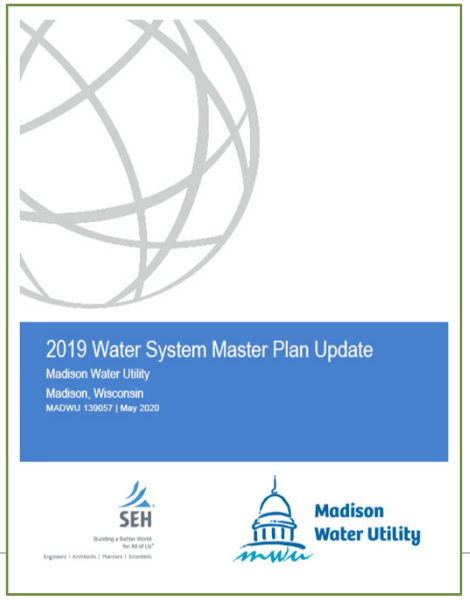
Madison Water Master Plan



Final Draft

Presentation to the Water Utility Board

November 24, 2020

Madison Water Utility

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Presentation Outline

- Growth Projections
- Historic Water Demands
- Conservation Impacts
- Projected Water Needs
- System Analysis
- Capital Improvement Program

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Executive Summary

- Master Plan meets WUB Policy for Long Term Planning
- Service Area Population may increase by 24% by 2040
- Water conservation is expected to continue and to improve
  - ✓System Annual Avg Water demand may increase: 0% to 13%
  - ✓Drought Max Day to Avg Day demand ratios may decrease 8%
- System is in good shape for fire flow, avg day supply, & pressure
- Drought conditions may stress supply during periods of max demand
- Projects: water quality & facility renewal: $60M over next 20 yrs
- Pipelines: Renew 7.1 miles per year @ $9.7M/yr

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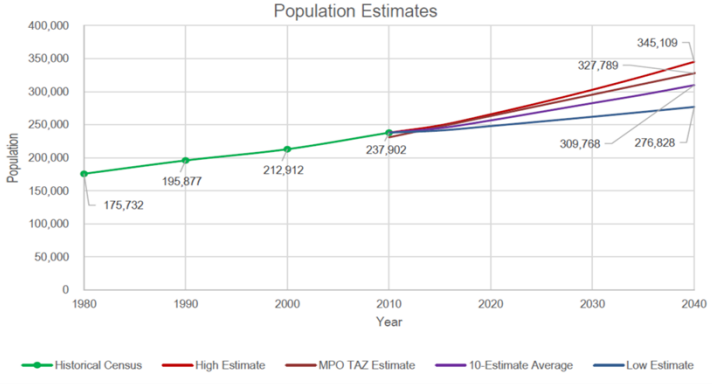
Population Projections

Table 2-3: Draft Population Estimates Provided by DPCED

Year	10-Estimate Average Population	10-Estimate Average Households	High Estimate Population	High Estimate Households	Low Estimate Population	Low Estimate Households
2015	244,704	109,885	248,956	113,500	241,177	108,151
2020	256,496	116,099	265,756	120,798	247,919	112,690
2025	269,510	122,971	283,695	130,135	254,850	116,904
2030	282,622	129,454	302,844	139,560	261,975	120,726
2035	295,575	136,266	323,287	150,366	269,299	125,255
2040	309,768	143,135	345,109	161,266	276,828	129,359
Annual Growth Rate	**0.95%**	**1.06%**	**1.31%**	**1.41%**	**0.55%**	**0.72%**

Figure 2-1 Historical and Projected Population Estimates



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Historic Water Demand

Table 3-1: Historical Water Production

	Year	AD (mgd)	MD (mgd)	MD:AD Ratio	MinD (mgd)	MinD:AD Ratio
	2007	31.2	54.0	1.73	22.4	0.72
	2008	29.9	45.1	1.51	21.1	0.70
	2009	28.4	41.9	1.48	18.4	0.65
	2010	28.1	39.8	1.42	18.3	0.65
	2011	28.3	43.0	1.52	18.6	0.66
Last Drought Year	2012	29.2	49.9	1.71	16.5	0.56
	2013	27.6	43.1	1.56	18.9	0.69
	2014	27.7	45.0	1.63	15.6	0.56
	2015	27.3	39.8	1.46	19.8	0.73
	2016	27.0	38.3	1.42	19.5	0.72
	Maximum	**31.2**	**54.0**	**1.73**	**22.4**	**0.73**
	90th Percentile	**30.0**	**50.3**	**1.71**	**21.2**	**0.72**
	5-year Average	**27.7**	**43.2**	**1.56**	**18.1**	**0.65**
	Minimum	**27.0**	**38.3**	**1.42**	**15.6**	**0.56**

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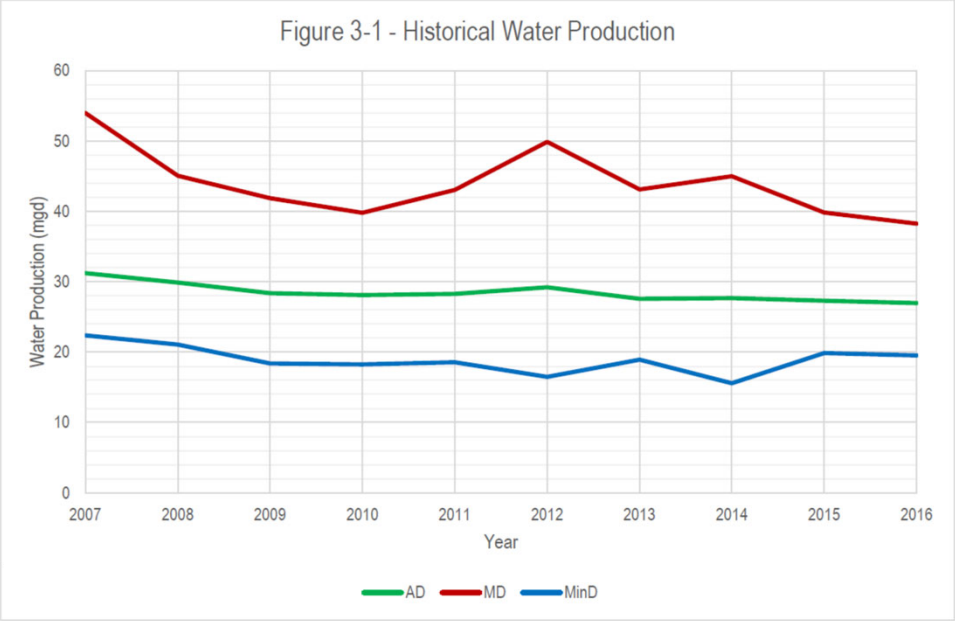
Historic Water Demand



