

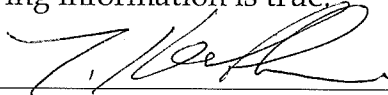
# Internal Monitoring Report

**Policy #:** O-2A Water Quantity

**Monitoring Frequency:** Annually

**Date:** September 27, 2016

I certify that the following information is true.

Signed  General Manager

## **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 the Utility budget for, fund, prioritize, plan for, design, and construct the necessary system improvements to provide adequate water quantity to all areas of the system. The Level of Service Memo developed as part of the East Side Water Supply project for the Utility, attached, establishes minimum standards for system supply, pressure, and fire protection capacity. These standards guide system component design, evaluation, and expansion. The Level of Service Memo is being expanded and updated as a part of the Master Plan update. A copy of the approved 2016 - 6 year capital budget (2016-2021) outlining planned projects to address identified deficiencies and growth areas is attached for your information and use.

Actual system performance is measured against the Utility's established level of service. Data is obtained using the Utility's Supervisory Control and Data Acquisition (SCADA) system and from information derived from the Utility's distribution system computer model. Using the Utility Master Plan as a guide the capital project list is reviewed and updated based on current system characteristics, operational records, and project priorities. From that analysis the annual capital budget is developed and implemented.

A major update of a portion of the 2006 Water Master Plan was completed as part of the East Side Water Supply project in mid 2012. This update included Pressure Zones 3, 4, 5

and 6E. An update of the 2006 Madison Water Utility Master Plan is currently under contract and scheduled to be completed by the end of 2017. The 2016 update will develop current water use statistics based on AMI data and build future water demand projections for long term planning. Using our water distribution system computer model, deficiencies in supply, pressure, and fire protection capacity will be identified and projects will be developed to mitigate those deficiencies.

A consultant, GHD, has been hired to develop a Strategic Asset Management Plan for the Utility. This plan will lead to the development of an Asset Management Program for Madison Water Utility. The development of an Asset Management Program over the next 3 to 5 years will guide reinvestment costs and project development to maximize the value and life cycle costs of Utility assets.

Other sources of data that will be used for this monitoring report will be consumer complaints and other records maintained by the Utility.

### **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 is established in Table 5 of the Level of Service memo. The system is tested against these criteria based on land zoning to identify areas of deficiency with respect to fire flow capacity.

It should be noted that the City was evaluated by the Insurance Services Office (ISO) during 2016 for quality and capacity of the fire fighting system. This analysis includes the Fire Department, the Water Utility, and the 911 system. We were pleased to learn that the City will be receiving a rating of 1 from the ISO. The previous ratings have been 2's so this is very good news. This is a great accomplishment and reflects the high quality of the service the Water Utility and Fire Department provides to the City.

The fire flow analysis developed in the 2006 Water Master Plan, Figure 5-8, is attached to this memo for your information and use. Fire flow capacity for the east side of the system was also evaluated as part of the 2012 ESWS study and Figure B12 from that report is attached. These documents provide a graphical representation of the fire flow capacity across the system as determined by the system hydraulic computer model. The fire flow capacity analysis identifies general geographical areas of fire flow deficiency. Capital improvement projects have been developed to mitigate these areas of fire flow deficiency. The 2016 Water Master Plan update will revise and update the fire flow capacity map and refine the capital project list to mitigate any identified deficiencies.

The Utility's Capital Improvement Program (CIP) identifies and develops projects that will mitigate the identified fire flow deficiency areas. These projects require significant capital investment and are typically budgeted for and implemented over the course of several years. We have reported to the Board on many of these projects in previous reports as the projects were developed and implemented.

Areas of fire flow deficiency identified in the 2006 Water Master Plan and 2012 ESWS plan and itemized in the Utility's Capital Improvement Program include but are not necessarily limited to: 1) Arbor Hills neighborhood; 2) Pressure Zone 4; 3) Lakeview Zone 5; and 4) North Sherman Avenue commercial area. Details of each project area follow:

**Arbor Hills:**

*Identified Need:* Water was supplied to the Arbor Hills Neighborhood through a single 8" diameter pipe. This situation resulted in reliability issues 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 2,000 gpm booster pumping station and 16-inch transmission main between Zones 6 & 7 in the Arbor Hills area.

**Project Phases:**

Phase 1: 2009 Approximately 2 miles of 16-inch transmission main was installed from Raymond Road toward Arbor Hills.

Phase 2: 2010 Installation of approximately 1 mile of 16-inch transmission main – this phase completed the connection complete between Raymond Road and the proposed pumping station.

Phase 3: 2012 Installation of 0.55 miles of 16-inch transmission main north of Pumping Station 118 to the UW Arboretum – This section includes a crossing of the beltline highway and greatly improved hydraulic capacity on the suction side of the pumping station.

Phase 4: 2012 Construction of Booster Pumping Station 118, a 2,000 gallon per minute capacity facility located in Leopold Park.

