Internal Monitoring Report

Policy #: O-2C Reliability **Date**: November 24, 2020

I certify that the following information is true.

Policy Language:

The Water Utility General Manager shall not cause or allow conditions, procedures, or decisions that prevent Madison Water Utility from meeting its obligation to provide current and future generations of customers within the City of Madison and its authorized service areas with reliable water service that is consistent in its quality and availability.

Accordingly, the General Manager shall not cause or allow conditions, procedures, or decisions that:

1. Assure that residents experience only minimal unplanned service interruptions.
2. Provide residents with adequate notice of planned service interruptions.
3. Provide residents with adequate notice in the case of planned maintenance work that would significantly reduce water flow or pressure, and/or cause water discoloration.

General Manager's interpretation and its justification:

Madison Water Utility (MWU) shall plan for, budget for, fund, prioritize, and construct the necessary drinking water system improvements to replace and sustain the Utility's infrastructure both now and into the future. MWU shall build in the necessary system redundancy and reliability, shall maintain all components of the system, and shall develop operational procedures to ensure reliable water service to all customers. The objective shall be to meet established system level of service and key performance indicators 24/7/365.

To achieve this objective, MWU will develop, routinely update, and implement long-term facility, and system master plans to identify system long term needs. MWU will develop, refine, and implement a comprehensive Asset Management Program to monitor, assess and regularly renew all Utility assets. The Asset Management Program will identify the right project, for the right reasons, at the right time, for the right price. To support this objective, MWU will annually build

capital and operating budgets supported by appropriate revenue streams approved by the Wisconsin Public Service Commission.

The Utility's maintenance program, built under the guidelines of the Asset Management Program, will be proactive and preventative to maximize component reliability, efficiency, and life cycle costs within the system. The Utility shall also establish work scheduling protocols and notification procedures that will minimize the impact to consumers during maintenance and repair work.

Data directly addressing the General Manager's interpretation:

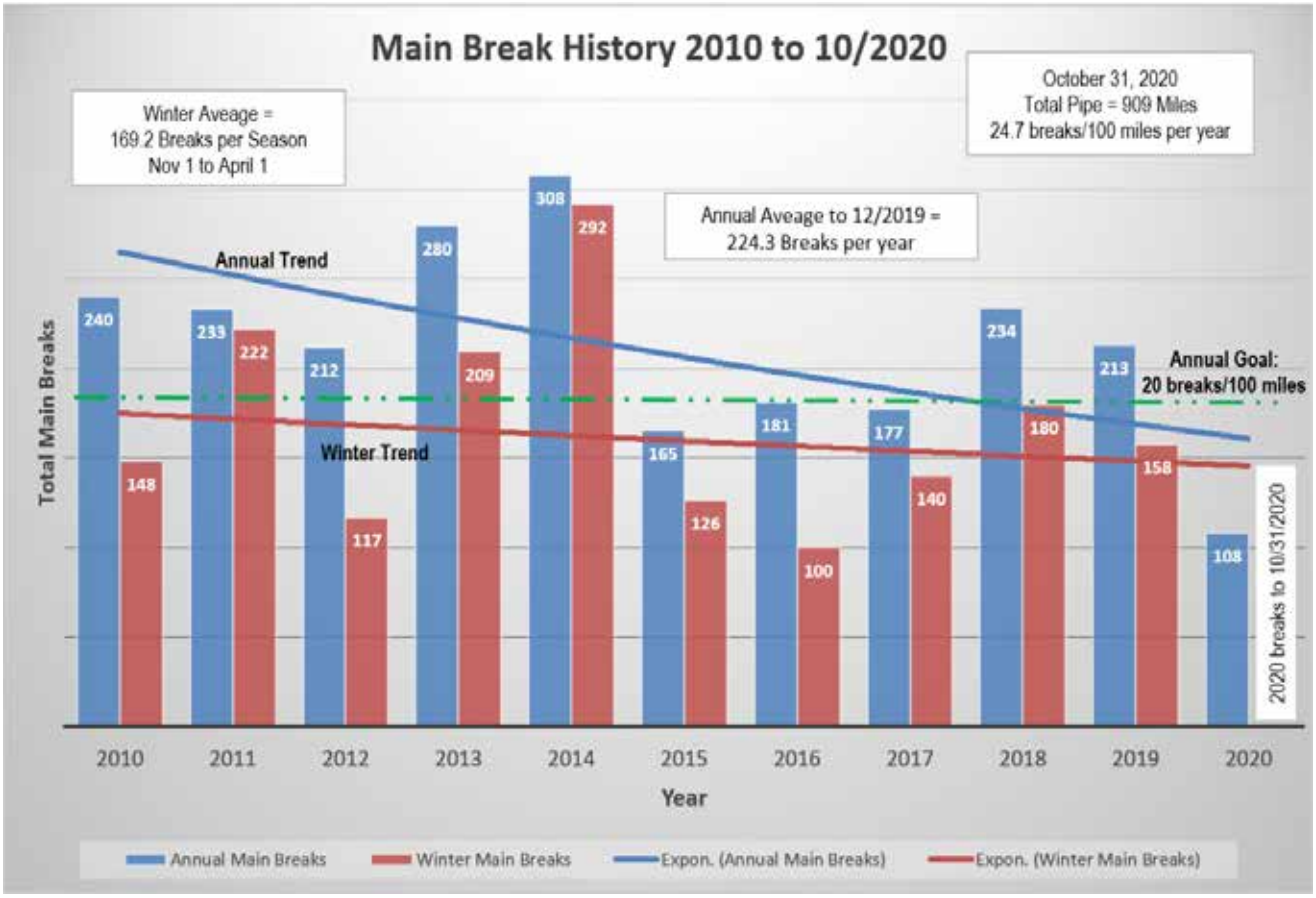
1. *Assure that residents experience only minimal unplanned service interruptions.*

    a. *Planned Infrastructure Renewal: To reduce the risk of unplanned service interruptions, the Utility shall budget for, fund, prioritize, and construct the necessary system improvements to replace and sustain the Utility's infrastructure.*

