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Madison Water Utility
Water Master Plan

Quality and Reliability since 1882

Madison Water Utility

February 17, 2009

Outline of Master Plan Presentation

- Level of Service Criteria
- Study Area Characteristics
- Water Requirements
- Water System Improvements

This Water Master Plan is a program of improvements to make the MWU system able to provide a Level of Service that meets established standards.

Level Of Service Criteria

- Max Day Demand = 250 gal/person/day
- Water Quality meets drinking water standards
- Normal operating pressures = 40 – 90 psi
- Equalization + Fire Storage in gravity tanks
- Emergency storage
- Effectively manage groundwater resource

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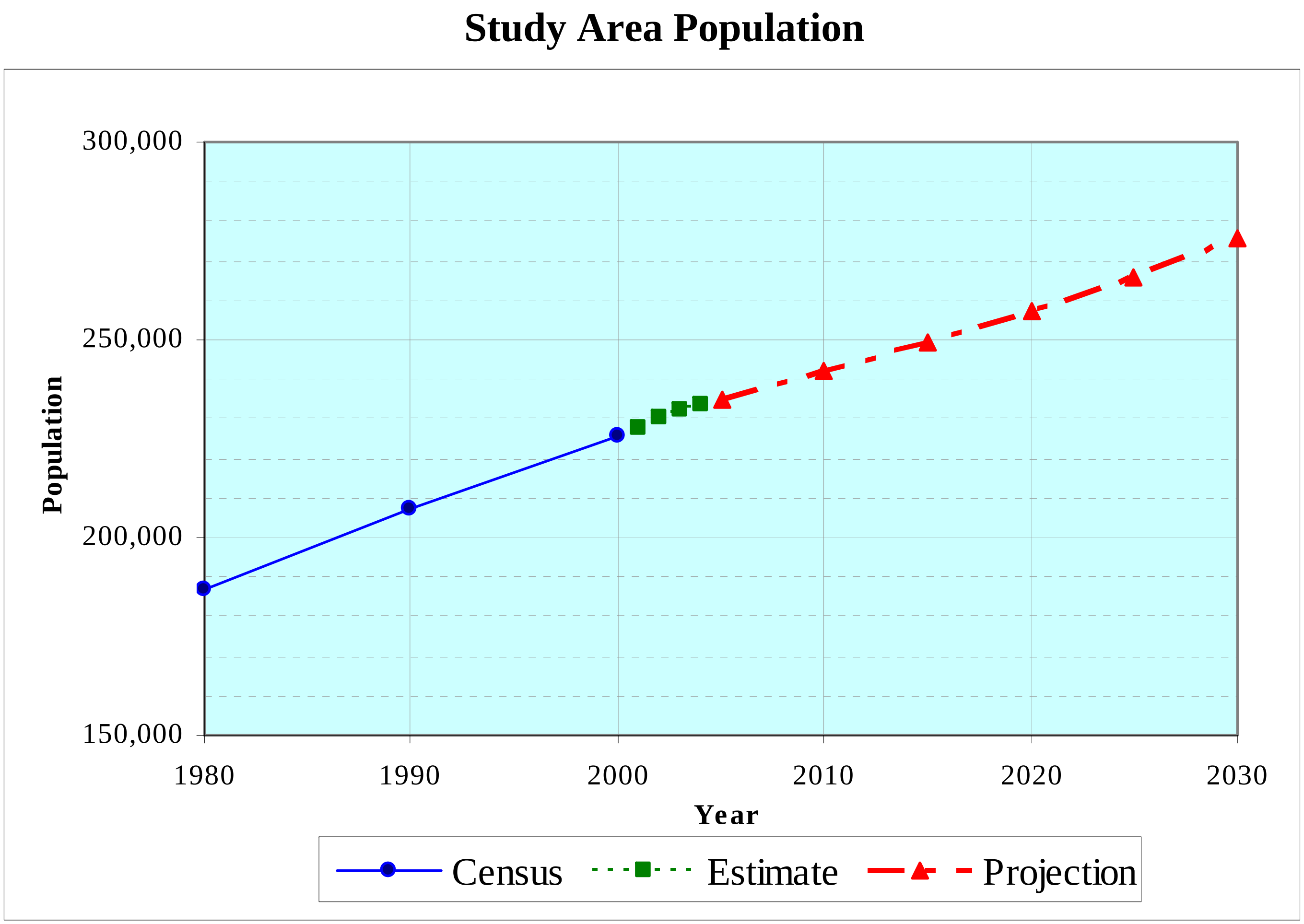
Study Area Characteristics

Study area characteristics were defined by the City's 2005 Comprehensive Plan.

Key Study Area Criteria

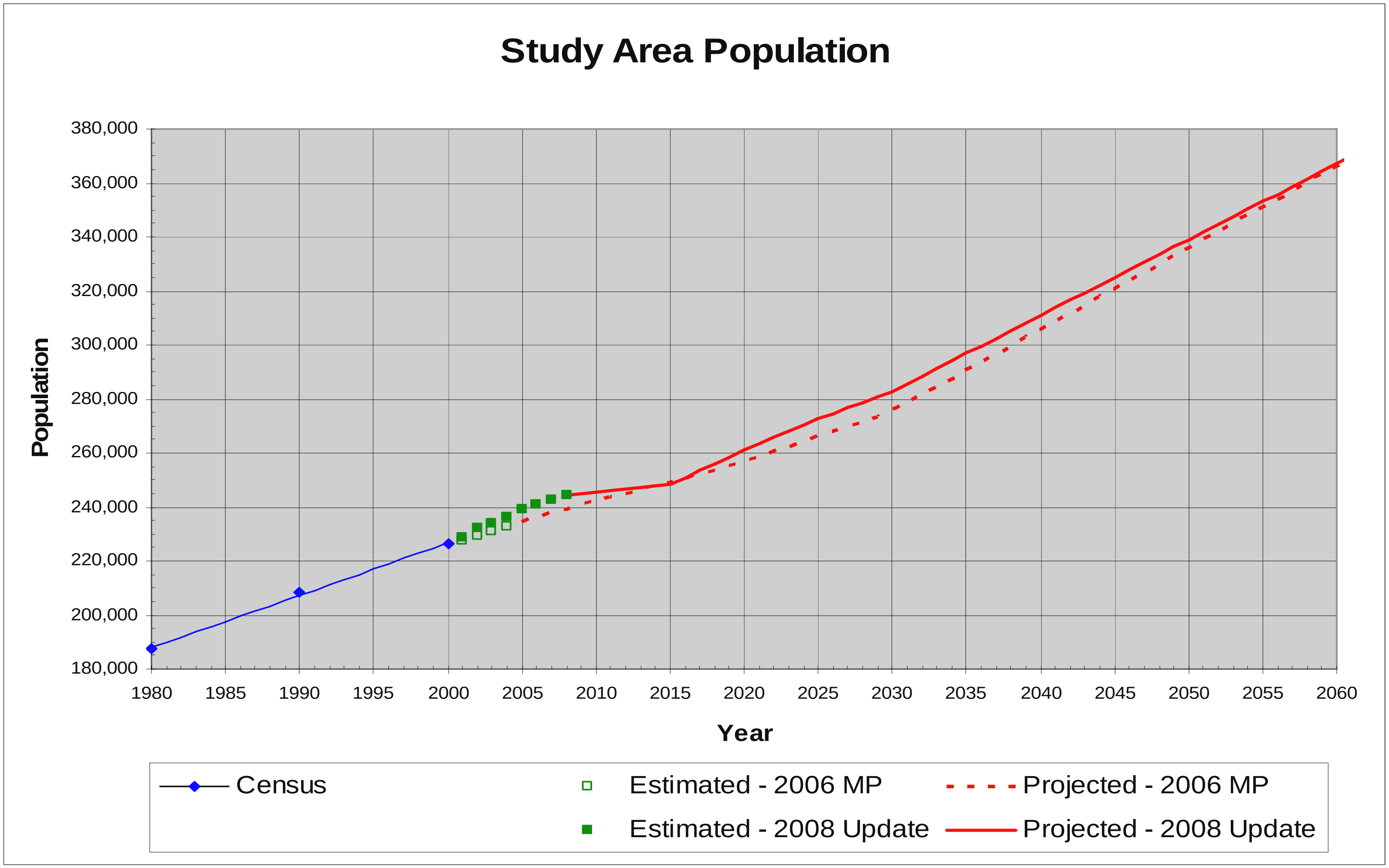
- Study area boundary
- Future land use
- Demographics
  - Population
  - Employment

Population was a key demographic used for projecting future water use.



Source: Final Official Population Projections for Wisconsin Municipalities, Jan 2004, Demographics Services Center, Wisconsin Department of Administration

2008 Update – The current study area population projection reflects impact anticipated from current economic conditions



Source: Final Official Population Projections for Wisconsin Municipalities, Oct 2008, Demographics Services Center, Wisconsin Department of Administration

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Water Requirements

Historical water production and metered use was used to define unit demands, water use rates and patterns.