Phase 5: 2012: Construction of 3500 feet of 12-inch transmission main from the Beltline Highway along Fish Hatchery to the railroad corridor. The majority of this construction was the replacement and upsizing of an existing pipeline.

Phase 6: 2015: Construction of 1300 feet of 12-inch transmission main from the Railroad corridor to Park Street along North Avenue.

Phase 7: 2017: Planned construction of approximately 2000 feet of 12-inch transmission main under the new bike path from Fish Hatchery Road to North Avenue to complete the connection between Booster Pumping Station 118 and Well 18.

Results:

The Cannonball pipeline and BPS 118 system accomplish two main objectives. It allows the transfer of water between Pressure Zone 6 and Pressure Zone 7 and back again. Secondly, the new facility significantly improves fire protection capacity and reliability of supply to the Arbor Hills area. With construction of the Cannonball pipeline and BPS 118, the Arbor Hills neighborhood and the Todd Drive area of the Beltline Highway now have a redundant water supply. At Leopold Elementary School fire flow capacity increased from an estimated 1500 gpm to an over 4000 gpm bringing it into compliance with Utility fire flow capacity standards. Similar increases in fire fighting capacity were realized throughout the Arbor Hills neighborhood. With the completion of all phases of the project in 2017, the pumping station will have the capacity to move approximately 1.5 million gallons of water per day from the Park Street area to Raymond Road and back again. This improvement is greatly increasing reliability and operational flexibility in the system.

Pressure Zone 4:

Identified Need: Zone 4 was fed by a single well, Well 9, a significant lack of redundancy and reliability. Well 9 is located in the north part of Zone 4 resulting in limited fire protection capacity to the southern portions of the Zone.

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

Project Phases:

Phase 1: 2009/2010 Selection of Well Site

Phase 2: 2011/2012 Test well installation and water quality testing.

Phase 3: 2013: Drill and develop production well on Tradewinds.

Phase 4: 2014: MWU selected SEH for engineering design development services for the project. A project that includes a detached reservoir, treatment facility, pumping station and storage garage was developed for design.

Phase 5: 2015: Construction of a 1.5 million gallon ground level reservoir. The reservoir was completed in the spring of 2016.

Phase 6: 2017: Due to budget constraints, the construction of the well house, filtration plant and pumping station was delayed to 2017. Final drawings and specifications are currently being developed and the project will be bid at the end of 2016 for a spring 2017 construction start. It is anticipated that the facility will be fully operational in early summer 2018.

Results:

When completed, Well 31 will provide the needed additional fire flow capacity and water supply redundancy to Zone 4 and bring it into compliance with the established utility level of service.

**Lakeview and Northport Drive Area Zone 5 and 6E:**

Identified Need: Zone 5 and the north end of Zone 6E had a storage deficiency that resulted in fire flow capacity challenges. Fire flow capacity deficiencies are noted in Zone 6E on the enclosed figures around Northport Drive in the Green Avenue/Troy Drive area and on Packers Avenue and near the airport. In Zone 5 fire flow deficiencies have been identified around the Dane County Human Services building and throughout the Zone 5 residential area.

Identified Project Alternative: To mitigate these fire flow capacity deficiencies, it is proposed to construct a new two zone reservoir and upgrade an existing pumping station in the Lake View Park area. These improvements will bring the fire flow capacity and reliability of the supply system for Zones 5 & 6E into compliance with Utility standards.

Project Phases:

Phase 1: Design and construct a dual zone reservoir to serve Zones 5 and 6E. The upper 300,000 gallon reservoir will replace an aging 55,000 gallon structure that has served the area since 1938. The new Zone 5 tank will provide the necessary fire flow capacity and emergency backup supply for the area. The additional capacity will allow Zone 5 to be expanded improving service to the hilltop area north of Northport Drive.

The lower tank will be a 1,000,000 gallon standpipe that will serve Zone 6E and provide additional emergency water storage capacity. The need for additional storage capacity on the north side was identified in the 2006 Water Master Plan and verified in the 2012 ESWS plan.

Lack of space and restrictions due to the Dane County Airport make a dual zone reservoir the only viable alternative to mitigate both Zone 5 and Zone 6E.

Construction of the reservoir started in 2015 and is slated to be in service by the end of 2016.

Phase 2: Design and construct a new pipeline connecting Northport Drive with the new Zone 6E reservoir and the pumping station feeding Zone 5. A new pipeline will be installed from the reservoir to Esch Lane to improve hydraulic capacity to the area north of the reservoir. These new pipelines will improve hydraulic capacity and stabilize pressures throughout the area. The pipelines will be constructed in 2017.

Phase 3: Upgrade the existing water pumping station that fills the upper Zone 5 reservoir. This upgrade will improve fire protection capacity and pump station capacity and reliability. These improvements will bring much of Zone 5 into compliance with the established Utility minimum level of service. The pumping station upgrade is currently scheduled for year 2020.