From 2010 through the end of 2019, Madison Water Utility (MWU) experienced an average of 224.3 water main breaks per year. Over the current 909 mile distribution system, the average annual break rate is approximately 24.7 breaks per 100 miles of water main. The break rate is driven by the winter weather and will move up or down due to the severity of the winter weather. Examining the break rate over several years will normalize the average and provide a trend. The 10 year annual average break rate presented in the 2019 O-2C Report to the WUB was 24.4 breaks per 100 miles per year. There is no published universally accepted standard for annual main breaks due to a wide variance in pipe construction, soil conditions, and climate. However, a commonly used goal for a well maintained system is to have no more than 20 breaks per 100 miles per year. Using this standard, the MWU annual main break goal would be no more than 182 main breaks per year for the Utility's 909 miles of pipeline. To reach the goal of a maximum of 20 breaks per 100 miles per year, MWU embarked on a program to replace or rehabilitate its aging water main system. In 2006, MWU identified over 400 miles of pipe to be replaced by the year 2055. MWU set a goal of replacing 10 miles of pipe per year for 40 years to update the system. In October 2017 the Utility celebrated completion of the 100th mile of main replacement since 2006.

Approximately 75% of all main breaks occur each winter from November to March. The annual total number of main breaks is driven by the severity of the winter weather and the depth of the frost. This fact was clearly illustrated during the polar vortex experienced in the winter of 2013/2014 when 292 main breaks occurred from November 2013 through March 2014. Total and winter main breaks by year since 2010 is presented in the following chart. The Annual

Main Break and the Winter Main Break totals are both trending down over the past 10 years potentially in part due to the replacement program started in 2006. The chart also indicates that from 2015 to 2017 the total number of main breaks was below the goal of 182 breaks per year. This could be the result of relatively mild winters during those years.



In 2005, Madison Water Utility completed its first Infrastructure Management Plan. This was a comprehensive condition assessment of all facilities both buried and above ground. The report laid out a plan to systematically renew the system over several decades. To update this system infrastructure renewal plan, MWU has developed an Asset Management Program. Utility staff, with the assistance of a consultant, GHD, completed an Asset Management Strategic Plan and an Asset Management Pilot project. Asset management strategies are being used to prioritize projects developed as a part of the Master Plan update.

The 2005 Infrastructure Management Plan recommended that the Utility invest a minimum of $9 million per year (2005 dollars) for pipe replacement and $2.5 million per year (2005 Dollars) for facility upgrade and renewal. In 2018, using Asset Management analytical methods, Utility staff developed a

pipe rating system. Using this system, the water system currently has 22.2 miles of pipe in a state of failure. Failure could be due to hydraulic limitations, break history, size, and age. Pipe in failure are designated as priority assets for replacement. Assuming no pipe replacement in the coming years, the total length of pipe in a failed state in 35 years, the year 2055, would grow to 252 miles. To mitigate this pipe failure, an average of 7.1 miles of pipe would need to be replaced each year. The anticipated annual cost for this pipe replacement program in 2020 dollars is $9.7 million.

MWU significantly increased its Capital Improvement Program for water main replacement in 2007. Using debt financing during eleven years of declining water demand has resulted in a significant debt load for MWU. In 2018, to manage debt load, the Utility significantly cut the capital pipe renewal budget to $9.65 million and facility projects were delayed to future years. The 2020 pipe renewal budget was further reduced to $7.0 million and the 2021 pipe renewal budget was set even lower at $4.32 million. Moving forward, the projected pipe renewal budget remains in the $3 or $4 million range through 2026. Facility projects have been delayed until 2022 when engineering design and planning work will resume. Facility construction is scheduled to resume in 2023.

MWU engineering staff develop and implement the Capital Improvement Program based on the approved annual Capital Budget. Pipe replacement projects are identified and developed in conjunction with City Engineering based on operational criteria, maintenance history, and staff recommendations.

MWU Utility engineers work closely with City Engineering to coordinate water main replacement projects with proposed street projects. Using the pipe rating system allows pipe replacement projects to be developed that maximize benefit to the water system. Coordinating water projects with street work saves the Utility pavement restoration costs and minimizes disruption to neighborhoods. Pipe segments are selected for replacement based on their overall rating, break history, hydraulic capacity, age, and material.

In an effort to repair system pipelines at lower cost and thus increase the impact of the total annual capital budget, a pipe lining program was started by MWU engineering staff in 2011. Working closely with Wisconsin DNR engineers, MWU successfully piloted and constructed the first water main lining project in the State of Wisconsin in the fall of 2011. Each year the program continues to grow as the Utility learns how to manage and process water main lining work. The cost of this operation, which rehabilitates the main to full pressure and structural capacity, is approximately 60% the cost of full replacement. It is expected that as competition for water main lining work increases in Wisconsin, the cost of lining will continue to go down. We

anticipate that savings will continue to grow as the cost of pipeline replacement continues to increase. Due to current overall debt load considerations, the pipe lining budget for 2020, is $200,000. This money is earmarked to fund the purchase of bypass piping materials. The objective is to for MWU crews to develop in house capability to provide water bypass systems for lining projects. MWU providing the bypass water system during a lining project will result in additional cost savings to the Utility. It is projected that pipe lining program will be fully restored in the 2021 capital budget with a budget of $$1,110,000.

