

Internal Monitoring Report

Policy #: O-2A Water Quantity

Monitoring Frequency: Annually

Date: October 27, 2020

Policy Language:

Current and future customers will receive water that meets or exceeds industry-accepted levels of service for fire protection and pressure.

This includes:

- 1. Water delivered to hydrants at proper flow rates for fire protection.*
- 2. Water delivered to the customer tap at a pressure that meets industry-accepted low, high, and emergency operation criteria.*
- 3. Water used for outdoor irrigation under drought-free conditions.*

General Manager's interpretation and its justification:

This Outcomes policy requires that MWU budget for, prioritize, plan for, design, and construct the necessary system improvements to provide adequate water quantity to all areas of the system. However, budget realities dictate that not all necessary system improvements are created equal. Therefore, MWU must identify and prioritize the list of required capital expenditures. The attached 2011 Level of Service Memo, developed as part of the East Side Water Supply project, established minimum standards for system supply, pressure, and fire protection capacity. These standards have guided system component design, evaluation, and expansion for the past 9 years. The Level of Service Memo formed the basis for broader, public facing, levels of service in the Utility's Strategic Asset Management Plan. Established Levels of Service form the basis for the Utility's key performance indicators (KPIs) that measure how well capital expenditures are addressing water quantity issues.

KPIs measure the performance of the system in relation to Levels of Service. If the system cannot consistently meet the Level of Service, operational and capital improvements are identified, planned, prioritized, budgeted and implemented. Asset Management processes manage utility risk. Capital projects are designed to reduce risk and improve overall performance. Projects are scored based on their value and the risk reduction they provide. The projects with the largest reduction in risk receive the highest priority score.

MWU is implementing an Asset Management Program that identifies the right project for the right price at the right time for the right reasons to sustain the established level

of service. For future capital expenditures and capital budgets, projects scored and prioritized will ensure a high return on investment.

A copy of the approved Water Utility 2020 – 6-year (2020-2025) capital budget is attached outlining planned capital projects to address identified deficiencies and growth areas. The 2020 capital budget was developed from the list of projects identified in the Water Master Plan, the East Side Water Supply Plan, the Infrastructure Management Plan, the Asset Management Plan and as defined by the Water Utility Board Water Quality Treatment Policy. Using current system characteristics, operational records, and project priorities, the capital project list is prepared and incorporated into the annual budget. The established methodology for asset management risk reduction prioritizes future CIP budgets.

A presentation of the Water Master Plan to the WUB at the end of 2020 will outline the latest comprehensive update. The Master Plan update implemented water use statistics based on AMI data and future water demand projections using updated census and development data. Using the MWU water distribution system computer model, deficiencies in supply, pump capacity, pressure, and fire protection capacity are identified and projects are developed to mitigate those identified deficiencies.

In 2017 MWU worked closely with GHD, Inc. to develop a strategic asset management plan (SAMP). The SAMP provides a policy and framework for how MWU will implement asset management. MWU and GHD have completed a well facility tactical asset management plan. This plan created a risk register for all well facilities as well as an investment profile for rehabilitation and maintenance for each well facility.

The next task of the overall asset management program is to develop a business case evaluation (BCE) process. A BCE provides a way to prioritize capital improvement projects. Other benefits of a BCE process include but are not limited to:

- A record of the issues identified and analysis performed to prepare and justify a project
- A framework for summarizing and reporting the results of the Project Validation, Risk Reduction, the Life Cycle Cost, and the Benefit/Cost for each project option considered
- A consistent way of receiving projects for consideration
- A basis for selecting the appropriate treatment option for a project
- A consistent way of considering and analyzing projects at a committee level, easily allowing comparison between projects
- Improved decision making based on operational data
- A structured way of presenting a project's justification to stakeholders
- Improved basis to justify decisions/recommendations to the Water Utility Board

Data directly addressing the General Manager's interpretation:

1. Water delivered to hydrants at proper flow rates for fire protection.

Minimum required fire flow capacity for the Madison system is established in Table 5 of the attached Level of Service memo. Results from fire flow field tests are compared to these criteria based on property zoning to identify areas of deficiency with respect to available fire flow capacity.

In 2017 the Insurance Services Office (ISO) gave the City of Madison a rating of 1 as a result of a 2016 firefighting system evaluation. The ISO rating includes ratings of the Fire Department, the Water Utility, and the 911 center.

Using the 2006 Water Master Plan as a guide, over the past 14 years, MWU has developed and implemented capital improvement projects to mitigate identified areas of fire flow deficiency. The most notable completed projects that benefit fire flow capacity include the Cannonball Pipeline project and Well 31. The current Water Master Plan update has updated the fire flow capacity map. The attached map, identified as Figure 2, illustrates areas of reduced fire flow capacity. Localized capital projects to mitigate identified fire protection deficiencies will be developed as the opportunity presents itself.

Projects identified to mitigate fire flow deficiencies require significant capital investment and are budgeted for and implemented over the course of several years. We have reported to the Board on fire flow capacity mitigation projects in previous reports as the projects were developed, budgeted, and implemented.

Areas of fire flow deficiency identified in the 2006 Water Master Plan and 2012 ESWS plan and mitigated in the Utility's Capital Improvement Program include but are not necessarily limited to: 1) Arbor Hills or Cannonball Pipeline; 2) Pressure Zone 4; 3) Lake View Pressure Zone 5; and 4) North Sherman Avenue commercial area.

Current status of these 4 areas of fire flow deficiency is as follows:

Arbor Hills:

Identified Need: A single 8" water main supplied the Arbor Hills Neighborhood. This situation resulted in limited water supply reliability and low fire flow capacity that did not meet the minimum level of service.

Identified Project Alternative: Review of several alternatives resulted in the recommendation to construct a booster pumping station and 16-inch transmission main between Zones 6 & 7 in the Arbor Hills area. The pump station delivers 1,000 gpm of supply from Zone 6W to Zone 7 and provides 2,000 gpm of reliable firefighting capacity to the Arbor Hills neighborhood.

Project Status:

All phases of the project are complete.

Results:

The Cannonball pipeline and BPS 118 system accomplished two main objectives. The transfer of water between Pressure Zone 6 and Pressure Zone 7, and the provision of increased fire protection capacity and improved drinking water supply system reliability to the Arbor Hills area.

Pressure Zone 4:

Identified Need: Well 9 was the only source of supply to Pressure Zone 4. This severely limited Zone 4 supply reliability and fire flow capacity in the southern reaches of Zone 4.

Identified Project Alternative: Construct a second well, pumping station and reservoir within Zone 4 to provide redundancy and improve fire protection. This work brings the southern portion of Pressure Zone 4 into compliance with MWU level of service standards.

Project Status:

Project complete.

Results:

Well 31 provides the required additional fire flow capacity and water supply redundancy to Zone 4 needed to bring it into compliance with the established utility level of service. The additional supply point and reservoir capacity provides the additional benefit of supporting time of day pumping. Only pumping at night when electric rates are lowest saves MWU money.

Lake View and Northport Drive Area - Pressure Zones 5 and 6E:

Identified Need: Pressure Zone 5 and the north end of Pressure Zone 6E had a storage deficiency that resulted in fire flow capacity deficiencies. Fire flow deficiencies were identified in Zone 6E around Northport Drive in the Green Avenue/Troy Drive area, on Packers Avenue, and near the Dane County Airport. In Zone 5 fire flow deficiencies have been identified around the Dane County Human Services building and throughout the Zone 5 residential area served by a system of 6-inch diameter pipe.

Identified Project Alternative: Provide additional gravity storage capacity with the construction of a two zone reservoir in 2016/2017. The 2020 capital budget request calls for an upgrade to the existing pumping station in the Lake View Park area beginning in 2025. The upgrade includes several pipe capacity

improvement projects within Zone 5. These improvements will bring the fire flow capacity and reliability of the supply system for Zones 5 & 6E into compliance with MWU standards.

Project Status: The new 300,000 gallon Zone 5 tank provides the necessary fire flow capacity and emergency backup supply for the area. The larger reservoir allows Zone 5 to be expanded improving service to residents on the top of the hill.

The lower tank has a capacity of 1,000,000 gallons for Zone 6E. The lower reservoir provides additional emergency water storage capacity, pressure stability, and operational flexibility.

Completed in late 2017, a new 16-IN diameter pipeline connecting Northport Drive with the new Zone 6E reservoir and the pumping station feeding Zone 5 improved hydraulic capacity. This additional hydraulic capacity benefits reservoir operations and improves fire flow capacity. A 12-IN diameter pipeline connection from Reservoir 313 to Esch Lane was also a part of this pipe project. The project provided a redundant connection to Zone 5 significantly improving system hydraulic interconnection to the north.

The existing water pumping station that fills the upper Zone 5 reservoir is in need of upgrade in conjunction with piping upgrades on Lake View Avenue and Sherman Avenue. A needed generator at BPS 213 will provide reliability to Zone 5 water supply. With the upgrade of the Lake View Booster Pumping Station, BPS 213, and the addition of a generator, Zone 5 fire protection will comply with MWU Level of Service requirements.

Results:

Replacing and enlarging the Zone 5 reservoir, adding a 1.0 million gallon reservoir to Zone 6E, and constructing a new 16" connection to Zone 6E have improved overall water system operation and reliability in the north part of the system. Upgrading BPS 213 and water transmission piping will bring the area into compliance with stated levels of service for fire protection capacity.

North Sherman Avenue commercial area:

Identified Need: There is an area of fire capacity deficiency in the commercial area around North Sherman Avenue, the Aberg Avenue area and around the closed Oscar Meyer plant.

Identified Project Alternative: Planned piping improvements will address fire flow deficiencies in the North Sherman commercial area.

Project Status: Well 7 was reconstructed and upgraded in 2015. The pumping station at Well 7 provides a capacity of approximately 3 million gallons per day

for normal operation and 3,500 gpm for fire protection. Well 7 has a 500,000 gallon ground level reservoir and a standby generator to provide reliable drinking water supply to the area.

To improve distribution system hydraulics and firefighting capacity, water transmission main projects will be developed to move water east, south, and north from Well 7. Pipe replacement projects that will upsize key pipe segments in the Aberg Avenue and Oscar Meyer Plant area will increase capacity and mitigate the identified fire flow deficiencies.

Results:

Upgrading Well 7 with a filtration system and VFD driven booster pumps improved water quality, station capacity, and provides operational flexibility to the system. The filtration system allowed Well 7 to become a major water supply point within Pressure Zone 6E. Well 7 is situated in the north central area of Pressure Zone 6E and provides an excellent hydraulic location for water supply to the north and east sides. Replacing key pipe segments will result in improved system hydraulics and will maximize the benefit of upgrading Well 7.

Hydrant and Valve Maintenance and Testing: MWU currently maintains approximately 9,284 hydrants in the system. Between September 2019 and August 2020, MWU crews inspected and serviced 5,772 hydrants as a part of the routine maintenance of the system. Throughout the year, crews repaired 124 hydrants and replaced 120 hydrants. MWU crews also service and maintain 15,591 system valves, 6,752 hydrant valves, and 4,021 service valves. Between September 2019 and August 2020 MWU crews inspected and turned 9,813 system valves as a part of routine maintenance of the system.