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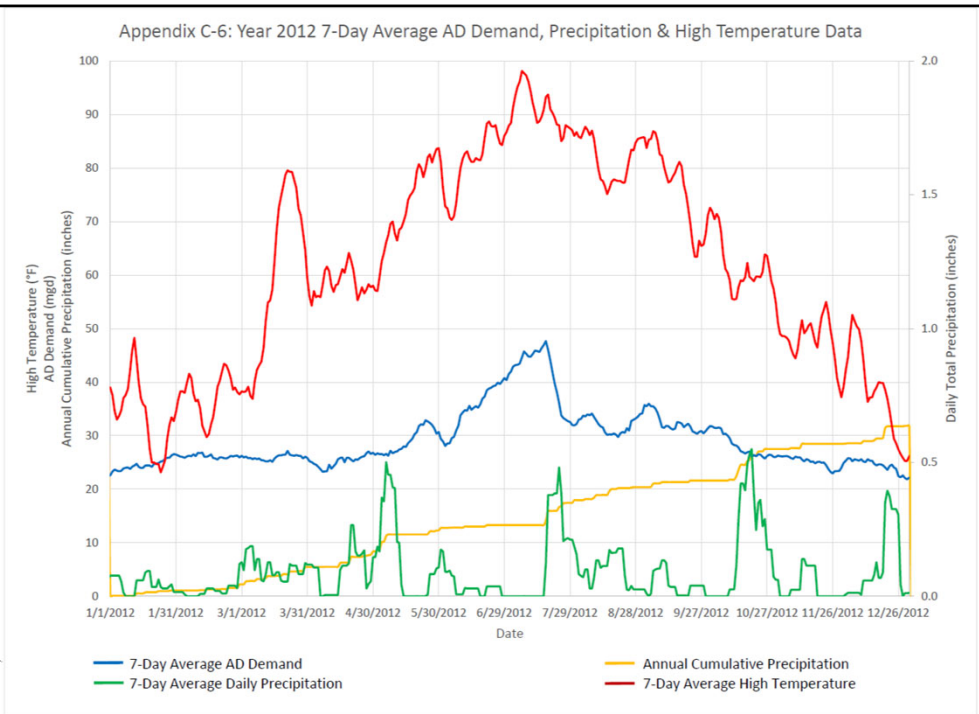
2012 Seasonal Water Use



Water Conservation – How low can you go?

Table 3-7: Indoor Conservation Potential - Per Capita Water Use

Water Use	REU 1999	REU 2016	2007 CP	High Eff.
Showers	11.6	11.1	8.8	8.4
Clothes Washers	15	9.6	10	4.7
Dishwashers	1	0.7	0.7	0.4
Toilets	18.5	14.2	8.2	6.1
Baths	1.2	1.5	1.2	5.8
Leaks	9.5	7.9	4	3.2
Faucets	10.9	11.1	10.8	6.5
Other Domestic Uses	1.6	2.5	1.6	1.6
TOTAL	**69.3**	**58.6**	**45.3**	**36.7**

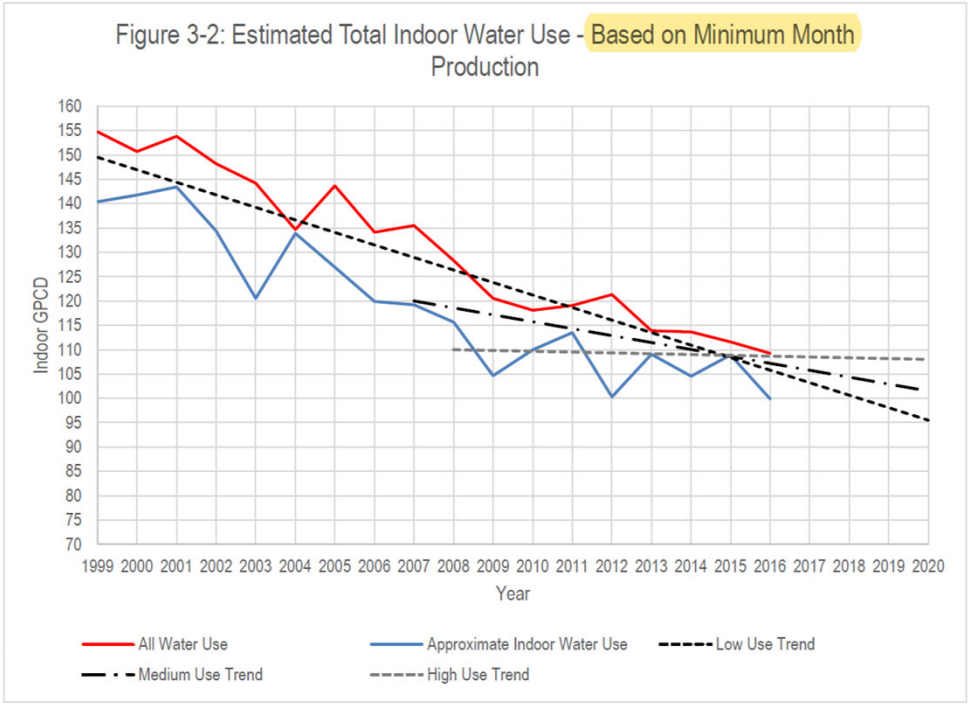
1999 report, Residential end use of water (REU 1999)
2016 report, Residential end use of water, Version 2 (REU 2016)
2007 Madison Water Conservation Plan (Vickers, Amy. 2002. Handbook of Water Use and Conservation: Homes, Landscapes, Industries, Businesses, Farms.
High Eff from 2016 report, Residential end use of water, Version 2 (REU 2016)

