

Internal Monitoring Report

Policy # O-2E Sustainability

Date: July 28, 2020

Frequency: Twice a year

Policy Language:

Madison residents will benefit from a sustainably managed ground water supply to ensure that water is available to protect public health, and to maintain and improve the economy and environment in Madison, now and in the future.

Accordingly,

1. Aquifers and wells will be monitored and the data evaluated to identify trends in water levels and potential contaminants.
2. Appropriate city, county, state and federal agencies will be called upon to enforce all pollution control and prevention measures within their authority, in order to protect water quality in the well head protection area of each unit well.
3. The adopted Conservation Plan shall be monitored and evaluated regarding progress to fulfill the goal of a 20% reduction per capita residential use of water by 2020, which equates to 58 gallons/capita/day. (Residential is defined as single family and duplex dwellings.)
4. To prevent over pumping and improve redundancy, the Utility's service level for capacity planning shall be 50% utilization for each unit well. Therefore, the Utility shall strive to limit the average pumpage to 50% of the annual rated capacity of each well. This can be achieved through water conservation, water supply system expansion, and operating procedures.
5. The Utility shall track the carbon footprint of Utility operations using quantitative tools (for example, energy intensity analysis) so that sustainability may be considered in planning for water treatment facilities, distribution system improvements, and other infrastructure projects.

General Manager's interpretation and its justification:

This policy prescribes certain activities intended to ensure the long term environmental, public health, and economic sustainability of Madison's water supply. Our actions relating to these objectives are detailed below.

Data directly addressing the General Manager's interpretation:

1. *Aquifers and wells will be monitored and the data evaluated to identify trends in water levels and potential contaminants.*

Water Levels

The water levels in the aquifers beneath Madison continue to be monitored on a routine basis. A deep groundwater monitoring well located in the basement of the State Capitol has provided water levels since 1946. A review of the monthly data indicates aquifer

levels continue to vary on a seasonal basis, a direct result of discharge (pumping) and recharge (precipitation.)

As in past years, winter water levels were higher than those experienced during the summer months. On average, levels were as much as 8 feet higher during the months of November through April. Overall, aquifer levels appear to be increasing or rebounding with an increase of approximately 18 feet since 2005. This is a good indication that the local aquifers are in the process of rebounding/recovering to pre-pumping levels. Recent data suggest that this rebound might be slowing or leveling off. However, levels since winter 2018 have been significantly higher than in past years. The water levels beneath the central part of our city during the last 30 years are displayed in Figure 1.

The static and pumping water levels in many of the Utility's wells varied slightly during the first six months of 2020. Variations however, were significantly less than those experienced during past years (i.e., 2012) when we were subject to extremely hot and dry summer conditions. Water levels in the Utility's wells continue to fluctuate seasonally and are greatly influenced by both pumping and precipitation events. A review of the recent water level data indicates that, with the exception of several wells, many of the water levels (static and pumping) are dropping as summer demands increase. The decrease in water levels is very minor and similar to that experienced at this time last year. Sufficient water levels in all of the wells appear to be sustainable for the near future.

Total precipitation during the first half of 2020 was above average. Madison received 18.7 inches of precipitation from January through June, 2020 which is about 2.3 inches more (14% more) than the six month average of 16.4 inches. It is anticipated that precipitation amounts in the Madison area will continue to be above average into the near future. This is important to note as the aquifers are recharged to a great extent by precipitation events.

UW 29 Sentinel Well

Water from the sentinel well located between UW 29 and the Sycamore Landfill continues to be monitored for both inorganic and volatile organic compounds on a semi-annual basis. Sampling is typically conducted in April and October of each year with 22 sampling events conducted to date.

The well was sampled on May 6 of this year because of an issue with the laboratory conducting the analysis. The May 2020 sampling indicates that the migration of contaminants from the Sycamore landfill is **not** a significant threat to water quality at Unit Well 29 at this time. This well continues to pump at half capacity on a 24/7 basis.