MWU works closely with Madison Fire Department to ensure firefighting capacity meets current and future needs. Hydrant flow testing of hydrants is performed as requested and recorded in the GIS database. From September 2019 to September 2020 MWU crews completed 34 requested hydrant flow tests. Other flow tests are also conducted by MWU crews during the course of routine maintenance and flushing operations.

Annually, the Utility's unidirectional flushing program systematically operates and exercises a significant number of the Utility's hydrants and valves. From September 2019 to September 2020 the 4 flushing crews unidirectionally flushed approximately 825 miles of pipe using 3,758 hydrants. In response to complaints and water quality concerns, MWU crews conduct some spot flushing. This program of hydrant maintenance and testing meets and exceeds WDNR requirements.

I report non-compliance with mitigation projects ongoing, budgeted, and scheduled.

2. *Water delivered to the customer tap at a pressure that meets industry-accepted low, high, and emergency operation criteria.*

The Utility receives very few low-pressure complaints. During the period from September 2019 to August 2020 MWU received 22 low-pressure complaints and 29 no water service complaints. The majority of these complaints were the result of service interruptions during construction, flushing operations, internal plumbing issues, or minor adjustments in system operation. Low-pressure complaints are investigated with the customer and typically resolved in a single service call.

See Table 2 of the attached Level of Service Memo pressure planning and design criteria. A query of the system indicated that approximately 293 fire hydrants indicate a static pressure reading above 100 psi. For areas with pressures greater than 100 psi, customer owned pressure reducing valves may be used on individual services to reduce pressures to acceptable levels.

High pressure areas are evaluated as to the feasibility of moving them to a lower pressure zone or creating another pressure sub-zone using system pressure reducing valves as opportunities come up. Maintaining adequate fire flow in the area will remain a prime objective in considering any changes to pressure zone boundaries.

Approximately 23 hydrants in the system recorded pressures below 35 psi. Over the past 10 years, MWU has successfully mitigated significant areas of chronic low pressure on the east side along I-90 and in the Bunker Hill area. The remaining few areas with low pressure are typically small and are located on the tops of hills or ridges and would be difficult to move to other pressure zones.

I report non-compliance with mitigation projects in progress and scheduled.

3. *Water used for outdoor irrigation under drought-free conditions*

During the 2019/2020 reporting period, Madison Water MWU was not required to and did not issue any irrigation restrictions due to water supply limitations within the system.

I report compliance.

Attachments:

1. 2020 City of Madison Water Utility approved capital budget
2. January 10, 2011 Level of Service Memo
3. Draft 2018 Master Plan Fire Flow Capacity Map Figure 2
4. Sections 4.2 and 4.3 of Madison Water Utility Strategic Asset Management Plan
5. Well Summary Sheet, Unit Well 11

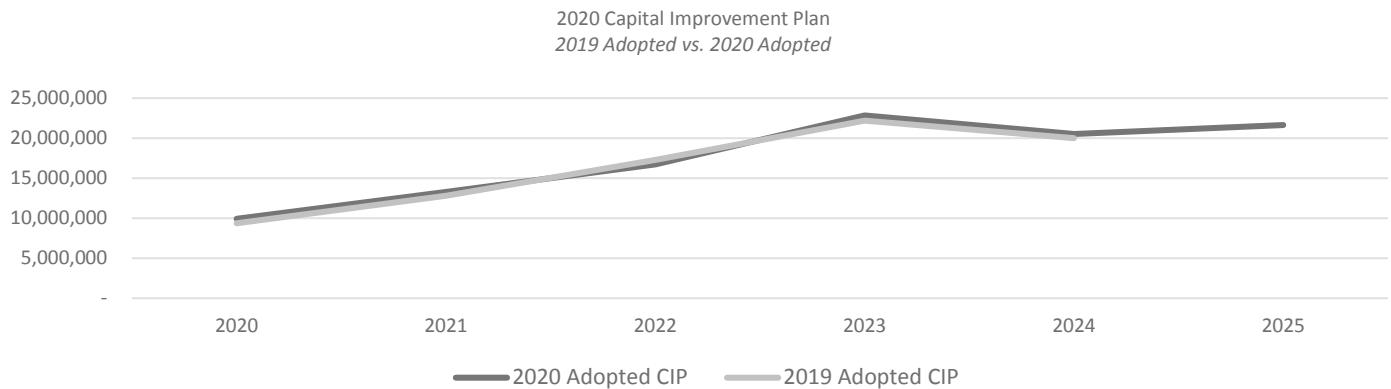
Water Utility

Capital Improvement Plan

Project Summary

	2020	2021	2022	2023	2024	2025
Booster Pump Station #128 Upgrade	-	-	-	92,000	440,000	-
Booster Pump Station #213 Lakeview Recons	-	-	-	-	-	238,000
Chlorinators & Florinators Program	31,000	32,000	33,000	34,000	35,000	36,000
Unit Well #15	-	82,000	16,000	16,000	16,000	16,000
Unit Well #8 Reconstruction	-	-	-	-	-	87,000
Unit Well 12 Conversion to a Two Zone Well	-	-	-	318,000	3,754,000	-
Unit Well Rehab Program	320,000	240,000	255,000	270,000	270,000	285,000
Water Hydrants Program	550,000	567,000	583,000	601,000	619,000	637,000
Water Mains - New	4,082,000	96,000	1,780,000	4,276,000	3,081,000	5,019,000
Water Mains Replace Rehab Improve - Paver	785,000	3,869,000	4,745,000	3,561,000	2,962,000	1,995,000
Water Mains Replace Rehab Improve - Pipe I	200,000	709,000	2,042,000	2,401,000	2,301,000	2,184,000
Water Mains Replace Rehab Improve - Recor	1,933,000	4,643,000	2,568,000	1,543,000	4,121,000	1,583,000
Water Meter and Fixed Network Program	650,000	666,000	683,000	700,000	718,000	736,000
Water Utility Facility Improvements	592,000	492,000	884,000	522,000	539,000	555,000
Water Utility Vehicles & Equipment	767,000	731,000	655,000	669,000	690,000	705,000
Water Valve Cut-In Program	15,000	16,000	16,000	17,000	17,000	18,000
Well 14 Mitigation	-	82,000	-	-	-	-
Well 19 Iron and Manganese Filter	-	891,000	81,000	6,691,000	-	-
Westside Water Supply	-	153,000	2,370,000	1,127,000	971,000	7,531,000
Total	\$ 9,925,000	\$ 13,269,000	\$ 16,711,000	\$ 22,838,000	\$ 20,534,000	\$ 21,625,000

Changes from 2019 CIP



Programs Added

- Chlorinators & Florinators Program: Program moved to Capital Budget from Operating Budget (\$0.2m)
- Unit Well Rehab Program: Program moved to Capital Budget from Operating Budget (\$1.64m)
- Water Hydrants Program: Program moved to Capital Budget from Operating Budget (\$3.6m)
- Water Meter and Fixed Network Program: Program moved to Capital Budget from Operating Budget (\$4.15m)
- Water Utility Vehicles & Equipment: Program moved to Capital Budget from Operating Budget (\$4.2m)
- Water Valve Cut-In Program: Program moved to Capital Budget from Operating Budget (\$0.1m)

Projects Added

- Westside Water Supply: Project added to CIP (\$12.15m)
- Unit Well #15: Project added to CIP (\$0.15m)
- Unit Well #14: Finance Committee Amendment 15 advanced funding for the Well 14 Mitigation projection from 2022 to 2021, and removed anticipated funding from 2023-2025 (-\$33,600)

Projects Removed

- Booster Pump Station #109: Project removed from CIP (\$3.1m)
- Booster Pump Station #129: Project removed from CIP (\$4.7m)

Water Utility

Budget Overview

2020 CIP by Expenditure Type

	2020	2021	2022	2023	2024	2025
Building	429,000	1,412,000	927,000	7,492,000	5,223,000	8,131,000
Machinery and Equipment	1,931,000	1,804,000	1,680,000	1,820,000	2,210,000	1,820,000
Water Network	7,565,000	10,053,000	14,104,000	13,526,000	13,101,000	11,674,000
Total	\$ 9,925,000	\$ 13,269,000	\$ 16,711,000	\$ 22,838,000	\$ 20,534,000	\$ 21,625,000

2020 CIP by Funding Source

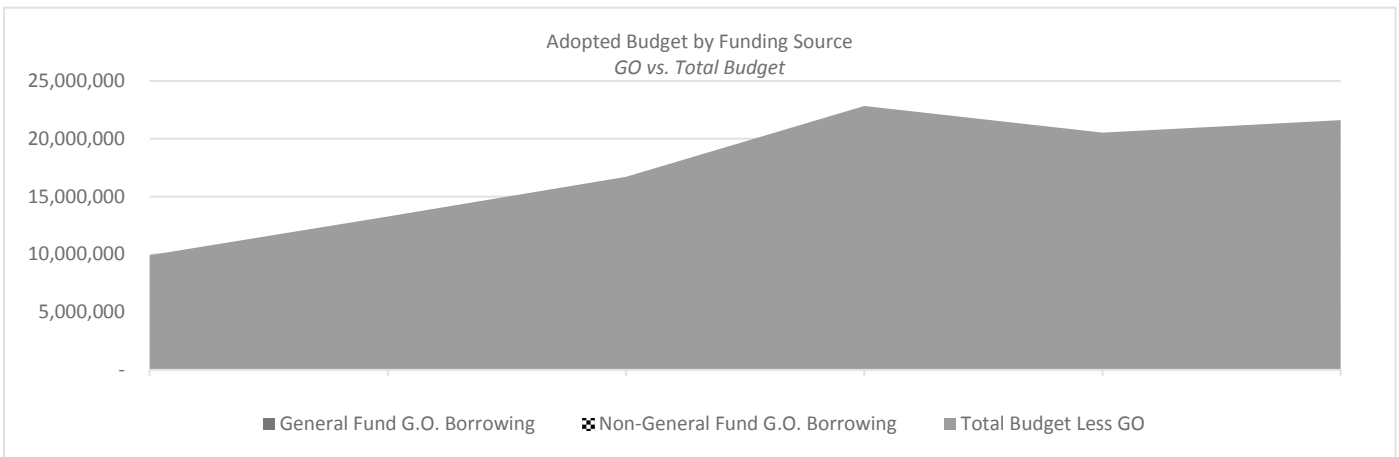
	2020	2021	2022	2023	2024	2025
Reserves Applied	2,333,000	2,252,000	2,225,000	2,291,000	2,349,000	2,417,000
Revenue Bonds	7,592,000	11,017,000	14,486,000	20,547,000	18,185,000	19,208,000
Total	\$ 9,925,000	\$ 13,269,000	\$ 16,711,000	\$ 22,838,000	\$ 20,534,000	\$ 21,625,000

Borrowing Summary

	2020	2021	2022	2023	2024	2025
Borrowing Schedule						
General Fund G.O. Borrowing	-	-	-	-	-	-
Non-General Fund G.O. Borrowing	-	-	-	-	-	-
Total	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Annual Debt Service

General Fund G.O. Borrowing	-	-	-	-	-	-
Non-General Fund G.O. Borrowing	-	-	-	-	-	-