Phase 4: Hydraulic upgrades to the distribution system. Piping upgrades on Lake View Avenue and Sherman Avenue are scheduled for 2020. These improvements will improve capacity, reliability, and service to the area.

Results:

Replacing and enlarging the Zone 5 reservoir, adding a 1.0 million gallon reservoir to Zone 6E, constructing a new 16" connection to Zone 6E, and upgrading the pumping station will improve overall water system operation and reliability.

***North Sherman Avenue commercial area:***

Identified Need: A fire capacity deficiency has been identified in the commercial area around North Sherman Avenue, the Aberg Avenue area and around Oscar Meyer.

Identified Project Alternative: Fire flow deficiencies in the North Sherman area will be addressed with planned hydraulic improvements to the distribution system.

Project Phases:

Phase 1: 2014/2015 re-construction of Unit Well 7 and the installation of an iron and manganese filtration system. The Well 7 filter project was completed and brought on line in June 2015 and is providing excellent water quality and quantity to the area. 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. The upgraded Well 7 has a 500,000 ground level reservoir and a standby generator to provide reliable drinking water supply to the area.

Phase 2: To improve distribution system hydraulics and therefore improve fire fighting 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 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. 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: The Utility currently replaces, retires, installs, and maintains approximately 8,933 hydrants in the system. During 2015 the Utility inspected and serviced 4,952 hydrants as a part of the routine maintenance of the system. Utility crews also service and maintain 14,713 system valves. During 2015 Utility crews inspected 3,794 system valves as a part of routine maintenance of the system.

The Utility works closely with Madison Fire Department to ensure fire fighting capacity meets current and future needs. Hydrant flow testing is performed as requested on fire hydrants and recorded in the GIS database. During 2015 Utility crews completed 92 requested hydrant flow tests were requested and completed. Flow tests are also conducted by Utility crews during the course of routine maintenance and flushing operations.

The Utility's unidirectional flushing program systematically operates and exercises the majority of the Utility's hydrants annually. During 2015 approximately 300 miles of pipe was flushed unidirectionally and approximately 490 miles of pipe was flushed conventionally. Some spot flushing is also conducted in response to complaints and water quality concerns. 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.*

Pressure planning and design criteria for Madison Water Utility are established in Table 2 of the attached Level of Service Memo. A query of the system indicated that of approximately 8,933 fire hydrants with static pressure readings, approximately 0.2% of the hydrants were below 35 psi and 4.8% were 100 psi or higher. 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.

Significant areas of chronic low pressure have been successfully mitigated 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 2016 reporting period, Madison Water Utility was not required to and did not issue any irrigation restrictions due to water supply limitations within the system.

I report compliance.

**Attachments:**

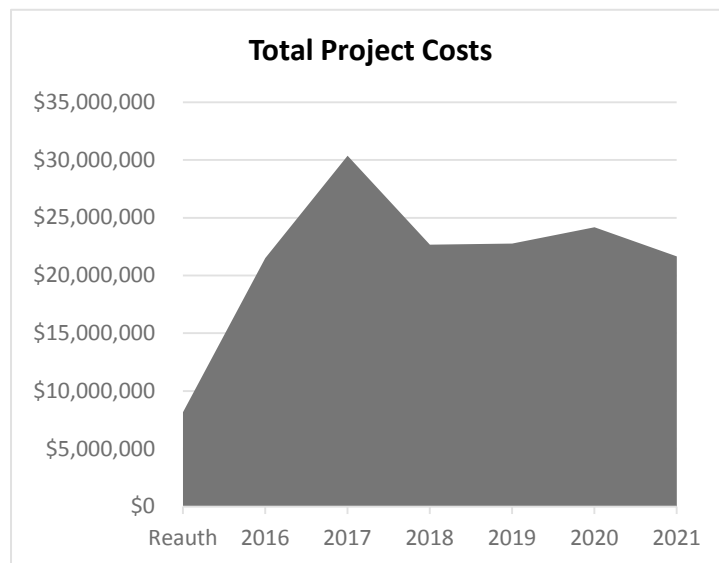
1. 2016 approved capital budget
2. Level of Service Memo – January 10, 2011
3. 2006 Master Plan Fire Flow Capacity Map Figure 5-8
4. Figure B12 – 2012 East Side Maximum Day Fire Flow Availability