Key Water Use Categories

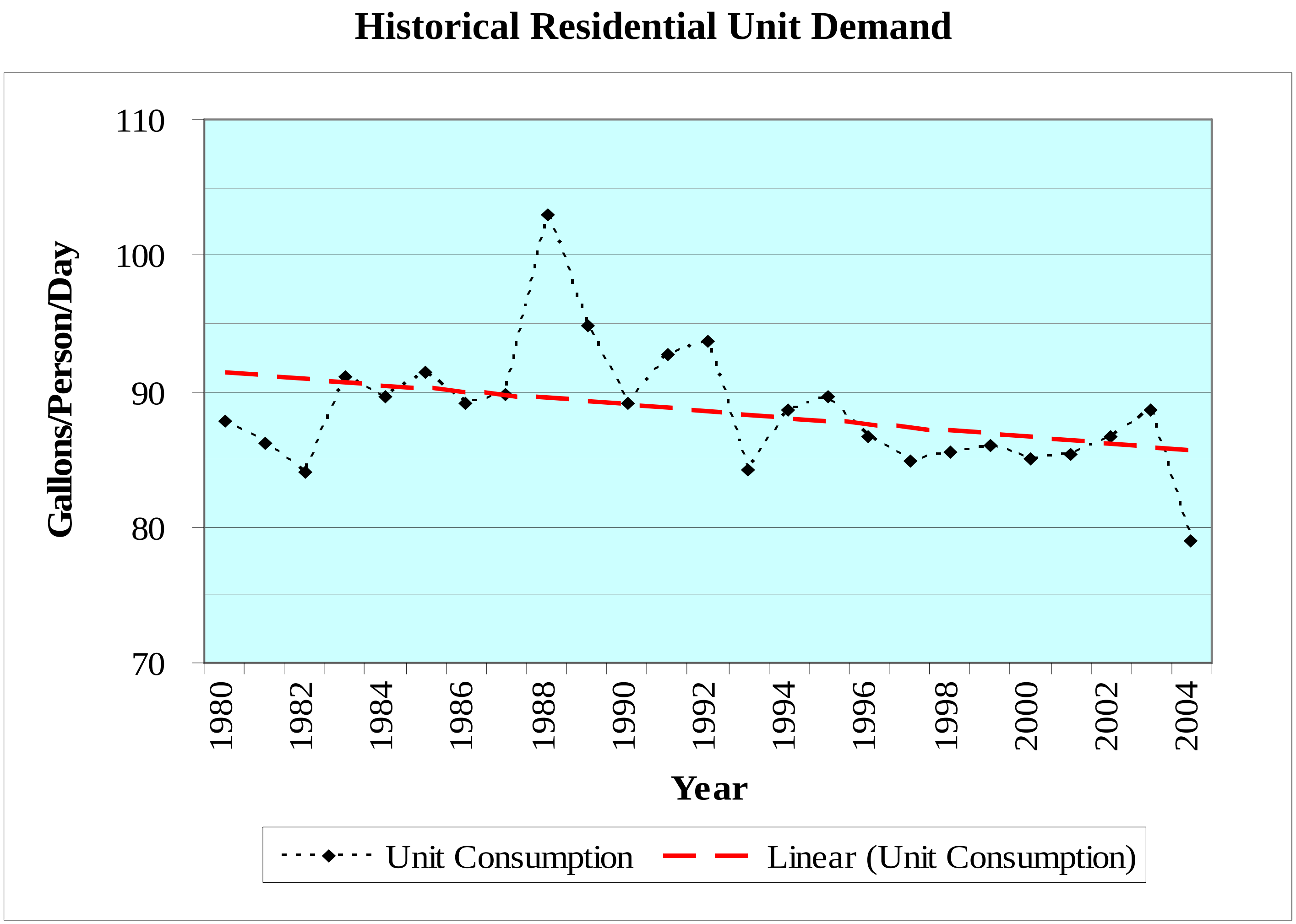
- Residential
- Largest ICI (a) customers
- Other ICI (a)
- Schools
- Non-Revenue

(a) ICI = Industrial – Commercial - Institutional

Projections of Annual Average (AA) demand based on unit demands are the beginning point for determining design demands.

Customer Category	Portion of Total System Demand Current - to - Buildout	Basis of Determination
Residential	66%	Population x Unit Demand No. Residents x gal/person/day
15 Largest Industrial/Commercial	25% to 18%	Individual Projections of Total Usage
Other Industrial/Commercial	9% to 15%	Employment x Unit Demand No. Employees x gal/employee/day

Master Plan Assessment: The residential unit demand has trended down to about 85 gallons per person per day.

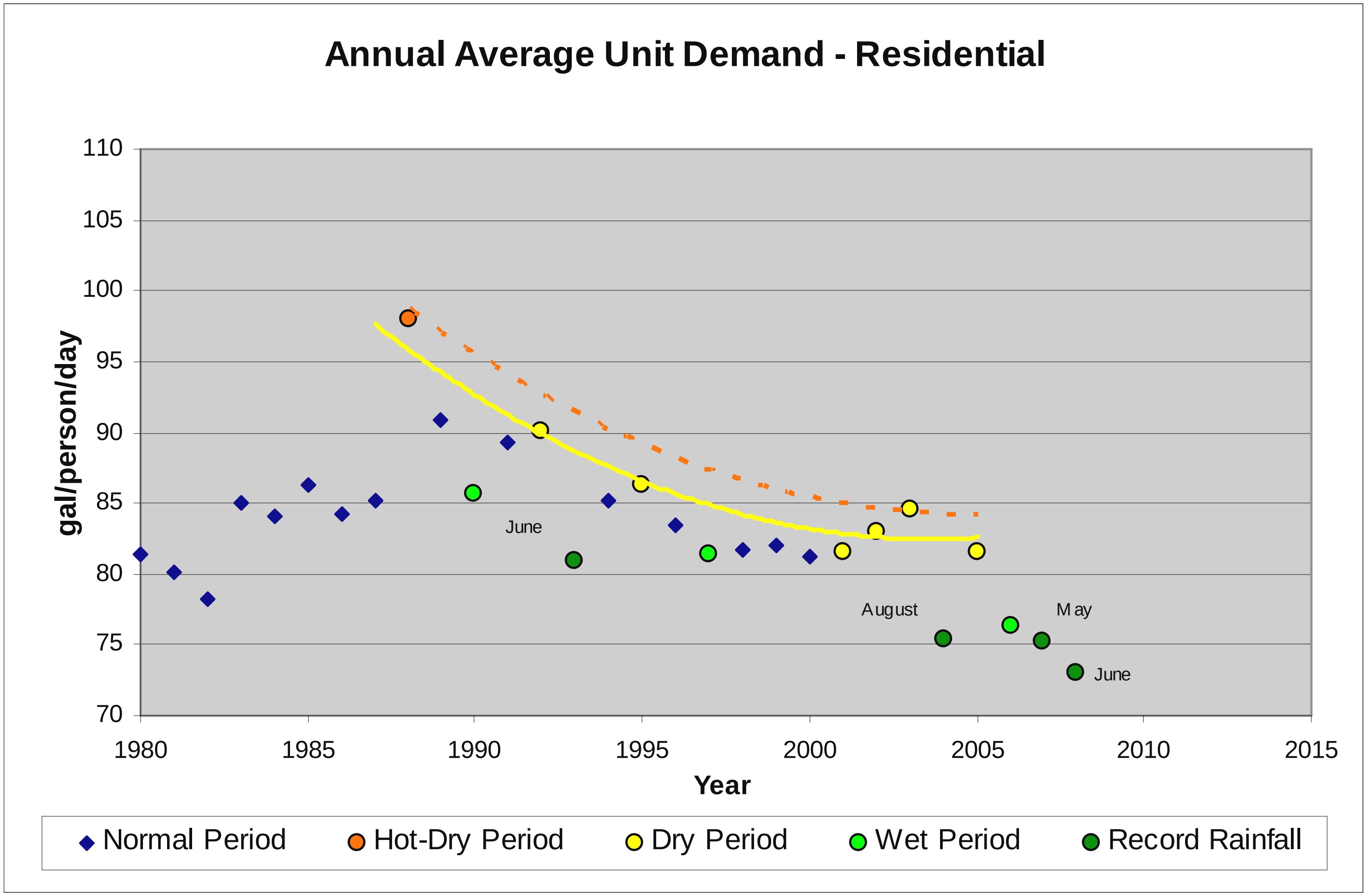


Master Plan Assessment: The two key design unit demands were related to residential and industrial/commercial/institutional (ICI) customers.

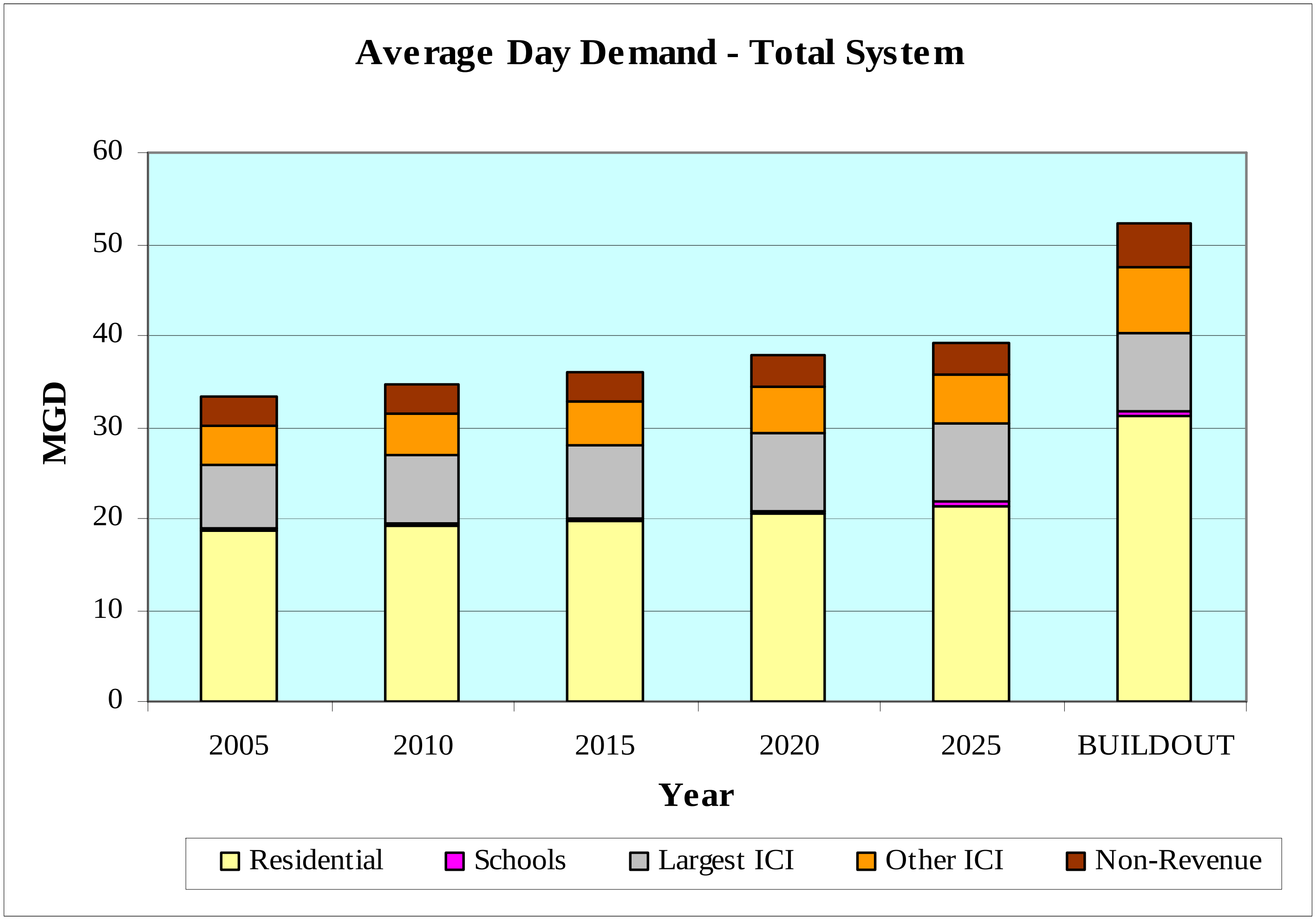
Customer Category	Annual Average Unit Demand Current – to – 2015 and after
Residential	87 to 85 gal/person/day
Other ICI	27 to 25 gal/employee/day

For system capacity to be adequately planned, design criteria must define high demand associated with periods of warm dry weather.