Copies of the summary sheet for the 2020 and 2021 MWU Capital budgets are attached for information and review. The 2011 level of service memo and the Asset Management Key Service Area and External Levels of Service Performance Measures are also attached for the readers' information.

b. Redundancy and Reliability: The Utility shall build in the necessary system redundancy, shall maintain all components of the system, and shall develop operational procedures to ensure reliable water service to all points in the system.

Using master planning, utility engineering standard practices, and regulatory requirements through the decades, a system of redundant pumping stations, standby power generators, and gravity storage reservoirs has been developed and constructed throughout the Madison Water Utility system. The 909 miles of pipe link the twenty-two operating wells to feed the ten pressure zones across the City. Pressure zones are established and defined using topographic conditions and isolation valves in the system piping. In the event of an emergency, these zone isolation valves could be opened to move water from a higher zone to lower zone and maintain water service. Pumping redundancy is designed and constructed into the system. If a pump in the system has a mechanical failure and is removed from service, pumping systems still have the capacity to meet anticipated system water demands. All pressure zones have a minimum of one gravity fed reservoir that provides emergency water supply. System elevated reservoirs, generator powered wells, and ground level gravity fed reservoirs are designed and sized to provide up to 12 hours of emergency supply based on the annual average demand during a power outage. Reservoir sizing also provides firefighting capacity and peak demand supply. The system contains approximately 19.6 million gallons of gravity fed storage capacity.

The Utility currently has access to 16 standby power generators, 9 leased from MGE and 7 owned by the Utility. Fourteen generators provide power to well facilities providing reliable water supply to the system. Two generators power standalone booster pumping stations to move water between zones. The

Utility is currently in talks with MGE to add a 10th leased standby generator to the system that would increase well supply capacity during a power outage. For new facilities not equipped with a generator, electric transfer switches have been installed that will allow the connection of a portable generator. The Utility does not currently own a portable standby generator and intends to rent or lease a generator if needed. The generators provide approximately 44.5 million gallons per day of well supply to the system.

c) *Comprehensive Planning: The Utility will develop, routinely update, and implement long term facility and system comprehensive and master plans to identify system needs and funding opportunities.*

In 1964 MWU developed its first Water Master Plan to evaluate system needs, plan for the future, and establish projects required to provide a reliable, redundant, and robust water system, to expand the system to growing areas and to budget for those improvements. The most recent planning efforts completed by the Utility are 1) the 2006 update to the Water Master Plan, 2) the 2012 East Side Water Supply Project, and 3) the 2018 Water Master Plan update. These documents identify capital project needs based on long term population and service area projections, water demand analysis, system wide hydraulic analysis, water quality issues, identified deficiencies, and fire protection capacity and needs.

The Water Master Plan establishes a list of capital projects necessary to meet the MWU established level of service. Level of service and key performance indicators are being further developed as a part of the Asset Management Program to optimize existing facilities and to work toward a fully redundant and reliable water supply and distribution system. Copies of the current level of service criteria and the key performance indicators from the Asset Management Program are attached for information and use.

Utility engineering staff worked with SEH Inc. to complete the 2018 MWU Water Master Plan. This edition of the Master Plan utilizes data from the AMI system to update and recalibrate the distribution system hydraulic computer model. Current and future water demand scenarios are being developed to evaluate the system using the distribution system computer model. Using the model with projected water demands will identify deficiencies in the system. Projects are developed and recommended to effectively mitigate these deficiencies. Asset Management prioritization is used to rank projects for the MWU Capital Improvement Program. The prioritized projects will be listed in the annual capital budget. A comprehensive list of facility project needs is provided in the following table.

Rank	#	Alternative Title	Score	Year	Budget Cost ($Million)
1	WQW-01	Water Treatment addition at Unit Well 19	63	2023	$6.5
2	TW-04	Unit Well 12 Upgrade and Conversion to a Two Zone Well	56	2024	$4.5
3	TE-01	Upgrade BPS 213	51	2025	$2.3
4	WQE-01	Reconstruction and Upgrade of Unit Well 8 to 3 zone well	61	2027	$11.8
5	TW-05	BPS 128 Upgrade	51	2029	$0.8
6	SW-01	Unit Well 32 - Far West Side	66	2030	$9.9
7	WQW-08	Well 30 Fe and Mn Filter	60	2032	$5.5
8	WQW-06	Relocate Well 14	59	2034	$7.9
9	TW-12	Arbor Hills Cannon Ball Pipeline Mods	57	2036	$1.4
10	TE-02	Relocate BPS 129	55	2038	$3.1
11	WQW-07	Well 28 Fe and Mn Filter	54	2040	$6.5
12	WQW-10	Well 27 Fe, Mn & Radium Filter	54	2042	$6.5
13	WQW-09	Well 18 Air Stripper	53	2044	$5.0
14	WQW-10	Well 17 Fe and Mn Filter	52	2046	$8.0
15	WQW-10	Well 24 Fe and Mn Filter	51	2048	$6.5

For the last 3 years MWU staff has been working with GHD to develop the MWU asset management program. A system of asset condition assessment and rehabilitation or replacement planning is being developed to track utility assets and plan for restoration. This deliberate system of data collection and analysis will result in data driven decision making based on business case analysis and reduction in risk. It is expected that a new Asset Manager will be hired in early 2021 and development and refinement of the asset management program will continue over the next 2 to 3 years.

d) Maintenance and Repair Programs: The Utility's maintenance program will be proactive and preventative to maximize component reliability, efficiency, and life cycle costs within the system.