**2016  
Capital Budget  
Capital Improvement Program**

**Agency Name: Water Utility**

Project	Reauth	2016	2017	2018	2019	2020	2021
1 Arbor Hills Fire Flow Supply	642,000	-	-	-	-	-	-
2 Asset Management System	-	200,000	-	-	-	-	-
3 Booster Station #106 Reconstruction	-	981,000	-	-	1,429,000	-	-
4 Far West Elevated Reservoir	-	284,000	2,761,000	1,899,000	-	736,000	-
5 Hillcrest Drive	-	520,000	-	-	-	-	-
6 Lakeview Reservoir Reconstruction	2,080,000	1,380,000	826,000	1,695,000	-	-	-
7 Paterson St Operations Center Remodel	4,444,000	1,795,000	2,845,000	400,000	-	-	-
8 Pump Station Improvements	-	448,000	862,000	561,000	967,000	616,000	168,000
9 Unit Well No. 8 Reconstruction	20,000	50,000	5,000	110,000	55,000	758,000	2,770,000
10 Voc Air Stripper at Well 18	-	-	10,000	260,000	1,660,000	2,400,000	-
11 Water Mains - New	-	1,350,000	1,451,000	1,560,000	1,677,000	1,803,000	1,803,000
12 Water Mains Replace Rehab Improve	-	11,719,000	12,655,000	13,525,000	14,466,000	15,484,000	14,782,000
13 Water Utility Facility Improvements	-	1,307,000	1,496,000	1,605,000	1,722,000	1,838,000	1,028,800
14 Well 12 Conversion	631,000	919,000	-	-	-	-	-
15 Well 19 Iron/Manganese Filter	100,000	485,000	3,531,000	-	-	-	-
16 Well 29 Filter Capacity Expansion	-	-	-	504,000	-	-	-
17 Zone 4 Fire Flow Supply Augment	250,000	70,000	3,925,000	550,000	744,000	-	-
18 Zones 7 & 8 Supply: Whitney Way	-	-	-	-	45,000	541,000	1,102,000
<b>Total</b>	<b>\$ 8,167,000</b>	<b>\$ 21,508,000</b>	<b>\$ 30,367,000</b>	<b>\$ 22,669,000</b>	<b>\$ 22,765,000</b>	<b>\$ 24,176,000</b>	<b>\$ 21,653,800</b>



**2016**  
**Capital Budget**  
**Expenditure Categories and Funding Sources**

**Agency Name: Water Utility**

**Agency No. 86**

	Capital Budget	Future Year Estimates					
	Reauth	2016	2017	2018	2019	2020	2021
<b>All Projects Expenditures:</b>							
Building	7,525,000	6,069,000	14,523,000	4,589,000	2,219,000	2,842,000	4,681,800
Land	-	-	-	-	-	321,000	-
Machinery and Equipment	-	580,000	942,000	1,791,000	2,230,000	2,990,000	387,000
Street	-	520,000	-	-	-	-	-
Water Network	642,000	14,339,000	14,902,000	16,289,000	18,316,000	18,023,000	16,585,000
<b>Total Project Costs</b>	<u>\$ 8,167,000</u>	<u>\$ 21,508,000</u>	<u>\$ 30,367,000</u>	<u>\$ 22,669,000</u>	<u>\$ 22,765,000</u>	<u>\$ 24,176,000</u>	<u>\$ 21,653,800</u>
<b>Funding Sources:</b>							
Reserves Applied	-	200,000	-	-	-	-	-
Revenue Bonds - Capitalized	8,167,000	21,308,000	30,367,000	22,669,000	22,765,000	24,176,000	21,653,800
<b>Total Other Sources</b>	<u>\$ 8,167,000</u>	<u>\$ 21,508,000</u>	<u>\$ 30,367,000</u>	<u>\$ 22,669,000</u>	<u>\$ 22,765,000</u>	<u>\$ 24,176,000</u>	<u>\$ 21,653,800</u>

**2016  
Capital Budget**

**Agency Name: Water Utility**

**Agency No. 86**

		<b>Arbor Hills Fire Flow Supply</b>	Project No.	10435	
GO	\$ -	This project is the final phase of the booster pump station 118 project that began in 2012. This project supports the fourth and final stage with the construction of the cannonball pipeline. The funding source is reauthorized revenue bonds from 2015 appropriations.			
Other	642,000				
			<u>\$</u>	<u>642,000</u>	
		<b>Asset Management System</b>	Project No.	17097	
GO	\$ -	This project will develop a city-wide asset management program designed to manage city assets. This will include a software system where specific program area functions will be configured to meet the needs of Public Works including Stormwater Utility, Engineering, Traffic Engineering, Water Utility and possibly other agencies.			
Other	200,000				
			<u>\$</u>	<u>200,000</u>	
		<b>Booster Station #106 Reconstruction</b>	Project No.	10444	
GO	\$ -	This project will provide hydraulic capacity improvements at booster pump station 106. The project will be funded with revenue bonds.			
Other	981,000				
			<u>\$</u>	<u>981,000</u>	
		<b>Far West Elevated Reservoir</b>	Project No.	10445	
GO	\$ -	This project combines 2014 capital projects #14 (zone 11 Blackhawk elevated reservoir) and #23 into one. The intent is to combine pressure zones 10 and 11, and construct a single far west side 1 million gallon elevated reservoir to hydraulically balance the two zones and supplement the storage at High Point Road. The 250,000 gallon High Point Road reservoir is reaching its capacity and does not provide sufficient emergency reserve capacity. Providing minimum fire flow requirements to this area of the distribution system is necessary to meet minimum utility standards. The project also provides a second feed to the area by using booster station 128, improving reliability. This 2006 Water Master Plan identified two elevated reservoirs for the far west side and this project will combine those two projects. Other funding is from revenue bonds.			
Other	284,000				
			<u>\$</u>	<u>284,000</u>	
		<b>Hillcrest Drive</b>	Project No.	11091	
GO	\$ -	This project is the Water Utility's portion of the Major Streets Hillcrest Drive project (Rural to Urban Streets). The project includes replacement of water main. Construction is planned for 2016.			
Other	520,000				
			<u>\$</u>	<u>520,000</u>	
		<b>Lakeview Reservoir Reconstruction</b>	Project No.	10439	
GO	\$ -	This project will continue reconstruction efforts at Lakeview Reservoir. The funding includes \$2,080,000 in reauthorized revenue bonds from 2015 appropriations.			
Other	3,460,000				
			<u>\$</u>	<u>3,460,000</u>	
		<b>Paterson Street Operations Center Remodel</b>	Project No.	10442	
GO	\$ -	This project funds rebuilding of the Water Utility operations center at Paterson Street. Construction began in 2015 and will be completed in 2017. The reconstructed space will address existing space limitations and improve employee safety. The funding includes \$4,444,000 in reauthorized revenue bonds from 2015 appropriations.			
Other	6,239,000				
			<u>\$</u>	<u>6,239,000</u>	