Water Utility

Project Overview

Project Citywide Element **Booster Pump Station #128 Upgrade Green and Resilient** **Project # Project Type** **12442 Project**

Project Description

This project is for Booster Pump Station #128 pumping capacity upgrades. The goal of this project is to meet pumping demand on the far west side of the water system. Pump capacity will be increased to 2100 gallons per minute.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Revenue Bonds	-	-	-	92,000	440,000	-
TOTAL	\$ -	\$ -	\$ -	\$ 92,000	\$ 440,000	\$ -

Project Citywide Element **Booster Pump Station #213 Lakeview Reconstruction Green and Resilient** **Project # Project Type** **12441 Project**

Project Description

This project is for reconstructing the Lake View Booster Pumping Station. The goal of the project is to meet fire fighting requirements and expansion in Zone 5. A generator will also be added to ensure reliability of the pumping station in the event of a power outage. Pump capacity will be increased to 1200 gallons per minute.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Revenue Bonds	-	-	-	-	-	238,000
TOTAL	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 238,000

Project Citywide Element **Chlorinators & Florinators Program Green and Resilient** **Project # Project Type** **12386 Program**

Project Description

This program rebuilds and replaces chlorinator and florinator equipment on a 10 year replacement cycle. The goal of this program is to reduce failures and service interruptions for safe and reliable water. Progress will be measured by the frequency of equipment failure.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Reserves Applied	31,000	32,000	33,000	34,000	35,000	36,000
TOTAL	\$ 31,000	\$ 32,000	\$ 33,000	\$ 34,000	\$ 35,000	\$ 36,000

Project Citywide Element **Unit Well #15 Green and Resilient** **Project # Project Type** **12443 Project**

Project Description

This project is for studying options to treat the perfluorinated compounds (PFOS) at Unit Well #15. USEPA and WiDNR have not established a regulatory level for PFOS at this time, however the current health advisory level is 70 parts per trillion.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Revenue Bonds	-	82,000	16,000	16,000	16,000	16,000
TOTAL	\$ -	\$ 82,000	\$ 16,000	\$ 16,000	\$ 16,000	\$ 16,000

Project Citywide Element **Unit Well #8 Reconstruction Green and Resilient** **Project # Project Type** **12440 Project**

Project Description

This project is for reconstructing Unit Well #8. The goal of the project is to reduce iron and manganese levels via filtration upgrades and to expand capacity to a three zone well.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Revenue Bonds	-	-	-	-	-	87,000
TOTAL	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 87,000

Project Citywide Element **Unit Well 12 Conversion to a Two Zone Well Green and Resilient** **Project # Project Type** **10452 Project**

Project Description

This project is for rebuilding and expanding Well #12 located on South Whitney Way. The goal of the project is to provide water supply capacity to five existing pressure zones which represents the majority of the City’s west side.

The system flexibility provided by this project will improve service reliability and maximize water supply. Funding in 2023 is for design and funding in 2024 is for construction.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Revenue Bonds	-	-	-	318,000	3,754,000	-
TOTAL	\$ -	\$ -	\$ -	\$ 318,000	\$ 3,754,000	\$ -

Project Citywide Element **Unit Well Rehab Program Green and Resilient** **Project # Project Type** **12341 Program**

Project Description

This program is for the 10 year unit well upgrade projects as recommended by WiDNR. The goal of this program is to ensure that all unit wells are functioning at an efficient level and to reduce annual maintenance costs. Progress will be measured by reduction of maintenance costs, fewer unit well failures, and compliance with the 10 year schedule.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Reserves Applied	320,000	240,000	255,000	270,000	270,000	285,000
TOTAL	\$ 320,000	\$ 240,000	\$ 255,000	\$ 270,000	\$ 270,000	\$ 285,000

Project Citywide Element **Water Hydrants Program Neighborhoods and Housing** **Project # Project Type** **12385 Program**

Project Description

This program is for the annual raising, replacing and moving of water hydrants. The goal of this program is to maintain reliable service for fire suppression.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Reserves Applied	550,000	567,000	583,000	601,000	619,000	637,000
TOTAL	\$ 550,000	\$ 567,000	\$ 583,000	\$ 601,000	\$ 619,000	\$ 637,000

Project **Water Mains - New** **Project #** **12507**
Citywide Element **Green and Resilient** **Project Type** **Program**

Project Description

This program is for installing new water mains throughout the City. The goal of the program is to strengthen and expand the existing distribution system, improve water pressure, improve fire protection, allow transfer of water between pressure zones, and to serve the growing areas of the City. Newly installed mains include hydraulic improvements consistent with the Water Utility Master Plan. Planned projects in 2020 include: Cottage Grove Road, Treetops Drive, Feather Edge Drive, Felland Road, and Lien Road.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Revenue Bonds	4,082,000	96,000	1,780,000	4,276,000	3,081,000	5,019,000
TOTAL	\$ 4,082,000	\$ 96,000	\$ 1,780,000	\$ 4,276,000	\$ 3,081,000	\$ 5,019,000

Project **Water Mains Replace Rehab Improve -** **Project #** **11894**
Citywide Element **Pavement Management** **Project Type** **Program**
Green and Resilient

Project Description

This program is for replacing existing water mains in conjunction with the repaving of roads as part of the City's Engineering-Major Streets Pavement Management program. The goal of the program is to update the water infrastructure reducing the risk of pipe failure. The program aligns with the Water Utility's goal to replace or rehabilitate over 400 miles of aging pipe within the City over a 40-year period to renew and maintain the system. Planned projects in 2020 include: South Brooks Street, Hathaway Drive, Strathmore Lane, Greenwich Drive, Devon Court, Davenport Drive, and Glenbrook Circle.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Revenue Bonds	785,000	3,869,000	4,745,000	3,561,000	2,962,000	1,995,000
TOTAL	\$ 785,000	\$ 3,869,000	\$ 4,745,000	\$ 3,561,000	\$ 2,962,000	\$ 1,995,000

Project **Water Mains Replace Rehab Improve - Pipe Lining** **Project #** **11892**
Citywide Element **Green and Resilient** **Project Type** **Program**

Project Description

This program is for cured-in-place-pipe lining (CIPP) to improve the quality of existing pipes in the water network throughout the City. The goal of the program is to lengthen the useful life of the pipes at a lower cost than replacing the pipe. The program measures the miles of pipe rehabilitated using the lining method. Locations for CIPP lining are evaluated on an annual basis.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Revenue Bonds	200,000	709,000	2,042,000	2,401,000	2,301,000	2,184,000
TOTAL	\$ 200,000	\$ 709,000	\$ 2,042,000	\$ 2,401,000	\$ 2,301,000	\$ 2,184,000

Project	Water Mains Replace Rehab Improve - Reconstruct Streets	Project #	11893
Citywide Element	Green and Resilient	Project Type	Program

Project Description

This program is for replacing existing water mains in conjunction with the reconstruction of roads as part of the City's Engineering-Major Streets Reconstruct Streets program. The goal of the program is to update the water infrastructure diminishing the risk of pipe failure. The program aligns with the Water Utility's goal to replace or rehabilitate over 400 miles of aging pipe within the City over a 40-year period to renew and maintain the system. Planned projects in 2020 include: West Towne Path, South Gammon Road, Gregory Street, Cross Street, Copeland Street, Western Avenue, Dunning Street, Jackson Street, Lafollette Avenue, Rethke Avenue, Dean Avenue, Allis Avenue, Tvler Circle, Seth Circle, and Rockstream Drive.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Revenue Bonds	1,933,000	4,643,000	2,568,000	1,543,000	4,121,000	1,583,000
TOTAL	\$ 1,933,000	\$ 4,643,000	\$ 2,568,000	\$ 1,543,000	\$ 4,121,000	\$ 1,583,000

Project	Water Meter and Fixed Network Program	Project #	12340
Citywide Element	Green and Resilient	Project Type	Program

Project Description

This program is for the water meter and fixed network advanced metering infrastructure (AMI) improvements. The program identifies projects via the State Public Service Commission (PSC) requirement for a prescribed schedule of meter replacement and testing. The goal of the program is to maximize the accuracy of the municipal services statements issued to customers. Progress will be measured by comparing the meter maintenance against the respective prescribed schedules as well as monitoring the total non-revenue water volume.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Reserves Applied	650,000	666,000	683,000	700,000	718,000	736,000
TOTAL	\$ 650,000	\$ 666,000	\$ 683,000	\$ 700,000	\$ 718,000	\$ 736,000

Project	Water Utility Facility Improvements	Project #	10440
Citywide Element	Green and Resilient	Project Type	Program

Project Description

This program is for repairing and upgrading Water Utility facilities. The goal of the program is to maintain the facilities for reliable service and reducing emergency repairs. Progress is measured by tracking the number of emergency calls, facility outages, and accidents each year. Funding in 2020 is for variable frequency drive (VFD) and flow meter installations.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Revenue Bonds	592,000	492,000	884,000	522,000	539,000	555,000
TOTAL	\$ 592,000	\$ 492,000	\$ 884,000	\$ 522,000	\$ 539,000	\$ 555,000

Project Water Utility Vehicles & Equipment **Project #** 12339
Citywide Element Green and Resilient **Project Type** Program

Project Description

This program is for the annual vehicle and equipment replacements and additions. Replacement schedules are based on age and mileage of the vehicles and equipment. The goal of this program is to provide reliable vehicles and equipment for Water Utility’s operations. Progress will be measured by the frequency of vehicle breakdowns and actual useful life obtained. In 2020 a dump truck, service truck, backhoe, and three service vehicles will be purchased.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Reserves Applied	767,000	731,000	655,000	669,000	690,000	705,000
TOTAL	\$ 767,000	\$ 731,000	\$ 655,000	\$ 669,000	\$ 690,000	\$ 705,000

Project Water Valve Cut-In Program **Project #** 12387
Citywide Element Green and Resilient **Project Type** Program

Project Description

This program is for installing new valve cut-ins to the existing water infrastructure. The goal of this program is to eliminate areas of the city where water service is negatively impacted during water system maintenance and repair. Success is measured by a reduction in complaints from customers for impacted service.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Reserves Applied	15,000	16,000	16,000	17,000	17,000	18,000
TOTAL	\$ 15,000	\$ 16,000	\$ 16,000	\$ 17,000	\$ 17,000	\$ 18,000

Project Well 14 Mitigation **Project #** 11900
Citywide Element Green and Resilient **Project Type** Project

Project Description

This project is for improvements to reduce chloride concentration levels at Well 14 on University Avenue near Spring Harbor. Due to winter road salt operations on University Avenue and the surrounding neighborhoods, chloride levels in the water pumped from Well 14 have been rising for several years.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Revenue Bonds	-	82,000	-	-	-	-
TOTAL	\$ -	\$ 82,000	\$ -	\$ -	\$ -	\$ -

Project Well 19 Iron and Manganese Filter **Project #** 10448
Citywide Element Green and Resilient **Project Type** Project

Project Description

This project is for a new iron, manganese, and radium treatment system at Well 19 located on Lake Mendota Drive or the City’s west side. The goal of this project is to improve water quality in the area. Progress will be measured by the change in iron, manganese, and radium concentrations, which currently do not meet Madison Water Utility standards. Funding in 2023 is for construction.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Revenue Bonds	-	891,000	81,000	6,691,000	-	-
TOTAL	\$ -	\$ 891,000	\$ 81,000	\$ 6,691,000	\$ -	\$ -

**Project
Citywide Element**

**Westside Water Supply
Neighborhoods and Housing**

**Project #
Project Type**

**12439
Project**

Project Description

This project is for developing a new source of supply on the far west side of the system. Water demand projections indicate that there will be a supply deficiency on the far west side of the system by 2029 as the area develops. Funding in 2021-2022 is for project planning, 2023 is for water network improvements, and 2024-2025 is for a well construction.

