess if the same software will provide benefits to the Cane Creek Raw Water Pump Station and the University Lake Pump Station.

4 Raw Water Transmission and Drinking Water Distribution System

4.1 Overview

OWASA's raw water is conveyed through approximately 14 miles of transmission pipes, and drinking water is conveyed through approximately 390 miles of distribution pipes. Transmission and distribution pipes range in size from 2- to 42-inches in diameter and pipe materials include cast iron, ductile iron, polyvinyl chloride (PVC), galvanized steel, copper, and asbestos cement. Figure 19 illustrates the water transmission and distribution system’s year of installation and material. Over 74% percent of the transmission and distribution system has been installed since 1971 for system expansion or replacement. The transmission and distribution system includes about 2,300 fire hydrants, 21,400 meters, and 13,100 valves.

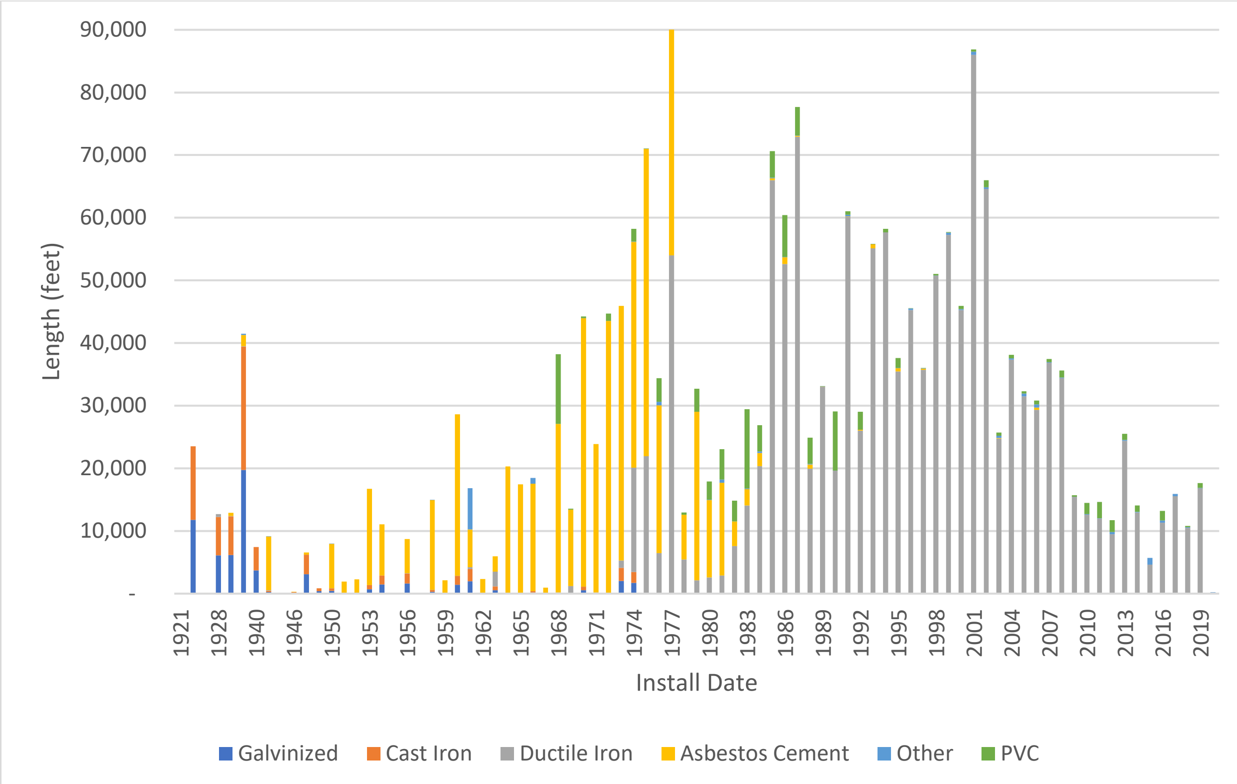

Figure 19:Raw Water Transmission and Drinking Water Distribution System Length of Pipe in Service by Installation Year and Type of Material (NOTE: Other includes CPP, concrete, brass, municipex, and unknown pipe materials as coded in GIS)

OWASA's inventory of transmission and distribution system assets stored in the GIS includes the following:

- Backflow assemblies
- Fire hydrants
- Fittings
- Meters
- Pipes
- Manholes
- Service laterals
- Valves and Blow-Offs

4.2 Current Activities

4.2.1 Surveying

OWASA staff completed a multi-year field verification effort in 2014 to improve the accuracy of the distribution system asset inventory. Within this effort, all distribution system assets were located and mapping grade global position system (GPS) equipment was used to document asset location and attribute information. Currently additional survey work using conventional survey techniques and NC Grid Coordinated is also ongoing to identify all visible assets in the distribution system.

4.2.2 Water Main Replacement Prioritization and Condition Assessment

OWASA has proactively replaced water mains since the 1980s, but the water main replacement program was enhanced in 2003 with the development of a risk-based prioritization model and has helped OWASA to reduce our main break rate by more than half over the past three decades. Figure 20 illustrates OWASA' historic break rate and main replacement rate since 1985.

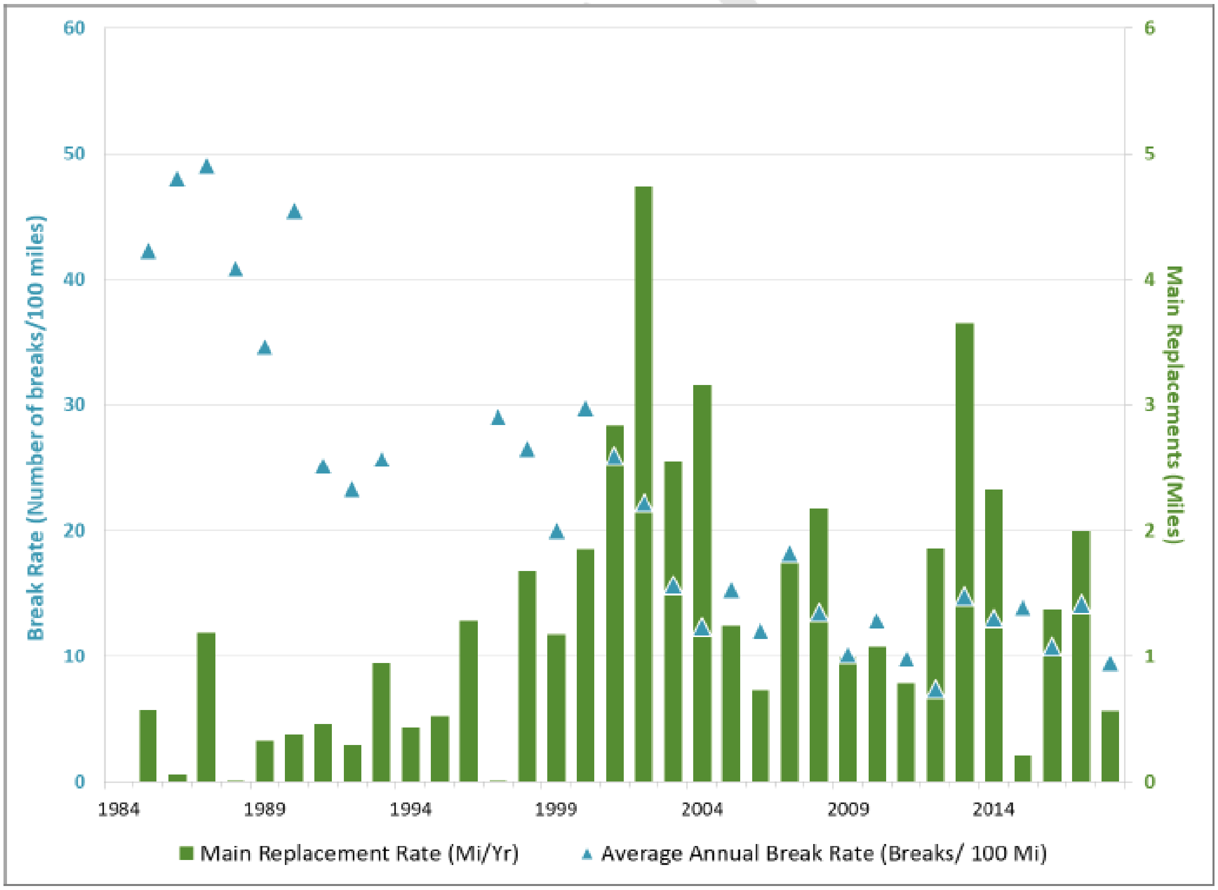

Figure 20: Historic Break Rate and Main Replacement Rate

Despite an overall reduction in break rates over the past several decades, additional work is being undertaken to improve the water distribution system management. This new program has developed a statistical analysis of historical pipe breaks to understand pipe deterioration drivers in the service area and determine potential future patterns. A new risk prioritization framework supports a dynamic risk model housed in GIS to support OWASA's decision process to prioritize the right pipes for renewal and replacement. Additional information on the specifics of the new prioritization framework and GIS model can be found in the Water Distribution System Management Program Technical Memo completed by HDR in 2020.

Additionally, a condition assessment program has begun for distribution system assets. OWASA is implementing an opportunistic condition assessment program as a means of gathering higher quality information on pipes to better understand the overall system condition. When a water main is exposed for any reason (service tap, break, valve replacement, main replacement, etc.), it provides a great opportunity to collect pipe and soil samples at a reduced cost since nearly 90% of the cost of condition assessment is due to accessing the pipe. Soil samples are being collected to understand the water main environment and potential causes of external corrosion. OWASA is currently testing for the following soil parameters within the opportunistic condition assessment frame work:

- Percent of Total Solids (%)
- Resistivity (ohms-cm)
- Chloride (mg/kg)
- Sulfate (mg/kg)
- pH

A GIS layer is being developed to track this information and identify where corrosive soils might exist within OWASA's service area. The soil data is being collected by OWASA staff responding to breaks and repairs as well as geotechnical consultants working on CIP projects and system development projects during the design phase.

Asbestos-cement pipe samples are also being collected as part of the opportunistic condition assessment program. Pipe samples are analyzed at an off-site laboratory using Scanning Electron Microscopy with Energy Dispersive X-Ray Spectroscopy (SEM/EDS). SEM/EDS lets us analyze the components of the AC pipe to see if calcium leaching, which causes weakening of the pipe, is occurring at various depths of the pipe wall. Samples results from breaks as well as taps/non-break situations are being trended to observe any correlations. An example of the SEM/EDS outputs is shown in Figure 21 and Figure 22. Figure 21 illustrates the SEM EDS output at different magnifications. The image on the left illustrates the cross section of the AC pipe with the **darker areas** indicating locations of more calcium leaching and therefore **less strength** and **less stability** in the pipe in those areas. The image on the right illustrates a closer magnification of the cross section of the pipe to take a closer look the "paste" of the AC pipe which is essentially the aggregate components of the AC components. The paste in this particular figure example illustrates a section of the pipe that is in good condition since there is not a lot of notable dark spots or rough areas. The following figure (Figure 22) illustrates the chemical output of the pipe cross section analysis. This chemical analysis illustrates if there has been any calcium leaching from the pipe which would cause a reduction of pipe strength. In this particular example there is little calcium identified in the pipe cross section, indicating that there has been previous calcium leaching and this pipe could have lost some of its strength.