		<b>Pump Station Improvements</b>	Project No.	10446
GO	\$ -	This project includes improvements to pump station, pressure reducing valve (PRV) stations, well improvements and tasks recommended by the Water Utility Master Plan. Water Utility reserves will pay for 2016 improvements.		
Other	448,000			
	<u>\$ 448,000</u>			
		<b>Unit Well No. 8 Reconstruction</b>	Project No.	10944
GO	\$ -	The project upgrades and replaces well 8. The project scope includes installation of a filter for iron and manganese to address current water quality issues at well 8. The funding includes reauthorizing \$20,000 in revenue bonds from 2015 appropriations.		
Other	70,000			
	<u>\$ 70,000</u>			
		<b>VOC Air Stripper at Well 18</b>	Project No.	12016
GO	\$ -	This project will construct a volatile organic compound (VOC) air stripper at well 18. Recent water quality analysis has shown increasing VOC levels in the water supply in the well area. The adopted CIP anticipates construction in 2019, with the location being fully operational in 2019.		
Other	-			
	<u>\$ -</u>			
		<b>Water Mains - New</b>	Project No.	10856
GO	\$ -	This project installs new water mains to help strengthen the existing distribution system, improve pressures, improve fire protection, allow transfer of water from pressure zone to pressure zone, and serve the growing Madison area. Newly installed mains will include hydraulic improvements consistent with the Water Utility Master Plan. 2016 marks the beginning of an increased investment in hydraulic investments that will span over the next fifteen years. Other funding is from revenue bonds.		
Other	1,350,000			
	<u>\$ 1,350,000</u>			
		<b>Water Mains Replace Rehab Improvements</b>	Project No.	10432
GO	\$ -	This project supports the replacement and upgrade of water mains. Assessment of an aging infrastructure indicates the Utility must replace or rehabilitate over 400 miles of pipe in approximately a 40 year period to renew and maintain the system. The adopted CIP continues the effort to accomplish this goal by 2050. Other funding is from revenue bonds.		
Other	11,719,000			
	<u>\$ 11,719,000</u>			
		<b>Water Utility Facility Improvements</b>	Project No.	10440
GO	\$ -	This project provides for miscellaneous project repair, improvements to Utility facilities, and security improvements. Projects planned for 2016 include: meter program (\$208,000), Olin administration office maintenance (\$51,000), Paterson office and shop maintenance (\$25,000), Paterson vehicle storage building maintenance (\$58,000), safety additions and modifications to wells (\$72,000), Scada maintenance and six year upgrade (\$100,000), well video system upgrades (\$43,000), and other improvements. This project is funded by revenue bonds.		
Other	1,307,000			
	<u>\$ 1,307,000</u>			
		<b>Well 12 Conversion</b>	Project No.	10452
GO	\$ -	This project converts well 12 to a two-zone well. The converted well will provide improved operational flexibility and reliability to Madison's west side.		
Other	1,550,000			
	<u>\$ 1,550,000</u>			
		<b>Well 19 Iron/Manganese Filter</b>	Project No.	10448
GO	\$ -	This project constructs an iron and manganese filter at well 19 to address existing water quality issues. This well is located in the west UW-Madison campus area. The funding includes reauthorizing \$100,000 in revenue bonds from 2015 appropriations.		
Other	585,000			
	<u>\$ 585,000</u>			

**Well 29 Conversion**

Project No. 10451

GO \$ - This project increases the filtration capacity of well 29. The well was originally constructed with a  
Other - filtration system that meets 50% of the well's full capacity. Construction is scheduled for 2018.