Project Budget by Funding Source

	2020	2021	2022	2023	2024	2025
Revenue Bonds	-	153,000	2,370,000	1,127,000	971,000	7,531,000
TOTAL	\$ -	\$ 153,000	\$ 2,370,000	\$ 1,127,000	\$ 971,000	\$ 7,531,000

Water Utility

2020 Appropriation Schedule

2020 Appropriation

Adopted Budget

	Request	Executive	GO Borrowing	Other	Total
Chlorinators & Florinators Program	31,000	31,000	-	31,000	31,000
Unit Well Rehab Program	320,000	320,000	-	320,000	320,000
Water Hydrants Program	550,000	550,000	-	550,000	550,000
Water Mains - New	4,082,000	4,082,000	-	4,082,000	4,082,000
Water Mains Replace Rehab Improve - Pavement Management	785,000	785,000	-	785,000	785,000
Water Mains Replace Rehab Improve - Pipe Lining	200,000	200,000	-	200,000	200,000
Water Mains Replace Rehab Improve - Reconstruct Streets	1,933,000	1,933,000	-	1,933,000	1,933,000
Water Meter and Fixed Network Program	650,000	650,000	-	650,000	650,000
Water Utility Facility Improvements	592,000	592,000	-	592,000	592,000
Water Utility Vehicles & Equipment	767,000	767,000	-	767,000	767,000
Water Valve Cut-In Program	15,000	15,000	-	15,000	15,000
Total 2020 Appropriation	\$ 9,925,000	\$ 9,925,000	\$ -	\$ 9,925,000	\$ 9,925,000



LEVEL OF SERVICE MEMO

Madison Water Utility
Madison, Wisconsin
119 East Olin Avenue
Madison, WI 53713

Black & Veatch Corporation
B&V Project 169092.0100
B&V File 41.0800

Black & Veatch Corporation
225 E. Mason Street, Suite 801
Milwaukee, Wisconsin 53202

January 10, 2011

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1. BACKGROUND

Criteria for evaluating the performance of existing facilities and for designing future facilities is a combination of regulations established by the Wisconsin Department of Natural Resources (DNR), Madison Water Utility (MWU) service level goals, and industry standards. Often the DNR establishes a minimum level of service, which is exceeded by MWU goals. Planning and Design Criteria are generally guidelines and provide a framework in which to evaluate the performance of the existing system and evaluate recommended facilities to serve future growth or changes in the distribution system.

2. UNIT WELLS

Criteria established for the unit wells include well capacity and emergency power/pumping. They are summarized in Table 1.

Table 1 – Unit Well Planning and Design Criteria

Criteria	Guideline
Well Capacity	For each pressure zone served by a well the well capacity must meet all of the following: <ul style="list-style-type: none"> • Average run time on unit wells less than 12 hours during the average day demand (ADD). • Total capacity of wells at least 115% of the maximum day demand (MDD). • Firm capacity (largest well in the zone out of service) of wells at least 100% of MDD. For pressure zones 6E and 6W, firm capacity shall be based on two wells out of service. ⁽¹⁾
Emergency Operation	Emergency power generation (or engine powered pump capacity) to meet at least the ADD.
Notes: ⁽¹⁾ Alternate guidelines for pressure zones 6E and 6W based on their size and importance.	

3. PRESSURE

Pressure criteria are established for low, high and emergency operations. The low pressure criterion is established to provide customers with adequate pressures for normal operation of residential and commercial fixtures including irrigation systems. The high pressure criterion is established to protect fixtures and pipelines from undue stress. Customers with normal operating pressures over 90 psi may consider installing a pressure reducing valve (PRV) on their service to protect indoor fixtures. MWU will reimburse 50 percent of the cost of the PRV for customers with normal pressures over 110 psi and 100 percent of the cost of the PRV for pressures over 125 psi. The emergency operating criterion is established to prevent negative system pressures during emergency and fire flow events. Table 2 summarizes the pressure criteria.

Table 2 – Pressure Planning and Design Criteria

Criteria	Guideline
Minimum Pressure Peak Demands	
Non-emergency	40 psi
Emergency	20 psi (at any point in the pressure zone)
Preferred Operating Pressure	50 – 90 psi
Maximum Operating Pressure	<125 psi (everywhere) <100 psi (expansion areas)

4. PIPELINES

Pipeline criteria are established for velocity, pipe roughness, minimum sizing, and pipe material. Velocity criteria are used to minimize system headlosses due to pipe size or roughness and to minimize the impact of transients in the distribution system. A roughness criterion is generally assumed or measured and is used for hydraulic model calibration and evaluation. Minimum sizing is used to ensure adequate capacity for fire protection. Table 3 summarizes planning and design criteria for pipelines.

Table 3 – Pipeline Planning and Design Criteria

Criteria	Guideline
Maximum Velocity	
Maximum Hour during MDD	< 5 fps
Fire during MDD	< 10 fps
Hazen-Williams Roughness Coefficient (C)	
Existing Pipes	125 ⁽¹⁾
High Density Polyethylene (HDPE) (new)	150 ⁽²⁾ (horizontal directional drilling only)
Ductile Iron (new, cement lined)	140 ⁽²⁾
Pipe Diameter ⁽³⁾	
General Grid Considerations	16-inch minimum diameter on 1 mile grid 12-inch minimum diameter on 0.5 mile grid (Larger diameter or closer spacing may be required based on use or zoning).
Arterial Collector Roads	12-inch minimum diameter
ICI Areas	10-inch minimum diameter
Residential Areas	8-inch minimum diameter (6-inch may be permitted for residential dead-end lines that are less than 200 feet in length with a fireflow requirement less than 1000 gpm).
Pipe Material	Ductile Iron Class 52 or greater ⁽⁴⁾
Notes:	
(1) From the 2006 IDSE hydraulic model calibration	
(2) WAC NR 811.70	
(3) MWU Planning Guidelines	
(4) HDPE is permitted for directional drilling or slip lining only (minimum pressure class 160 psi).	

5. BOOSTER PUMP STATIONS AND STORAGE

Pump station and storage criteria are designed to ensure adequate capacity for maximum hour, fireflow, or emergency demands. Table 4 summarizes planning and design guidelines for booster pump stations and storage.

**Table 4 – Booster Pump Station and Storage
 Planning and Design Criteria**

Criteria	Guideline
Booster Pump Stations	
Capacity	Firm Capacity (largest pump out of service) able to meet either: <ul style="list-style-type: none"> • MDD for pressure zones with equalization storage • Maximum hour plus fireflow for pressure zones without equalization storage.⁽¹⁾
Storage	
Volume	Every pressure zone be able to meet both of the following: <ul style="list-style-type: none"> • 12 hour supply at ADD⁽²⁾ • Fire flow plus equalization storage
Equalization storage	Volume required to deliver difference between maximum hour demand (MHD) and MDD for each pressure zone (normally 15 – 30% of MDD)
Fire Storage	Fire flow goal X fire duration (see Table 5 for fire flow and duration recommendations)
Notes:	
⁽²⁾ Pressure zone 11 is the only existing pressure zone without equalization storage.	
⁽³⁾ Emergency reserve	

6. FIRE FIGHTING CRITERIA

Projected water demands are developed from existing water demands and the anticipated impact of growth and conservation on the demand. Table 5 summarizes the fire flow goals and durations.

Table 5 – Fire Fighting Planning and Design Criteria⁽¹⁾

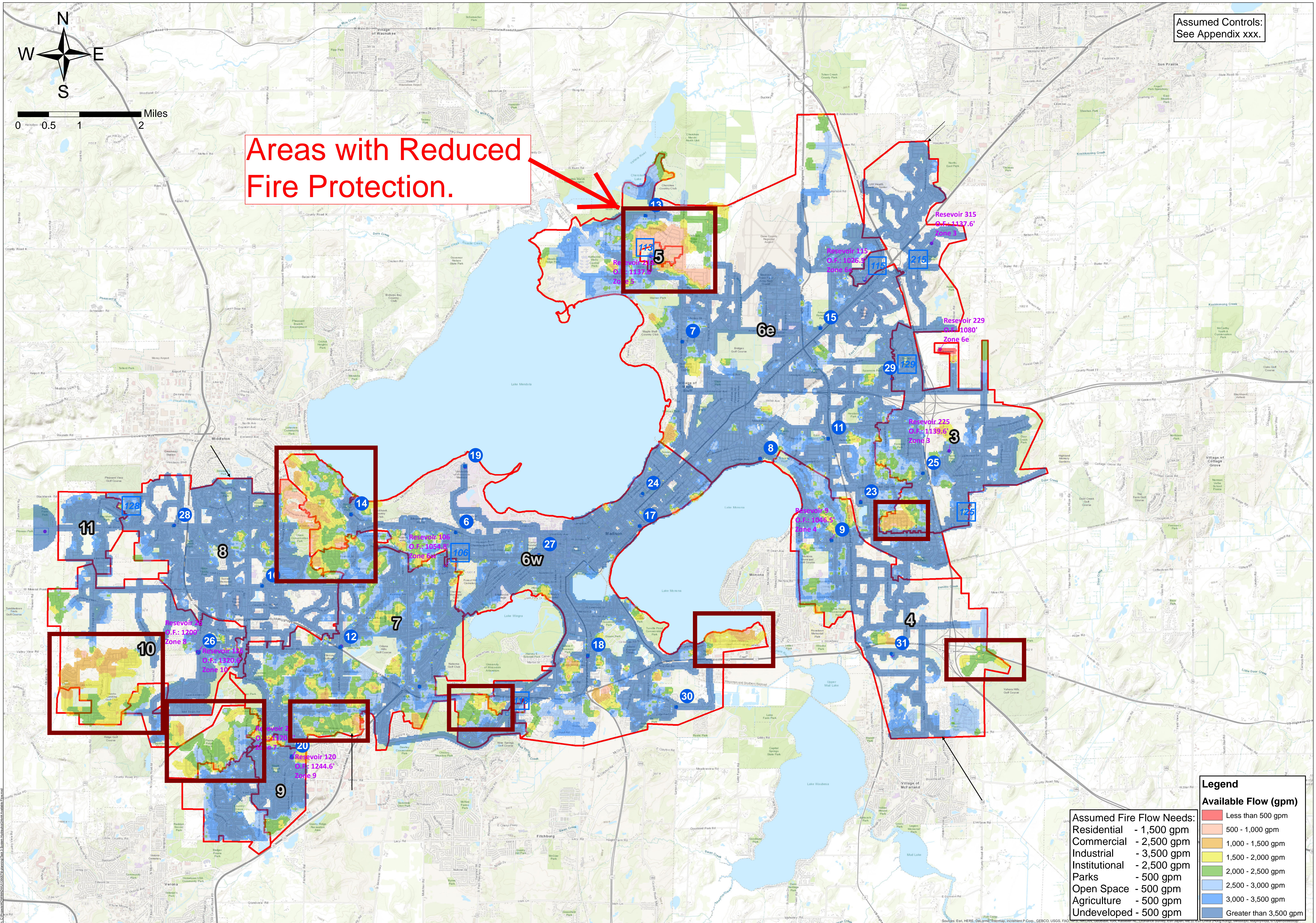
Land Use	Fire Flow Goal (gpm)	Fire Duration⁽²⁾ (hrs)	Hydrant Spacing (feet)
Low Density Residential (LDR), Neighborhood Planning Area (NPA), Traditional Neighborhood Development (TND)	1,000	2	400
Medium Density Residential (MDR), Neighborhood Mixed Use (NMU)	2,000	2	375
High Density Residential (HDR), Community Mixed Use (CMU), General Commercial (GC)	2,500	2	360
Regional Mixed Use (RMU), Regional Commercial (RC), Employment (E), Special Institutional (SI), Downtown (D), Campus (C), Airport (SP), Industrial (I)	3,500	3	300
Notes: ⁽¹⁾ Fire flow in addition to MDD. ⁽²⁾ <i>Distribution System Requirements for Fire Protection, AWWA M31, 1989</i>			



0 0.5 1 2 Miles

Assumed Controls:
See Appendix xxx.