Madison Kipp Corporation/UW #8 Sentinel Well

The Madison Kipp Corporation (MKC) continues to run its groundwater extraction and treatment system at its Waubesa Street site. The remedial system is being utilized to remove volatile organic compound (VOC) mass and hydraulically contain VOC contaminated groundwater present in the upper bedrock aquifer beneath the site.

The Utility continues to work with MKC, their consultant - TRC, the WDNR, and the WGNHS on the area's groundwater contamination issues. Groundwater at and adjacent to the facility continues to be monitored routinely for VOCs. The most recent groundwater results from the April and October 2019 samplings indicate that PCE levels in the groundwater between the site source and UW 8 remain relatively constant. The southeastern extent of the plume appears stable with the edge approximately 600 horizontal feet from UW 8. Contaminant concentrations within the extraction well's zone of contribution continue to decrease (improve).

The sentinel well planned for the UW 8 area has been postponed because of budgetary constraints. This deep monitoring well was to be installed at a location between the Madison Kipp Corporation groundwater contaminant plume and UW 8. Initial sampling would have provided MWU with deep groundwater quality information immediately north of the unit well. Subsequent routine sampling would have provided an early warning for any migrating contaminants. It is hopeful that this well can be installed in the near future.

UW 27 Radium Study/Monitoring Well

This study, including the groundwater monitoring well, has been put on hold until the appropriate funds become available

UW 19 - Radium Removal Study

A pilot scale test to remove iron, manganese and radium was recently completed at UW 19. The conclusions and results of this study will be utilized in designing the appropriate filter system for this site. The construction of the filter system has been postponed until the year 2023.

UW 14 - Chloride Study

The investigation into potential sources of chloride contamination at Well 14 is ongoing. The monitoring activities of the two water table monitoring wells located in

Spring Harbor Park were concluded in 2019. Results of the study should be available in the near future.

UW 15 - PFAS Removal

UW 15 has been out of service since March of 2019 because of PFAS concerns. This well is a very important component in our system as it once supplied approximately 1 million gallons per day to Zone 6E. To determine if this site can be brought back into the system, MWU recently asked for proposals to complete a MWU-led feasibility study to evaluate various treatment technologies for PFAS removal. TRC Environmental Corporation with Evoqua Water Technologies was selected to conduct the study. This study will include bench-scale testing, analytical modeling, preliminary design specifications, and cost estimating for a full-scale treatment system. It is hoped that the results will provide MWU with the most cost-effective treatment method to remove both PFAS and Volatile Organic Compounds from the water at UW 15. The study will take approximately 6 months to complete with the final report due to MWU no later than March 1, 2021.

UW 31 - Zone 4 Production Well

The WDNR continues to monitor the groundwater monitoring and remedial activities associated with the GE Health care site, a contaminated site located to the northeast of UW 31. There are no new updates to report for this site. To date, no TCE or any other volatile organic compounds have been detected at the Tradewinds Parkway well. The Tradewinds Parkway site is located over 6000 feet from the source of the TCE contamination.

2. Appropriate city, county, state and federal agencies will be called upon to enforce all pollution control and prevention measures within their authority...

The Utility continues to work with the Mayor's office, City Engineering, Public Health, the WDNR, and the WGNHS in addressing contaminated groundwater issues within the City limits.

3. The adopted Conservation Plan shall be monitored and evaluated regarding progress to fulfill the goal of a 20% reduction per capita residential use of water by 2020...

MWU pumped a total of 4,283,202,000 gallons of water to the distribution system during the first half of 2020. This is approximately 2.9% less than the 4,413,214,000

gallons pumped during the first half of last year (2019). 2020 average, maximum and minimum day volumes were similar to last year.

2020 Average Day: 23,534,000 gallons (last year 24,382,000 gallons)

2020 Max Day: 30,150,000 gallons on June 18 (last year 29,660,000 gallons - June 5)

2020 Min Day: 18,870,000 gallons on April 19 (last year 19,090,000 gallons - Jan. 1)

As mentioned earlier in this report, precipitation for the first half of 2020 is currently above average. In addition, rainfall events have occurred on a fairly regular basis limiting the number of heavy pumpage days.