Wells, booster pumping stations, and reservoirs are routinely inspected, serviced, and maintained. System operation is monitored and recorded by the Utility SCADA system and by routine daily inspections by Utility Rounders. Well pumps are scheduled for removal, inspection, and rebuilding or replacing every 10 years. System reservoirs are inspected and cleaned every 5 to 10 years. MWU budgeted $592,000 in 2020 for planned well and facility maintenance projects, upgrades, and additions.

The MWU Asset Management Program will use a system of inspection, evaluation, and preventative maintenance procedures to maximize return on investment for maintenance work. CityWorks, a Computerized Maintenance Management System (CMMS) will continue to track investment in operating

and maintaining MWU assets. This system records all repair work and tracks maintenance operations providing operational data on the system.

e) *Minimizing unplanned Service Interruptions: Notification and management*

Unplanned service outages are typically due to water main breaks or mechanical breakdowns. When an outage occurs, MWU repair crews respond to the area and contact impacted customers in person and inform them of the situation and the expected length of the outage. When a water main break is identified, valves will be closed to minimize the impact of the break to the smallest area possible. Crews work with impacted customers to minimize the service disruption and will modify the repair work as needed. When water service is restored, utility crews check with area residents to make sure that there are no further complications resulting from the water outage.

During calendar year 2020 from January 1st to October 31st there have been 108 main breaks. This is down from 2019 when during the same period there were 182 main breaks. During the first 10 months of 2020, during the 108 main breaks there were an average of 8.3 customers out of water for 3.18 hours during each break. Each break is unique and may require more time to complete repairs or impact more customers.

During in the first 10 months of 2020, construction activities have resulted in 18 water main breaks. 123 total customers were out of water for an average duration of 2.5 hours due to these unanticipated construction related man breaks.

I report compliance.

2. Provide residents with adequate notice of planned service interruptions.

Planned service interruptions are necessary in the vicinity of pipe line replacement projects, valve and hydrants repairs, and many other maintenance and construction operations. Procedures established in construction contracts set the requirements for working with customers to minimize the disruption of their water service. Similar procedures are utilized by MWU crews during the various maintenance procedures that they perform throughout the year.

Prior to starting any planned work that will require an interruption of service; customers are individually notified. Either the contractor or a Water Utility employee contacts all impacted residents and explains the need for the work and the expected duration of the water outage. Contractors provide residents a minimum of 2 working days' notice of any planned service interruptions during their work. Planned service interruptions are typically 4

to 6 hours in length. If the resident is unnecessarily inconvenienced by the planned outage, the work crew will modify the work plan to accommodate the customer to the greatest extent possible. When the work is completed and water service has been restored, customers are notified and asked to flush their services to minimize the risk of problems.

During 2020, construction work has resulted in 44 planned water outages that impacted 105 customers for an average of 4 hours. Planned water outages by MWU crews are not tracked at this time but follow the same guidelines.

Due to the interconnected nature of the system, service interruptions due to maintenance of wells, pump stations, and reservoirs are rare and localized in nature. If an interruption of service due to work on a well, pumping station or reservoir is unavoidable, those impacted customers are notified by post card or door hanger a minimum of 7 to 10 days in advance of the planned interruption. Planned service interruptions are kept to no more than 4 to 8 hours. During 2020 there were no planned service interruptions due to work at a well, pump station or reservoir.

Consumers generally accept the inconvenience of water service interruption when proper notification is provided. Complaints resulting from planned service interruptions are generally caused by delays in re-establishing water service. Utility field personnel are diligent in minimizing the impacts of such delays. If a re-establishment of service is delayed, impacted customers will be notified of the additional delay as soon as possible.

I report compliance.

3. *Provide residents with adequate notice in the case of planned maintenance work that would significantly reduce water flow or pressure, and/or cause water discoloration.*

When a facility is taken out of service for planned maintenance work, the operation of other Water Utility facilities is modified to ensure that water service is not interrupted and pressures are stable. The water distribution system is interconnected and allows operating wells to provide service to all parts of a specific pressure zone.