Areas with Reduced
Fire Protection.



Legend

Available Flow (gpm)	
[Red]	Less than 500 gpm
[Orange]	500 - 1,000 gpm
[Yellow]	1,000 - 1,500 gpm
[Light Green]	1,500 - 2,000 gpm
[Green]	2,000 - 2,500 gpm
[Light Blue]	2,500 - 3,000 gpm
[Blue]	3,000 - 3,500 gpm
[Dark Blue]	Greater than 3,500 gpm

Assumed Fire Flow Needs:

Residential	- 1,500 gpm
Commercial	- 2,500 gpm
Industrial	- 3,500 gpm
Institutional	- 2,500 gpm
Parks	- 500 gpm
Open Space	- 500 gpm
Agriculture	- 500 gpm
Undeveloped	- 500 gpm



Project: MADWU 139057
Print Date: 8/25/2017
6808 Odana Road, Suite 200
Madison, WI 53719-1137
Phone: 608.620.6109
Toll Free: 800.732.4362
FAX: 608.908.8166
www.mwu.com

Available Flow at 20 psi
WATER NEEDS ASSESSMENT
Madison, Wisconsin

Figure
2

Embed sustainable asset management practices throughout the organization.

- Engage the entire organization to provide training on asset management processes and procedures appropriate to individual roles and responsibilities.
- Establish defined roles and responsibilities to implement and sustain asset management practices.
- Apply effective data and information technology solutions to support the asset management program.
- Dedicate adequate resources to support the continued development and implementation of the asset management program.

See Appendix D for a copy of the finalized SAM Policy.

The SAM vision, mission and policy are key elements of the implementation strategy for MWU.

4.2 Levels of Service Framework and Performance Measurement

Policy Statement – Maintain a high level of service to MWU’s customers and stakeholders.

Objectives:

- Understand customer and stakeholders requirements and expectations.
- Understand and record the current levels of service provided.
- Continually refine and report levels of service to meet future demands and expectations.
- Communicate frequently and effectively to customers and stakeholders.

One of the key elements of an SAM Program is to define the levels of service (LOS) that customers, end users, and key stakeholders experience. LOS describes the outcomes that a utility expects to achieve in providing services to its customers. LOS connects the strategic direction of the utility to the performance requirements established within the various parts of the organization.

As stated in the International Infrastructure Management Manual (IIMM), levels of service:

“are a key business driver and influence all Asset Management decisions. Levels of Service statements:

- *Describe the outputs the organization intends to deliver to customers;*
- *Commonly relate to service attributes such as quality, reliability, responsiveness, sustainability, timeliness, accessibility and cost;*
- *Should be written in terms the end user can understand and relate to; and*
- *Should drive the selection of performance measures.”*

A LOS framework links operational activities with tactical and strategic outcomes and articulates how the management of assets contributes to the overall vision, mission and guiding principles. This type of framework helps utility organizations place focus on continuous improvement efforts that keep the service output foremost in mind while measuring and minimizing asset life cycle cost and asset system risk. LOS also is used in determining needed investment levels across utility’s asset portfolio by understanding performance, condition and operations targets to be achieved through asset maintenance, renewals and new construction.

For MWU, customers and the services provided are summarized in Figure 6 as identified in the SAM Framework development process.



Figure 6 MWU Customers and Services Provided

Customer expectations can be articulated in the following service attributes:

- **Water Quality/Safety:** Services are delivered such that they minimize health, safety and security risks and meet all regulations.
- **Reliable:** Services are predictable and continuous.
- **Suitable:** Services are suitable for the intended function (fit for purpose).
- **Sustainable:** Services preserve and protect the natural and heritage environment.
- **Available:** Services of sufficient capacity are convenient and accessible to the served community.
- **Cost Effective:** Services are provided at the lowest possible cost for both current and future customers, for a required level of service, and are affordable.
- **Responsive:** Opportunities for community involvement in decision making are provided; and customers are treated fairly and consistently, within acceptable timeframes, demonstrating respect, empathy and integrity.

For purposes of MWU's SAM Program, the term **External LOS** refers to performance metrics related to how MWU customers and stakeholder experience MWU's service delivery and how performance is *received and perceived by the customer*. External LOS do not seek to measure the internal activities or the efficiency of the organization. The term **Internal LOS** refers to performance metrics related to how MWU operates internally on a day-to-day basis with metrics that are important to MWU staff but not specifically visible to MWU customers and stakeholders.

Like other performance measures, External LOS must have specific, measurable indicators that provide the organization with a focus when planning the physical (asset) infrastructure and functional (organizational) infrastructure required to deliver the service. LOS define a set of service characteristics that identify the minimum level of performance expected to be generated by the

assets. These characteristics typically include aspects such as *how much* and *how frequently* the service will be delivered. They also serve as reference points to measure the effectiveness of the organization in delivering on its objectives, and provide a focus for day-to-day activities and decisions.

Figure 7 shows the relationship between output objectives, External LOS, Internal LOS, data, and underlying technology tools. A LOS framework identifies the metrics that have the most significant and direct impact on service delivery to customers and stakeholders. It also enables utility organizations to track trends, report progress against targets, and make critical adjustments when necessary.

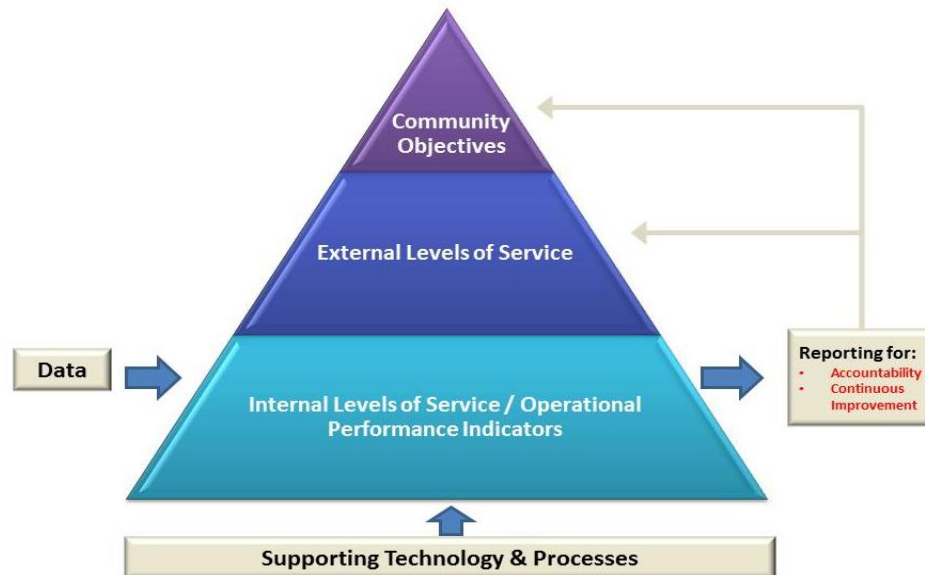


Figure 7 Levels of Service and Performance Measure Framework

4.2.1 Identifying Levels of Services for MWU

MWU has identified the following Key Service Areas (from the 2016 Madison Measures Report) as the utility's primary categories of External Levels of Service as shown in Figure 8 below.

Key Service Area	Key Service Area Description
KS1	We deliver every day a high quality, reliable supply of drinking water that protects public health. The citizens of Madison depend on it for safe water to drink, prepare our food, wash our clothes, and bathe our families.
KS2	We work to protect our precious groundwater source by using sustainable practices ourselves and encouraging conservation by our customers. We are all stewards of the water infrastructure and resources handed down to us by previous generations.
KS3	We ensure that a sufficient supply of water is available at hydrants throughout the city to fight fires. We keep this water flowing at the right pressure to enable the Fire Department to protect lives and property.
KS4	The water pipes below our streets make everyday conveniences possible and provide the Madison community a high quality of life. We all support essential water service by paying for the necessary infrastructure and processes to get water to every customer.
KS5	We deliver a reliable and affordable supply of fresh water to support the local economy, to supply business, industry, government, and a world-class research university with an essential need.

Figure 8 MWU Key Services Areas

To determine if MWU is delivering its services as defined in the Key Service Area description, performance indicators are identified and associated with each Key Service Area. Table 1 below identifies performance indicators that are aligned with the Key Service Areas and service delivery attributes.

To meet the performance identified for the Key Service areas, MWU is using the following strategies:

- Long-term planning for capital improvements.
- Infrastructure management and business strategies.
- Preventative maintenance and repair.
- Continual monitoring, sampling and reporting of water quality.
- Compliance with state and federal regulations.
- Water conservation and source water protection.
- Attention to financial matters, business practices and customer service.