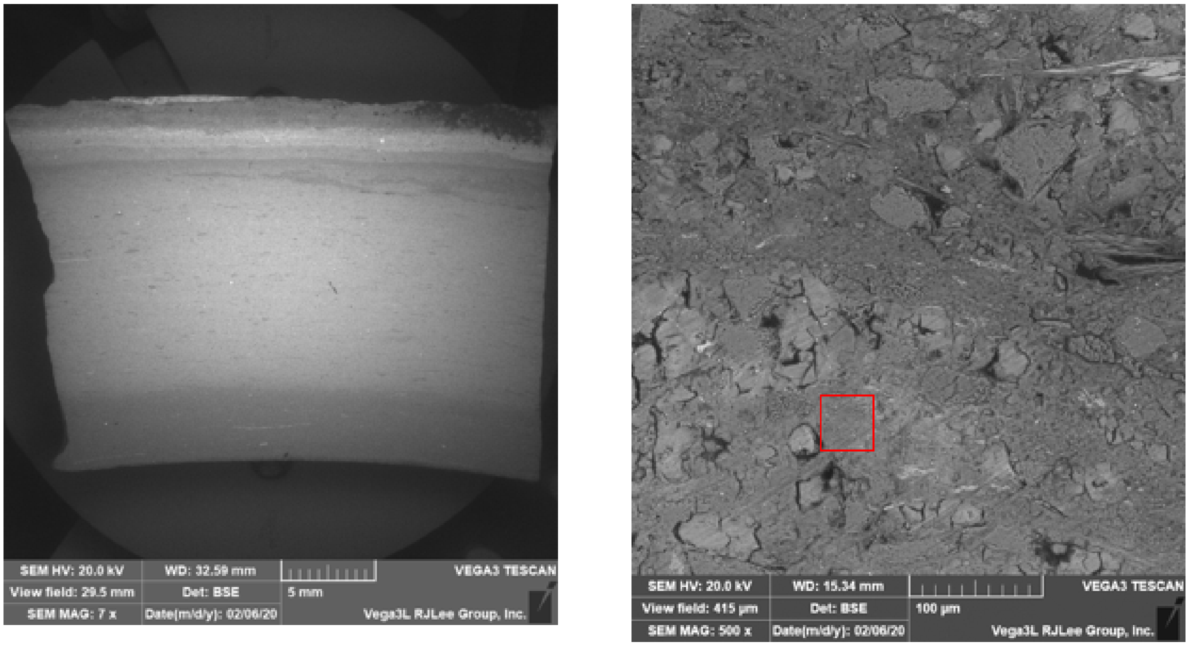

Figure 21: SEM/EDS Output

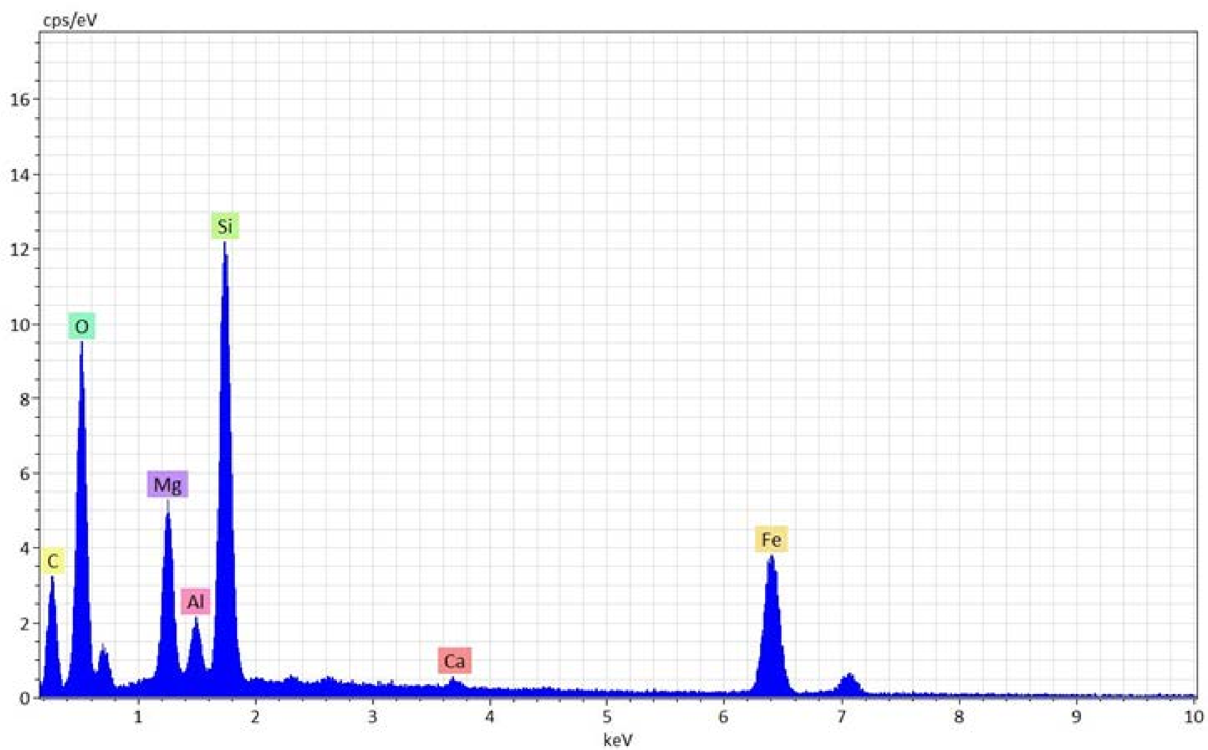

Figure 22: SEM/EDS Chemical Component Output

Results from the opportunistic condition assessment sampling are still being compiled to determine a baseline. It is the hope that in future years more samples will yield a range of data that can be used to determine future life expectancy of other AC pipes.

Proactive condition assessment, which is when the main is taken out of service for inspection prior to a failure, is currently being evaluated by OWASA. For proactive condition assessment, the methods and proprietary technologies for pressurized water main condition assessment have continued to advance in recent years but are generally very expensive to implement. OWASA has reviewed the state of available technology that might be appropriate for the pipe materials and sizes in the OWASA distribution system and is working on gathering information to begin a pilot test of one or more in-pipe technologies. The pilot would be aimed at assessing the benefit and programmatic investment in given technologies and how the data from in-pipe technologies could supplement data gaps about condition on high consequence of failure pipes. However, detailed discussions about implementation has revealed some logistical concerns including in-line valves and tapping locations for the insertion and extraction of the condition assessment tools. Additionally, the OWASA distribution system has relatively few candidate pipes for proactive condition assessment, and even fewer that would not pose a significant risk to the overall distribution system should the tool become stuck or need emergency extraction.

OWASA currently has a long-term framework and decision logic for the cost-effective use of proactive condition assessment to assess pipe risk and inform replacement decisions. However, at this time the CIP reflects a ramped approach to the use of proactive condition assessment, which starts with non-invasive condition assessment methods and then moves towards the use of in-pipe technologies with the expectation that logistical concerns will be addressed over time with the continued development of in-pipe technologies. The following two figures illustrate the condition assessment decision logic approaches for both metallic pipes and non-metallic pipes (Figure 23 and Figure 24).