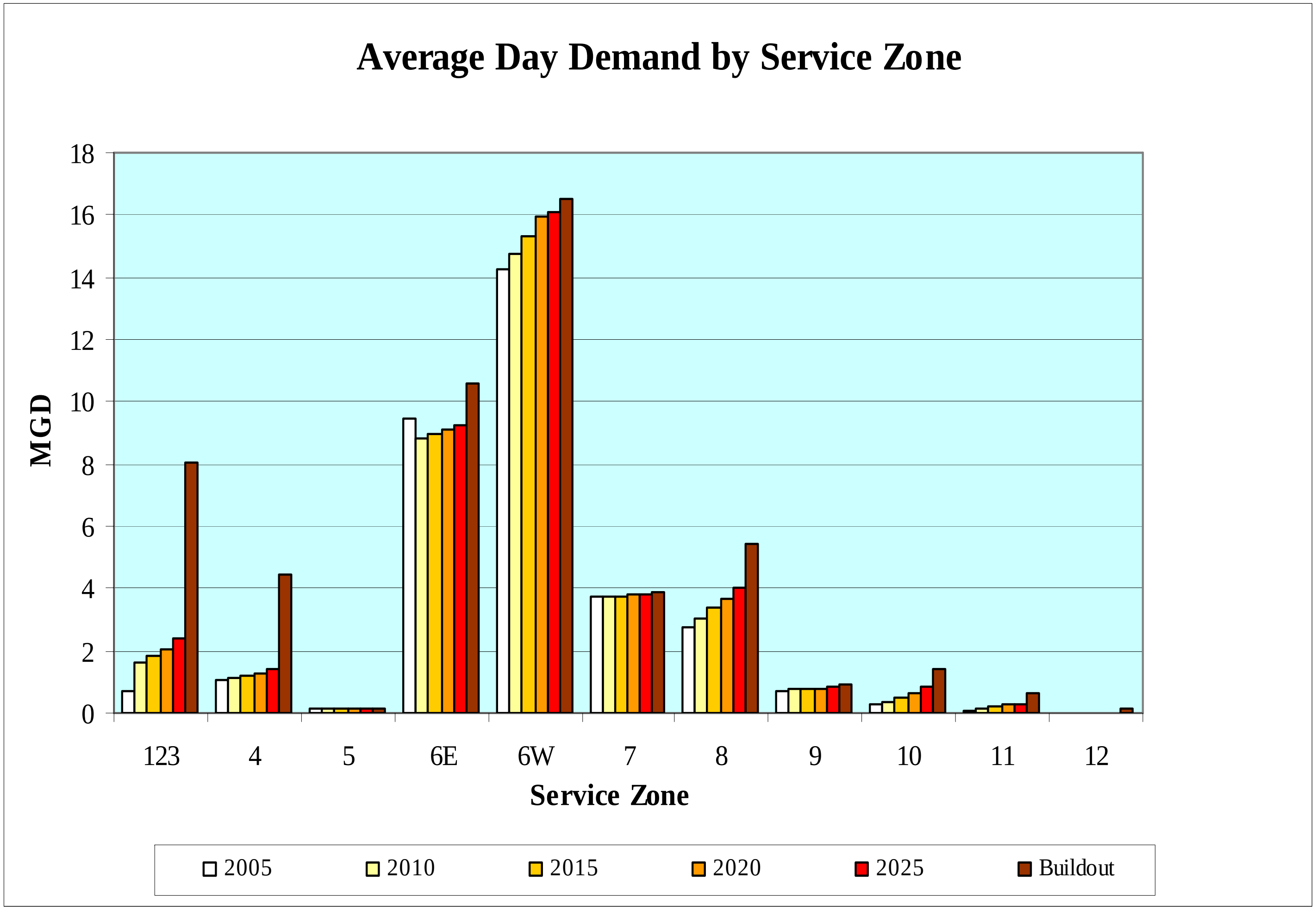
2008 Update – Design residential unit demand is substantiated by historic dry period usage



Projected demographics and design unit demands were used to calculate projected future design water demand.



The key water use rates were also calculated for each service zone using demographics, unit demands, and water use peaking factors .



Master Plan Assessment: Design Maximum Day (MD) demand is determined by applying a peaking factor to Annual Average (AA) demand

Approach	Example
Design AA Demand	10.0 MG
x MD:AA Ratio	x 1.74
Design MD Demand	17.4 MG

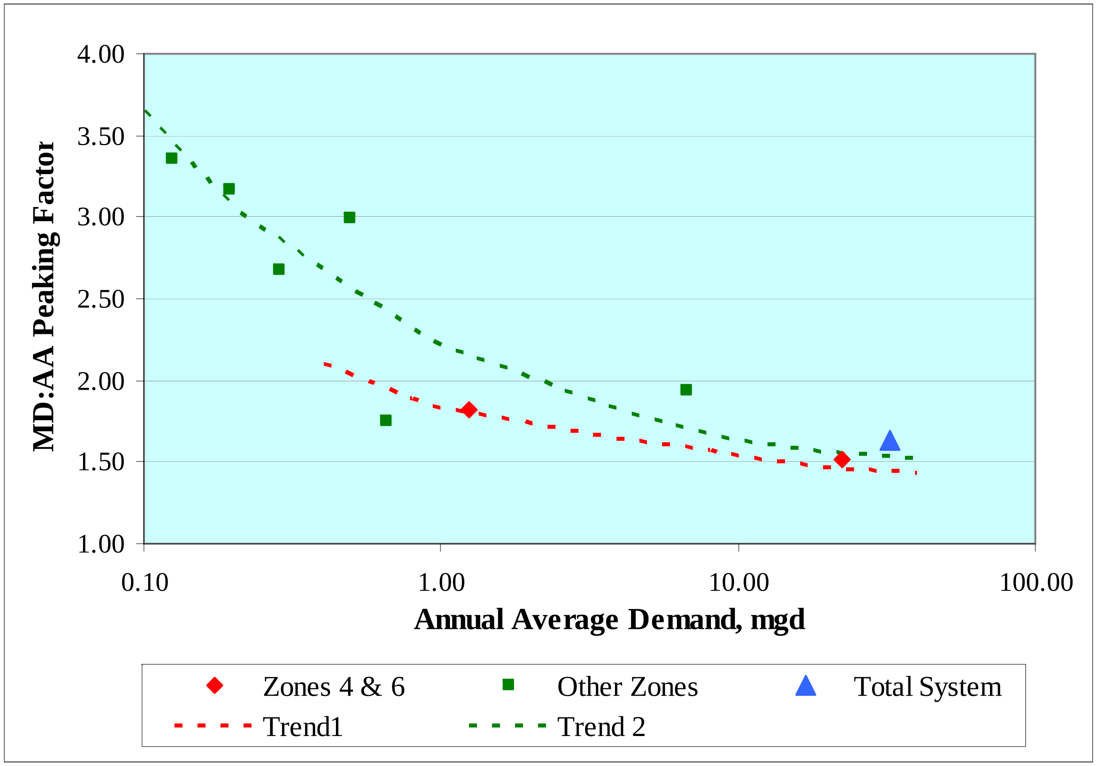
Design MD:AA = 1.74 is defined from historic production records

Design

Table 3-20
Design MD:AA Peaking Factors

Service Zone	Max Day-to-Ann Ave Peaking Factor (MD:AA) Design Year 2010	Design Year 2025
123	2.42	2.33
4	1.82	1.80
5	3.38	3.37
6 East	1.74	1.72
6 West	1.51	1.50
7	2.05	2.04
8	2.06	1.96
9	2.70	2.65
10	3.04	2.56
11	3.42	2.83
12	NA	6.75
Total System	**1.74**	**1.74**

Historic



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2008 Update - Design MD:AA = 1.74 is Substantiated by recent production

- Dry periods define design MD:AA peaking factor
- Required supply capacity is defined by dry period MD demand

Wet	
Dry	

Year	Total System Demand			
	Ann Ave	Max Day		Peaking Factor
	MGD	MGD	Date	MD:AA
1997	31.3	43.19	17-Aug	1.38
1998	32.9	49.37	29-Jul	1.50
1999	32.5	49.97	16-Jul	1.54
2000	31.8	43.50	16-Aug	1.37
2001	33.2	54.21	12-Jul	1.63
2002	32.5	53.27	16-Jul	1.64
2003	32.0	52.89	22-Aug	1.65
2004	30.2	40.34	15-Sep	1.34
2005	32.5	54.77	24-Jun	1.69
2006	30.5	47.17	18-Jul	1.55
2007	30.9	53.97	26-Jul	1.75
2008	29.9	45.10	18-Aug	1.51