Table 1 External Levels of Service Performance Measures

Service Criteria Area	Key Performance Indicator #	Key Performance Indicator	Target Level of Service (Interim Goal)	Measurement Data	Current Performance
Water Quality - Color KS1		# of complaints per year	<200 per year	Madison Measures; WQ Correspondence database	265 (2015)
Water Quality - Taste KS1		# of complaints per year	<30 per year	Madison Measures; WQ Correspondence database	24 (2015)
Water Quality - Odor KS1		# of complaints per year	<30 per year	Madison Measures; WQ Correspondence database	41 (2015)
Water Safety - Microbiology		# E. coli positive samples	0	Wisconsin State Laboratory of Hygiene (WSLH) analysis	0
Water Safety - Chemistry		# samples above a primary drinking water standard (MCL)	0	WDNR and internal MWU databases	1
Water Safety - Lead		90th percentile lead level, single family residential	<5 ppb	Lead & Copper Rule monitoring results	3.5 ppb (2014)
Water Safety - Compounds of Concern		# unregulated contaminants monitored per year	2-3	EPA UCMR program; Internal MWU database	3
Reliability - High Pressure		# complaints per year	<25 per year	Madison Measures; WQ Correspondence database	TBD
Reliability - Low Pressure		# complaints per year	<25 per year	Madison Measures; WQ Correspondence database	TBD
Reliability – Pressure KS1		Pressure levels at the tap	80 psi 99% of time tested	SCADA, pressure gauge data	TBD
Water Quality / Safety – Lead Mitigation KS1		# of known lead service laterals in the system	0 known lead laterals	Lead database	TBD

Service Criteria Area	Key Performance Indicator #	Key Performance Indicator	Target Level of Service (Interim Goal)	Measurement Data	Current Performance
Sustainability - WHP		# of wellhead protection plans reviewed	4/year	Madison Measures	100%
Sustainability – Aquifer Water Levels KS2		Aquifer water levels at each well point within X standard	100% of wells	Well location aquifer water level data	100%
Reliability / Availability / Safety - Fire Protection KS3		Hydrant functions correctly	Each zone and every hydrant meets fire flow capacity 100% of the time. (Interim Goal: 99%) Fire Rating: Class 1	See Capacity report	98% MWU has Class 1 utility fire rating
Reliability / Availability / Safety - Fire Protection KS3		Hydrant functions correctly	100% of hydrants repaired within 72 hours of hydrant issue identified (except construction areas)	Fire Dept. log in / log out hydrant data	TBD
Reliability / Availability / Safety - Fire Protection KS3		Hydrant functions correctly	100% of hydrants inspected every two years and issues addressed	Hydrant database	100% of hydrants assessed within the last two years or more recently
Reliability / Availability / Safety / Responsive - Fire Protection KS3		Hydrant flow test	33% of all hydrants tested every 5 years.	Hydrant database?	100% of flow test requests addressed in one week or less
Reliability / Availability - Planned Water Outages KS1, 3, 4, 5		Time out of service	85% of planned outages <4 hours in duration	Work order time stamp data; leak reports	TBD

Service Criteria Area	Key Performance Indicator #	Key Performance Indicator	Target Level of Service (Interim Goal)	Measurement Data	Current Performance
Reliability / Availability – Unplanned Outages KS1, 3, 4, 5		Time out of service	95% of planned outages <8 hours in duration	Work order time stamp data; leak reports	TBD
Reliability – City Call Center Management and Execution KS1, 3, 4, 5		% of City Call Center issues routed to the appropriate dept. in the first instance	TBD	Call Center data	TBD
Reliability / Availability – Residential Customers KS1, 4		Number of residential system leaks per year	1/block/year 3/block/7 years	Leak and repair information	TBD
Reliability / Availability – Wholesale Customers KS4, 5		Volume of water provided per agreements	Meet 100% of agreed water volume supply	Water meters	100% of agreed water volume provided
Reliability / Availability – Commuters KS4, 5		# of commuter complaints per year	TBD	Customer complaint database	TBD
Reliability – Availability – Business Owners KS4, 5		# of business complaints per year	TBD	Customer complaint database	TBD
Responsiveness – Permit Issuance for New Potable Water KS1, 2, 3, 4, 5		Average time to review applications and issue permits	60 days from completed application submitted	PW database	TBD

Service Criteria Area	Key Performance Indicator #	Key Performance Indicator	Target Level of Service (Interim Goal)	Measurement Data	Current Performance
Reliability / Responsive – Mapping Customers Internal/External System Connections KS 1, 4, 5		Map accuracy	100% of DSRs to scale	Map data source	15% exceeding (TBD)
Responsive – Public Communication KS 1, 2, 3, 4, 5		# of press releases	TBD	Press releases	22 in 2016
		# of earned media mentions	TBD	Earned media mentions	57 in 2016
		# of content media articles	TBD	Content media articles	11 in 2016
Responsive – Public Communication KS 1, 2, 3, 4, 5		# of content media articles picked up	TBD	Content media articles picked up	TBD
		# of email list subscribers	TBD	Email list subscribers	~2,000
Well Capacity / Pumping Ratio		Ratio of capacity to pumping for all wells and reported to the Water Board	50% pumping vs. capacity for all 22 wells	TBD	16 of 22 wells are pumping at 50% or less of available capacity
Facility Inspections		# of inspections for high hazard facilities per year	100% of high hazard facilities inspected at least once in two years	Database	TBD

Table 2 Internal Levels of Service Performance Measures

Service Criteria Area	Key Performance Indicator #	Key Performance Indicator	Target Level of Service (Interim Goal)	Measurement Data	Current Performance
Water Safety - Microbiology		# coliform samples collected	250/month	WSLH and Public Health Analysis	Monthly average: 305
Water Clarity – Turbidity		Miles of main flushed per year (UDF)	xxx miles/year	Field reports	xxx miles (201X)
Water Quality - Iron & Manganese		% samples above the secondary standard (SMCL)	<5%	Internal MWU database	1.4%
Disinfection - Entry Point		% samples within the range, 0.30 - 0.55 mg/L chlorine	>95%	Chlorine analyzer; daily check by Rounder, WQ Aide	96.5%
Disinfection - Distribution		% samples >0.1 mg/L chlorine	>99%	Measurements by Water Quality Aide	98.9%
Fluoridation		% samples within the range, 0.70 +/- 0.15 mg/L fluoride	>90%	Daily check by Operator II	91.9%
Water Quality - Water Age		TBD	TBD	TBD	TBD
Water Supply		# of deep wells off-line at the same time	1 deep well off-line due to mechanical failure. Well returned to service within 60 days of failure.	TBD	TBD
Booster Pump Down Time		# of pumps impacted at any one time	Maximum of one booster pump off line at any one time	SCADA	TBD
Chlorine Level		Chlorine residual concentration at key representative points in the system	0.30 - 0.55 mg/L No more than one chlorine related facility outage per year.	Measured by CI2 monitor	TBD

Service Criteria Area	Key Performance Indicator #	Key Performance Indicator	Target Level of Service (Interim Goal)	Measurement Data	Current Performance
Fluoride Level		Fluoride concentration at key representative points in the system	No more than one fluoride incident per year	TBD	TBD
Chemical Usage Volume		% on-time monthly reporting of chemical usage volume to DNR	100% on-time monthly reporting	Calculated and actual values based on volume	100% on time monthly reporting to DNR
Flow Meter Testing		% of flow meters tested annually and reported to the PSC	100% of flow meters tested annually and reported to the PSC	TBD	100%
Well Capacity / Pumping Ratio		Annual ratio of capacity to pumping for each well reported to the Water Board	50% pumping vs. capacity	TBD	Wells are pumping at 50% of less of available annual capacity
Facility Inspections		# of inspections for high hazard facilities per year	100% of high hazard facilities inspected at least once in two years	Database	TBD

DRAFT

Level 2 Asset Assessment (Visual)

The purpose of level 2 is to undertake a more detailed assessment of the assets through visual inspection and observation. Where assets cannot be assessed visually as a result of being buried, concealed or in a confined/inaccessible space, ratings should be determined either through advanced visual inspection tools or in consultation with staff. In cases where poor condition is suspected, asset samples may be selected for more detailed level 3 condition assessment (such as removing coupons from existing pipes for testing) or excavation to improve the visual assessment. This is an acceptable method to enhance the level 1 approach for most assets and especially those that do not have a more sophisticated system.

The level 2 process involves the enhancement of the organization's ability to more effectively rank those assets that constitute a significant problem. E.g. condition scores, 3, 4, and 5 (particularly 4 and 5) from the level 1 assessment.

For each asset, one rating (from 1 to 5) is to be determined for each of the parameters based on a specific distress mechanism. More than one parameter is commonly assessed for each asset. However, one overall condition rating for each asset is selected. The intent of the level 2 condition rating is to select the life limiting parameter (worst case) for each type of asset. This parameter establishes the level of condition when an asset would be considered to require replacement or rehabilitation. For example, for a structure, the structural or foundation condition would both be life limiting parameters, rather than surface condition. When a rating of any life limiting parameter is equal to 5, an overall rating of 5 is adopted.

Level 3 Asset Assessment (Advanced)

Level 3 assessments are only undertaken for those assets that are further determined as requiring higher level assessment. Assets to be considered for level 3 assessments should be placed on a schedule of condition testing, based on a filtering process. Example selection criteria include:

- Having a Business Risk Exposure score requiring a level 3 level assessment.
- High replacement value assets.
- Condition/Reliability Rating of 4 or 5.
- Whether condition testing would provide worthwhile additional information.
- The budget available for condition testing.
- An assessment of whether the condition assessment is a cost effective step (i.e. is the management strategy run to failure?).

4.3 Business Risk Exposure Framework

Policy Statement – Understand and manage MWU's business risk exposure.

Objectives:

- Identify and focus on those assets that are critical to MWU's service levels and prioritize their management to prevent their failures.
- Identify, understand, and manage the business risks associated with operating MWU's resources.

A Business Risk Exposure (BRE) method provides a set of rules for determining the direct and indirect implications of the failure of an asset and helps management teams focus on high-risk assets and related issues. Figure 11 is a schematic representation of the key variables of business risk exposure with components that contribute to each variable. The term "core risk" is defined as

the product of consequence of failure (CoF) and the probability of failure (PoF) without adjusting for risk mitigation measures that may be in place for the asset or system. The term ‘risk mitigation’ refers to those practices applied to an asset to either reduce the probability of failure (by adding “resistance” to the asset) or the consequence of failure by, for example, providing a parallel asset/process (e.g., redundancy) with the same functionality as the critical asset that can be used should the critical asset fail or be out of service. Once the core risk is calculated as a baseline measurement, risk mitigation strategies can be considered and/or developed that can reduce the level of risk. Business risk exposure is closely related to the consequences associated with the total loss or failure of the asset. It is noteworthy that critical assets may be in good condition and therefore unlikely to fail in the immediate future, but the asset remains critical to the provision of services.