Madison 2020
Madison Residential: 50.8 gpcpd
Est. Indoor Use: 45.3 gpcpd
Avg Annual Outdoor Use: 5.5 gpcpd*
* Assume Outdoor annual average is constant
Est. Lowest Indoor Use: 36.7 gpcpd
Projected Lower Limit 42.2 gpcpd

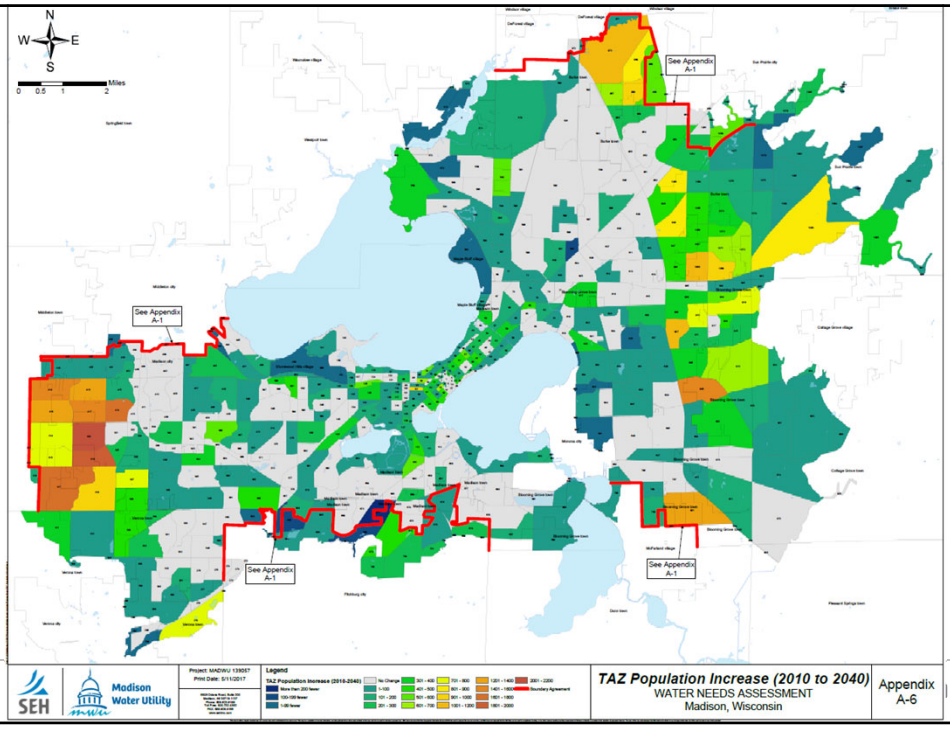
Speculated Lowest Projection:
2040 Avg Day: 27.8 MG