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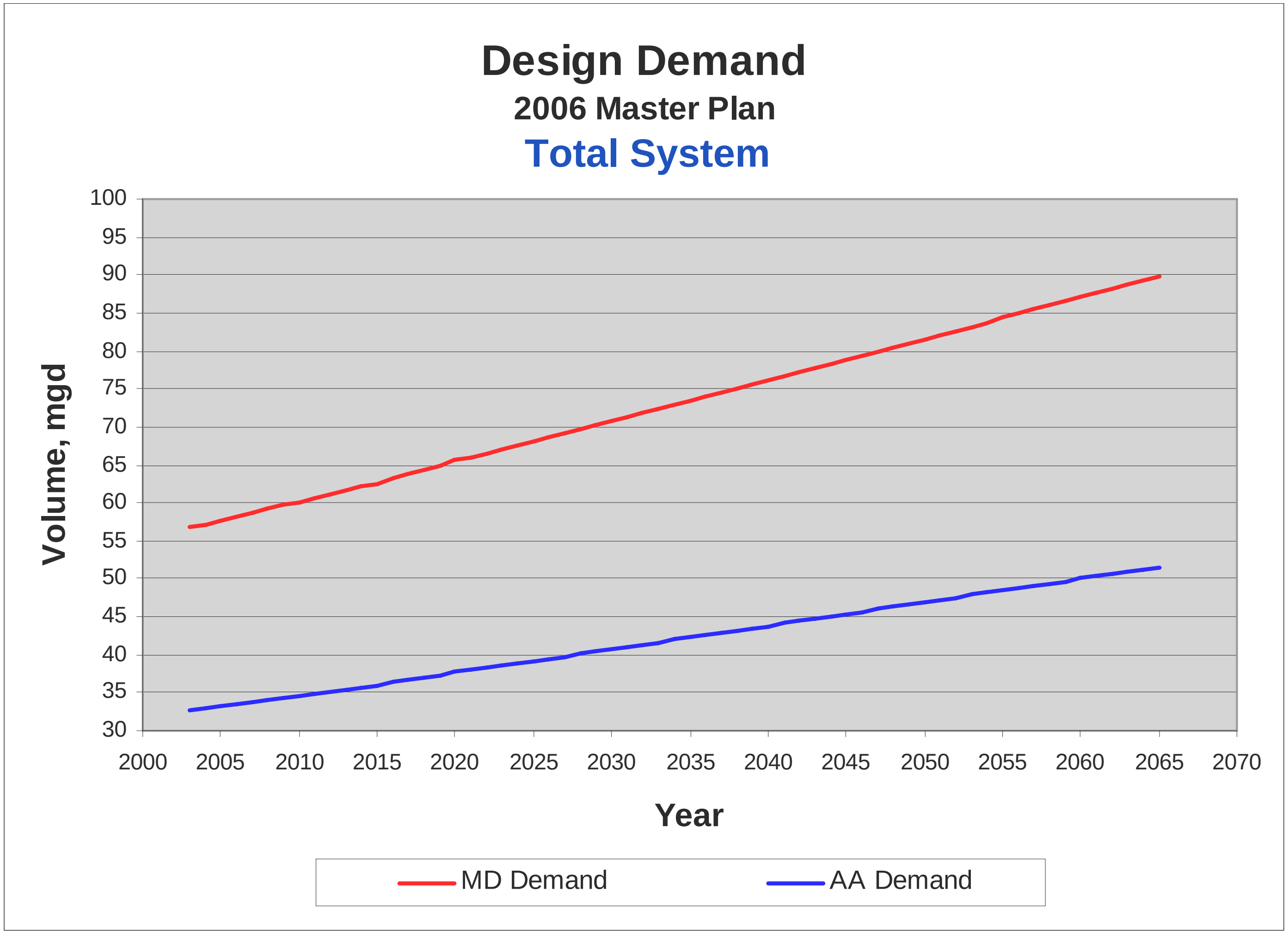
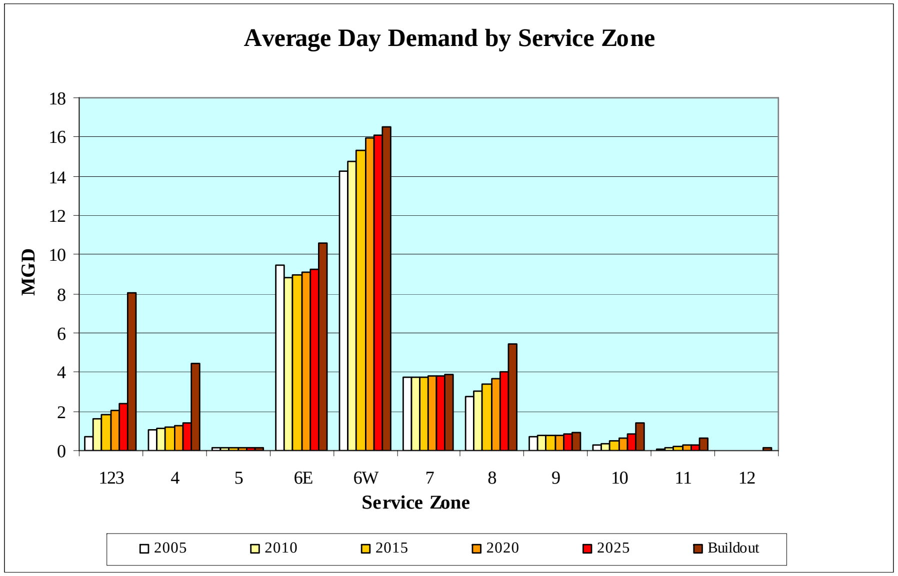
Design Demand is the projected dry period maximum day demand



Design MD Demand was also defined for each individual service zone.



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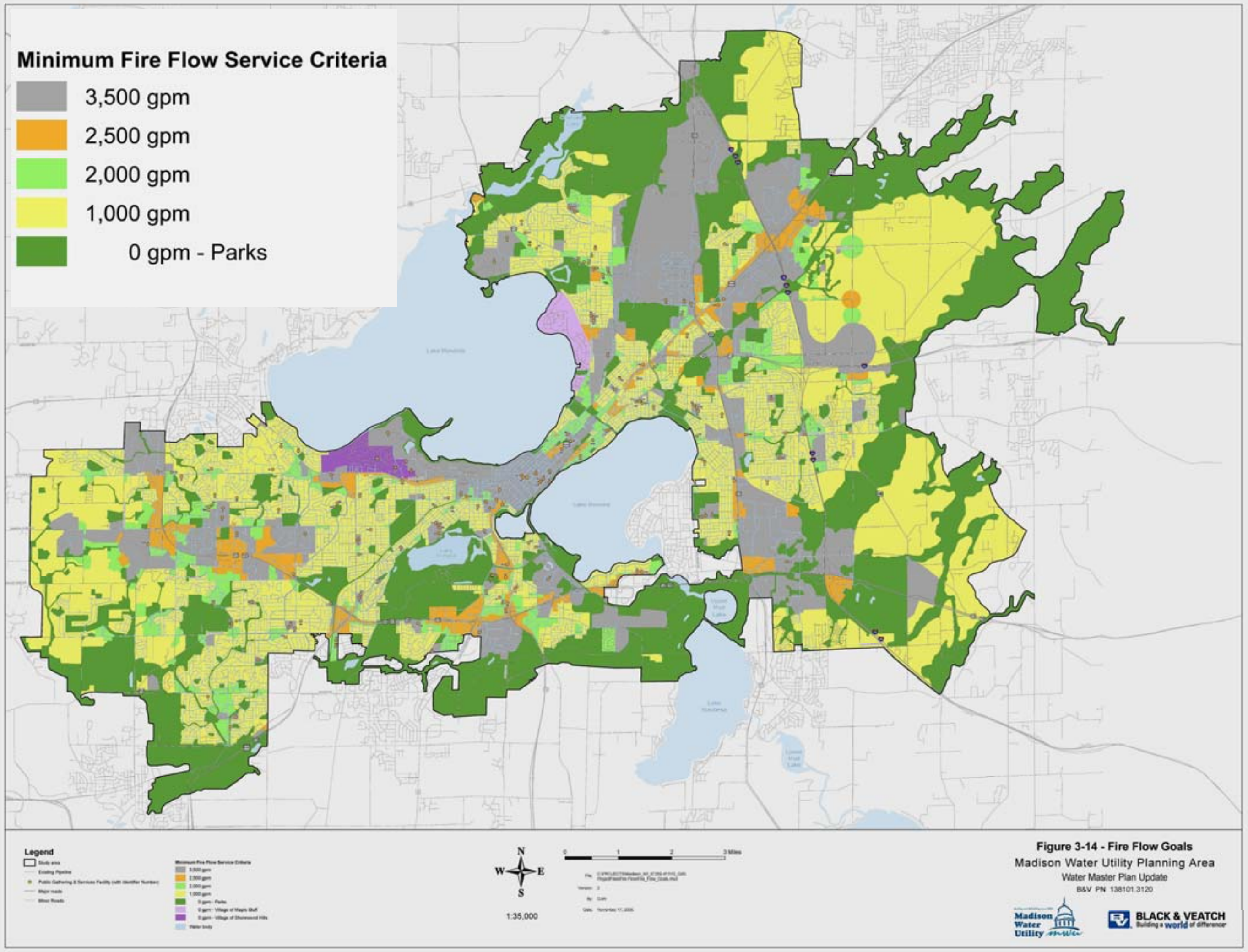
Service Zone Max Day Demands

Fire flow goals were defined based on land use types and ISO requirements for buildings typical for land use types.



Land Use Category	Fire Flow Goal, gpm
Residential - SF	
Low - Density	1,000
Medium-Density	2,000
High-Density	2,500
Mixed Use	
Neighborhood	2,000
Community	2,500
Regional	3,500
Commercial	
General	2,500
Regional	3,500
Employment	3,500
Industrial	3,500
Other	
Special Institutional	3,500
Downtown	3,500
Campus	3,500
Airport	3,500

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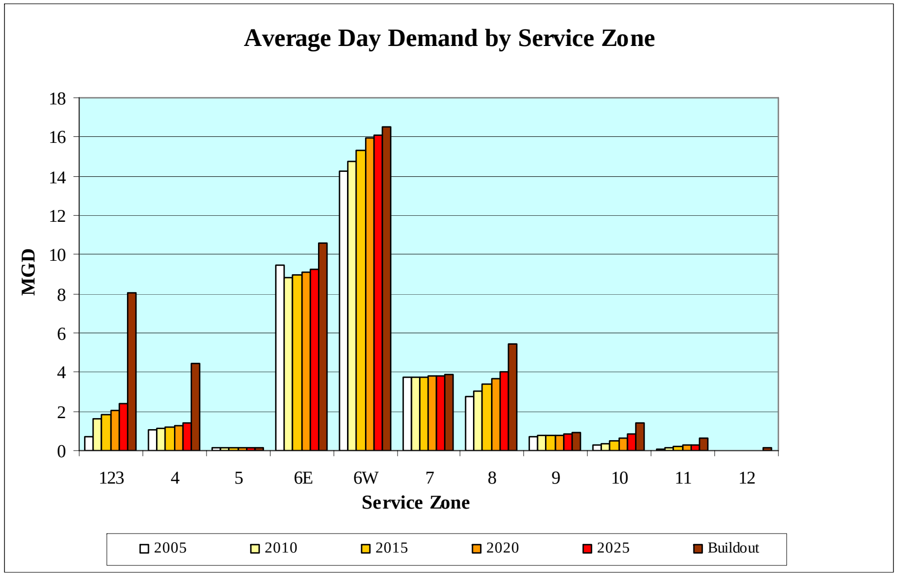
Water System Evaluation

Design MD Demand was also defined for each individual service zone.