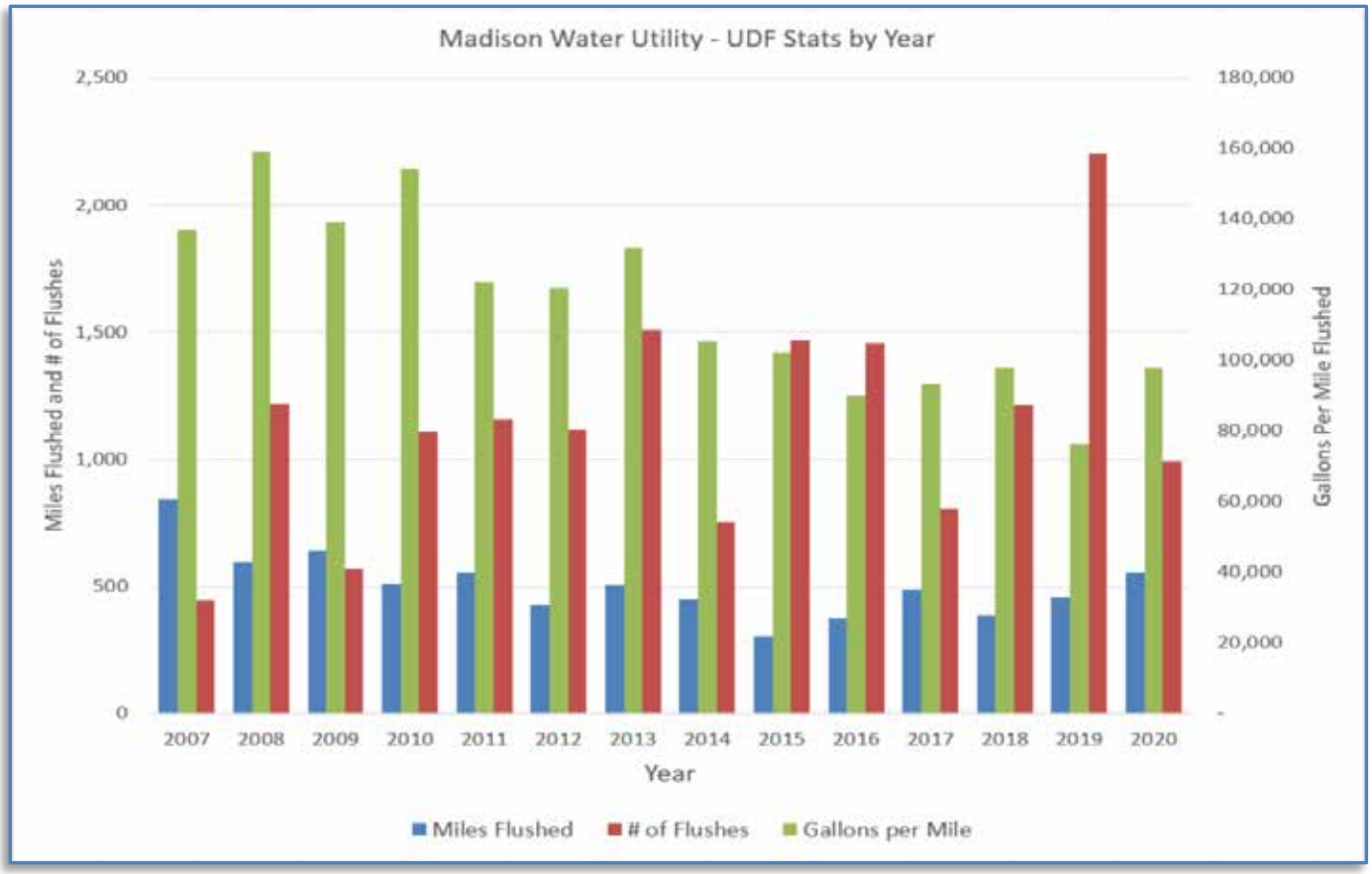
In the event that the removal of a facility from service has the potential of reducing water capacity and/or pressure and poses the risk of water discoloration, those impacted customers are notified by post card a minimum of 7 to 10 days in advance of the planned interruption. The Utility may also use other electronic means such as social media and email listserv to notify area residents of an anticipated reduction in service. Madison Fire Department is

notified whenever a reservoir is taken out of service for maintenance. While we do not anticipate a reduction in fire protection capacity, the MFD notification is considered a worthwhile precaution.

Since 2006, MWU has conducted annual unidirectional flushing of the system to maintain water quality and reduce the risk of colored water events. The annual unidirectional flushing program has a goal of flushing up to 500 miles of the system from April to November. Routine unidirectional flushing and cleaning of the distribution system will cause a temporary reduction in water pressure and flow in the immediate vicinity of the flushing operation and some temporary water discoloration in the neighborhood. Residents are notified of flushing activities and generally understand the benefits of flushing the system. Residents are notified of routine flushing operations in their neighborhood by yard signs, phone calls and an electronic listserv. Annual flushing schedules are published and posted on the Utility web page in the spring and a detailed schedule is maintained throughout the flushing work. During the 2020 flushing season, 554 miles of main were unidirectionally flushed using 54.3 million gallons of water with 993 hydrants operated.

The chart below indicates the historic unidirectional flushing data. It can be noted that the number of miles flushed varies from year to year depending on need and schedule, crew availability, and weather conditions. The benefits of routine flushing is also evident from this plot. Yearly flushing has resulted in a cleaner system that cleans up faster requiring less flushing water. Routine annual flushing makes flushing more efficient and effective.

I report compliance.



Attachments

1. 2020 Water Utility Capital Budget Summary
2. 2021 Water Utility Capital Budget Summary
3. 2011 Level of Service Memo
4. 2018 MWU_Samp_4.2 – Asset Management Key Service Area and External Levels of Service Performance Measures