Residential consumption in gallons per capita by year:

Goal: 2020 58

Year(s)	Single-family homes /duplexes: Average per-person daily consumption	Multifamily homes/ apartments: Average per-person daily consumption	All residential: Average per-person daily consumption
1980-2000	81.5		
2002-2007	71.8		
2008	69.8		
2009	67.8		
2010	65.0		
2011	65.2		
2012	70.3		
2013	61.0		
2014	62.2		
2015	60.9	55.0	
2016	55.4	46.7	51.4
2017	55.4	46.0	51.1
2018	53.0	44.3	48.9
2019	50.8	43.1	47.1
2020	In progress	--	--

4. To prevent over pumping and improve redundancy, the Utility's service level for capacity planning shall be 50% utilization for each unit well.....

Our service level for capacity planning is 50% utilization. One of the ways to accomplish this level is through system expansion and/or modification. The Utility continues to propose and build additional booster stations, PRVs, and new well facilities to help achieve this goal. In addition, variable frequency drives (VFDs) are being added to existing motors/pumps each year to optimize system flows.

Overall, utilization rates during the first half of 2020 were very similar to those experienced in 2019. Through June 30, 2020, five different wells (7, 11, 12, 14, 18 and 30) slightly exceeded the 50% utilization rate (see table 1).

- The rates at three of the wells (7, 11 and 12) can be decreased by increasing pumpage at adjacent sites. We will try to slightly increase pumpage rates at adjacent sites to lessen the usage of these three wells during the second half of 2020.
- Unfortunately, the utilization rate at 18 continues to increase. The specific capacity at this well continues to decrease resulting in the need to pump it longer. The formation pores within the borehole are likely becoming plugged with deposits and need rehabilitation. This procedure is expensive and has been budgeted for. It is expected to be addressed in December of this year.
- Rates at the other two well sites (14 and 30) cannot be lessened without improvements to the Utility's infrastructure.

Well repair/reconstruction projects and the necessary use of seasonal wells on a year round basis continue to significantly influence individual well rates.

The addition of VFDs on the deep wells at a number of its sites has allowed the Utility to directly minimize the utilization rates of these wells. In addition, they will help in lowering the Utility's electrical costs. Twelve deep wells currently have VFDs - 6, 7, 14, 15, 17, 23, 25, 26, 27, 29, 30, and 31. Well 13 is scheduled to get a VFD on its deep well later year.

Indirectly, VFDs on booster pumps have also allowed us to minimize deep well pumping at some sites. MWU recently installed VFDs on the booster pumps at Wells 6 and 27. The booster pumps at Wells 9 and 13 are scheduled to get VFDs installed on their booster pumps later this year.

MWU continues to automate the operations at a number of its well sites utilizing its SCADA system. Certain wells and boosters now operate on a time basis, insuring that a certain amount of run time/volume is produced on a daily basis. This, where implemented, has allowed us to control utilization rates significantly. We will continue to expand the automated operations where possible in the near future.

MWU is also currently planning/working on several construction projects which will affect utilization rates:

- The construction of a booster station 109 at the UW 9 well site. This project, which is scheduled to begin in September of this year, will make UW 9 a two

zone well, allowing the transfer of water from Zone 4 (surplus water) to Zone 6E (water deficient at times.) Utilization rates will increase at wells 9 and 31 while decreasing at wells 7 and 11.

- The reconstruction of UW 12, making it a two zone well, will allow optimization of utilization rates for the wells in the far west pressure zones (Zones 7 and 8). This project is scheduled for 2024.
- The construction of Booster Station 129 on the Far East side of the city. The addition of this facility will reduce utilization rates at UW 25, the only well site located in Zone 3. This project is scheduled for 2025.
- The construction of a new well on the far west side of the city. The project would lower the utilization rates for all of the wells located in Zone 8. It is projected to occur in 2025.

5. The Utility shall track the carbon footprint of Utility operations using quantitative tools (for example, energy intensity analysis) so that sustainability may be considered in planning...

Prior to 2018, the City of Madison (COM) calculated the carbon footprint of all of its departments every two years. The Utility had planned to do their own in house analysis for the year 2019 with the help of a UW student. Unfortunately, the student hire had to be postponed because of the City's 2020 hiring freeze. It is hoped that the hire can be completed in early 2021.