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=

Service Zone Max Day Demands

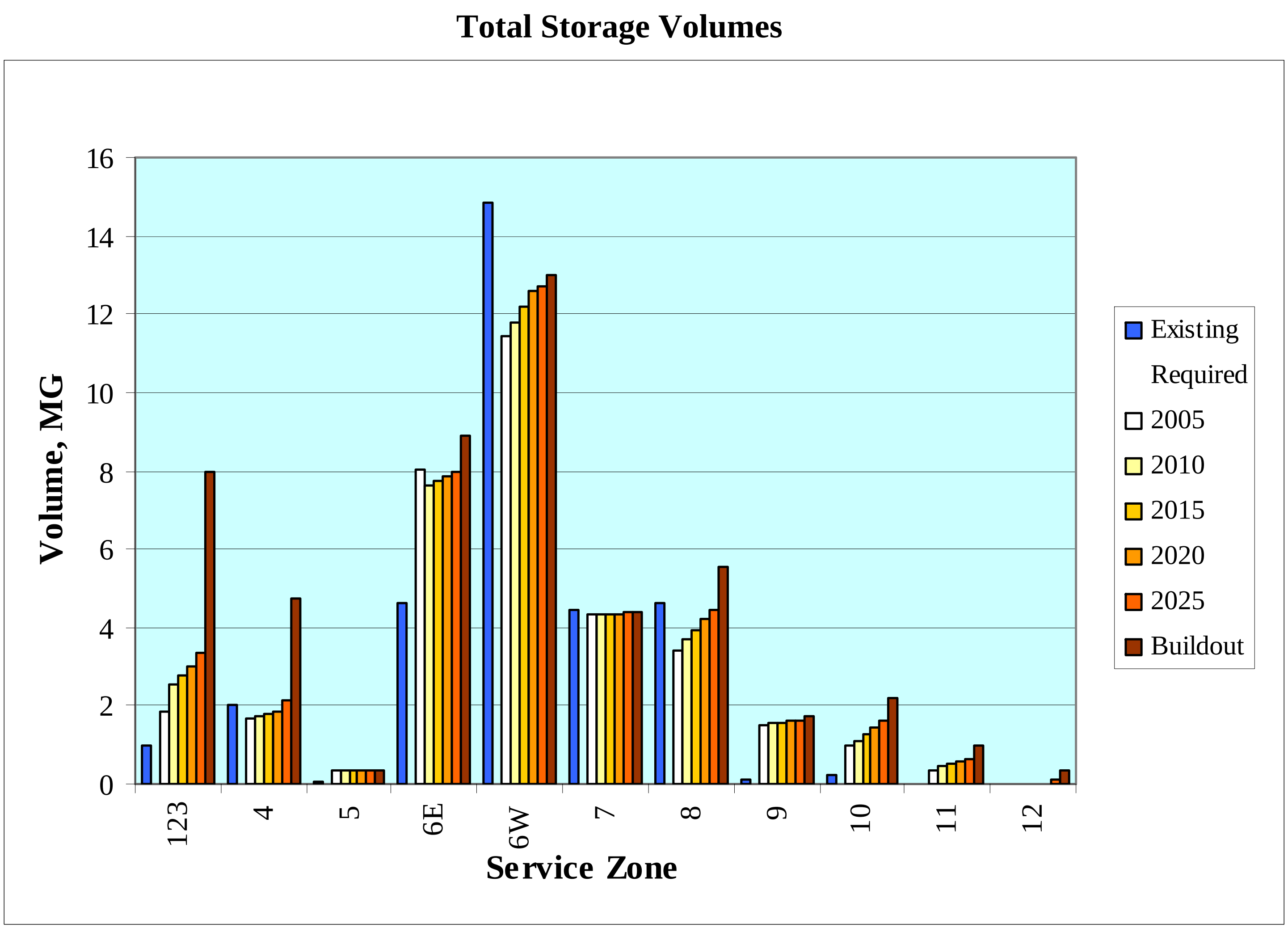
Required supply capacity was then determined for each service zone.

Inter-zone transfer, required to balance supply and demand, will vary over time with incremental demand growth and step increases in supply capacity.

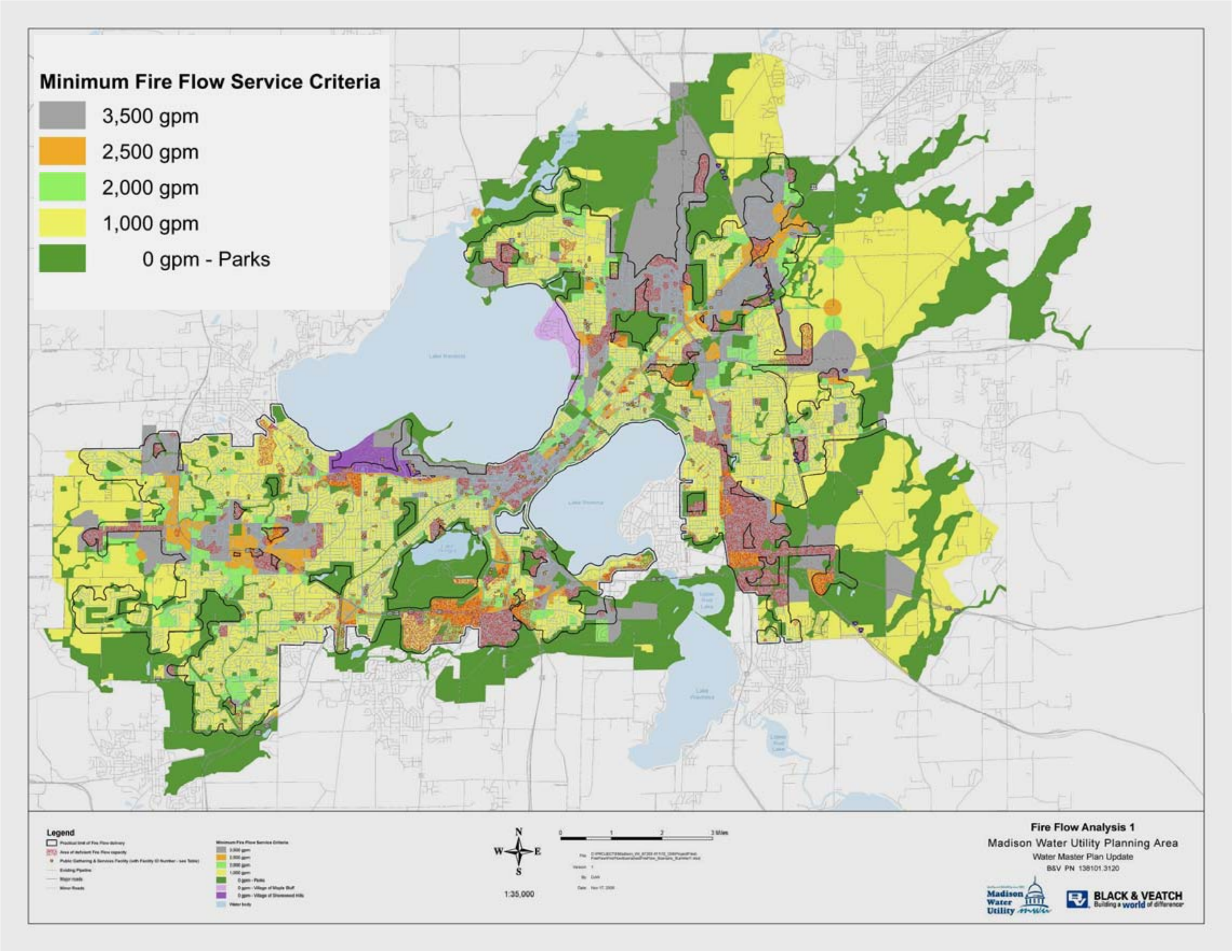
Inter-zone transfer capacity assessed

- Booster stations
- Pressure reducing valves

Storage improvements were defined by comparing current storage volume with needed Equalization, Fire and Emergency Storage volume.



A fire flow analysis of the existing system identified areas of needed capacity improvements.



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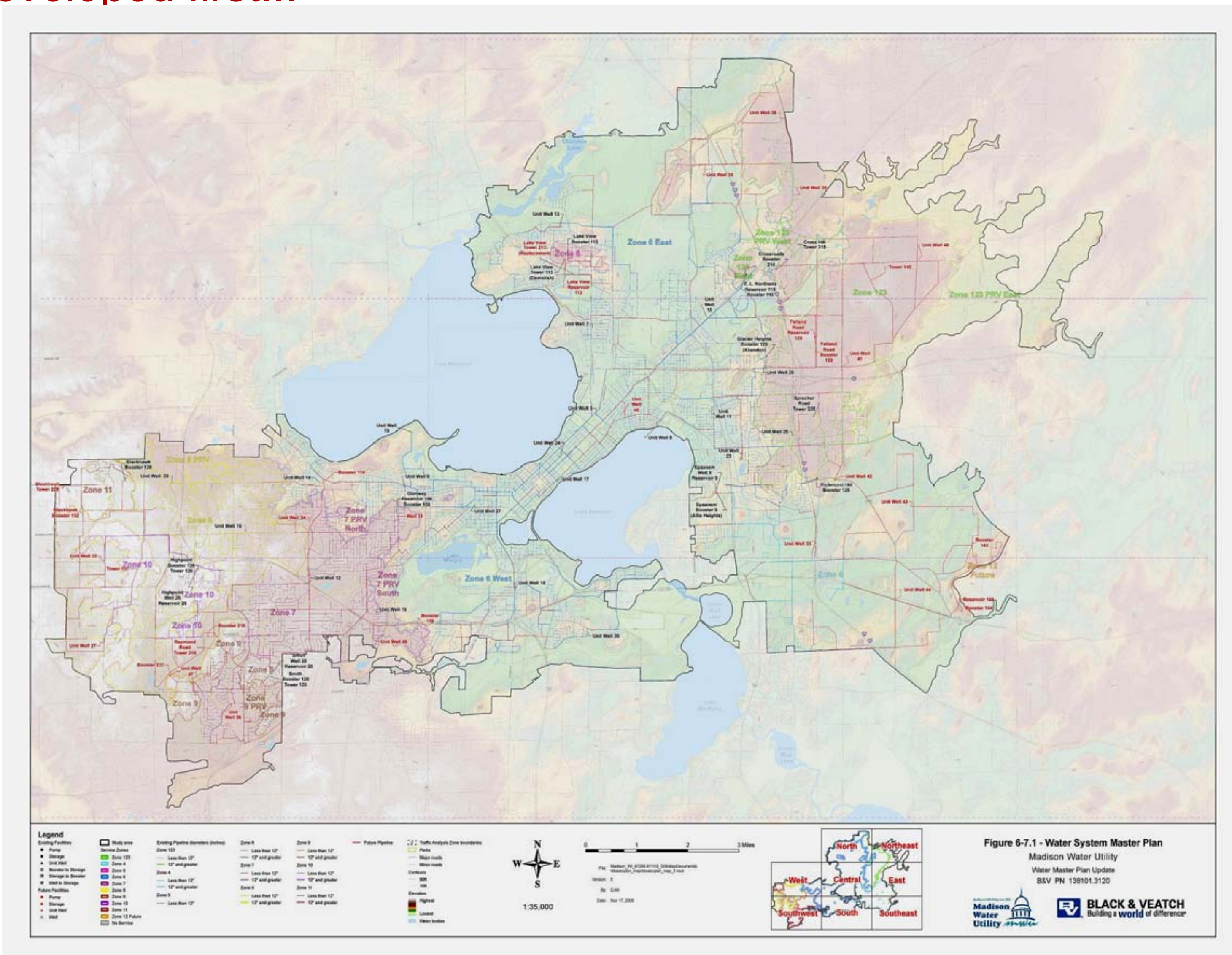
Capital Improvements Program

A Master Plan of system improvements that will be needed at buildout was developed first...