Based on Residential demands for Single Family and Duplex Homes

Water Conservation

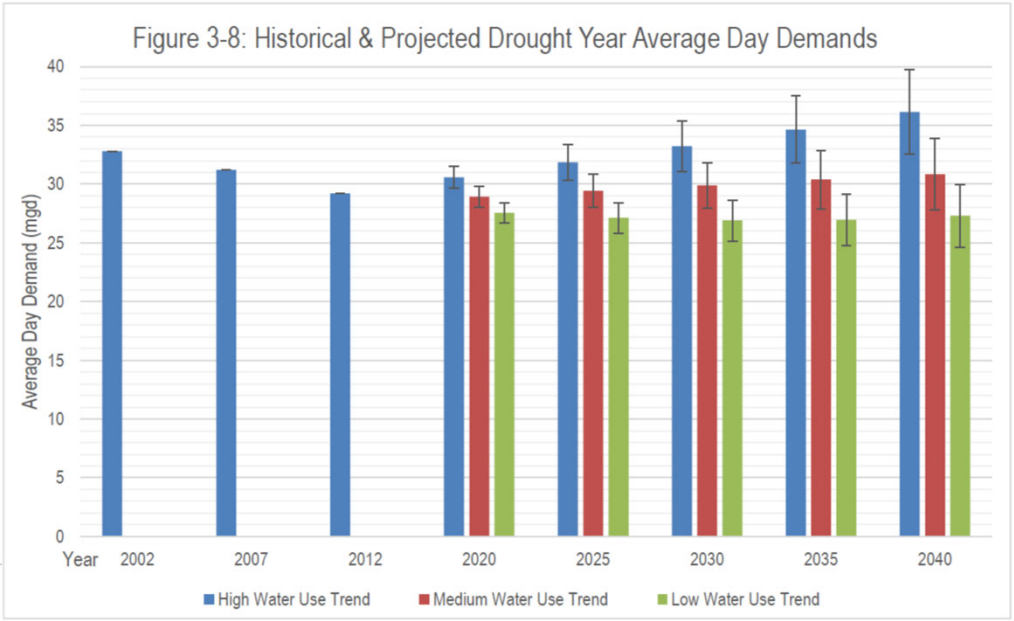


Growth Location



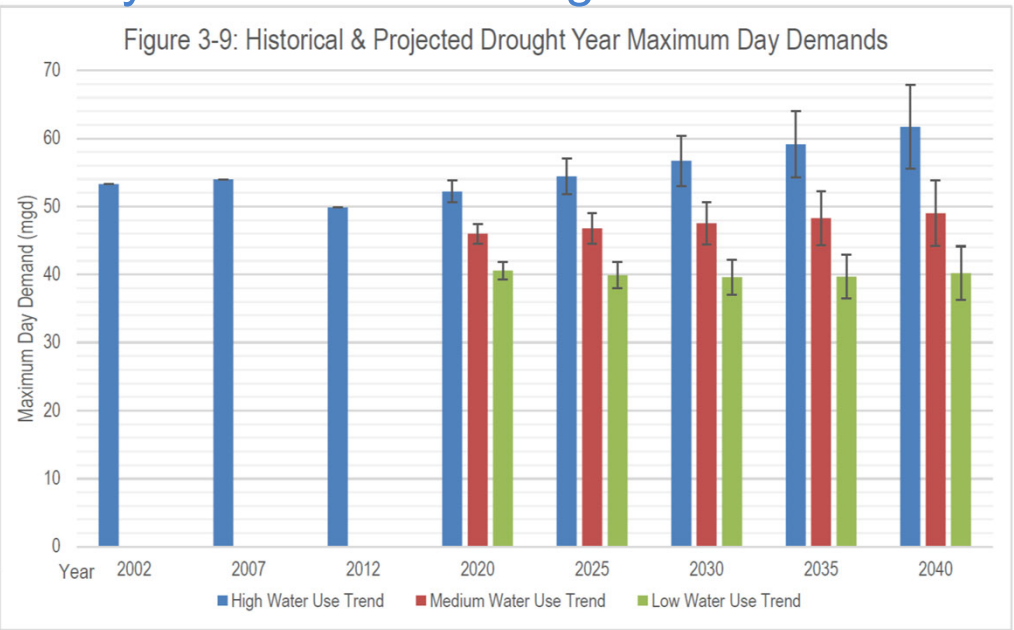
Average Day Demands – Drought Year

- Projections are typically expressed as a range based on past data.
- Actual conditions and trends in the future are unknown.



Maximum Day Demands – Drought Year

- Projections are typically expressed as a range based on past data.
- Actual conditions and trends in the future are unknown.



Hydraulic Analysis Criteria

- Use AMI water demand data
- Recalibrate the system computer model to current conditions
- Develop manageable analysis areas
  - ✓Regions and Geographical Areas
- Assume 3 wells are out of service in the analysis area
- WUB policy requires redundancy and reliability
- Evaluate Avg Day, Max Day, Max 10-Day demand patterns
- Fire Flow capacity
- Water Transfer Potential between zones

Modeling Analysis

- Identify System Deficiencies
- Design Period
  - ✓2020 = Short Term
  - ✓2040 = Long Term
- Extended Period Computer Simulation – Max 10 Day
- Develop Alternatives to Mitigate Deficiencies
- Test Alternatives
- Refine Alternative and Retest

Max 10 Day Period Analysis

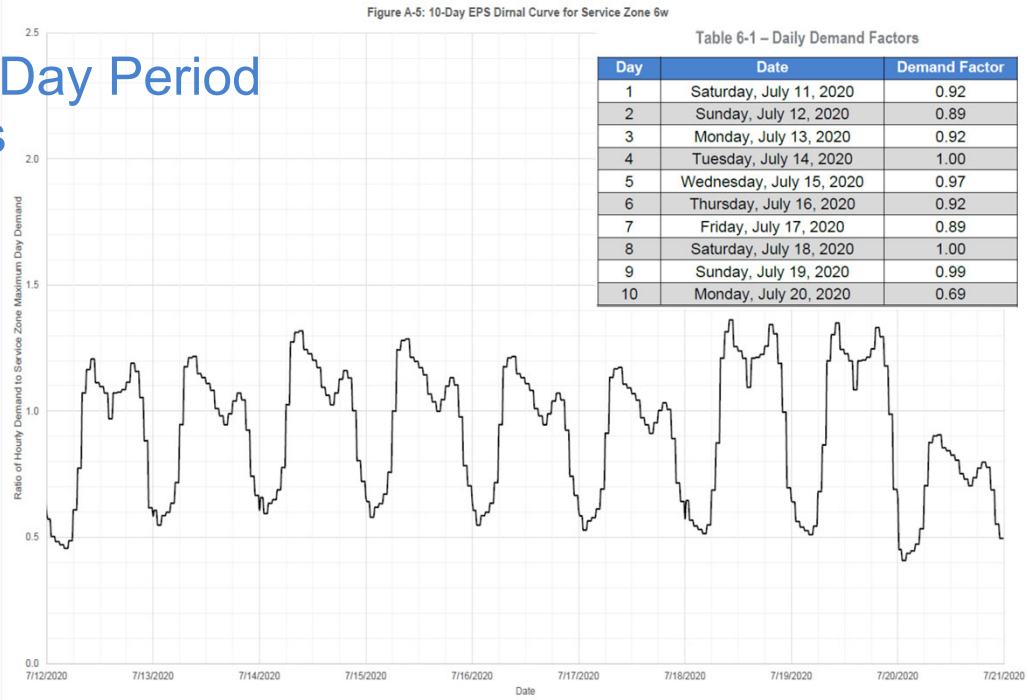


Table 6-1 – Daily Demand Factors

Day	Date	Demand Factor
1	Saturday, July 11, 2020	0.92
2	Sunday, July 12, 2020	0.89
3	Monday, July 13, 2020	0.92
4	Tuesday, July 14, 2020	1.00
5	Wednesday, July 15, 2020	0.97
6	Thursday, July 16, 2020	0.92
7	Friday, July 17, 2020	0.89
8	Saturday, July 18, 2020	1.00
9	Sunday, July 19, 2020	0.99
10	Monday, July 20, 2020	0.69

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Water Supply Mass Balance

- Evaluate regional water demand projections
- ID areas of need
- ID areas of surplus
- Evaluate pumping water from area of surplus to area of need
- Consolidate geographical areas, east and west
- Develop alternatives that mitigate deficiencies