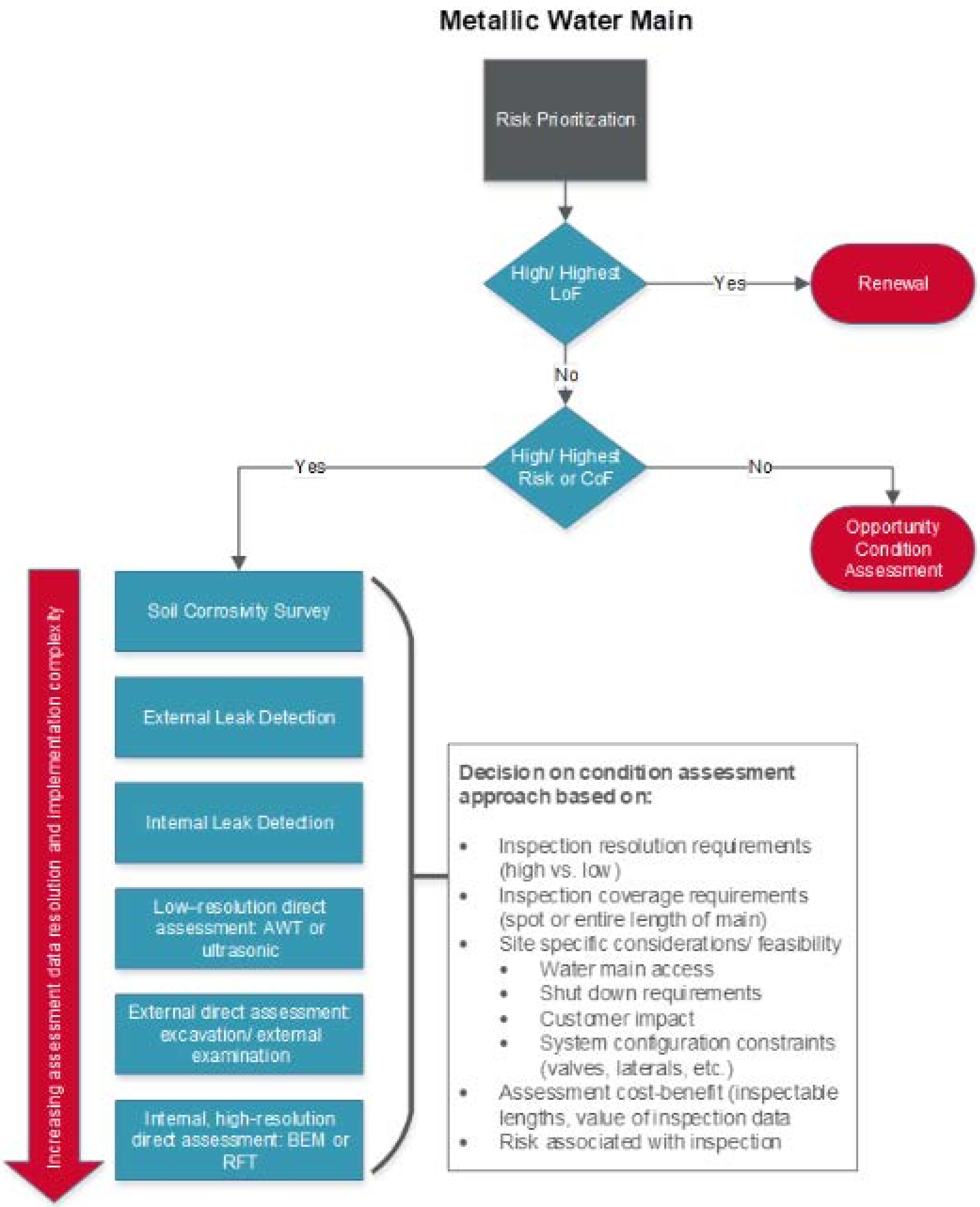

Figure 23: Metallic Water Main Condition Assessment Decision Logic

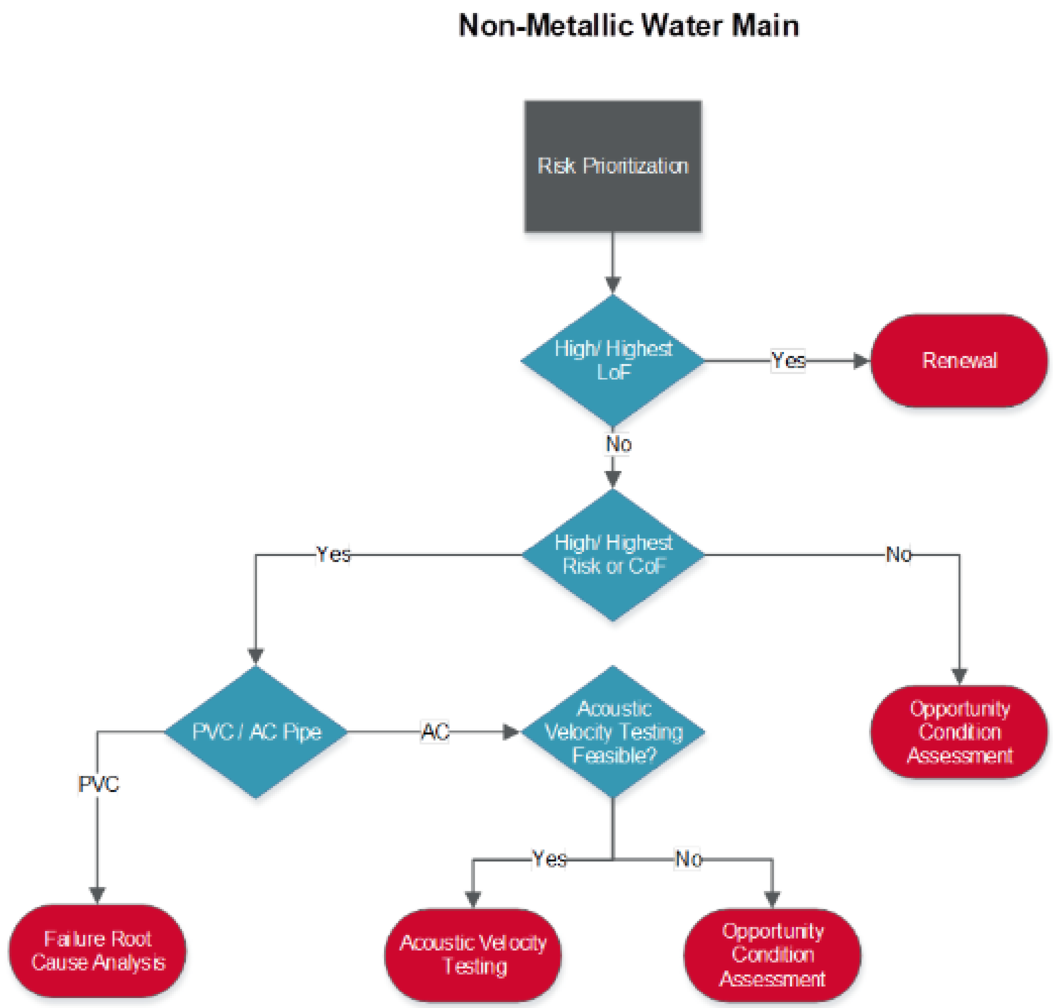

Figure 24: Non-Metallic Water Main Condition Assessment Decision Logic

Whether it is proactive condition assessment or opportunistic condition assessment, work order (WO) documentation is extremely important for the condition assessment program as well as utilizing the improved water distribution system risk prioritization model in GIS. OWASA has made great strides over the past year in improving WO documentation and accuracy as part of the improvements to the water distribution prioritization model. OWASA currently uses Cityworks for work order management with the distribution system. In 2019 OWASA staff performed a detailed review of the over 700 water main breaks that were captured by Cityworks, as well as previous work order management software as part of the water main prioritization project. This detailed review allowed break WOs that were not previously accurate to be best matched to the appropriate asset/pipe. The review used the available work order information including pipe diameter, pipe material type, and the comment field notes. The updated and accurate WO information was used in the updates of the water distribution system risk prioritization model and current work is ongoing to update the WOs in Cityworks to reflect the updated changes. Furthermore, additional fields have been added to water main related work orders in order to capture additional data in the field when crews have completed planned or emergency work. An example of the current template for the water main break Cityworks WO is shown in Figure 25.

Custom Fields

Category: Type of leak

DEPTH OF PIPE	3
TOTAL FOOTAGE REPAIR	1
# OF CUSTOMERS OUT OF SERVICE	2
HOURS OUT OF SERVICE	1
PLANNED WORK	No
# OF LANE CLOSURES	
TOTAL GALLONS FLUSHED	50
LOCATE TICKET #	
WATER MAIN BREAK	Yes
TYPE OF LEAK	Pin Hole
BOIL WATER ADVISORY	Yes
EXTERNAL CORROSION	GRADE 1
FORM OF CORROSION	Galvanic
POSITION OF FAILURE	Side
LOCATE WAS ACCURATE	N/A
FIRST RESPONDER ARRIVAL TIME	10:30
SEDIMENT CONTROL ARRIVAL TIME	N/A
ROOT CAUSE	AGE
VOLTMETER READING (mV)	0
COLLECTED SOIL SAMPLE?	No
PICTURE OF PIPE BREAK?	No
COLLECTED/LABELED PIPE SAMPLE?	No
VERIFY PIPE MATERIAL	Galvinized
VERIFY PIPE SIZE	2
PAVING REQUIRED?	NO
ENGINEERING REVIEWED?	Yes
ENGINEERING COMMENTS	All Correct - this line is slated for removal/rehab with C

Figure 25: Example Cityworks Custom Fields for Water Main Break WOs

OWASA currently has a valve maintenance and condition assessment program. This program was revamped in 2018 following a large water main breaks that was very difficult to isolate. Isolation valves are used during scheduled repairs and emergency repairs of mains to isolate the flow of water and enable staff to access the pipe to perform work.

A pipe break response tool has been developed to assist with improved response processes. The pipe break response tool was developed using a valve trace analysis, identifying all primary and secondary isolation valves for each water main and provide a visualization in an ArcGIS Online platform. The web platform provides OWASA field crews access to the tool for break response and repair planning. Figure 26 and Figure 27 show the interface and output from the break response tool.

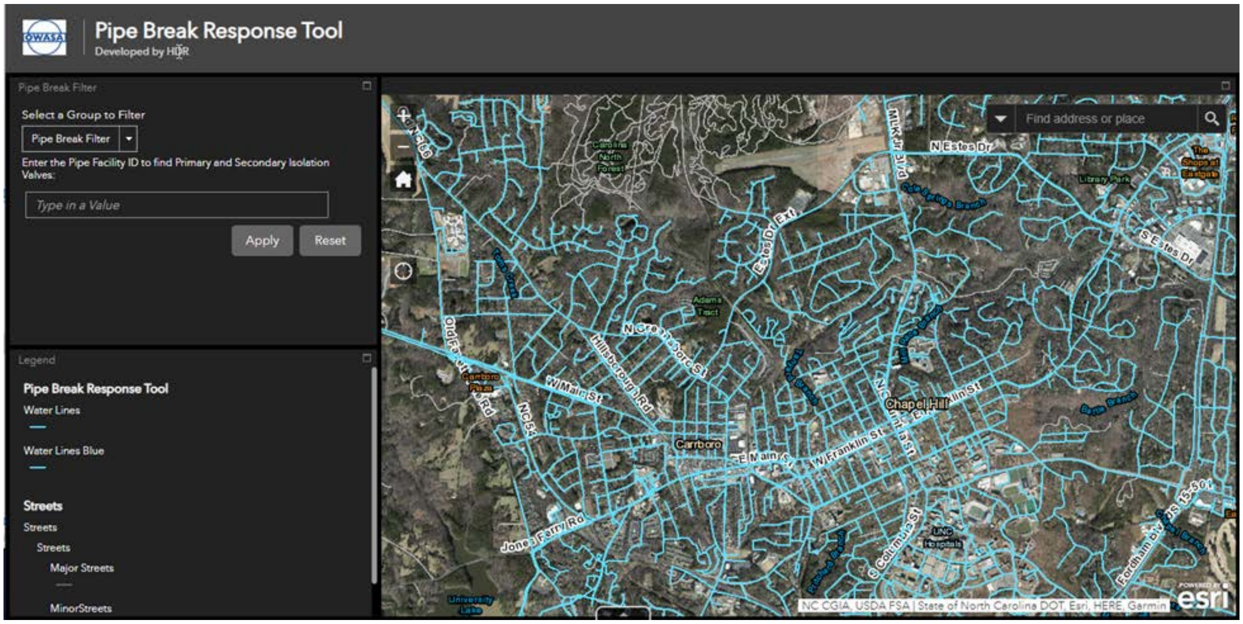

Figure 26: System Wide Pipe Network within the Pipe Break Response Tool

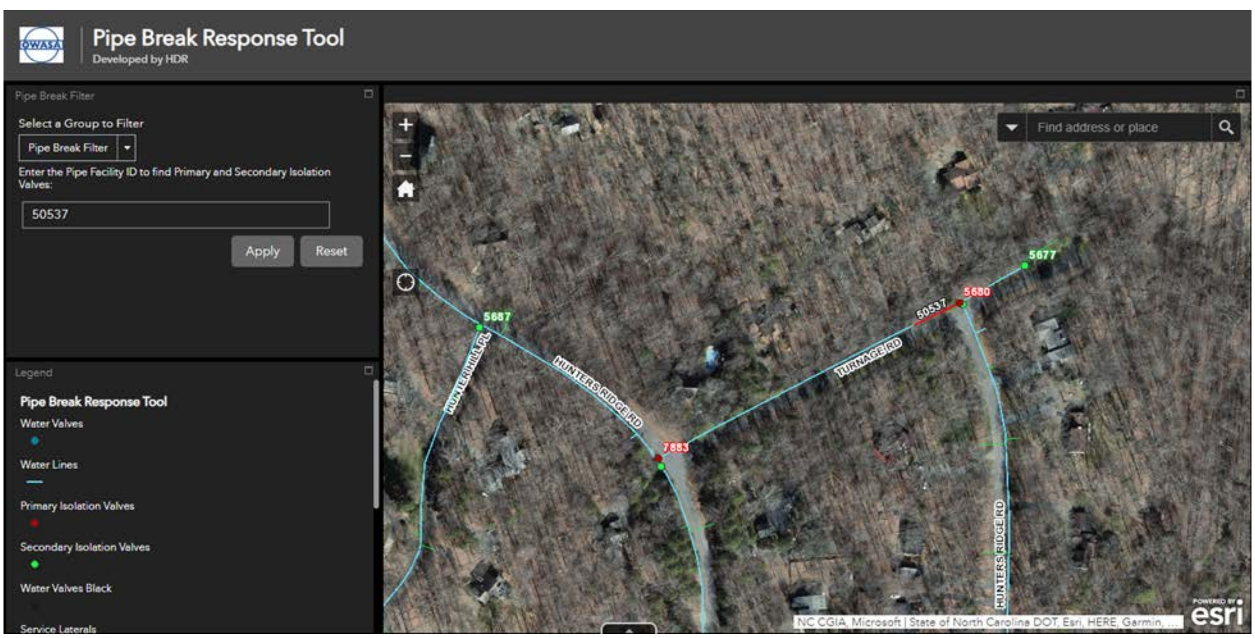

Figure 27: Primary (red) and Secondary (green) Isolation Valves Identified in the Pipe Break Response Tool

4.2.3 Valve Maintenance Program

The valve program focuses on making sure that our valves are operable and in good condition. The program provides that all critical valves are inspected annually and all valves within the distribution system are inspected at least once every 4 years. Critical valves are defined as any valve that is 12-inch or larger in the distribution system. The valve program uses a valve truck (E.H. Wachs) to help turn the valves in the distribution system to a specified number of turns based on the size of the valve as well as apply the required amount of pressure and torque without breaking tight valves. The distribution system team also has a trailer mounted valve machine that can be deployed in tighter locations or if the valve truck is already in use. An additional truck-mounted valve machine is also on order and is expected to arrive in FY2021. Additionally, the valve machines use a software called Vitals which is directly linked to the GIS system so all valve maintenance activities and inspection reports can be reported and saved into GIS directly to the valve asset being maintained. An example of the valve truck being used during the valve maintenance program is shown in Figure 28.