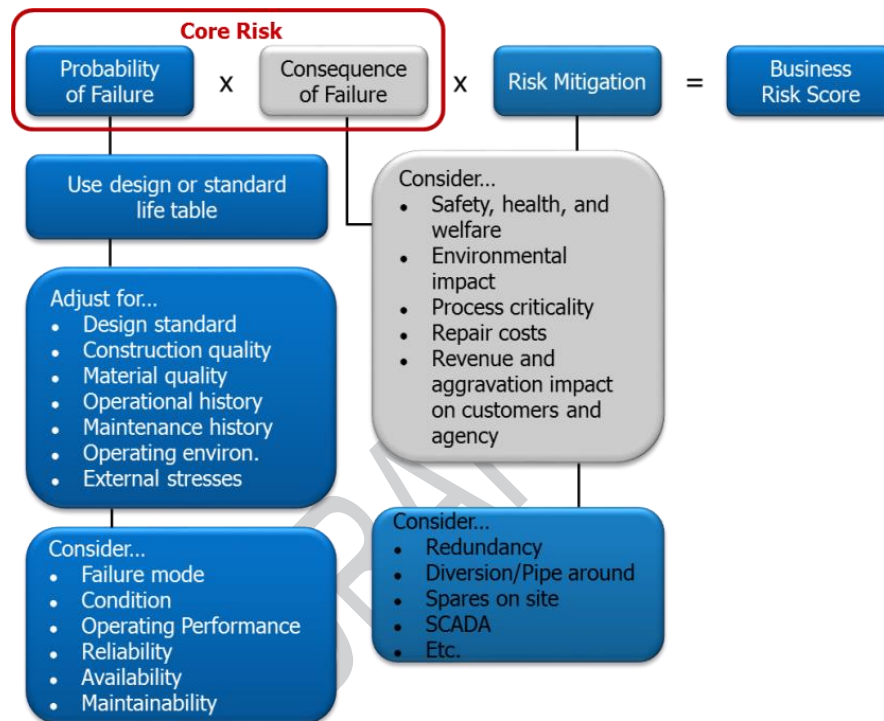


Figure 11 Business Risk Exposure Elements

The probability of failure aspect of BRE is directly related to the asset’s condition as previously discussed in Section 4.2.2. The consequence of an event can be expressed in Triple Bottom Line (TBL) categories. Triple bottom line categories used for the MWU AM Framework are as follows:

Table 6 Triple Bottom Line Categories and Elements

Categories	Category Elements
Social/Community	Public Trust, Customers Affected, Critical Customers, Public Health, Public Safety, Loss of Service, Water Quality/Water Pressure
Financial	Total Cost of Failure, Operational/Resource Impact
Environmental/Regulatory	Board Policy and Regulatory Compliance, Environmental Impact

Table 7 presents the consequence of failure scoring matrix for the AM Framework. The scoring system is based on a 1 to 5 score, with 1 being a low consequence and 5 being a high consequence.

Table 7 MWU AM Consequence of Failure Scoring Table

CoF Elements		Social/Community				
Public Trust	No Impact	Alert posted on website but no media attention	Local coverage	State coverage	National coverage	
Customers Affected	No Impact	Level 1	Level 2	Level 3	Greater than Level 3	
Critical Customers	Residential/Multi-family only	High water users*	Wholesale customers**	Schools or Child care centers, Public Utilities	Hospitals, Health clinics	
Public Health	No impact	Minor illness	Moderate some sickness	Major sickness	Potential for fatalities	
Public Safety	No impact	Minor injury	Moderate injury	Major Injury	Potential for fatalities	
Loss of Service	Can be out of service for extended period	Cannot be out of service for a week	Cannot be out of service for several days	Cannot be out of service of several hours	Critical - cannot be out of service	
Water Quality	Short-term (< 3 months) SMCL exceedance	Long-term (>3 months) SMCL exceedance	Short-term (<1 year) exceedance of MCL for chemical constituent where chronic exposure leads to illness	MCL exceedance leads to situation in which acute illness is possible	MCL exceedance leads to situation in which acute illness is probable in <24 hrs	
	1	2	3	4	5	
CoF Rating						
		Financial				
Total Cost of Failure	<\$5,000	\$5,000 – \$25,000	>\$25,000 to \$100,000	> -\$100,000 to \$500,000	>\$500,000	
Operational / Resource Impact	Negligible impact	Low impact	High impact (scheduled work is delayed)	High impact and diverts funds	Outsourcing to specialty contractors	
	1	2	3	4	5	
CoF Rating						
		Environment/Regulatory				
Board Policy and Regulatory Compliance	No consequence	Regulatory sanction possible	Regulatory sanction likely	Extensive regulatory sanction virtually assured	Severe sanctions likely	
Environmental Impact	Damage reversible within a week	Damage reversible within three months	Damage reversible in less than one year	Damage reversible in one to five years	Damage reversible in five years or more	
	1	2	3	4	5	
CoF Rating						

*High water users include hotels, motels, Holiday Inns; commercial laundromats; food producers and distributors

**Wholesale customers include the University of Wisconsin, other municipalities, etc.

Depending on asset type, there are different attributes that help measure the impact associated with each of the elements shown in Table 7.

The consequences based on each of the attributes that are applicable to an asset type (e.g., well facility, transmission mains) are added in order to develop a comprehensive consequence rating for that asset. The consequence of an event is calculated based on a 1 to 5 score for each TBL

category and associated elements. The minimum consequence of failure score is three and the maximum is 15.

Table 8 presents example attributes for each element. Example data requirements for the consequence of failure analysis are summarized in Table 9.

Table 8 Example Triple Bottom Line Attributes and Elements

Attributes	LoS Elements										
	Public Trust	Customers Affected	Critical Customers	Public Health	Public Safety	Loss of Service	Water Quality/Water Pressure	Total Cost of Failure	Operational/Resource Impact	Board Policy and Regulatory Compliance	Environmental Impact
Number of customers connected to the segment	●	●	●	●		●	●	●	●	●	
Critical customer category	●	●	●	●		●	●		●		
Proximity to roads	●	●		●	●			●	●		●
Proximity to railroads		●			●			●	●	●	●
Proximity to environmentally sensitive areas				●	●			●	●	●	●
Proximity to buildings	●	●	●	●				●	●		
Repair costs								●			
Zoning and land use	●	●		●				●		●	●

Table 9 Example Data Requirements for Pipe CoF Assessment

Data Type	Attributes	Source
Asset attributes	Date of installation	GIS / Record drawings
	Material	GIS / Record drawings
	Size	GIS / Record drawings
	Length	GIS / Record drawings
	Customer count	GIS / Customer billing database
	Critical customer type	GIS / Customer billing database
	Repair costs	Contract data
	Geospatial parameters	Proximity to roads
Proximity to other utilities		
Proximity to railway lines		
Proximity to environmentally sensitive areas (e.g., wetlands, open water)		
Proximity to high-risk institutions (hospitals, etc.)		
Proximity to buildings		

The probability and consequence of events are used to develop the BRE chart. An example BRE chart is shown in Figure 12. The BRE chart is divided into five risk management zones. Each zone is described as follows:

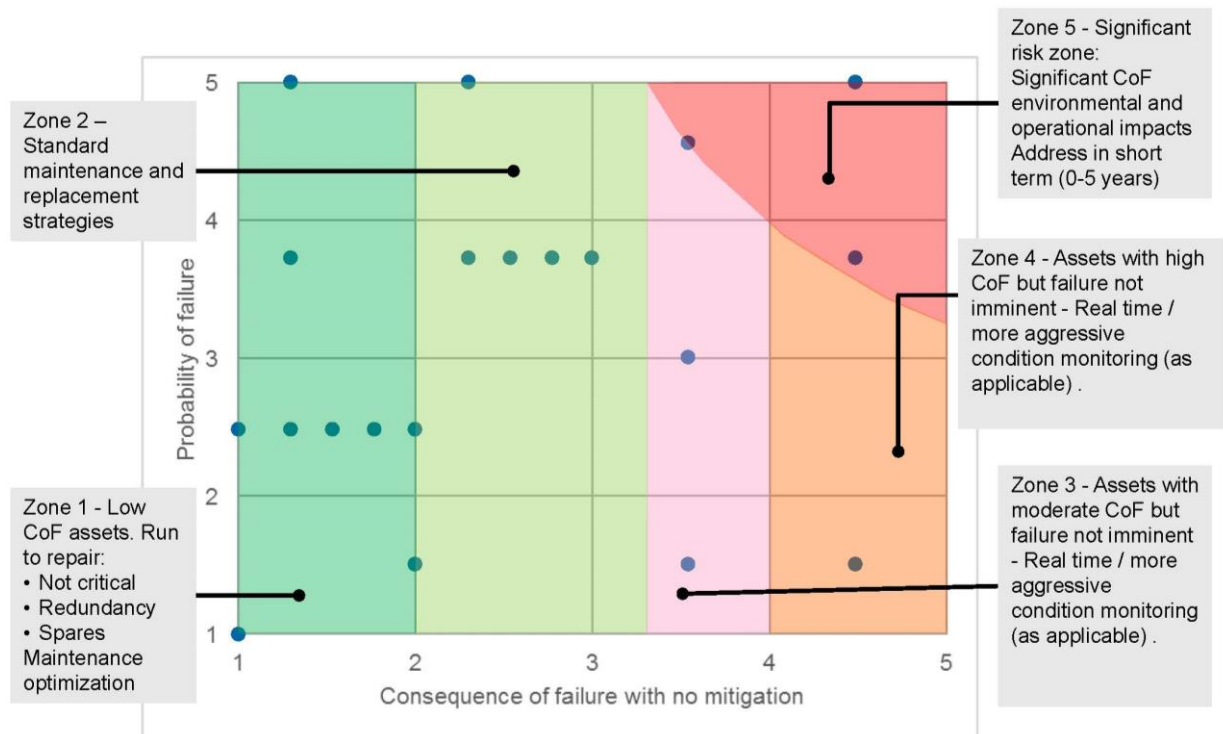


Figure 12 Example BRE Chart (with example assets)

Zone 5: Contains assets that represent a significant risk to the organization. In general, these assets are approaching the end of their useful life and upon failure, may cause significant social, financial, and environmental impacts.

Zone 4: Contains assets that have a high consequence of failure but have not deteriorated enough to be included in the significant risk zone (Zone 5). Increased visual and/or predictive condition assessments (thermal scanning, oil analysis, etc.) may be justified as their condition deteriorates and they move vertically in the graph approaching Zone 5.

Zone 3: Contains assets that would experience failure consequences that are tolerable because they may be being managed through designed redundancy and operational mitigation such as spares and condition monitoring. Zone 3 assets can also migrate into Zone 5 and as such, require additional focus by management.

Zones 1 & 2: Contains assets with lower consequences of failure. Applicable management strategies for these assets may be run to fail and maintenance optimization.

4.3.1 BRE Business Process Mapping

The BRE Framework as a key element for MWU is shown in Figure 13, as well as in Appendix C. There are multiple inputs and outputs with ownership of different elements of the process predominantly in Planning, Engineering and Operations & Maintenance. Example inputs include condition assessment data, staff knowledge and understanding of what happens if an asset fails, and geo-spatial proximity analysis using GIS. Example outputs are risk registers and risk profiles. Outputs are used in the development of asset management plans (including the development of the risk register) and in business case evaluations.

Facility Name	Unit Well 11	Facility Description
Well ID	BF511	Drilled in 1956, Unit Well 11 has a pumping capacity of 2,300 gallons per minute. It operates year-round and serves Madison's East side including the Emerson East, Eken Park, Marquette, Schenk-Atwood, Hawthorne, and Worthington Park neighborhoods as well as homes in Burke Heights, Hiestand, Rolling Meadows, and Eastmorland. In 2017, the well pumped 625 million gallons of water compared to its 5-year average of 526 million gallons annually.
Service Zone	6E	
Capacity	2.88 MGD	
Reservoir Capacity	0.150 MG	
Number of Assets	31	
Current Replacement Cost	\$3.2M	

Asset Condition Profile

Overall Condition Assessment: The assets at Unit Well 11 are in good to excellent condition with over 90% scoring 3 or better.