City of Madison 2020 Capital Improvement Plan

Agency Request Summary

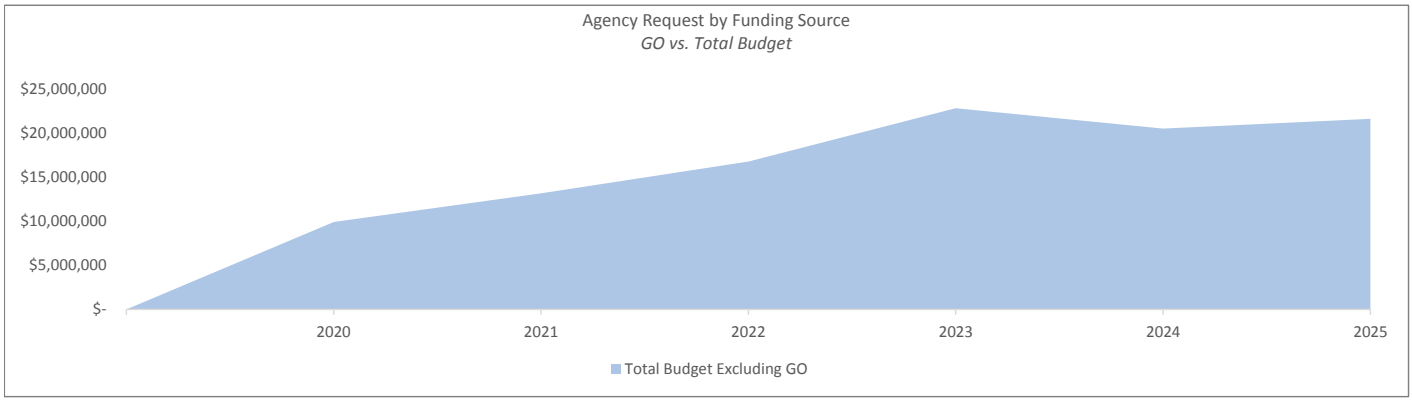
Agency : Water Utility

Agency Request by Item (All Funds)

	2020	2021	2022	2023	2024	2025
Water Utility Facility Improvements	592,000	492,000	884,000	522,000	539,000	555,000
Well 19 Iron and Manganese Filter	-	891,000	81,000	6,691,000	-	-
Unit Well 12 Conversion to a Two Zone Well	-	-	-	318,000	3,754,000	-
Water Mains Replace Rehab Improve - Pipe Lining	200,000	709,000	2,042,000	2,401,000	2,301,000	2,184,000
Water Mains Replace Rehab Improve - Reconstruct Streets	1,933,000	4,643,000	2,568,000	1,543,000	4,121,000	1,583,000
Water Mains Replace Rehab Improve - Pavement Manageme	785,000	3,869,000	4,745,000	3,561,000	2,962,000	1,995,000
Well 14 Mitigation	-	-	82,000	16,000	16,000	16,000
Water Utility Vehicles & Equipment	767,000	731,000	655,000	669,000	690,000	705,000
Water Meter and Fixed Network Program	650,000	666,000	683,000	700,000	718,000	736,000
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
Chlorinators & Florinators Program	31,000	32,000	33,000	34,000	35,000	36,000
Water Valve Cut-In Program	15,000	16,000	16,000	17,000	17,000	18,000
Westside Water Supply	-	153,000	2,370,000	1,127,000	971,000	7,531,000
Unit Well #8 Reconstruction	-	-	-	-	-	87,000
Booster Pump Station #213 Lakeview Reconstruction	-	-	-	-	-	238,000
Booster Pump Station #128 Upgrade	-	-	-	92,000	440,000	-
Unit Well #15	-	82,000	16,000	16,000	16,000	16,000
Water Mains - New	4,082,000	96,000	1,780,000	4,276,000	3,081,000	5,019,000
	$ 9,925,000	**$ 13,187,000**	**$ 16,793,000**	**$ 22,854,000**	**$ 20,550,000**	**$ 21,641,000**

Agency Request by Funding Source

Project	2020	2021	2022	2023	2024	2025
Reserves Applied - Water	2,333,000	2,252,000	2,225,000	2,291,000	2,349,000	2,417,000
Revenue Bonds-Water	7,592,000	10,935,000	14,568,000	20,563,000	18,201,000	19,224,000
Total	**$ 9,925,000**	**$ 13,187,000**	**$ 16,793,000**	**$ 22,854,000**	**$ 20,550,000**	**$ 21,641,000**