Figure 28: Valve Truck and Valve Crew in Action

To track the valves within the distribution system that still need maintenance, a GIS dashboard was developed. The dashboard provides an easy tool to track the progress of the valve crews and the overall progress of the maintenance program. The dashboard contains a map on one side showing the small and large valves remaining to be inspected (not previously inspected in the past 4 years if not a critical valve) and a chart showing the total monthly inspections for the year. The valve dashboard map shows the location of the valves still needing inspection so the valve crew leader can program the most efficient work orders to maximize valves completed in a day. A screen shot of the valve dashboard is shown in Figure 29.

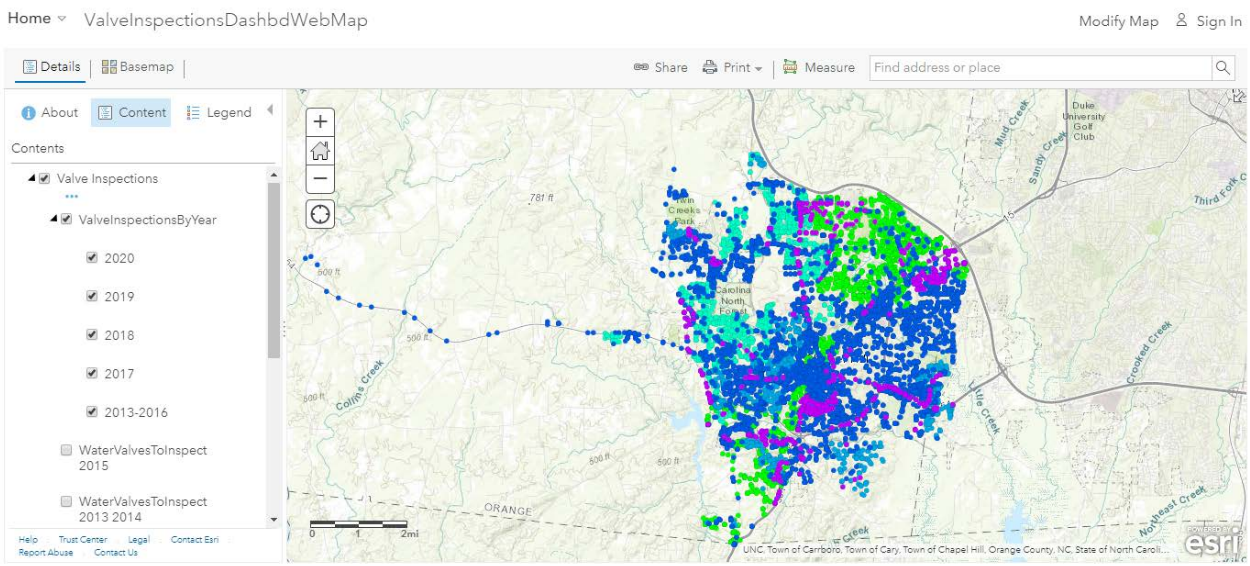

Figure 29: Valve Inspection Dashboard with All Recent Inspections Illustrated (Purple = 2020 inspections, Dark Blue =2019 inspections, Light Blue = 2018 inspections, Teal = 2017 inspections, Green = 2013-2016 inspections)

4.2.4 Critical Spare Parts

As part of the overall Water Distribution System Management Program, the critical water main repair spare parts inventory was reviewed. Based on the work completed, a majority of OWASA's water main repair spare parts inventory was sufficient based on the historic break data as a predictor of future annual water repair needs. However, there were a few gaps identified and some of those items will be budgeted with our Operating Budget in the upcoming year. Many of the gaps that were observed in the critical water main repair spare parts were for portions of the water system where OWASA has no history of water main breaks, such as the large diameter transmissions mains, or the spare parts were easily-procured new parts with a short turnaround time.

With evaluating critical water main repair spare parts recently, there was an opportunity to further enhance the warehouse operations at OWASA. Warehouse management through Cityworks Storeroom is one item also currently being worked on through the Asset Management Plan. Some of the best management practices for using Storeroom are being evaluated and tested with staff.

All of these current activities support the following KPIs:

- Water Sold to Water Produced KPI >92%
- Water Main Breaks KPI <8.7/100 miles
- Water Quality Customer Inquiries
- Primary and Secondary drinking Water Violations = 0
- Percent of Total Customers with Water Service >99.999%

4.3 Next Steps

4.3.1 Condition Assessment

In the upcoming years, OWASA plans to conduct a condition assessment pilot as part of the overall condition assessment program. This pilot will allow OWASA to better understand the remaining useful life of the inspected water main assets. OWASA is working on identifying the appropriate scope and priorities for a condition assessment pilot. A lower resolution inspection, such as general corrosivity and surface leak detection, as well as higher resolution assessments, such as those that can identify detailed defects in pipe walls, are both being considered. Additionally, different condition assessment techniques are going to be considered for metallic pipe versus asbestos cement pipe. There are few condition assessment techniques for asbestos cement pipe, so for the condition assessment pilot, OWASA has decided to focus on cast iron pipes. It is expected that the condition assessment pilot will start out at a small scale. OWASA will gain more experience with the program and then the proactive condition assessment work will expand.

4.3.2 Cross-Connection Control/Backflow Preventer Program

Additional improvements are planned for the backflow preventer and cross connection control program. Currently, BSI Online manages the backflow preventer cross-connection control program database for OWASA. This service company assists with sending reminder letters to the 3,182 customers that are known to have backflow preventers within the service area. These letters are sent approximately 30 days before the required annual inspection and testing, and approximately 30 days after a required inspection date has lapsed. The reminder letters include the information about the backflow preventer assembly, the name and phone number of who previously completed the testing, and options to reach out to OWASA if there are questions. If no response is received within 30 days, BSI sends a lapsed-inspection letter. The lapsed-inspection letter includes a restatement of the importance of maintaining backflow preventers, an additional 10 days to comply with the ordinance, and mention of non-compliance resulting in a water service disconnection or fines of up to $200 per day per violation. The lapsed-inspection letter also includes an OWASA contact for the Cross Cross-Connection Control Program as well as a link to OWASA's website on the importance of backflow prevention. As of February 5, 2020, OWASA has 560 backflow preventers out of compliance. To date, the practice has been to continue to send a lapsed inspection notice letter to the customer, but no other enforcement action has been taken. Many of those customers who are out of compliance have been issued many notification letters and have still not completed the required annual testing. Enforcement actions are mentioned in all the lapsed inspection notices sent to customers but without any action. Therefore, actions are going to be implemented to improve the overall compliance of the backflow testing and inspection program. Recommendations shall be proposed that are phased to allow our customers to fully understand the importance of the program. Recommendations will also provide sufficient time for customers to meet the requirements of the ordinance without becoming overly burdensome.

The distribution system is constantly changing due to re-development and new development of the service area, so continuous survey efforts are needed to ensure changes are captured and updated in GIS.

4.3.3 Hydraulic Model Update

OWASA plans to update the water distribution hydraulic model in the coming years. OWASA first developed a water distribution system model in 1982. The model was a "skeletonized" model including only 12-inch and larger transmission pies and key 8-inch diameter pipes in addition to pumping and storage facilities. The model was updated in 1992 and again in 2000 as part of the Comprehensive Water and Sewer Master Plan. OWASA began developing an "all pipes" distribution system a part of the Unidrectional Flushing Project completed in 2004. The project combined OWASA's GIS and the hydraulic model so all water pipes are represented in the model. The full pipe model was calibrated in 2006 under then-current demand conditions and long-range water demand projections were added to the 740-foot pressure zone. In FY 2011, long range water demand projections were added for the 642-foot pressure zone. The next upgrade to the model, planned for 2022, is expected to include the following items:

- Review existing information
- Update the model with pipes and pumps that have been installed or removed since the last major update in 2007
- Distribute demand projections and develop peaking factors for a 20-year planning period and for full system buildout
- Evaluate any pipe and booster pump station projects for water quality improvements and looping
- Evaluate the need for distribution system pressure sensors
- Evaluate the unidirectional flushing program

Lastly, OWASA is looking into in-house distribution system modeling. OWASA would be able to use their own staff to run distribution hydraulic models and various scenarios for CIP and system development questions and designs. This could potentially improve turn-around time on answering questions on distribution system capacity and hydraulic looping and connectivity issues, however this must be contrasted with the expense of training staff and procuring the necessary software to complete the modeling.

All of these efforts support the following KPIs:

- Water Sold to Water Produced KPI >92%
- Water Main Breaks KPI <8.7/100 miles
- Water Quality Customer Inquiries
- Primary and Secondary Drinking Water Violations = 0
- Percent of Total Customers with Water Service >99.999%

5 Collection System and Pump Stations

5.1 Overview

The wastewater collection system, also called the sanitary sewer system, includes approximately 335 miles of gravity sewer pipes ranging in size from 4- to 60-inches in diameter, of which almost 90% is 8-inch diameter pipe. Ductile iron and vitrified clay represent approximately 85% of pipe material by length, however the collection system also contains pipe materials such as cast iron, reinforced concrete, cured-in-place pipe (CIPP), PVC, and various other materials. Figure 30 illustrates the gravity sewer pipe's year of installation and material. The collection system also includes about 11,000 manholes installed on the gravity sewer pipes.