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\$ -

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**Zone 4 Fire Flow Supply Augment**

Project No. 10434

GO \$ - This project will construct unit well 31. The well 31 project will correct a significant system deficiency  
Other 320,000 in the southeast corner of the system identified by the Water Utility Master Plan. Construction began  
in 2015 with the construction of a site ground reservoir. The well house, filter, and booster pump  
station will be constructed in 2017. The well will be finished and fully operational in 2018. The  
funding includes reauthorizing \$250,000 in revenue bonds from 2015 appropriations.

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\$ 320,000

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**Zones 7 and 8 Supply: Whitney Way**

Project No. 10438

GO \$ - This project constructs an additional well to serve Madison's west side. Construction of the new  
Other - location is in anticipation of continued growth to Madison's west side. Planning and design is  
scheduled to begin in 2019, with the new well being functional in 2024.

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\$ -

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**2016  
Capital Budget  
Summary**

**Agency Name: Water Utility**

**Agency No. 86**

Project Name	Agency Request	Executive	Adopted		
			GO Borrowing	Other Funding	Total
1 Arbor Hills Fire Flow Supply	642,000	642,000	-	642,000	642,000
2 Asset Management System	200,000	200,000	-	200,000	200,000
3 Booster Station #106 Reconstruction	981,000	981,000	-	981,000	981,000
4 Far West Elevated Reservoir	284,000	284,000	-	284,000	284,000
5 Hillcrest Drive	-	-	-	520,000	520,000
6 Lakeview Reservoir Reconstruction	3,460,000	3,460,000	-	3,460,000	3,460,000
7 Paterson St Operations Center Remodel	6,239,000	6,239,000	-	6,239,000	6,239,000
8 Pump Station Improvements	448,000	448,000	-	448,000	448,000
9 Unit Well No. 8 Reconstruction	70,000	70,000	-	70,000	70,000
10 Voc Air Stripper at Well 18	-	-	-	-	-
11 Water Mains - New	1,350,000	1,350,000	-	1,350,000	1,350,000
12 Water Mains Replace Rehab Improve	11,719,000	11,719,000	-	11,719,000	11,719,000
13 Water Utility Facility Improvements	1,307,000	1,307,000	-	1,307,000	1,307,000
14 Well 12 Conversion	1,550,000	1,550,000	-	1,550,000	1,550,000
15 Well 19 Iron/Manganese Filter	585,000	585,000	-	585,000	585,000
16 Well 29 Filter Capacity Expansion	-	-	-	-	-
17 Zone 4 Fire Flow Supply Augment	320,000	320,000	-	320,000	320,000
18 Zones 7 & 8 Supply: Whitney Way	-	-	-	-	-
<b>Total</b>	<u>\$ 29,155,000</u>	<u>\$ 29,155,000</u>	<u>\$ -</u>	<u>\$ 29,675,000</u>	<u>\$ 29,675,000</u>



## 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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Table 5 – Fire Fighting Planning and Design Criteria <sup>(1)</sup> .....	4

## 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**

<b>Criteria</b>	<b>Guideline</b>
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"><li>• Average run time on unit wells less than 12 hours during the average day demand (ADD).</li><li>• Total capacity of wells at least 115% of the maximum day demand (MDD).</li><li>• 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. <sup>(1)</sup></li></ul>
Emergency Operation	Emergency power generation (or engine powered pump capacity) to meet at least the ADD.
Notes: <sup>(1)</sup> 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 <sup>(1)</sup>
High Density Polyethylene (HDPE) (new)	150 <sup>(2)</sup> (horizontal directional drilling only)
Ductile Iron (new, cement lined)	140 <sup>(2)</sup>
Pipe Diameter <sup>(3)</sup>	
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 <sup>(4)</sup>
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
<b>Booster Pump Stations</b>	
Capacity	Firm Capacity (largest pump out of service) able to meet either: <ul style="list-style-type: none"> <li>• MDD for pressure zones with equalization storage</li> <li>• Maximum hour plus fireflow for pressure zones without equalization storage.<sup>(1)</sup></li> </ul>
<b>Storage</b>	
Volume	Every pressure zone be able to meet both of the following: <ul style="list-style-type: none"> <li>• 12 hour supply at ADD<sup>(2)</sup></li> <li>• Fire flow plus equalization storage</li> </ul>
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)
<b>Notes:</b> <sup>(2)</sup> Pressure zone 11 is the only existing pressure zone without equalization storage. <sup>(3)</sup> Emergency reserve	