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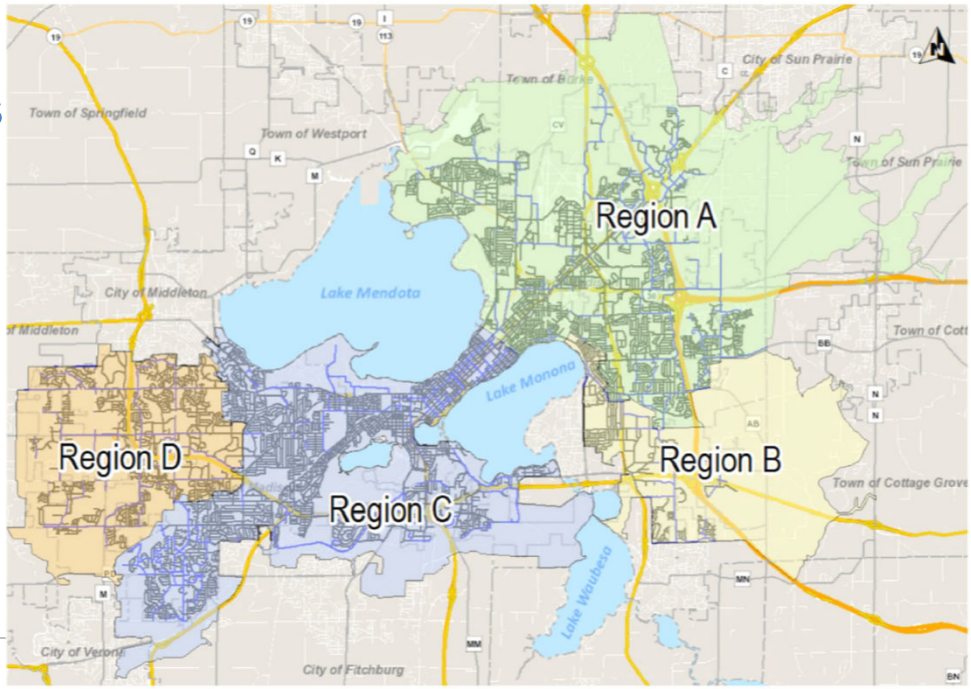
Demand Projections by Region



Mass Balance – Region D - (Zones 6w, 7 & 9)

Supply Capacity Analysis	Design Year				
	2020	2025	2030	2035	2040
Condition 1 - Average Day Capacity					
Average Day Demand (mgd)[2]	4.5	4.7	4.8	5.0	5.1
Existing 12-Hour Pumping Capacity (mgd)[3]	4.6				
12-Hour Capacity Mass Balance (mgd)[4]	0.1	-0.1	-0.2	-0.4	-0.5
Condition 2a - Maximum Day Capacity					
Maximum Day Demand (mgd)[1]	10.1	10.8	11.5	12.2	12.9
Existing Firm Supply Capacity (mgd)[3]	6.0				
Firm Capacity Mass Balance (mgd)[4]	**-4.1**	**-4.8**	**-5.5**	**-6.2**	**-6.9**
Condition 2b - 115 % Maximum Day Capacity					
115 % Maximum Day Demand (mgd)	11.6	12.4	13.2	14.0	14.8
Existing Total Pumping Capacity (mgd)[3]	9.2				
115 % Max Day Capacity Mass Balance (mgd)[4]	-2.4	-3.2	-4.0	-4.8	-5.6

[1] See Appendix G of Chapter 2-2 (*Water Needs Analysis Report*).
[2] See Appendix F of Chapter 2-2.
[3] See Appendix D of Chapter 3 (Hydraulic Analysis Report).
[4] Positive numbers equals the potential pumping capacity surplus. Negative numbers equal the pumping capacity deficit.