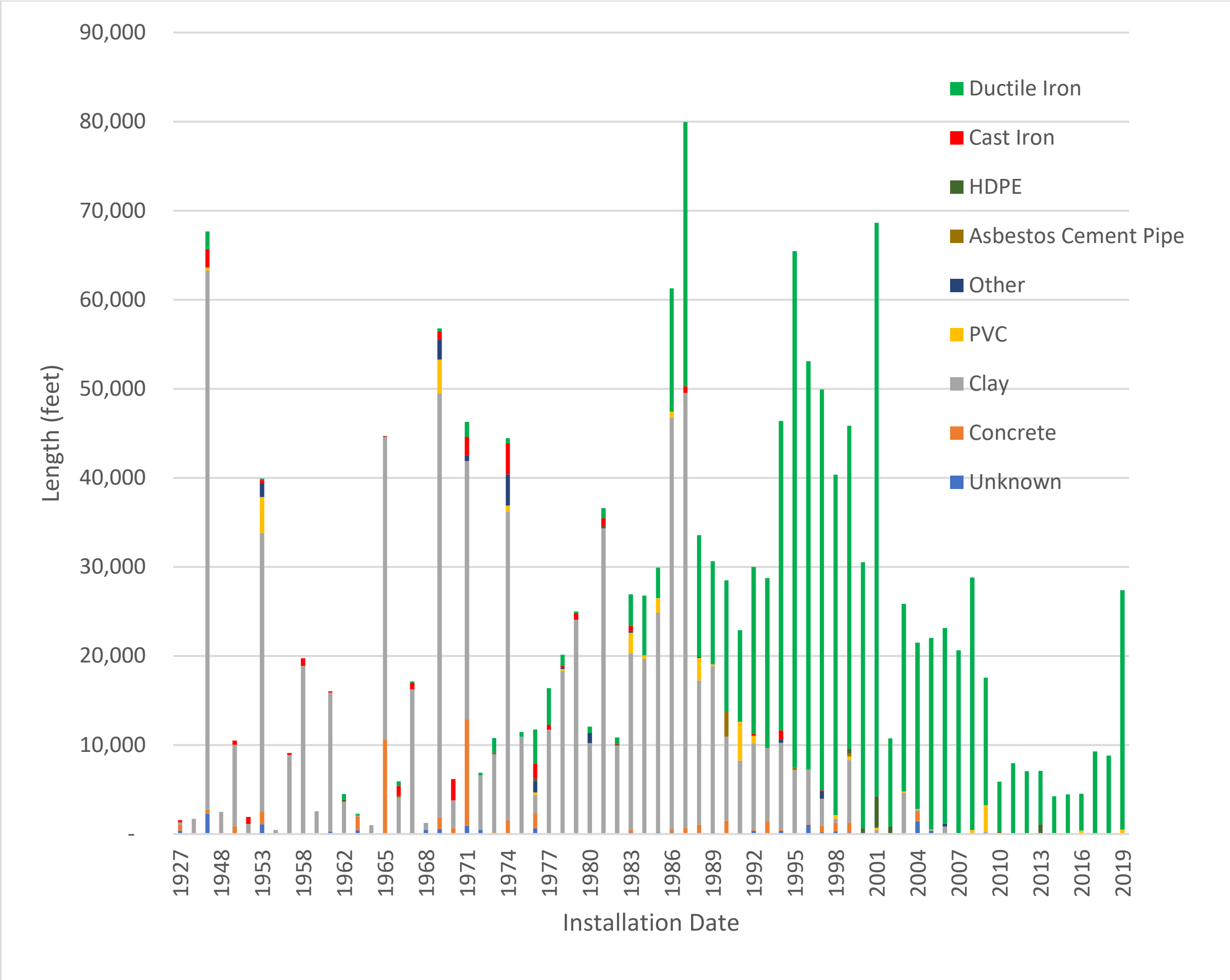

Figure 30: Gravity Sewer System Length of Pipe in Service by Installation Year and Type of Material

In addition to the gravity sewer pipes, there are 14 miles of pressurized sewer pipes, also called force mains, in the service area that convey pumped sewage. The pressurized sewer pipes vary in size from 2- to 48-inches in diameter and materials include PVC, ductile iron, cast iron, galvanized and asbestos cement. Figure 31 illustrates the pressurized sewer collection system's year of installation and material. Approximately 97% of the pressurized sewer pipes were installed since 1980 and 93% of these pipes are made of PVC and ductile iron.

OWASA's inventory of wastewater collection system assets stored in the GIS includes the following:

- Fittings
- Pipes
- Grease traps (privately owned)
- Manholes
- Valves
- Creek Crossings

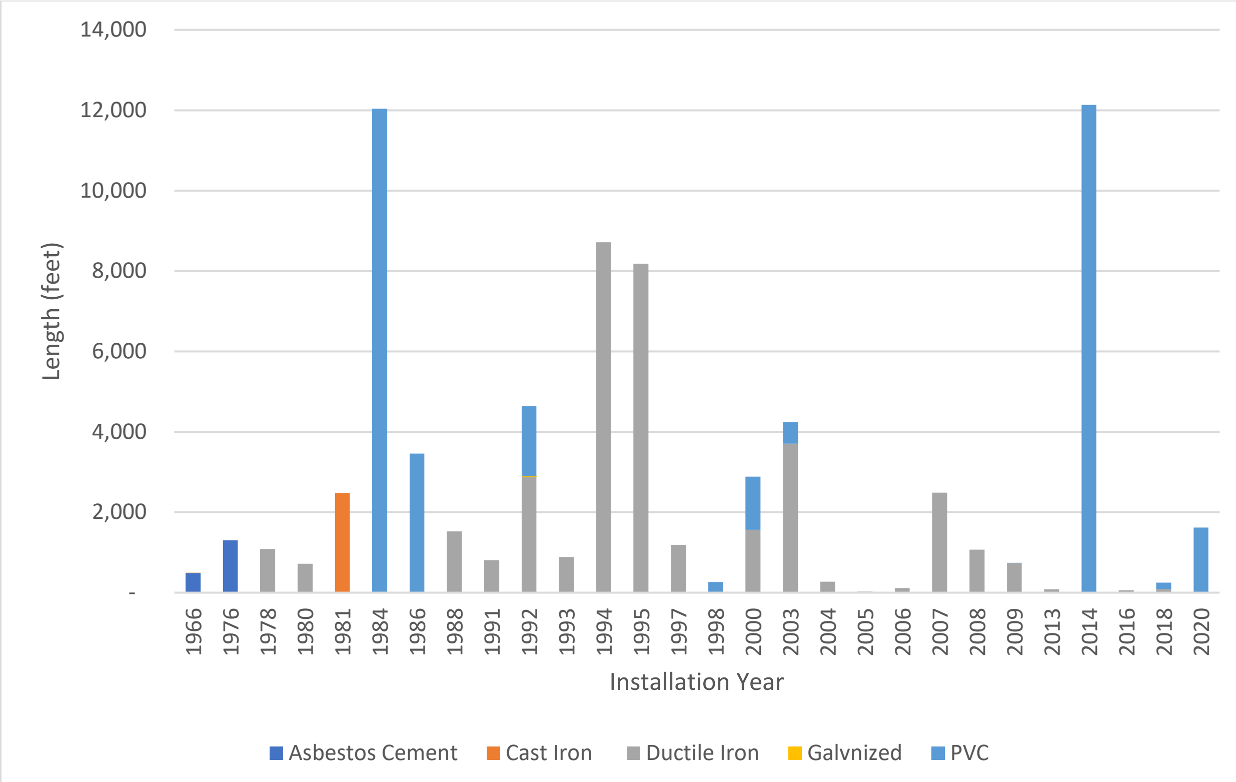

Figure 31: Pressurized Sewer System Length of Pipe in Service by Installation Year and Type of Material

5.2 Current Activities

5.2.1 Surveying

OWASA staff began a field verification effort in 2013 using conventional survey techniques based on NC grid coordinates to improve the accuracy of the collection system asset inventory. (collecting x-y coordinates and manhole rim elevations). All visible assets are surveyed as part of this staff-led effort. Figure 32 shows an example of the type of changes OWASA is making to the GIS as part of the field verification program.

Sewer Location as Shown in GIS Before Field Verification

Sewer Location Shown in GIS After Field Verification

Figure 32: Wastewater Collection System Field Verification

Staff is working diligently to survey the sewer collection system in its entirety however, this goal is prioritized among the other efforts that must be completed by staff. Also, note that COVID-19 impacted the progress of the survey starting in March 2020 when non-emergency surveying activities out in the field were stopped in order to promote social distancing and to enforce stay at home orders. Figure 33 illustrates the current progress of the collection system survey. At the current pace and current other workload for staff, it is anticipated that the entire collection system could be surveyed within the next four years.

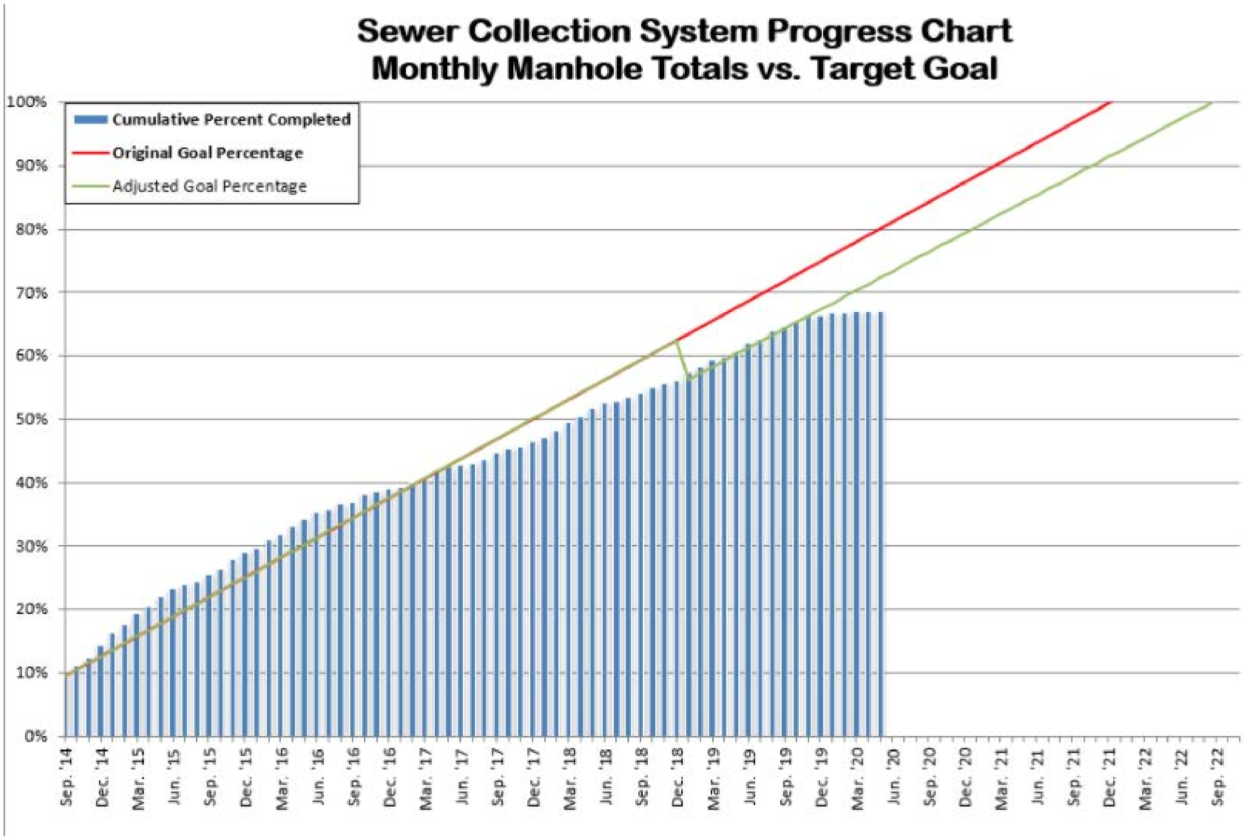

Figure 33:Collection System Survey Progress

In addition to manholes and the gravity sewer collection system, significant effort has been put into surveying the Rogerson Drive force main. This force main transports about 50% of the wastewater from OWASA's service area to the WWTP and has recently undergone an emergency repair and associated improvements (April 2018 -April 2019). As part of that project, staff surveyed the top of pipe elevations for new pipe being installed as well as the location of all bends and fittings.