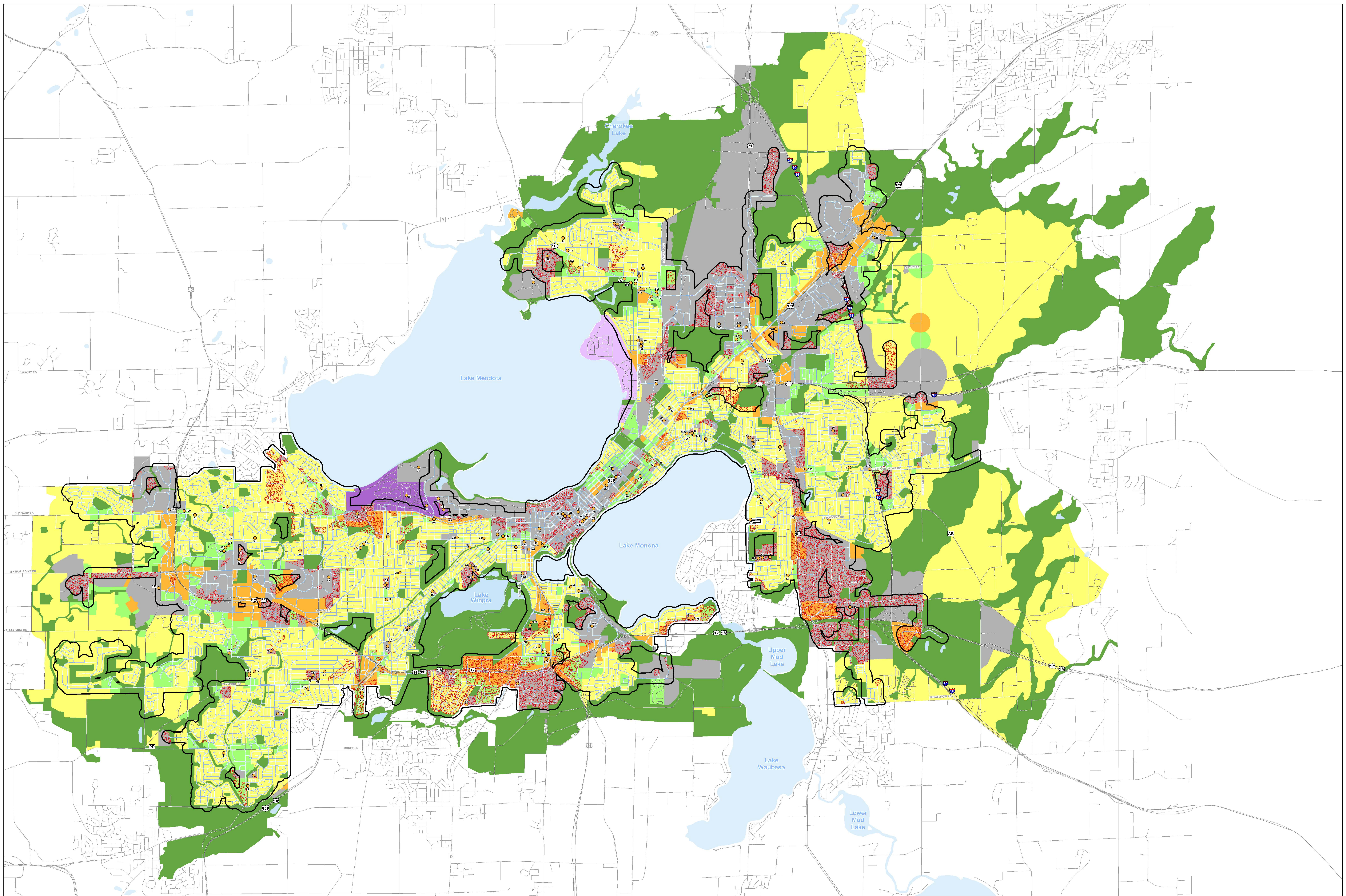
## 6. FIRE FIGHTING CRITERIA

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<sup>(1)</sup>**

<b>Land Use</b>	<b>Fire Flow Goal (gpm)</b>	<b>Fire Duration<sup>(2)</sup> (hrs)</b>	<b>Hydrant Spacing (feet)</b>
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
<b>Notes:</b> <sup>(1)</sup> Fire flow in addition to MDD. <sup>(2)</sup> <i>Distribution System Requirements for Fire Protection, AWWA M31, 1989</i>			

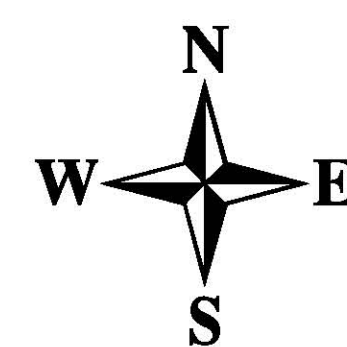




#### Legend

- Practical limit of Fire Flow delivery
- Area of deficient Fire Flow capacity
- Public Gathering & Services Facility (with Facility ID Number - see Table)
- Existing Pipeline
- Major roads
- Minor Roads

- Minimum Fire Flow Service Criteria**
- 3,500 gpm
  - 2,500 gpm
  - 2,000 gpm
  - 1,000 gpm
  - 0 gpm - Parks
  - 0 gpm - Village of Maple Bluff
  - 0 gpm - Village of Shorewood Hills
  - Water body