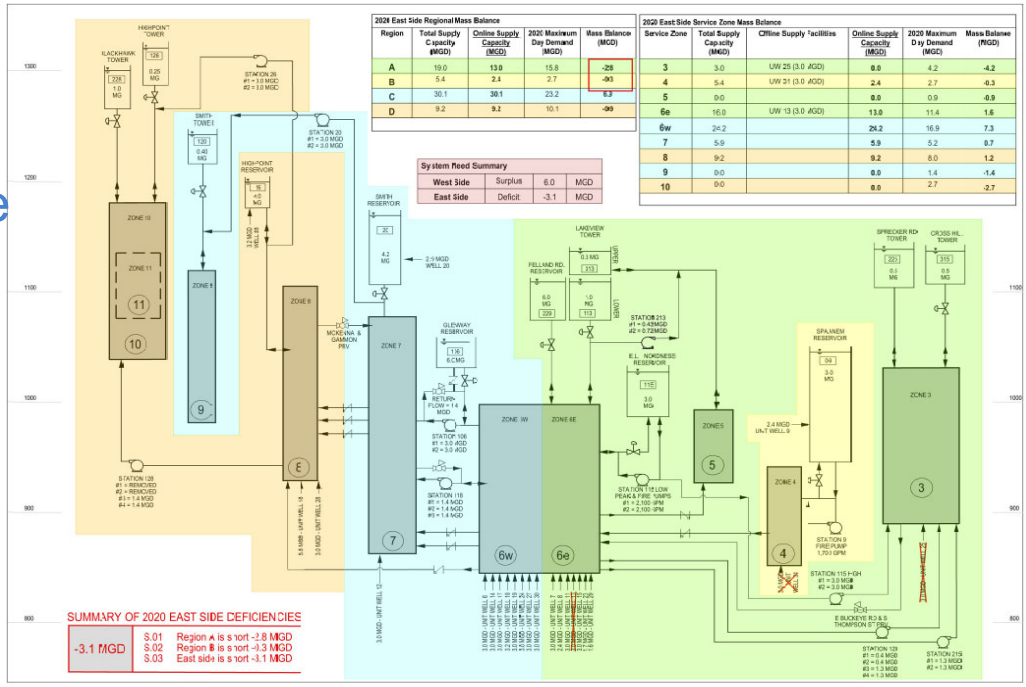
EAST SIDE ANALYSIS

Supply Capacity Analysis	Design Year				
	2020	2025	2030	2035	2040
Condition 1 - Average Day Capacity					
Average Day Demand (mgd)[2]	10.9	11.2	11.5	11.7	12.0
Existing 12-Hour Pumping Capacity (mgd)[3]	13.8				
12-Hour Capacity Mass Balance (mgd)[4]	**2.9**	**2.6**	**2.3**	**2.1**	**1.8**
Condition 2a - Maximum Day Capacity					
Maximum Day Demand (mgd)[1]	18.5	19.3	20.1	20.9	21.6
Existing Firm Supply Capacity (mgd)[3]	15.4				
Firm Capacity Mass Balance (mgd)[4]	**-3.1**	**-3.9**	**-4.7**	**-5.5**	**-6.2**
Condition 2b - 115 % Maximum Day Capacity					
115 % Maximum Day Demand (mgd)	21.3	22.2	23.1	24.0	24.9
Existing Total Pumping Capacity (mgd)[3]	24.4				
115 % Max Day Capacity Mass Balance (mgd)[4]	**3.1**	**2.2**	**1.3**	**0.4**	**-0.5**

[1] See Appendix G of Chapter 2-2 (*Water Needs Analysis Report*).
[2] See Appendix F of Chapter 2-2.
[3] See Appendix D of Chapter 3 (Hydraulic Analysis Report).
[4] Positive numbers equals the potential pumping capacity surplus. Negative numbers equal the pumping capacity deficit.

2020 Mass Balance East Side

3 Wells Out
#25, 31, 13



WEST SIDE ANALYSIS

Supply Capacity Analysis	Design Year				
	2020	2025	2030	2035	2040
Condition 1 - Average Day Capacity					
Average Day Demand (mgd)[2]	18.3	18.5	18.7	18.9	19.0
Existing 12-Hour Pumping Capacity (mgd)[3]			19.6		
12-Hour Capacity Mass Balance (mgd)[4]	**1.3**	**1.1**	**0.9**	**0.7**	**0.6**
Condition 2a - Maximum Day Capacity					
Maximum Day Demand (mgd)[1]	33.3	34.4	35.4	36.4	37.4
Existing Firm Supply Capacity (mgd)[3]			29.9		
Firm Capacity Mass Balance (mgd)[4]	**-3.4**	**-4.5**	**-5.5**	**-6.5**	**-7.5**
Condition 2b - 115 % Maximum Day Capacity					
115 % Maximum Day Demand (mgd)	38.3	39.5	40.7	41.8	43.0
Existing Total Pumping Capacity (mgd)[3]			39.3		
115 % Max Day Capacity Mass Balance (mgd)[4]	**1.0**	**-0.2**	**-1.4**	**-2.5**	**-3.7**

[1] See Appendix G of Chapter 2-2 (*Water Needs Analysis Report*).
[2] See Appendix F of Chapter 2-2.
[3] See Appendix D of Chapter 3 (Hydraulic Analysis Report).
[4] Positive numbers equals the potential pumping capacity surplus. Negative numbers equal the pumping capacity deficit.

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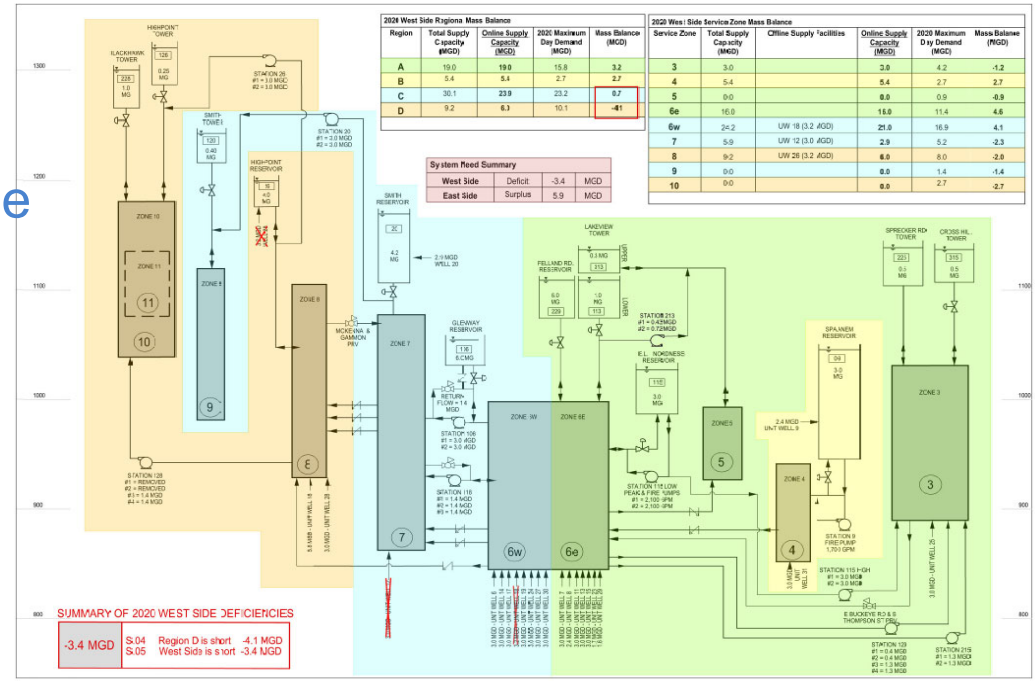
2020 Mass Balance West Side