5.2.2 Gravity Sewer Master Plan Update and Condition Assessment

In 2010 OWASA completed the Sanitary Sewer Service Area Study. The study involved the evaluation of the condition and the capacity of the wastewater collection system to provide inputs into the CIP plan. Approximately every 10 years, OWASA reevaluates the gravity sewer master plan using flow monitoring and modeling. In 2019 OWASA started the most recent gravity sewer assessment and it was finalized by CDM Smith in 2020. The main goals of the 2019/2020 assessment were as follows:

- Develop a calibrated hydraulic model
- Develop flow projections based on the latest development and planning information
- Identify areas where rainfall dependent inflow and infiltration (RDI/I) is entering the system
- Prioritize high RDI/I areas for evaluation and rehabilitation
- Identify and prioritize capacity and condition improvements for a 20-year planning period

The gravity sewer model currently runs with the 10-year dormant design storm with the following criteria to trigger recommended improvements:

- Surcharging within 3 feet from the manhole rim
- Surcharge more than 3 feet above the crown of the pipe
- Pipe more than 75% full during peak dry-weather flow
- Force main peak hour velocity > 8 ft/sec
- Pump station firm and total capacity
    - 2.5 times the ADWF meets firm capacity
    - Wet weather: peak 1-hour flow> firm capacity
    - Dry weather: peak 1-hour flow> firm capacity

Since the early 2000s OWASA has been working on sewer main condition assessments. Through a phased project, gravity sewers are given a condition and a criticality score representing the possibility of failure and the consequence of failure of each sewer pipe and recorded in GIS. Based on the score, there was a recommended course of action ranging from short-term and long-term reassessment to renewal projects. The course of action-based matrix is shown below in Figure 34.

		Criticality				
		1	2	3	4	5
Condition	5	Mid Priority Program Rehab	High Priority Program Rehab	High Priority Program Rehab	Highest Priority Action	Highest Priority Action
	4	Mid Priority Program Rehab	Mid Priority Program Rehab	High Priority Program Rehab	Highest Priority Action	Highest Priority Action
	3	Low Priority	Low Priority	Regular Monitoring	Frequent Condition Evaluation	Frequent Condition Evaluation
	2	Low Priority	Low Priority	Regular Monitoring	Frequent Condition Evaluation	Frequent Condition Evaluation
	1	Low Priority	Low Priority	Regular Monitoring	Regular Monitoring	Regular Monitoring

Figure 34: Recommended Course of Action for Gravity Sewer Mains Based on Condition and Criticality Ratings

Five phases of the project have been completed, to date (Phase 1, 2, 3, 4A, and 4B). Additional work is expected to occur in the future to continue to look at specific lines in mini-basins that have not yet been evaluated or were slated for short-term reassessment based on the criticality and condition matrix.

Based on the recommendations from the condition assessment, in conjunction with the gravity sewer hydraulic master planning and modeling efforts, OWASA staff is now focusing on more specific areas of the gravity sewer system which have been identified as needing potential rehabilitation. By focusing our closed circuit television (CCTV) and smoke testing efforts in specific mini-basins and sub-basins, additional improvements can be made to reduce infiltration and inflow (I/I) in our collection system. Staff responsible for the in-house CCTV program are now guided by the results from the engineering studies rather than working in a grid-type fashion across the service area, as was previously conducted.

Input from both the engineering studies along with staff recommendations from the in-house CCTV program are guiding the sewer rehab program at OWASA. CIPP lining, push patches, and manhole rehabilitation are some of the recommended improvements coming from the combined engineering and operations coordination to improve the sewer collection system. CIPP lining is contracted out to contractors through the CIP program, whereas push patches are completed in-house by staff. Both the lining and the push patches are now also being routinely inspected to ensure that OWASA is seeing the desired longevity of these rehabilitation techniques. Push patches have been used in the OWASA gravity collection system for about 5 years and this year was the first time they were re-inspected. The push patches were found to be in good condition and it is recommended that they should be reevaluated and re-inspected on a 5-year rotating basis to confirm the longevity for this rehabilitation solution.

OWASA also currently has a program for tree root control in the collection system. OWASA contracts with an experienced contractor to apply chemical treatment to clay sewer lines in locations where roots could pose a problem for the structural integrity of the piping or where roots could restrict the flow of wastewater through the pipe. The chemicals applied to the roots are registered by the US EPA for controlling nuisance tree roots in sanitary sewer line collections. OWASA maintains a database of which sewer lines receive treatment on a rotating basis and works with the contractor on an annual basis to make sure priority lines are treated. Not all clay lines in the collection system are treated annually. Emphasis is placed on clay lines which are most prone to roots or have experienced root problems in the past.

All of these current activities support the following KPIs:

- Collection System Operating Permit Violations = 0
- Sewer (reportable) Overflows = 0
- I/I Dashboard = Reduction in R-Values

5.3 What are the next steps

5.3.1 Collection System Monitoring

OWASA plans to implement real-time collection system monitoring in the future to assist with infiltration and inflow (I/I) issues and monitor the health and capacity of the collection system. Flow and rainfall monitoring is the key to maintaining a robust sewer hydraulic model and sewer condition assessment and rehabilitation program. The main goals of the real-time collection system monitoring program will be the following:

- Estimate the volume of I/I entering various sewer segments, sewer segments, drainage basins, and sub-basins
- Provide data for the capacity assessment of various sewer segments
- Predict and measure the effectiveness of sewer rehab for I/I reduction
- Provide modeling input data for system flow calibration and projections
- Identify sanitary sewer segments requiring additional inspections or analysis

A real-time collection system monitoring program is expected to consist of both permanent and temporary flow monitors in various locations around the service area as well as potentially additional rain gauges.

Micro-monitoring is being considered as an option for real-time collection system monitoring for I/I assessment. Micro-monitoring is a proven way to efficiently isolate I/I sources specifically within small diameter sewers where low flows are common and traditional flow monitoring practices are less efficient. Micro-monitoring takes only short durations per site to generate sufficient data and then the equipment can be moved to a new target location. This type of collection system monitoring could allow OWASA to monitor numerous locations with suspected I/I problems within one wet season.

5.3.2 Air-Release Valves

An air-release valve (ARV) program is also in development for force mains. The program would include the following goals:

- Ensure accurate inventory and GIS of all ARVs and associated force mains
    - Markers could also be placed in the field when locations are deemed important enough
- Ensure proper operation of ARVs and force mains to avoid failure
- Maximize pump capacity and reduce energy costs
- Avoid unscheduled maintenance to avoid sewage releases
- Ensure proper equipment and material selection and application
- Eliminate any unnecessary ARVs if possible
- Create prioritized approach to detailed ARV and force main assessments
    - Condition assessment should include photos of the ARV, component condition assessment scores, exercised isolation valves, and draining and testing ARV functionality

Upon completion of the program leaky, faulty, and non-functional ARVs would be replaced. Please note a similar ARV program will also be utilized on the distribution system assets.

5.3.3 Surveying

Addition survey work is also planned in the collection system as staff time and priorities allow. Collecting subsurface information such as manhole depths and inverts could be added to GIS for an additional layer of data for the collection system. Additionally, the collection system is constantly changing due to re-development and new development of the service area, so continual re-survey efforts will need to be ongoing.

5.3.4 Drones

Interest exists in using drones to better understand some of OWASA’s assets. While OWASA is already using drones for some of the land management activities and in the past has used them for inspection activities at the Wastewater Treatment Plant, OWASA may consider the use of drones in the future to look at sewer easements and manhole conditions. Other larger utilities are already leveraging drones and some even have their own drone departments. Drones could provide a quicker and potentially safer way of surveying the status of easements and looking for where easement conflicts (i.e. sheds or play structures) may occur.

5.3.5 In-House Sewer Modeling

Lastly, OWASA is looking into in-house sewer system modeling. OWASA would be able to use their own staff to run sewer hydraulic models and various scenarios for CIP and system development questions and designs. This could potentially improve turn-around time on answering questions on sewer capacity questions, however this has to be contrasted with the expense of training staff and procuring the necessary software to complete the modeling.

All of the above future work would support the following KPIs:

- Collection System Operating Permit Violations = 0
- Sewer (reportable) Overflows = 0
- I/I Dashboard = reduction in R-values

6 Wastewater Treatment and Biosolids Recycling

6.1 Overview

The Mason Farm Wastewater Treatment Plant treats approximately 8 MGD per day of domestic sewage from the Carrboro/Chapel Hill Community. Additionally, the WWTP also accepts and treats septage pumped from septic tanks serving the surrounding rural area. Furthermore, the WWTP is responsible for treating, storing, and pumping reclaimed water to customers within the service area. The WWTP also produces 3-4 dry tons of biosolids each day. Table 7 provides a summary of these assets. OWASA's inventory of individual assets located at these facilities is stored in the CMMS database. The database contains 3,958 mechanical, electrical, and structural assets for the wastewater system.

Table 7: Wastewater System Vertical Assets

Asset Type	Purpose	Count	Capacity
Wastewater Pump Stations (PS)	Pump wastewater from areas in the collection system where gravity flow is not feasible.	21	0.06-18.5 MGD
Wastewater Treatment Plant (WWTP)	Remove impurities from wastewater using biological, chemical and physical processes. Treated water is discharged to Morgan Creek or pumped into the reclaimed water distribution system.	1	14.5 MGD permitted capacity for max-month of flow, 43 MGD for short-term peak flow conditions
Reclaimed Water Storage Tank (at WWTP)	Store reclaimed water before pumping into distribution system.	1	0.60 MG
Reclaimed Water Pump Station (at WWTP)	Pump water into the reclaimed water distribution system to maintain flow and system pressure.	1	3 MGD
Remote Biosolids Storage Tanks	Store liquid biosolids during extended periods when land application is not possible.	2	0.9-1.5 MG