Energy Conservation Assessment- Graduate Student

MWU's sponsored Graduate Student, Tara Hawes, continues with her energy conservation research on pumping operations. Tara is working on developing an energy conservation pumping schedule with the goal of minimizing costs and energy. The specific objectives of this energy conservation research project include:

1. Identifying pumping operation protocols and schedules that will optimize energy conservation.
2. Identifying projects with the highest potential for energy reduction.
3. Evaluating ways to reduce energy costs through off-peak pumping.
4. Evaluating, recommending, and demonstrating energy conservation projects.
5. Developing the framework for system pump optimization.

Tara is currently analyzing energy requirements and pumping schedules for Pressure Zones 6e and 3, the east side of the system. Using SCADA data and the system computer model, pump operating times and sequences are evaluated for energy use. As noted in the far west study completed last year, peak charges significantly impact overall energy costs. Controlling peak energy use within Zones 6e and 3 is expected to have a cost savings similar to the west side. Ideally, protocols developed will guide

further optimization of operations and additional opportunities for energy conservation will be identified.

I report compliance.

Attachments:

Aquifer Water Level Graph
Unit Well Capacity Table

Figure 1: Aquifer Water Levels - State Capitol Well

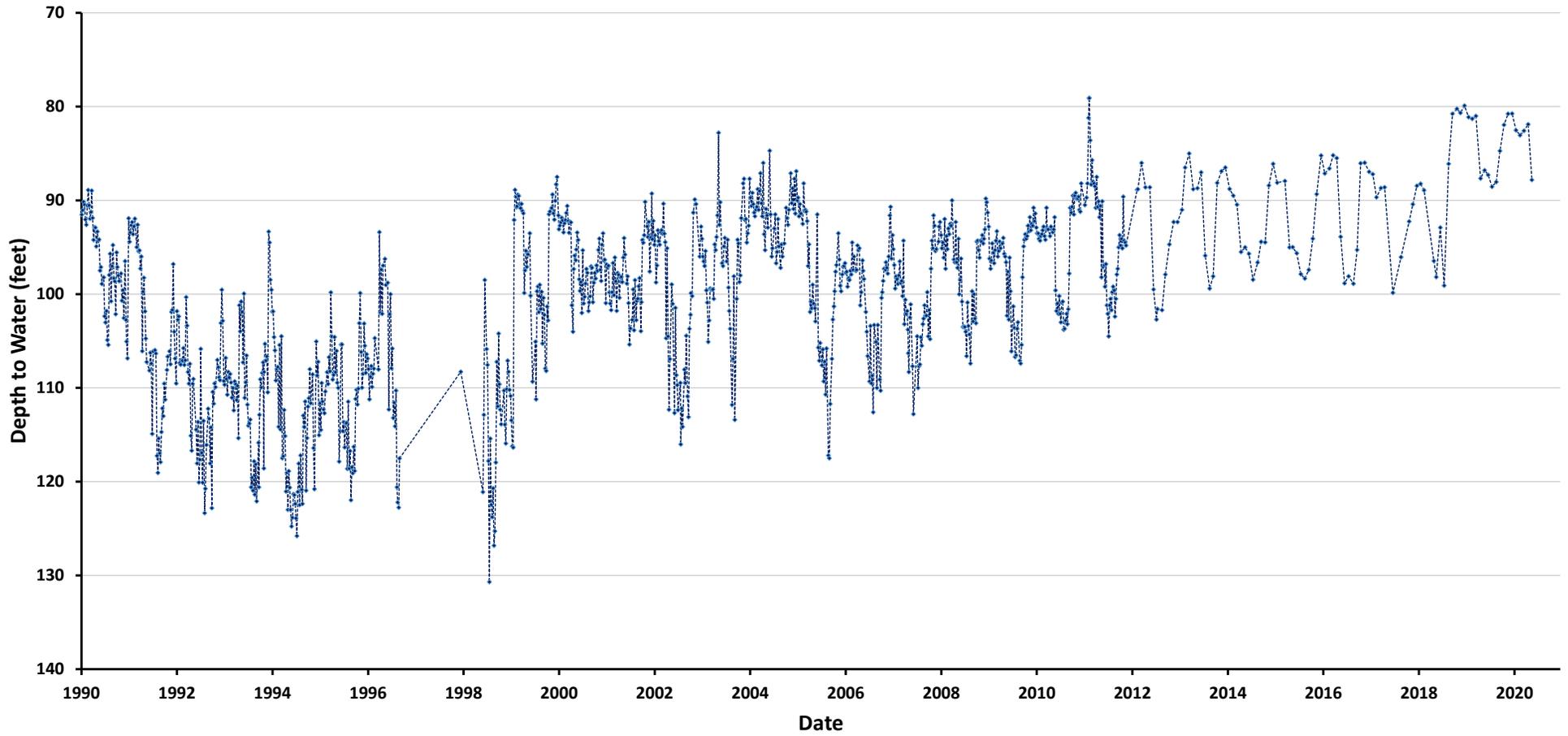


Table 1: 2020 Unit Well Capacity

Start Date: January 01, 2020

End Date: June 30, 2020