3 Wells Out
#12, 18, 26



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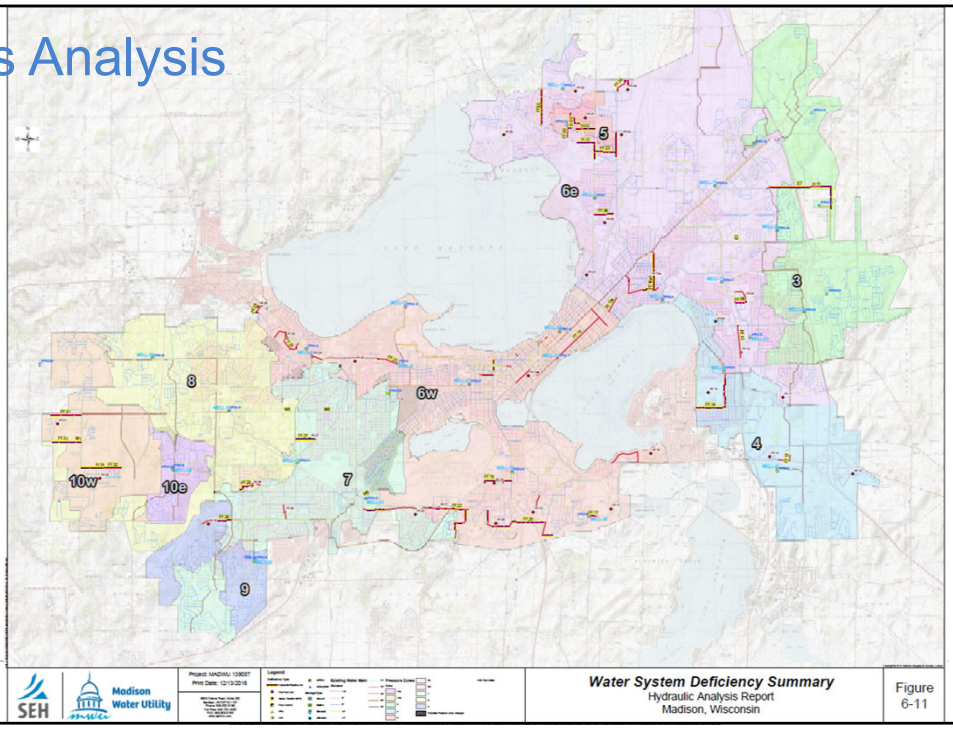
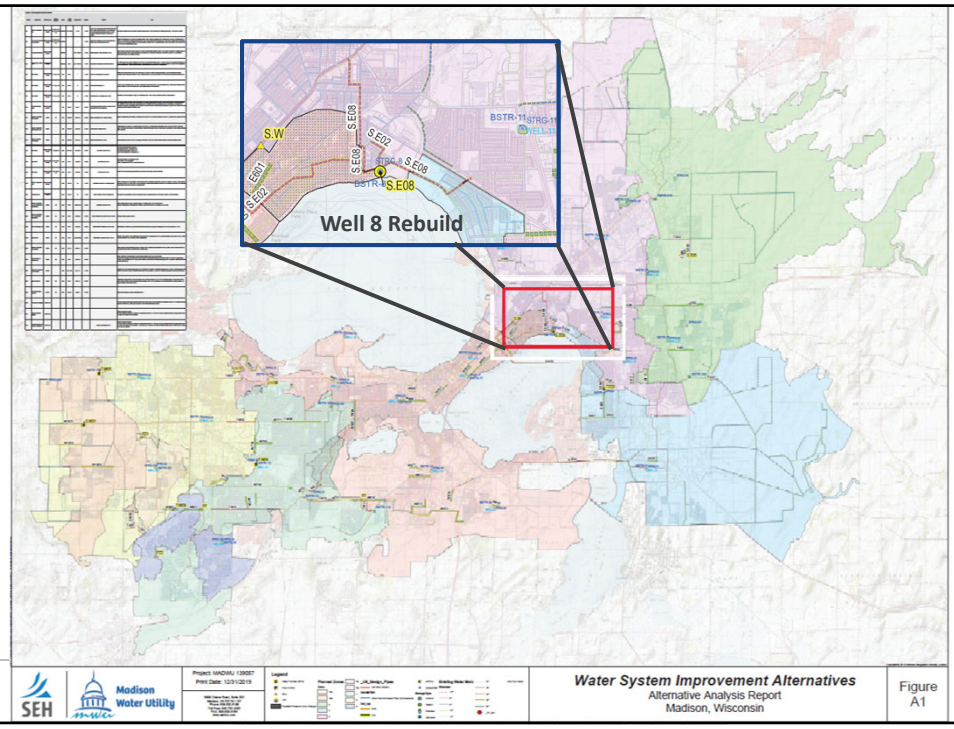
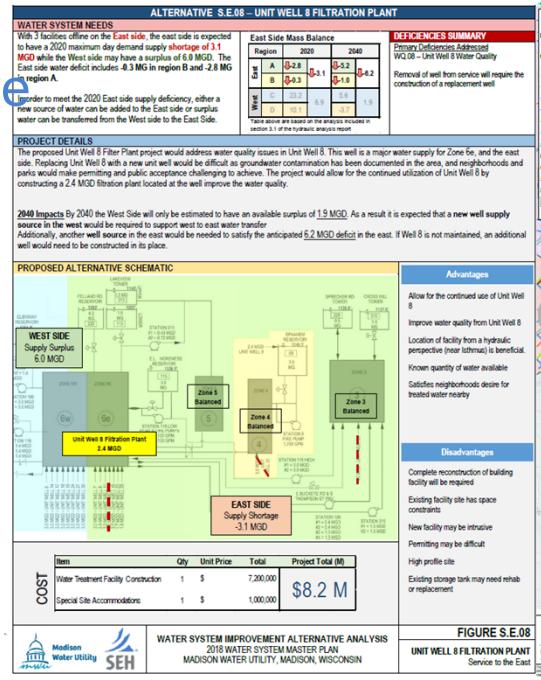
Deficiencies Analysis