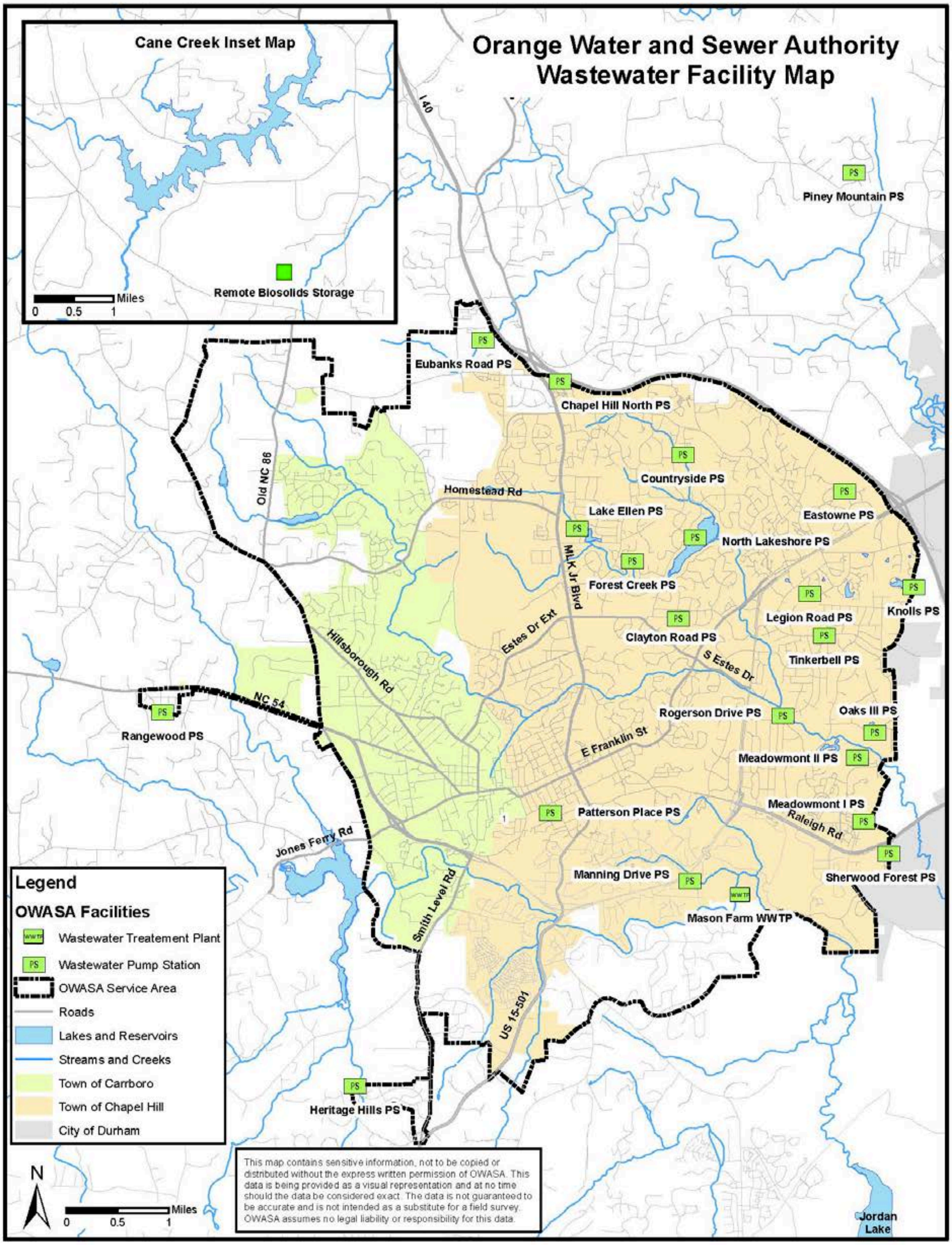

Figure 35: Wastewater System Vertical Assets

6.2 Current Activities

6.2.1 Computerized Maintenance Management System

OWASA has recognized the need to assess their current maintenance management practices at the water treatment plant for a potential new Computerized Maintenance Management System (CMMS). OWASA has used Infor's MP2 CMMS for WTP and WWTP facility maintenance functions for upwards of 20 years. Work is planned for the upcoming years to assess OWASA's current business process for maintenance management at the WTP and WWTP, develop a business case for procuring a new software system, and implement and train on a new CMMS system. Some of the additional asset management items that will investigated during the new CMMS project include the following:

- Condition scores on equipment
- Tracking PM:CM ratio
- Inventory
- Vibration analysis on equipment
- Predictive maintenance

As part of the interim solution until a new work order (WO) system/CMMS system can be implemented, staff is working on improving WO management and data accuracy and collection on WOs.

6.2.2 Risk Assessments

In 2018 CH2MHill completed a Reliability and Risk Assessment at the Wastewater Treatment Plant. That work was the result of an after-action review from a water emergency in February 2017 that identified the need for a reliability and risk assessment to be performed on OWASA's water, wastewater, and reclaimed water systems. This project analyzed the most critical plant subsystems (as identified by OWASA staff) through a formal reliability and risk analysis process. The main objective of the assessment was to develop and implement a plan following best practices that focused on operations and maintenance (O&M) strategies and the identification of potential capital projects to mitigate and manage risk of a system failure. A detailed risk register came out of that report and the items and projects within that register have and will continue to be incorporated into the O&M and CIP programs at the WWTP as appropriate. Please see Section 3.2.3 for a more detailed discussion of the risk register.

6.2.3 Critical Spare Parts

The WWTP currently maintains a critical spare parts list, but additional work is being conducted to expand and enhance the list. The list is being driven by the CMMS system and it is grouped by the different processes within the treatment plant. Each treatment process has a list of critical needs, as well as the reason for criticality. The list also identifies the availability of current spares and future actions needed for that treatment process (i.e. additional spare parts needed or if spare parts need to start being stocked). Cost is identified for the spares along with any applicable contractors who are responsible for spares. The cost information assists with development of the upcoming operating budgets. Spare parts that can easily be procured (within a day or so) are not typically identified to be kept on hand in order to reduce cost and storage requirements. For example, emergency power disconnects are not typically kept on hand since they can easily be gotten from any electrical store. The critical spare parts list assists OWASA with "what-if" scenarios for emergency situations. Currently the critical spare parts lists are complete for the wastewater pump stations, however the WWTP list is still in development.

These efforts currently support the following KPIs:

- NPDES Permit Violations = 0
- Wastewater Treatment Plant Odor Events = 0
- Biosolids Operating Permit Violations = 0

6.3 Next Steps

6.3.1 Bulk Tank Inspection Checklist

As with the water treatment plant, a standardized enhanced bulk tank inspection protocol/checklist will be employed at the WWTP. It is expected that this checklist will help provide better insight into potential future failures before they happen. This standardized bulk tank inspection protocol will go beyond coatings and tank wall thickness measurements. Additional details on the inspection checklist can be seen in the Water Treatment Plant Next Steps Section 3.3.1.

6.3.2 Facility wide valve maintenance program

See section 3.3.2 for more information on the upcoming facility wide valve maintenance program.

6.3.3 Updating Equipment Condition Scores

See section 3.3.3 for more information on the upcoming condition score efforts at the treatment facilities.

these future efforts would support the following KPIs:

- NPDES Permit Violations = 0
- Wastewater Treatment Plant Odor Events = 0
- Biosolids Operating Permit Violations = 0

7 Reclaimed Water System

7.1 Overview

The reclaimed water system consists of approximately five miles of ductile iron pipe ranging in size from 6- to 24-inches in diameter. A majority of the system was constructed between 2005 and 2011 and includes 137 valves and 11 meters. OWASA's inventory of reclaimed water system assets stored in the GIS includes the following:

- Backflow assemblies (privately owned)
- Fittings
- Hydrants
- Laterals
- Meters
- Pipes
- Manholes
- Valves and Blow-Offs

7.2 Current Activities

In 2014 and 2019 the reclaimed water system experienced some leaks. Both leaks occurred along a weld seam within a ROMAC coupling within a restrained flanged coupling adaptor. In 2019, an independent third-party assessment revealed that the weld seam failures occurred from the inside of the coupling, likely due to the result of internal corrosion and stress fracturing. It is thought that other restrained flanged coupling adaptors in the reclaimed water system may be experiencing the same failure conditions, and as such, OWASA is planning a project to replace all existing ductile iron restrained flanged coupling adaptors with steel counterparts, provide a more robust internal coating on new coupling adaptors installed, and provide additional support to the valve assemblies after the couplings have been replaced.

These efforts currently support the following KPIs:

- Reclaimed Water Operating Permit Violations = 0

7.3 Next Steps

In addition to the planned project to replace the restrained flanged coupling adaptors, a more thorough water valve condition assessment should be planned in the near future. This condition assessment should not just stop at valves, though, a thorough investigation of the overall reclaimed water system should be undertaken. This condition assessment will assist staff with better understanding of the potential future failures associated with the system and other replacement and rehabilitation projects that are needed in the future.

Additionally, since the reclaimed water system is now approximately 15 years old, OWASA needs to start planning for the overall renewal and replacement (R&R) of the infrastructure. The reclaimed water system is not currently part of our R&R model. The current R&R model is a deterministic forecast model that calculates and identifies the 20-year renewal and replacement funding demand for vertical and horizontal assets, with the exception of the reclaimed water system, based on asset age, asset condition, asset replacement value and useful life. As a result, in the coming years, an update of the R&R model will be needed with an additional module that includes the reclaimed water system to be developed so OWASA can continue to plan and fund for the replacement of portions of the reclaimed water system over time along with the other horizontal and vertical assets as they reach the end of their useful life.

These efforts would support the following KPIs:

- Reclaimed Water Operating Permit Violations = 0

8 Vehicles and Associated Equipment

8.1 Overview

OWASA owns 220 vehicles and associated appurtenances, and heavy equipment. Vehicles and equipment are used to maintain OWASA's water, wastewater, and reclaimed water systems and transport staff, equipment, and material. OWASA's inventory of vehicles and associated equipment is stored in the CMMS database. Table 8 provides a summary of OWASA's vehicles and associated equipment that are currently in use.

Table 8: OWASA Vehicles and Associated Equipment

Vehicle Category	Examples	Count
Pickup Trucks	All Trucks (1/4 to 2 Ton)	57
Vehicles	Vans, Sedans, Sport Utility Vehicles	9
Heavy Duty Vehicles	Road Tractors, Dump Trucks, Vacuum Trucks, CCTV Truck	12
Equipment	Tractors, Backhoe Loaders, Excavators, Forklifts, Mowers, Portable Generators, Spreaders, Tampers, Valve Machine, Pumps, Portable Jetters, Portable Valve Machines, Message Boards, ATVs	67
Trailers	Tanker Trailers, Trailers	37
Appurtenances	Emissions analyzers, air compressors, lifts	36
Boats	Patrol Boats	2
Total		220

8.2 Current Activities

Vehicle information is stored in MP2, where oil changes and other preventative maintenance needs are tracked along with costs. Additional corrective maintenance activities are also tracked in MP2.

OWASA also uses the University of North Carolina's (UNC's) fuel data tracking to identify which vehicles have been fueled, and the frequency and amount, however that data set is only useful for accounting purposes rather than tracking fuel efficiency.

8.3 Next Steps

Automated fleet vehicle tracking of additional parameters was evaluated in 2015 and at that time was found to not be worth the investment for OWASA. However, fleet vehicle tracking is back on the table as a future option for tracking vehicles for maintenance, efficiency purposes, and safety. Fleet vehicle tracking could monitor the following information:

- Date of travel
- Run Time (total)
- Mileage
- Engine Idle Run Time
- Location (heading)
- Speed
- Acceleration

Fleet tracking ideally would have the capability to automatically trigger corrective maintenance and preventative maintenance work orders. Corrective maintenance work orders could be triggered by the vehicle's check engine light and other potential error codes. Preventative maintenance work orders could be triggered by the vehicle's mileage and engine run time, if connected to the vehicle's on-board diagnostics system.

Overall equipment performance and reliability could also be tracked with fleet vehicle maintenance. This could provide better insight into replacement decisions and performance tracking.

Additionally, energy management goals could benefit from implementing fleet vehicle tracking by looking at fuel consumption and idling history to help minimize greenhouse gas emissions whenever possible.

9 Summary

The comprehensive asset management approach ensures the sustainable long-term operation, maintenance, replacement and expansion of OWASA's water, wastewater, and reclaimed water systems. The execution of the Asset Management Plan is a team effort with all departments within the organization playing a role in the success of the program. Prioritized goals have been identified for each of the operating departments and support departments (such as engineering) and are provided as appendices to this report. Overall the main goals of the plan are to prioritize projects that reduce risk, optimize maintenance and renewal opportunities, reinforce fiscal responsibility, utilize new technology when appropriate, and improve accurate data collection. Additionally, the asset management program is intended to be a continuous improvement process and the associated tools and practices, as well as goals, are frequently refined and improved.

The asset management plan will be updated annually at the start of each fiscal year. Based on reviewing implementation results of the planned asset management activities, any necessary adjustments will be made.