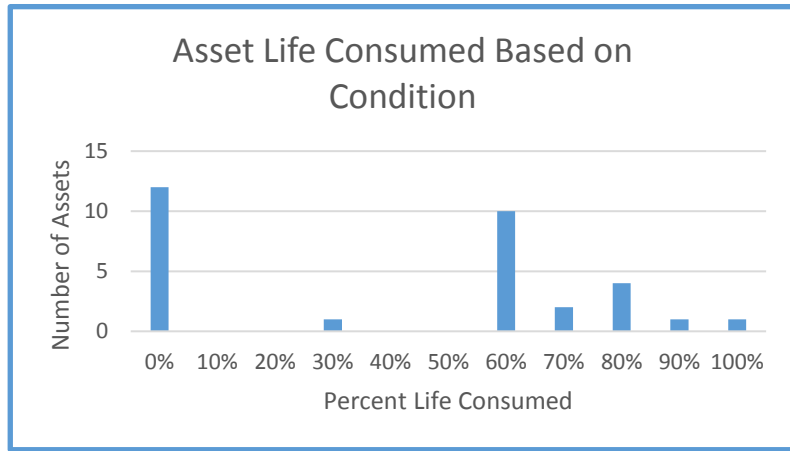


Figure 1. Life Consumed

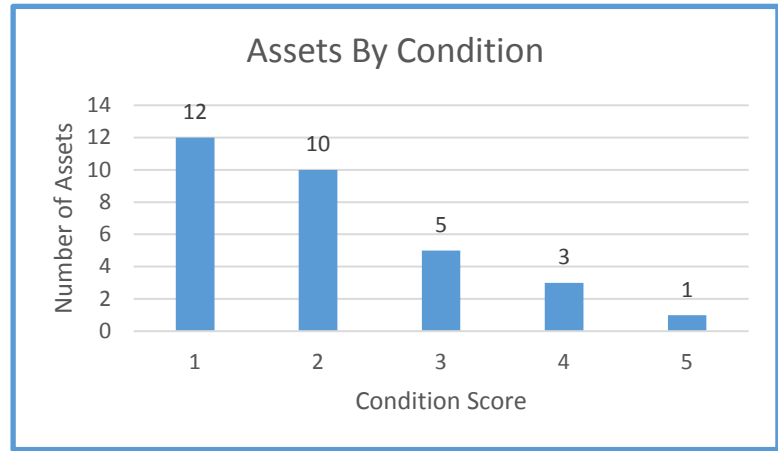


Figure 2. Asset Condition

Asset Risk Profile

Based on the analysis, there are 3 assets falling in zone 5 (significant risk zone) that require immediate attention, including: Chlorine System, Fluoride System, and PUMP-71 Starter. The MCC and Level/Pressure Instruments fall just outside zone 5 and should also be addressed in the short term.

Failure Modes

Failure modes acting on Unit Well 11 include Capacity, Levels of Service, and Physical Mortality. Signs of pumping sand have been observed. There have been water quality issues related to VOCs. Huge caverns have been observed underneath. The reservoir is undersized. The chemical storage room has code violations.

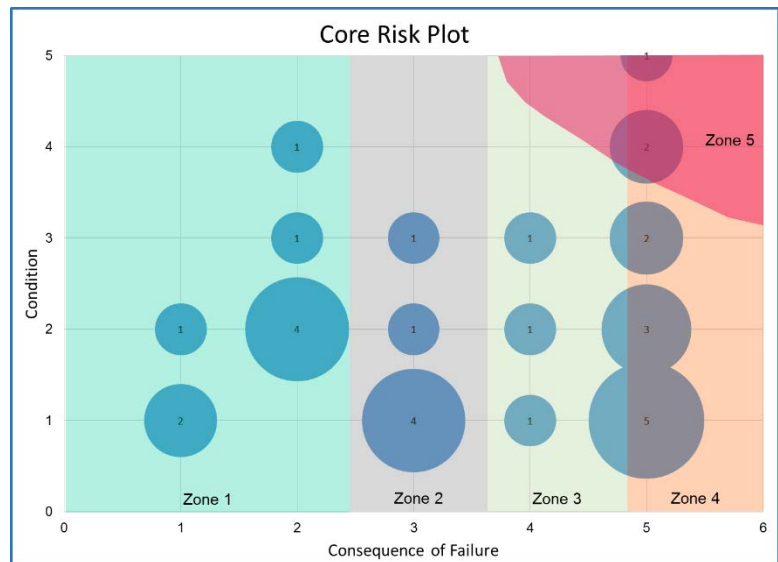


Figure 3. Risk Zone Plot

Investment Scenarios

Two investment scenarios were analyzed in order to estimate the future investment requirements.

Base Scenario Description

The Base Scenario runs all assets to failure (condition 5) regardless of risk management zone. This scenario results in a baseline, lowest possible investment requirements, without regard to risk. The Base Scenario 10-year investment requirement for Unit Well 11 is shown in Figure 4. Although the investment requirement is relatively low with this scenario, it results in a much higher level of residual risk.

Significant Risk Scenario Description

The Significant Risk Scenario establishes a trigger for asset replacement or rehabilitation for assets that reach the tolerable core risk limit of 16. In this scenario, intervention occurs for assets in risk management zones 3 and 4 before they reach the significant risk zone. Action is taken to move assets that are already in zone 5. Assets in zones 2 and 3 are run to failure (condition 5). The Significant Risk Scenario 10-year investment requirement for Unit Well 11 is shown in Figure 5.

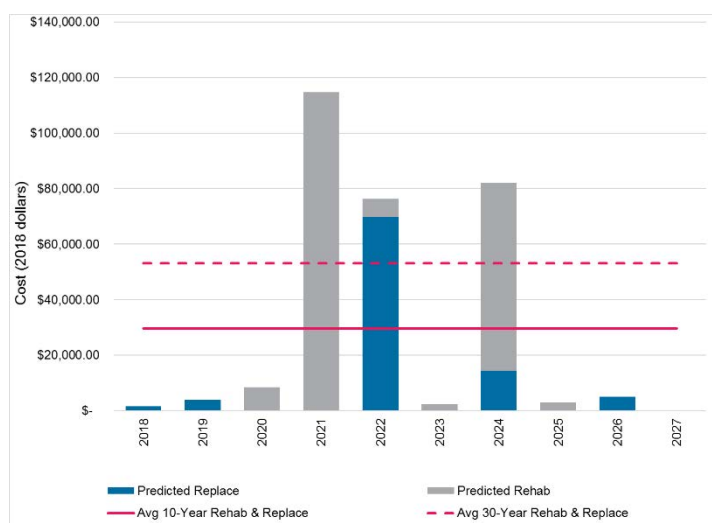


Figure 4. Base Scenario 10-Year Investment Requirements

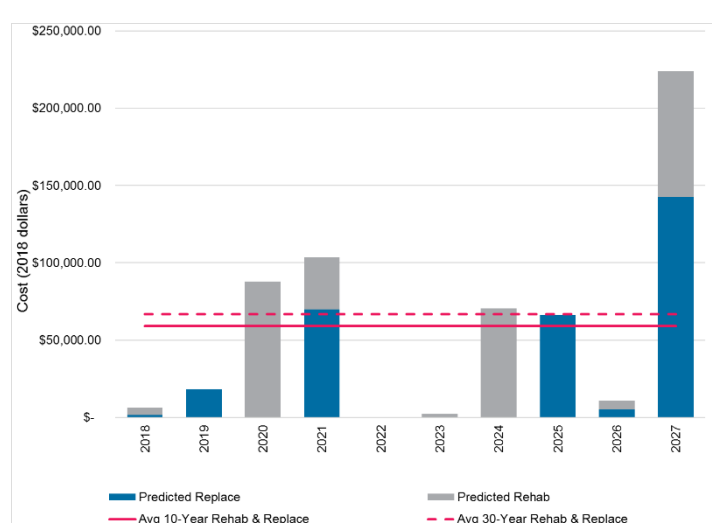


Figure 5. Significant Risk Scenario 10-Year Investment Requirements

Recommended Operations & Maintenance Strategies

Continued preventive and corrective maintenance is recommended for assets falling in zones 3 and 4. Evaluate zone 1 and 2 assets for maintenance optimization.

2018 - 2019 Recommended Projects

Asset Name	Intervention Type	Driver	Cost
Chlorine System	Rehabilitation	Risk	\$2,398
Fluoride System	Rehabilitation	Risk	\$2,398
MCC	Replacement	Risk	\$14,452
PUMP-71 Starter	Replacement	Risk	\$1,530
Level/Pressure Instruments	Replacement	Risk	\$3,910
		Total	\$24,688

Asset Register (sorted by TBL Risk score)

Asset ID	Asset Name	Condition Rating	Replacement Cost	% Life Consumed Based on Condition	Estimated Remaining Life (years)	Core Risk	TBL Risk (w/ mitigation)	Enterprise Risk (w/ system mitigation)	Risk Zone
24	PUMP-71 Starter	5	\$1,530	100%	0	25	55	9.2	5
5	Chlorine System	4	\$11,900	83%	3	20	44	7.3	5
11	Fluoride System	4	\$11,900	83%	3	20	44	7.3	5
17	MCC	3.5	\$14,452	85%	6	17.5	38.5	6.4	5
23	PUMP-71	3	\$36,574	62%	13	15	33	2.8	4
31	WELL-11 Borehole	2.5	\$1,001,300	71%	59	12.5	30	2.5	4
19	MTR1-11	2	\$69,767	60%	4	10	22	3.7	4
1	Analyzer	2	\$5,100	60%	5	10	22	3.7	4
12	General Interior	3.5	\$42,500	85%	12	14	21	3.5	4
26	Roof	2	\$40,923	60%	10	8	18	3.0	4
16	Level/ Pressure Instruments	4	\$3,910	91%	1	8	16	2.7	2
13	HVAC	3	\$11,627	62%	8	9	15	2.5	3
29	Valves	2	\$20,418	36%	13	6	14	2.3	3
28	Structure	3	\$191,350	79%	21	6	12	2.0	2
25	PUMP-72	1	\$32,794	0%	35	5	11	1.8	4
27	SCADA	1	\$25,500	0%	50	5	11	1.8	4
30	VFD PUMP-72	1	\$38,162	0%	10	5	11	1.8	4
20	MTR1-12	1	\$104,651	0%	10	5	11	1.8	4
7	Exterior	2	\$53,639	60%	24	4	10	1.7	2
14	Interior	2	\$53,639	60%	24	4	10	1.7	2
22	Piping	2	\$29,270	60%	20	4	10	1.7	2
6	Column	1	\$1,002,150	0%	200	5	9	1.5	4
4	Chlorine Leak and Shut-off	1	\$5,100	0%	12	4	8	1.3	4
3	CCTV	1	\$4,080	0%	10	3	8	1.3	3
8	Exterior Lighting	2	\$12,762	60%	32	4	8	1.3	2
2	Card Access	1	\$4,080	0%	10	3	7	1.2	3
10	Fire Extinguishers	1	\$23,205	0%	80	3	6	1.0	3
21	Pavement	2	\$331,022	60%	30	2	6	1.0	1
9	Eye Wash Station	1	\$4,250	0%	30	3	5	0.5	3
15	Landscaping	1	\$42,500	0%	200	1	3	0.5	1
18	Meters	1	\$5,865	0%	20	1	3	0.5	1