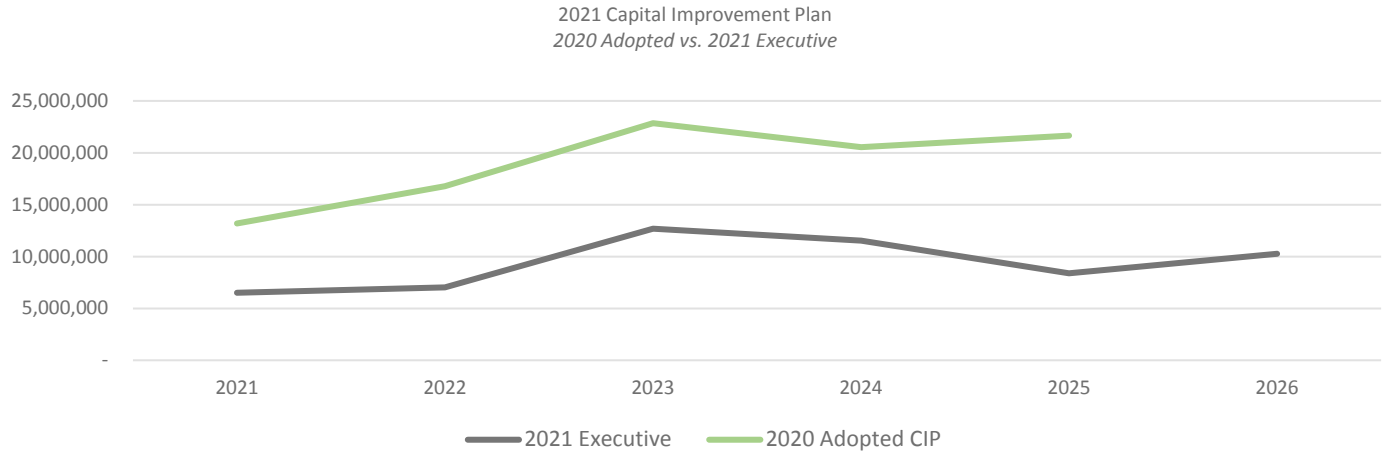
Water Utility

Capital Improvement Plan

Project Summary: Executive Budget

	2021	2022	2023	2024	2025	2026
Booster Pump Station #213 Lakeview Reconstruc	-	-	-	188,000	1,161,000	-
Chlorinators & Florinators	31,000	35,000	35,000	40,000	40,000	41,000
Unit Well #15	122,000	-	-	-	-	-
Unit Well #8 Reconstruction	120,000	-	-	88,000	1,778,000	2,292,000
Unit Well 12 Conversion	-	-	263,000	3,754,000	41,000	-
Unit Well Rehab Program	240,000	330,000	247,000	340,000	254,000	350,000
UW#23 Abandonment	50,000	-	-	-	-	-
Water Hydrants Program	350,000	350,000	350,000	350,000	350,000	350,000
Water Mains - New	152,000	159,000	166,000	1,429,000	178,000	185,000
Water Mains - Pavement Mgt	1,208,000	1,586,000	1,286,000	335,000	362,000	378,000
Water Mains - Pipe Lining	1,110,000	983,000	1,111,000	1,036,000	1,077,000	1,419,000
Water Mains- Reconstruct Streets	1,848,000	392,000	593,000	1,662,000	1,169,000	2,917,000
Water Meter & Fixed Network Prg	500,000	513,000	526,000	539,000	552,000	566,000
Water Utility Facility Improvements	417,000	1,167,000	1,152,000	1,119,000	1,153,000	1,187,000
Water Utility Vehicles & Equipment	344,000	521,000	246,000	539,000	256,000	557,000
Water Valve Cut-In Program	16,000	16,000	17,000	18,000	19,000	20,000
Well 14 Mitigation	-	82,000	-	-	-	-
Well 19 Iron and Manganese Filter	-	891,000	6,691,000	81,000	-	-
Total	**$ 6,508,000**	**$ 7,025,000**	**$ 12,683,000**	**$ 11,518,000**	**$ 8,390,000**	**$ 10,262,000**

Changes from 2020 CIP



Major Changes

- Booster Pump Station #213 Lakeview Reconstruction
  - Project moved from 2025/26 to 2024/25
- Unit Well #15
  - Project moved from 2021-2025 to 2021
- Unit Well #8 Reconstruction
  - Project budget increased to include full project scope in the CIP ($4.2m)
  - Project moved from 2025 to 2021 and 2023-2026
- UW#23 Abandonment
  - Project added to CIP in 2021 ($50k)
- Water Utility Facility Improvements
  - Program budget increased in 2022-2025 based on scheduled facility improvements ($2.0m)
- Well 14 Mitigation
  - Project moved from 2021 to 2022

- Well 19 Iron and Manganese Filter

  Project moved from 2021-2023 to 2022-2024
- Program Budget Reductions

  Various program budgets reduced across CIP based on goals outlined in financial plan submitted to Public Service Commission

  Program budgets reduced include: Water Hydrants ($1.3m), New Water Mains ($12.2m), Water Main Replacements ($12.4m), Water Main Pipe Lining ($4.3m), Fixed Network ($873k), and Vehicle & Equipment Purchases ($1.5m)

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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Building a world of difference®

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TABLES

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: • 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: • 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: • 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) *Distribution System Requirements for Fire Protection*, AWWA M31, 1989

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.

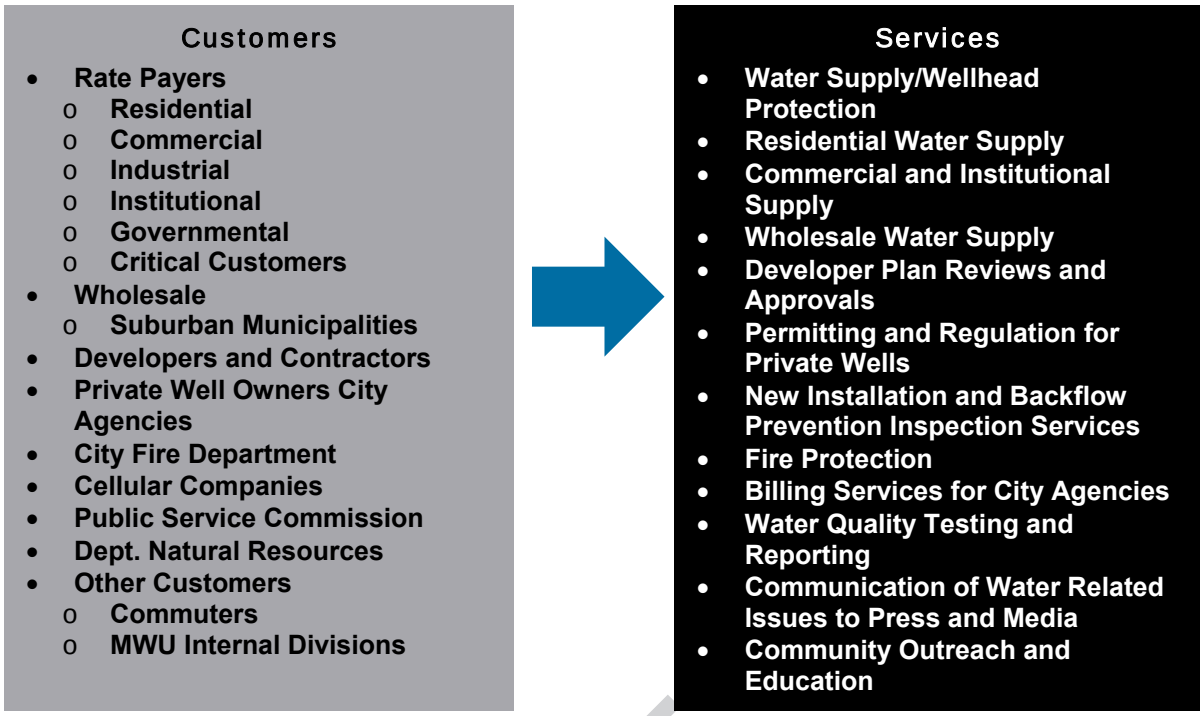

Figure 6 MWU Customers and Services Provided

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.