1:35,000

0 1 2 3 Miles

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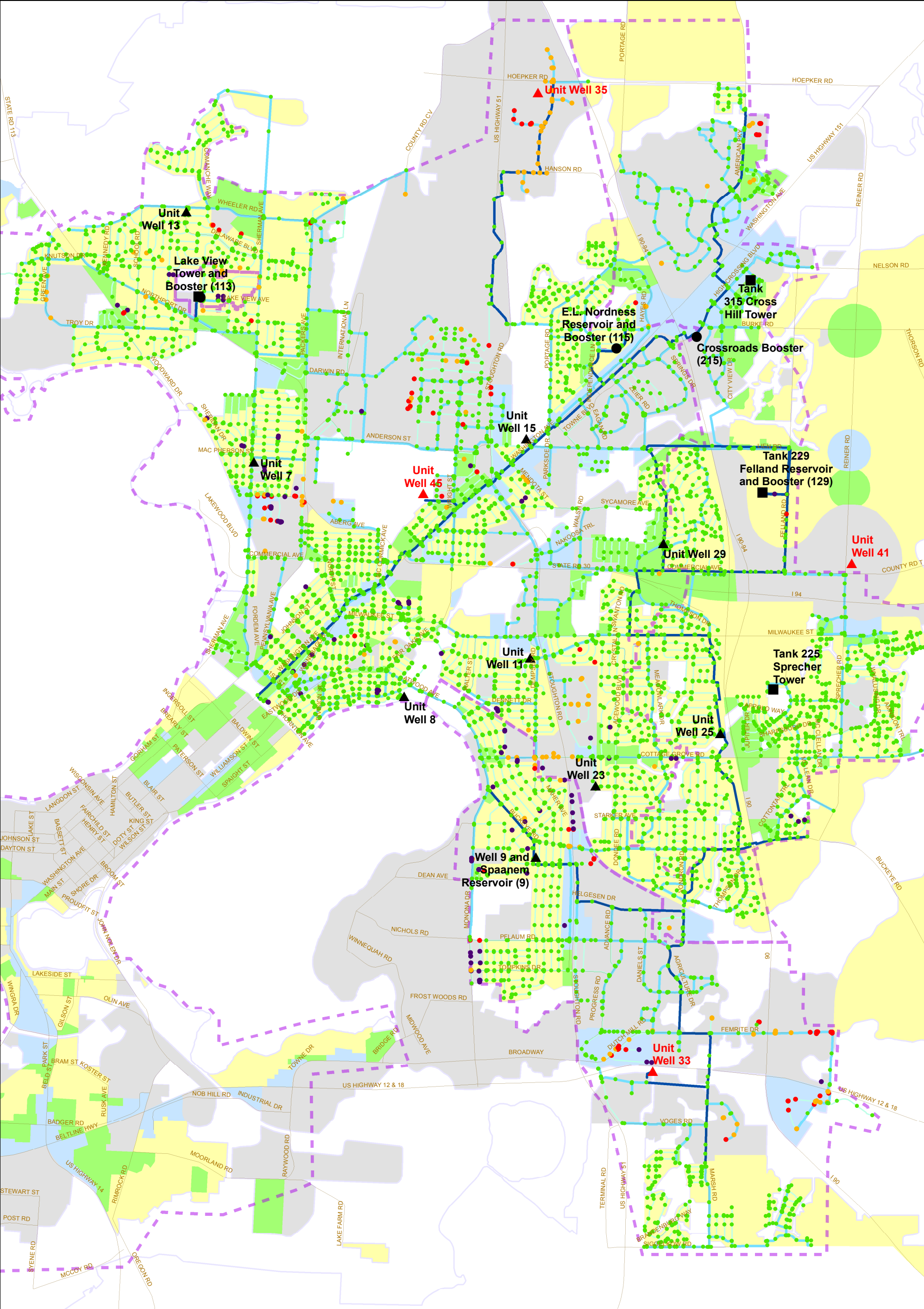
By: DJW

Date: Nov 17, 2006

**Figure 5-8 - Fire Flow Analysis**  
**Madison Water Utility Planning Area**  
 Water Master Plan Update  
 B&V PN 138101.3120







**NOTE:** Available fire flow based on the demand at hour 85 of a Maximum 10-Day scenario and is equivalent to Maximum Day demand.

**Legend**

**Pipe Diameter**

- 8 inch or less
- 10 - 14 inch
- 16 inch and greater

**Fire Flow Criteria**

- 0 gpm
- 1,000 gpm
- 2,000 gpm
- 2,500 gpm
- 3,500 gpm

**Junction Fire flow Category**

- Available Flow > Criteria
- Available Flow 75% - 99% Criteria
- Available Flow 50% - 74% Criteria
- Available Flow < 50% Criteria

**Other Symbols**

- Floating Storage
- Booster Pump Station
- Well
- Pressure Zone Boundary
- Streets

**Figure B12**  
**2015 East Side**  
**Maximum Day**  
**Fire Flow Availability**

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