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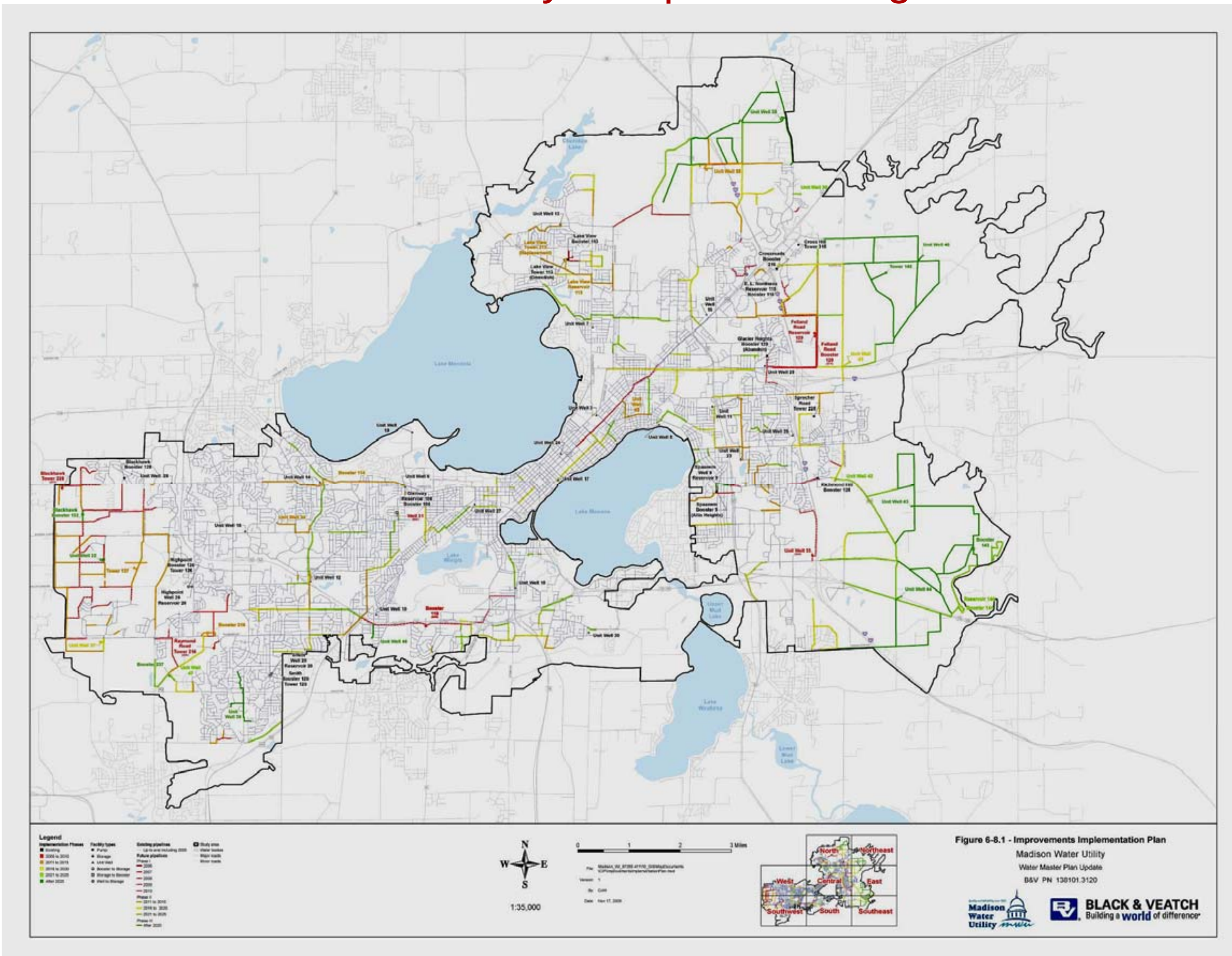
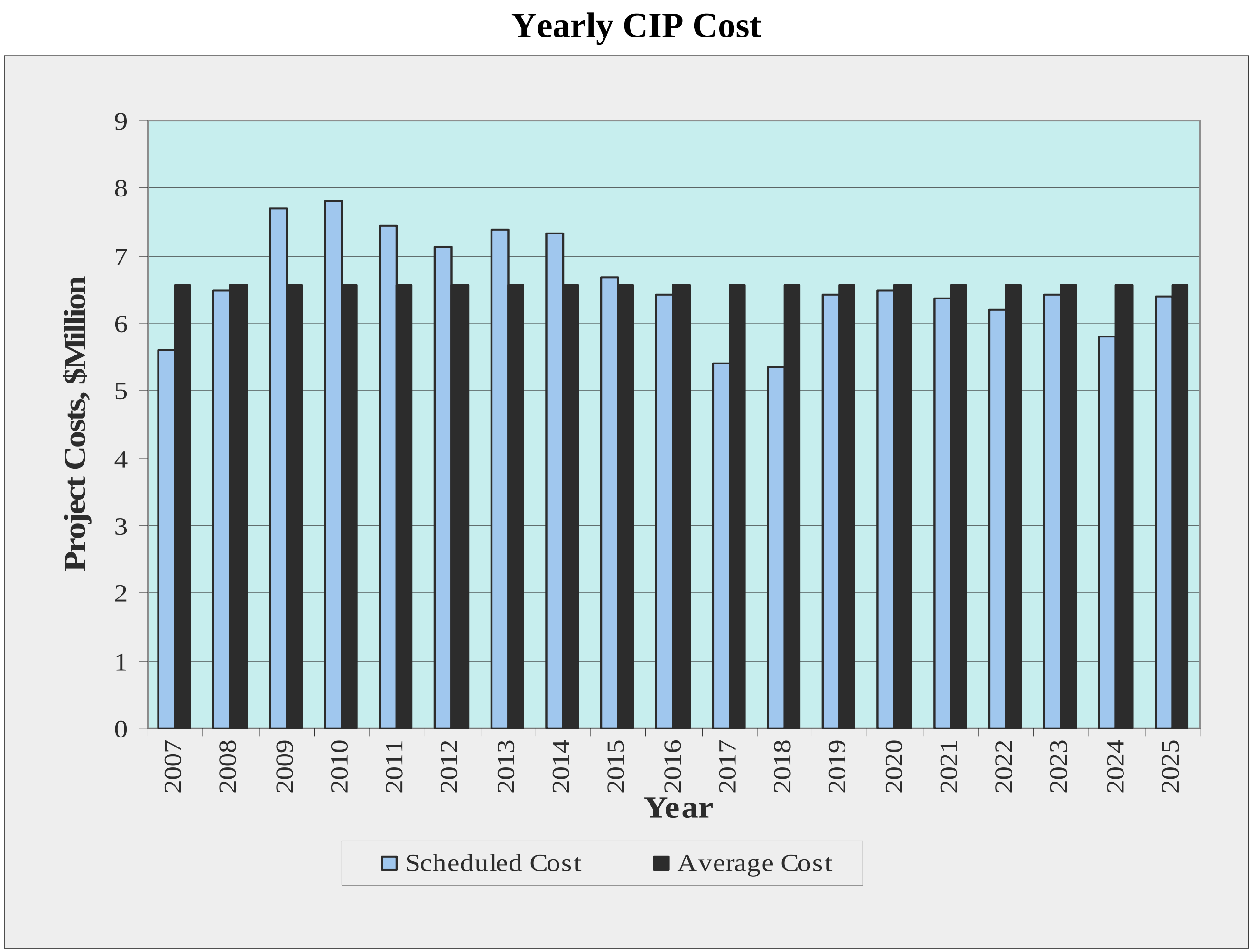
…then a strategy for implementing Master Plan improvements was devised to correct current deficiencies early and provide for growth over time.



Project timing balances need for the improvements with required revenue stream and project delivery capacity.



Current system challenges are addressed by the Five-Year CIP.

Improve East-side Pressure

- Zone 6E above elevation 988 ft
- Consolidate into Zone 123
  - Transmission pipeline connections / enhancements
  - Valve closures
  - Unit Well 25 supply
  - Increased booster capacity; Booster Stations115 and 129

Current system challenges are addressed by the Five-Year CIP.

Improve Fire Flow Capacity

- Arbor Hills
  - Cannon Ball Trail transmission pipeline
  - Booster Station 118 (new)
- Service Zone 123
  - Reservoir 229 – Felland Road (new in 2007)
  - Booster Station 115 – Bunker Hill (upgrade)
  - Booster Station 129 – Felland Road (new)
- Service Zone 4
  - Transmission pipeline from Unit Well 9 (2008)
  - Pressure Reducing Station (new)
  - Unit Well 33 (new)

Current system challenges are addressed by the Five-Year CIP.

Improve Fire Flow Capacity

- Service Zone 5
  - Booster Station 113 – Northport Drive (upgrade)
  - Elevated Reservoir 113 (new)
- Service Zone 9; Elevated Reservoir 216 (new)
- Service Zone 10; Elevated Reservoir 137 (new)
- Service Zone 11; Elevated Reservoir 228 (new)

Current system challenges are addressed by the Five-Year CIP.