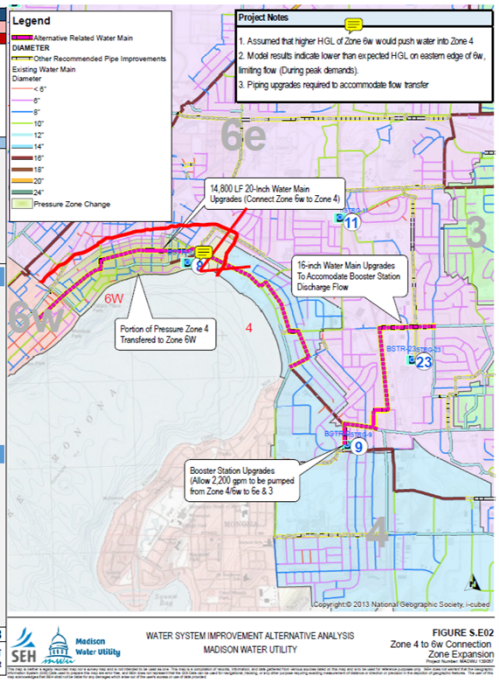


Alternative Map



Prelim Alternative Analysis





Ranking of 37 Alternatives

Table 7-1 – Alternative Project Scoring

Project #	Project Name	Project Planning Horizon	Weighted Score
SE-01	Booster Pumping Station 124	2025	49.7
SE-02	Convert UW8 to 3 Zone Well (Zones 6w,6e,4)	2025	39.8
SE-03	Lake Monona Pipe Crossing	N/A	21.9
SE-04	City of Monona Transmission Main	2025	28.8
SE-05	Unit Well 33A - Felland Rd	2025	63.9
SE-06	Unit Well 33B - Stoughton Rd/Milwaukee Street	2025	52.8
SE-07	Unit Well 33C - Buckeye Road	2025	58.7
WQE-01	Reconstruction and Upgrade of Unit Well 8	2025	60.8
WQE-02	Relocate Unit Well 8	2025	56.3
WQE-03	UW8 Treatment Upgrades	2025	53.8
SW-01	Unit Well 32 - Far West Side	2022	66.1
SW-02	Unit Well 34 - Whitney Way and Mineral Point	2022	67.0
SW-03	Unit Well 35 - Co Hwy M and Midtown Road	2022	50.1
SW-04	Isthmus Transmission Main to Well 24	2025	38.0
SW-05	Yahara River PRV	2025	45.0
WQW-01	Water Treatment addition at Unit Well 19	2025	62.7
WQW-02	Water Blending - Well 6 and Well 19	2025	67.5
WQW-03	New University Well to Replace Well 19	2025	50.2
WQW-05	Water Treatment addition at Unit Well 14	2030	49.5
WQW-06	Relocate Well 14	2030	59.3
TE-01	Upgrade BPS 213	2020	51.1
TE-02	Relocate BPS 129	2020	55.3
TE-03	Booster Pumping Station 109	2030	39.9
TW-01	Booster Pumping Station 114	2030	39.4
TW-02	Booster Pumping Station 134	2025	47.8
TW-03	Transmission main from BPS 106	2030	43.6
TW-04	BPS 112	2020	51.3
TW-04.5	Unit Well 12 Upgrade and Conversion to a Two Zone Well	2020	56.3
TW-05	BPS 128 Upgrade	2025	51.2
TW-06	BPS at Well 10 site	2030	28.5
TW-07	Z9 to Z8 PRV @ Raymond Rd	2030	46.6
TW-08	BPS 220 @ Elver Park	2035	44.2
TW-09	BPS 106 Discharge 6w to 8	2035	37.4
TW-10	Arbor Hills Frontage Road Water Main Upgrade	2030	48.0
TW-11	Raymond Road Water Main Upgrade	2030	48.0
TW-12	Arbor Hills Cannon Ball Pipeline Mods	2030	57.4
TW-13	Booster Station 126 Upgrade	2030	54.9

Definitions for the Triple Bottom Line

		Total Points Available	Weighted Value
Environmental/Regulatory	**30.0%**	**300**	**30**
Regulatory/Board Policy	15.0%	100	15
City Sustainability Policy	5.0%	100	5
Environmental/Community/Neighborhood Impact	10.0%	100	10
Financial	**30.0%**	**500**	**30**
Benefit/Cost Efficiency	10.0%	100	10
Operational Improvement	2.5%	100	2.5
Risk Reduction	12.5%	100	12.5
Supplemental Benefits (e.g. innovation)	2.5%	100	2.5
Coordination with other projects	2.5%	100	2.5
Social/Community	**30.0%**	**600**	**30**
Public Trust	3.0%	100	3
Customers/Critical Customers Benefitted	3.0%	100	3
Water Quality	13.0%	100	13
System Growth & Capacity	3.0%	100	3
Public Health & Safety	3.0%	100	3
City Equity Policy	5.0%	100	5
Engineering/Construction	**10.0%**	**300**	**10**
Siting & Permitting Feasibility	3.4%	100	3.4
Operation and Maintenance Complexity	3.3%	100	3.3
Constructability	3.3%	100	3.3
TOTAL	**100.0%**	**1700**	**100**

Capital Improvement Program - Facilities

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

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Capital Improvement Program - Pipelines

Annual Pipe Renewal Program			Annual Cost (2020 Dollars)
Pipe Replacement (Miles):		7.1	
Pipe Replacement:		75%	7,254,000
	New Pipe:	10%	957,000
	Pipe Lining:	25%	1,451,000
	Annual Budget:		9,662,000

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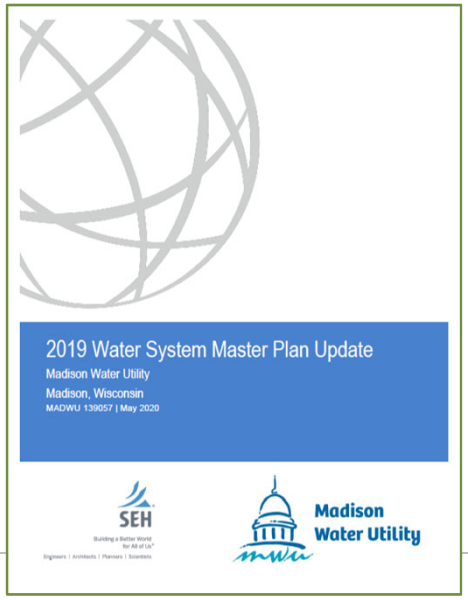
Madison Water Master Plan



Questions?