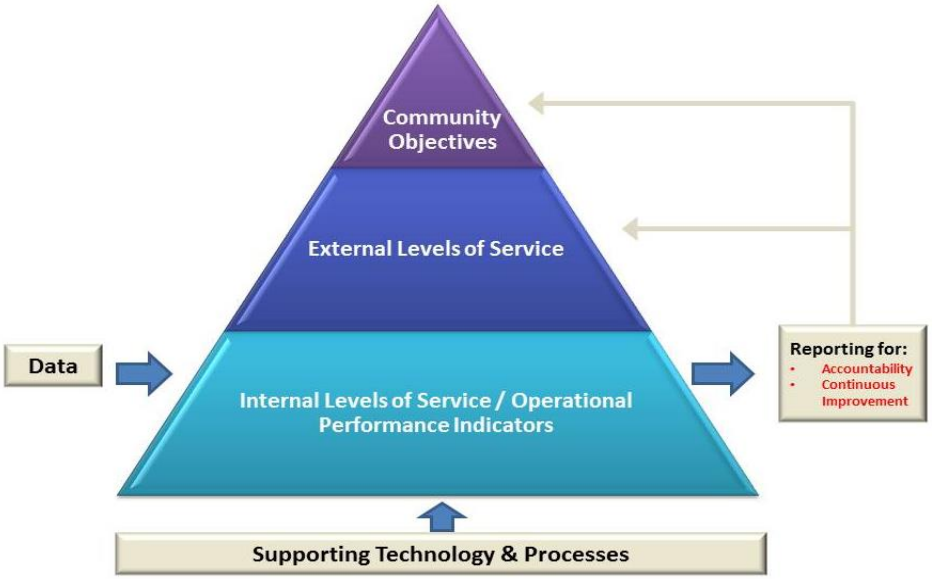

Figure 7 Levels of Service and Performance Measure Framework

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.

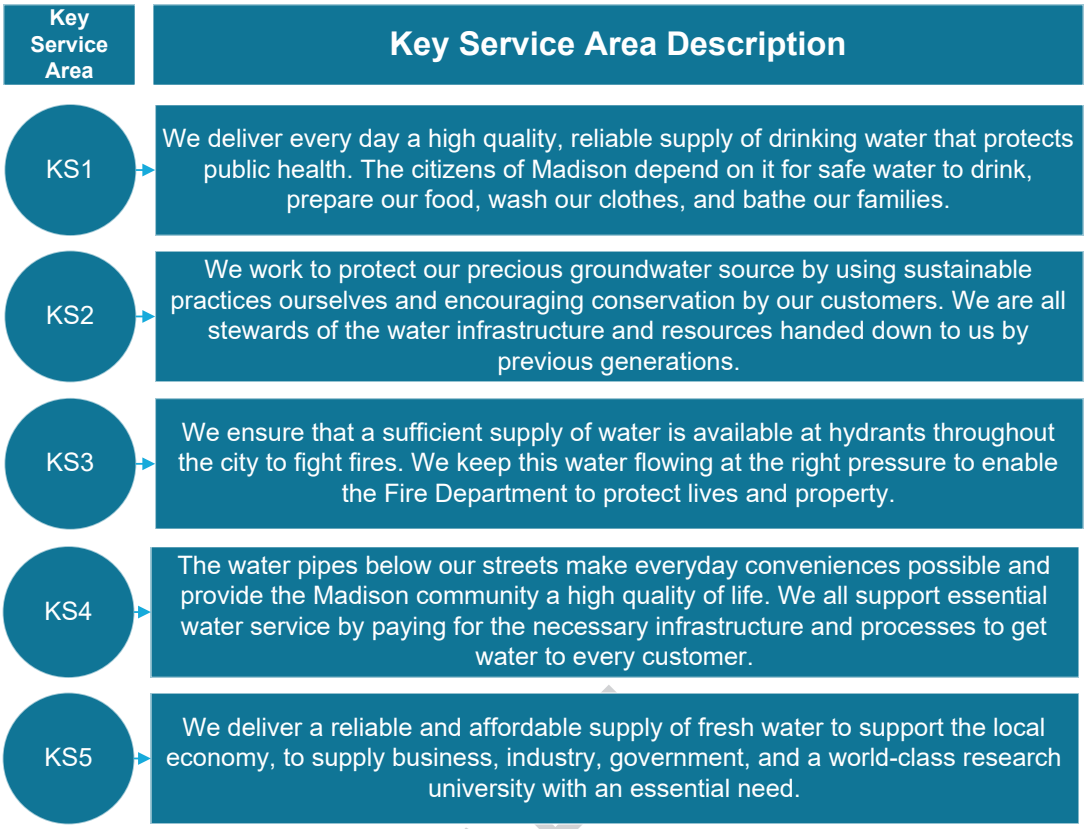

Figure 8 MWU Key Services Areas

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 # of earned media mentions # of content media articles # of content media articles picked up	TBD TBD TBD TBD	Press releases Earned media mentions Content media articles Content media articles picked up	22 in 2016 57 in 2016 11 in 2016 TBD
Responsive – Public Communication KS 1, 2, 3, 4, 5		# 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 Cl2 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