Manage Water Quality

- Unit Well 3: Abandoned in 2008
- Unit Well 8: Construct a filter
- Unit Well 10: Reserve capacity; Either filter or replace
- Unit Well 29: Filter on line 2009

Five-Year CIP – Year 1

Only Unit Well 29 filter has been completed

Year 2007 Improvements		
Description	**Purpose**	**Cost, $**
Wells		
Well31: New deep well UW29: Treat or Replace	Meet increased West Campus demand; Replace capacity lost to reduced use of UW10. Provide treatment or replace existing well.	1,300,000 **2,400,000**
Booster Stations		
BS106: Demolish & rebuild	Replace aging facility; Increase capacity and reliability; transfer normal supply to postpone supply expansion in Zone 7; transfer emergency supply until unit wells are built.	850,000
BS113: Change / add pumps	Improve fire supply capacity until fire storage is built in year 2012. Transfer normal and emergency supplies.	200,000
PRV Stations (booster station)		
@ BS106	Improve RES106 refill ability; Improve reliability	30,000
PRV Stations (above-grade structure)		
@ Vondron Rd	Improve fire flow capacity in Zone 4; Improve reliability	75,000
@ Gammon Rd	Provide emergency supply transfer capability; Improve reliability	75,000
Pipelines		**2,080,000**
	Year 2007 Subtotal	**7,010,000**

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Five-Year CIP – Year 2

Only some of the pipeline work was completed

Year 2008 Improvements		
Description	**Purpose**	**Cost, $**
Booster Stations		
BS120: Change / add pumps	Increase capacity and reliability; transfer normal supply to postpone supply expansion in Zone 9; transfer emergency supply until unit wells are built	320,000
PRV Stations (booster station)		
@ UW120	Improve reliability; supply transfer during abnormal conditions	30,000
Storage		
TWR216 (Raymond Road) –New 1.0 MG elevated tank	Eliminate current storage deficiency in Zone 9	1,500,000
Pipelines		**5,630,000**
	Year 2008 Subtotal	**7,480,000**

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Five-Year CIP – Year 3

No progress on this list

Year 2009 Improvements		
Description	**Purpose**	**Cost, $**
Unit Wells		
UW25: Change pumps	Provide head to deliver to Zone 123; First Zone 123 unit well	200,000
UW33: New unit well	Increase Zone 4 fire flow capacity; Reliability via dual zone supply	3,000,000
Booster Stations		
BS115: Change pump, add VFD	Improve pressure in RES 115 area; transfer normal supply to postpone supply expansion in Zone 123; supplement fire supply; transfer emergency supply until unit wells are built	100,000
BS118: New booster station	Transfer normal supply to replace capacity lost by reduced use of Unit Well 10 and to postpone supply expansion in Zone 7	640,000
PRV Stations (booster station)		
@ UW33	Improve reliability; supply transfer during abnormal conditions	30,000
@ BS115	Improve reliability; supply transfer during abnormal conditions	30,000
@ BS118	Improve reliability; supply transfer during abnormal conditions	30,000
@ BS126	Improve reliability; supply transfer during abnormal conditions	30,000
Pipelines		3,630,000
	Year 2009 Subtotal	**7,690,000**

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Five-Year CIP – Year 4

No progress on this list

Year 2010 Improvements		
Description	**Purpose**	**Cost, $**
Booster Stations		
BS129 (Felland Road): New booster station	Replace BS129 Glacier Heights; Provide capacity to transfer fire flows from storage in Zone 6E	1,200,000
PRV Stations (booster station)		
@ BS129	Improve reliability; supply transfer during abnormal conditions	30,000
Storage		
TWR228 (Blackhawk) – New 0.75 MG elevated tank	Eliminate current storage deficiency in Zone 11	1,200,000
Pipelines		5,380,000
	Year 2010 Subtotal	**7,810,000**

Five-Year CIP – Year 5

No progress on this list

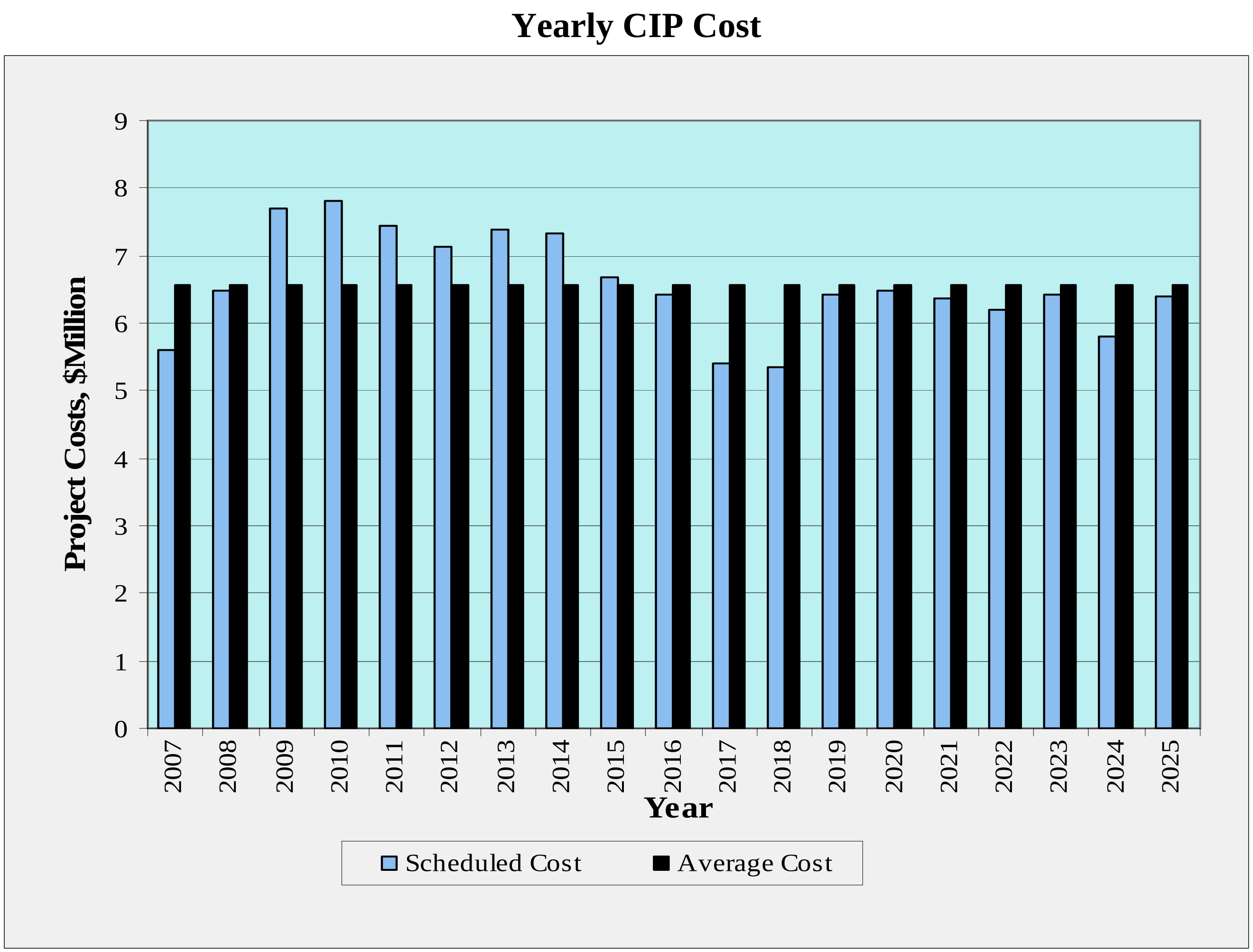
Year 2011 Improvements		
Description	**Purpose**	**Cost, $**
Unit Wells		
UW3: Abandon	Groundwater contamination renders well unusable	50,000
UW45: New unit well	Replace UW3. Maintain Zone 6E supply capacity	3,000,000
PRV Stations (booster station)		
@ BS125	Improve reliability; supply transfer during abnormal conditions	30,000
@ BS215	Improve reliability; supply transfer during abnormal conditions	30,000
Storage		
TWR137: New 1.0 MG elevated tank	Eliminate current storage deficiency in Zone 10	1,500,000
Pipelines		2,790,000
Demolition		
BS129 (Glacier Heights)	Obsolete facility replaced by BS129 (Felland Road)	50,000
	Year 2011 Subtotal	**7,450,000**

This Water Master Plan is a program of improvements to make the MWU system able to provide a Level of Service that meets established standards.

Level Of Service Criteria

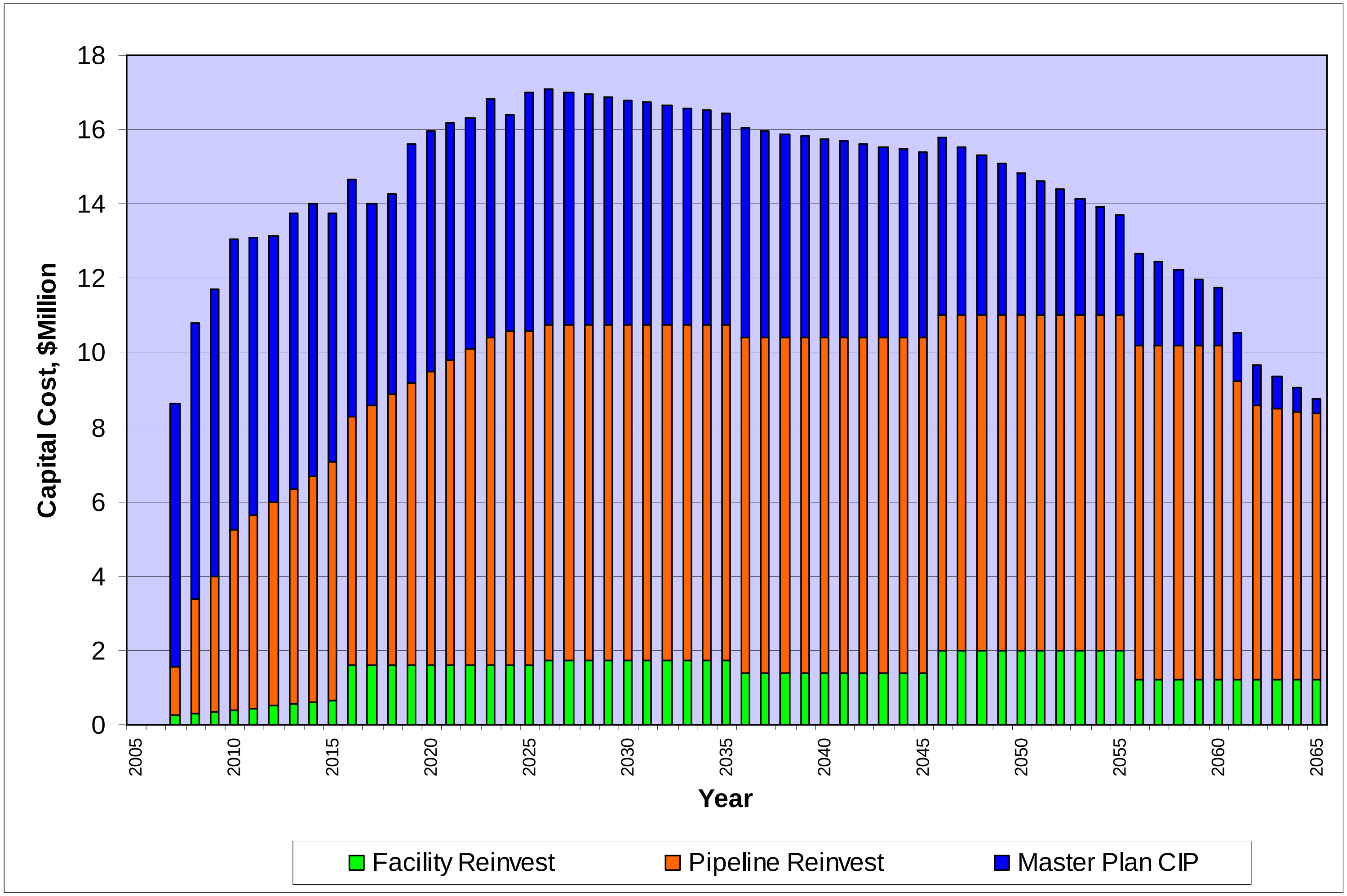
- Max Day Demand = 250 gal/person/day
- Water Quality meets drinking water standards
- Normal operating pressures = 40 – 90 psi
- Equalization + Fire Storage in gravity tanks
- Emergency storage
- Effectively manage groundwater resource