Appendices

A1 2020 Asset Management Action Plan – Distribution and Collection Systems

A2 2020 Asset Management Action Plan – Engineering

A3 2020 Asset Management Action Plan – Vehicle Maintenance

A4 2020 Asset Management Action Plan – Wastewater Treatment and Reclaimed Water

A5 2020 Asset Management Action Plan – Water Treatment

Appendix A1

Department	Action	Timeline to start/ continue~*	Priority (High, Med, Low)	Outcome/ Task Owner	Est. Cost	Est Timeframe to complete
Water Distribution	Evaluate Proactive Condition Assessment	Ongoing, Low risk in pipe technology pilot within the next year	High	Asset Manager	$	⧖⧖
	Update Water Main Risk Prioritization	Ongoing (update annually prior to CIP Development)	High	Asset Manager	$	⧖⧖
	Continue and Evaluate Valve Maintenance Program	Ongoing, Document key accomplishments every 5 yeas	High	Distribution and Collection Systems Manager	$	⧖⧖
	Continue Critical Spare Parts Inventory	Within the next year	Low	Distribution and Collection Systems Manager	$	⧖⧖
	Improve Backflow Preventer Program	Within the next year	High	**Distribution and Collection Systems Manager** Asset Manager	$	⧖⧖
	Update Hydraulic Model /Master Plan	Within the next 3 years	High	CIP Manager	$$$	⧖⧖
	Evaluate Improvements to Unidirectional Flushing Program	To Align with Hydraulic Model Update	Medium	**Asset Manager** Distribution and Collection Systems Manager	$$	⧖⧖
	ARV Inspection Improvements/ SOPs	Within the next year	Low	Distribution and Collection Systems Manager	$	⧖
	Inventory Management	Within the next year	Medium	**Distribution and Collection Systems Manager** Asset Manager	$	⧖⧖

	Evaluate leak Detection Technology and additional Pressure Monitors	Within the next year	Medium	**Asset Manager** Distribution and Collection Systems Manager	$	⌛⌛
Collection System	Complete Collection System Surveying	Ongoing but complete within the next 3-5 years, depths could be completed in the next 5-10 years	Medium	Systems Development Manager	$	⌛⌛⌛
	Complete CDM Master Plan Action Items Following items identified over the next 1-5 years: • Create policy on WTP discharge during rain events (**Asset Manager**) • Evaluate critical pipes that had previously been found to be in fair condition (**D&C Manager**) • Evaluate pipes that had been previously found to be in good condition (**D&C Manager**) • Check pipes in Table 6-1 for slope/reverse grade (**D&C Manager**) • Confirm manhole depths and inverts of identified problem areas (see Gravity Sewer Master Plan Action Item 2020 List, **D&C Manager**)	Within the next 1 to 10 years	High	CIP Manager Asset Manager Distribution and Collection Systems Manager	$$$$	⌛⌛⌛⌛

	• Rehab sewersheds 12, 23, 28 and 6(**CIP Manager**) • Raise or bolt MHs identified see Gravity Sewer Master Plan Action Item 2020 List, **D&C Manager** • Complete cobblestone drive area flow monitoring (**Asset Manager**) • Evaluate RDPS PER (**CIP Manager)**					
	Evaluate Pump Station Monitoring Strategies	Within the next year	Medium	Sustainability Manager Asset Manager	$	⌛⌛
	Begin Flow Monitoring for I/I Reduction	Within the next 2 years (Business Case within the next year Internal and external program -AM)	Medium	**Asset Manager** Distribution and Collection Systems Manager	$$	⌛⌛⌛
	Create SOP for ARV and Force Mains Inspections	Within the next year	Low	**Distribution and Collection Systems Manager** Asset Manager	$	⌛
	Evaluate potential for in-house sewer modeling	Within the next year	Medium	**CIP Manager** Asset Manager	$	⌛⌛
	Improve WO Data Quality	Ongoing	Medium	**Distribution and Collection Systems Coordinator** Asset Manager	$	⌛⌛
	Evaluate/Improve Root Control Program	Within the next year	Low	**Distribution and Collection Systems Manager** Asset Manager	$	⌛⌛

	Evaluate Current Sewer Line Cleaning and CCTV Program Efficiency (May include evaluation of condition assessment technology like SL-RAT)	Within the next year	Medium	**Asset Manager** Distribution and Collection Systems Manager	$	⌛⌛
	Complete Rogerson Drive PS and Force Main Survey and Locate Efforts	Within the next year	High	Asset Manager	$$$	⌛⌛⌛

*Depending on Funding and Staff Time Availability (subject to change)

~Year = Fiscal Year (July 1 through June 30)

Note that other action items that support the asset management plan may be captured by other plans such as the energy management plan and the forestry management plan and by typical operating tasks at the facilities and in the distribution and collection system.

Appendix A2

Department	Action	Timeline to start/ continue~*	Priority (High, Med, Low)	Outcome/ Task Owner	Est. Cost	Est Timeframe to complete
Engineering	Update R&R Model across organization	Within the next 2 years	High	Asset Manager	$$	⌛⌛
	Update Standards and Specs	Within the next year	High	Systems Development Manager	$$	⌛⌛
	Evaluate drones to track OWASA assets	Within the next 5 years	Low	Asset Manager	$	⌛
	Plan for Switch to ESRI Utility Network/GIS Master Plan (could include outside assistance)	Within the next 3 years	High	**GIS Coordinator** Asset Manager Planning Manager	$$	⌛⌛⌛
	Evaluate Innovyze Asset Planner	Within the next year	Medium	Asset Manager	$	⌛
	Create Treatment Facility Wide Valve Maintenance Program	Inventory valves within the next year, create program within the next 3 years	Medium	Asset Manager	$	⌛⌛⌛

*Depending on Funding and Staff Time Availability (subject to change)

~Year = Fiscal Year (July 1 through June 30)

Note that other action items that support the asset management plan may be captured by other plans such as the energy management plan and the forestry management plan and by typical operating tasks at the facilities and in the distribution and collection system.

Appendix A3

Department	Action	Timeline to start/ continue~*	Priority (High, Med, Low)	Outcome/ Task Owner	Est. Cost	Est Timeframe to complete
Vehicles/Equipment	Begin Tracking Fuel Efficiency	Within the next 2 years	Low	**Asset Manager** Sustainability Manager	$	⏳⏳
	Complete Equipment and Vehicle Condition Assessments	Ongoing	Low	**Asset Manager** Vehicle Maintenance	$	⏳
	Evaluate Automated Fleet Tracking	Within the next 2 years	Low	Asset Manager	$	⏳

*Depending on Funding and Staff Time Availability (subject to change)

~Year = Fiscal Year (July 1 through June 30)

Note that other action items that support the asset management plan may be captured by other plans such as the energy management plan and the forestry management plan and by typical operating tasks at the facilities and in the distribution and collection system.

Department	Action	Timeline to start/ continue~*	Priority (High, Med, Low)	Outcome/ Task Owner	Est. Cost	Est Timeframe to complete
Wastewater Treatment	Begin CMMS System Assessment/ Improvements	Within the next year	High	Asset Manager	$$	⧗⧗
	Complete Survey of any remaining underground utilities	Within the next year	Medium	Asset Manager	$	⧗⧗
	Create Process to Update Equipment Condition Assessment	Within the next 2 years	High	**Asset Manager** Maintenance Coordinator Maintenance Supervisor	$	⧗⧗
	Complete Critical Spare Parts Inventory	Within the next year	High	Maintenance Coordinator	$	⧗⧗
	Create SOP for Chemical Bulk Tank Inspections	Within the next year	Medium	**Asset Manager** Maintenance Supervisor	$	⧗⧗
	Improve WO data collection	Ongoing	High	**Maintenance Supervisor** Asset Manager Maintenance Coordinator	$	
	Create Organization Wide Valve Maintenance Program	**Inventory** valves within the next year, create program within the next 3 years	Medium	Asset Manager	$	⧗⧗⧗
	Concrete Condition Assessment	Ongoing	Medium	Maintenance Supervisor	$	⧗▪
	Building Envelope Condition Assessment (includes roofs)	Ongoing	Medium	Maintenance Supervisor	$	⧗▪
	HVAC Assessments	Ongoing	Medium	Maintenance Supervisor	$	⧗▪
Reclaimed Water	Begin Condition Assessment of Reclaimed Water Distribution System	Within the next year	High	**CIP Manger** Wastewater Treatment and Biosolids Manager	$	⧗⧗

				(communication with UNC) Distribution and Collection Systems Manager (coordination of the system)		
	Create Process for Updating Equipment Condition Assessments	Ongoing	Medium	**Asset Manager** Wastewater Treatment and Biosolids Manager	$	⌛⌛
Collection System	Evaluate Pump Station Monitoring Strategies	Within the next year	Medium	Sustainability Manager Asset Manager	$	⌛⌛▪
	Begin Flow Monitoring for I/I Reduction	Within the next 2 years (Business Case within the next year Internal and external program -AM)	Medium	**Asset Manager** Distribution and Collection Systems Manager	$$	⌛⌛⌛▪
	Continue PS Monitoring for I/I	Ongoing	High	**Asset Manager** Wastewater Treatment and Biosolids Manager	$	

*Depending on Funding and Staff Time Availability (subject to change)

~Year = Fiscal Year (July 1 through June 30)

Note that other action items that support the asset management plan may be captured by other plans such as the energy management plan and the forestry management plan and by typical operating tasks at the facilities and in the distribution and collection system.

Department	Action	Timeline to start/ continue~*	Priority (High, Med, Low)	Outcome/ Task Owner	Est. Cost	Est Timeframe to complete
Water Supply and Treatment	Complete Dam Inspections	Every 2 years	High	Water Supply and Treatment Manager	$	⌛
	Complete Cane Creek Raw Water Transmission Study	Within the next year	High	**CIP PM** CIP Manager	$$$	⌛⌛
	Complete Underground Asset Survey	Within the next 5 years	Medium	Asset Manager	$-$$	⌛⌛⌛⌛
	Begin CMMS System Assessment and Improvements	Within the next year	High	Asset Manager	$$	⌛⌛
	Complete Critical Spare Parts Inventory	Within the next year	High	Maintenance Coordinator	$	⌛
	Evaluate Pump Station Monitoring Strategies	Within the next year	Medium	Sustainability Manager Asset Manager	$	⌛⌛
	Improve WO data collection	Ongoing	High	**Maintenance Supervisor** Asset Manager Maintenance Coordinator	$	⌛⌛
	Update Process for Equipment Condition Assessments	Within the next year	High	**Asset Manager** Maintenance Coordinator Maintenance Supervisor	$	⌛⌛
	Create SOP for Chemical Bulk Tank Inspections	Within the next year	Medium	**Asset Manager** Maintenance Supervisor	$	⌛⌛
	Create Organization Wide Valve Maintenance Program	**Inventory** valves within the next year, create program within the next 3 years	Medium	Asset Manager	$	⌛⌛⌛
	Concrete Condition Assessment	Ongoing	Medium	Maintenance Supervisor	$	⌛

	Building Envelope Condition Assessment (includes roofs)	Ongoing	Medium	Maintenance Supervisor	$	⌛
	HVAC Assessments	Ongoing	Medium	Maintenance Supervisor	$	⌛

*Depending on Funding and Staff Time Availability (subject to change)

~Year = Fiscal Year (July 1 through June 30)

Note that other action items that support the asset management plan may be captured by other plans such as the energy management plan and the forestry management plan and by typical operating tasks at the facilities and in the distribution and collection system.