Unit Well	DW Capacity GPM	Total Daily Capacity MGD	Total Capacity To Date Mil Gal	Actual Pumpage To Date Mil Gal	% DW Utilization		DW Run Hours To Date	DW Rest Hours To Date	% DW At Rest To Date	% DW Running To Date
6 *	2,650	3.8	690.7	226.5	32.8%		1,551.1	2,816.9	64.5%	35.5%
7 *	2,200	3.2	573.4	292.3	51.0%		2,805.6	1,562.4	35.8%	64.2%
8	1,980	2.9	516.1	40.0	7.8%		373.3	3,994.7	91.5%	8.5%
9	1,640	2.4	427.4	66.1	15.5%		663.0	3,705.0	84.8%	15.2%
11	2,090	3.0	544.7	284.1	52.2%		2,263.2	2,104.8	48.2%	51.8%
12	2,200	3.2	573.4	294.0	51.3%		2,175.2	2,192.8	50.2%	49.8%
13	2,600	3.7	677.7	238.0	35.1%		1,594.3	2,773.7	63.5%	36.5%
14 *	2,450	3.5	638.6	326.1	51.1%		3,153.3	1,214.7	27.8%	72.2%
15 *	2,200	3.2	573.4	0.0	0.0%		0.0	4,368.0	100.0%	0.0%
16	2,400	3.5	625.5	222.4	35.6%		1,529.2	2,838.8	65.0%	35.0%
17 *	2,290	3.3	596.9	79.6	13.3%		1,305.8	3,062.2	70.1%	29.9%
18	1,550	2.2	404.0	213.6	52.9%		2,204.8	2,163.2	49.5%	50.5%
19	2,350	3.4	612.5	145.8	23.8%		1,017.5	3,350.5	76.7%	23.3%
20	2,025	2.9	527.7	228.8	43.4%		1,850.8	2,517.2	57.6%	42.4%
23 *	1,310	1.9	341.4	0.0	0.0%		0.0	4,368.0	100.0%	0.0%
24	2,025	2.9	527.8	169.8	32.2%		1,369.3	2,998.7	68.7%	31.3%
25 *	2,000	2.9	521.3	193.3	37.1%		1,998.9	2,369.1	54.2%	45.8%
26 *	2,250	3.2	586.4	230.4	39.3%		1,864.0	2,504.0	57.3%	42.7%
27 *	1,775	2.6	462.6	107.1	23.1%		1,036.2	3,331.8	76.3%	23.7%
28	2,250	3.2	586.4	245.2	41.8%		1,811.8	2,556.2	58.5%	41.5%
29 *	2,200	3.2	573.4	281.2	49.0%		4,237.0	131.0	3.0%	97.0%
30 *	2,400	3.5	625.5	328.9	52.6%		4,021.8	346.2	7.9%	92.1%
31 *	2,200	3.2	573.4	79.8	13.9%		985.5	3,382.5	77.4%	22.6%

* Denotes wells with variable frequency drives (VFDs)