Master Plan Capital Costs



Total Plan Capital Costs

IMP Reinvestment + MP Improvements



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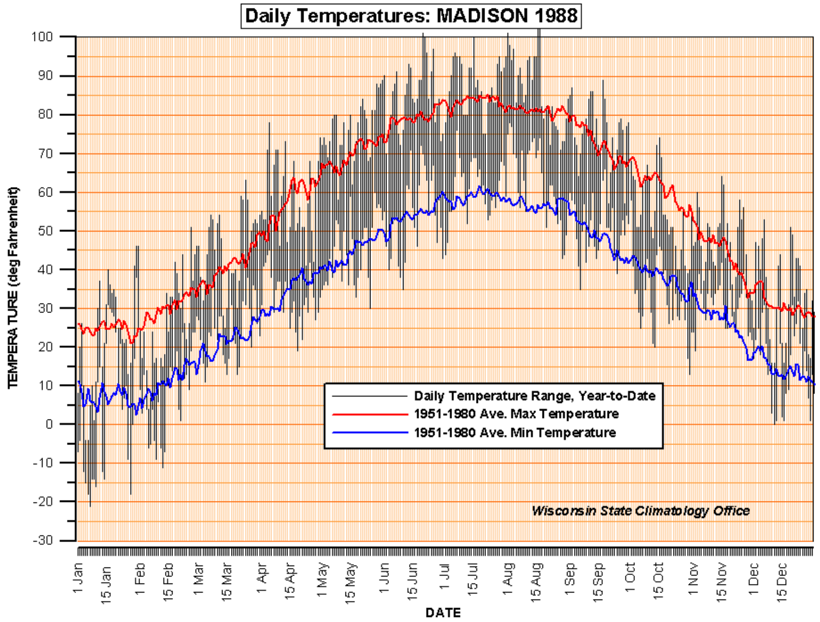
Questions ?

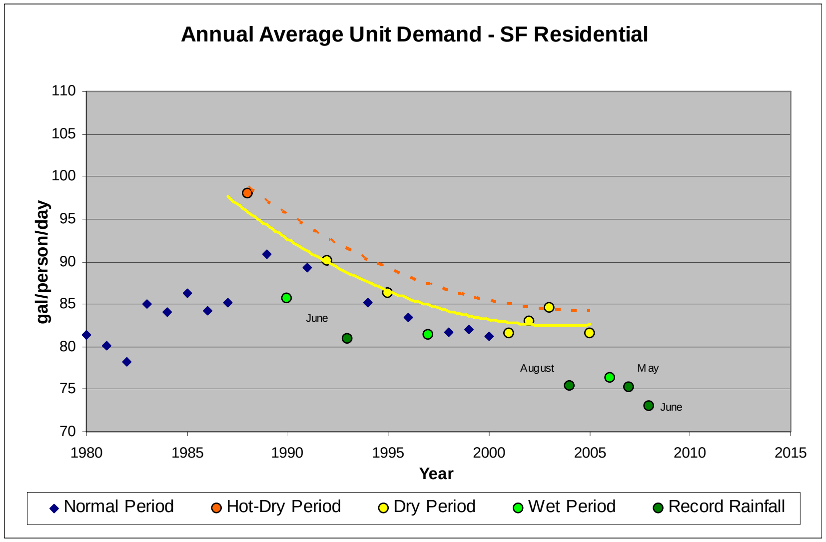
Additional Information

Unit Demand Update

Design Unit Demand Is Based on Warm-Dry Period Historic Usage

1988



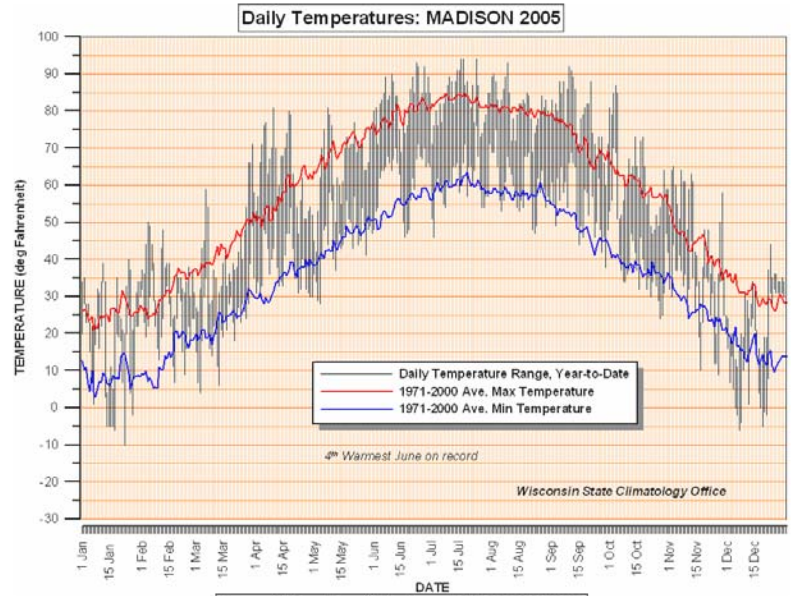


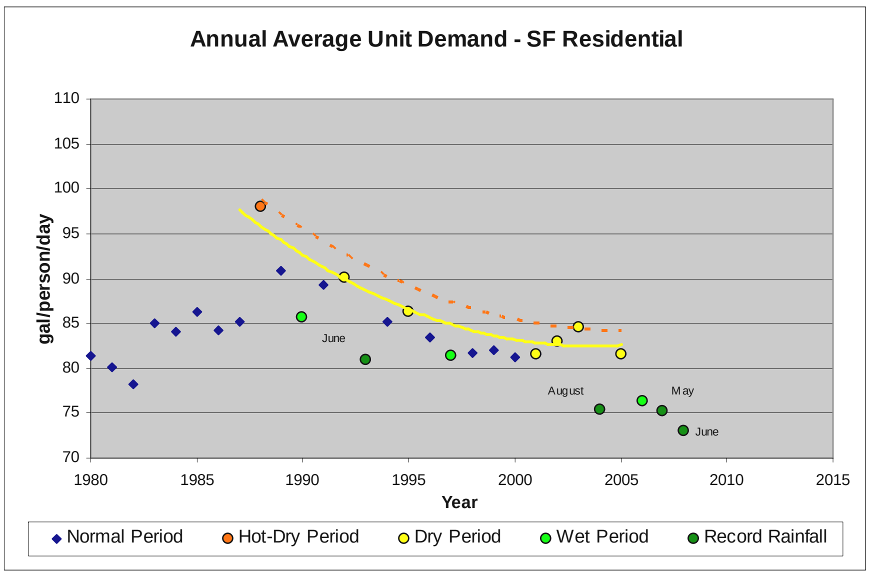
Total 1988 Precipitation: 24.57 inches (10 inches below normal) (similar to 2005)

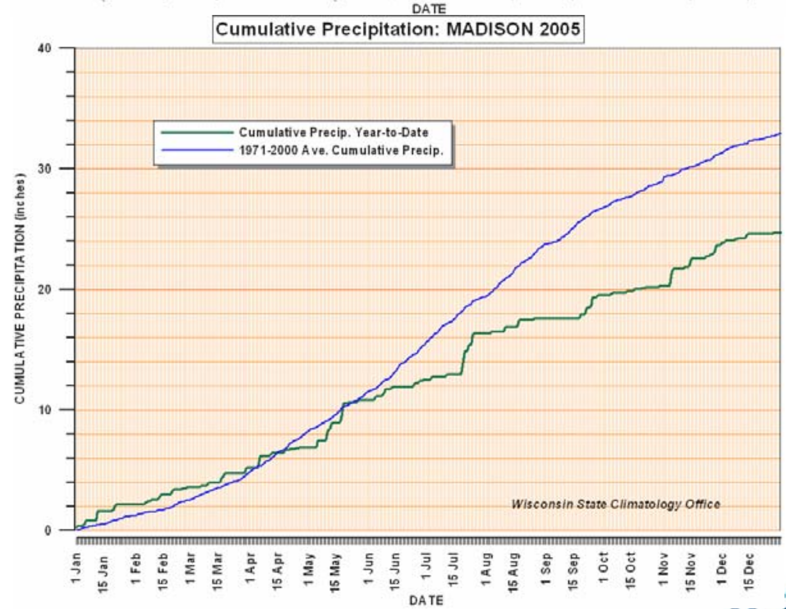
Unit Demand Update

Design Unit Demand Is Based on Warm-Dry Period Historic Usage

2005



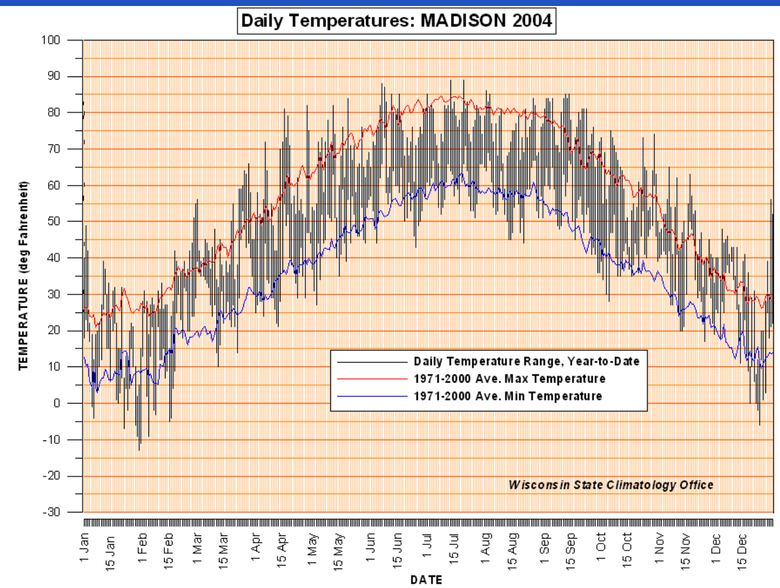


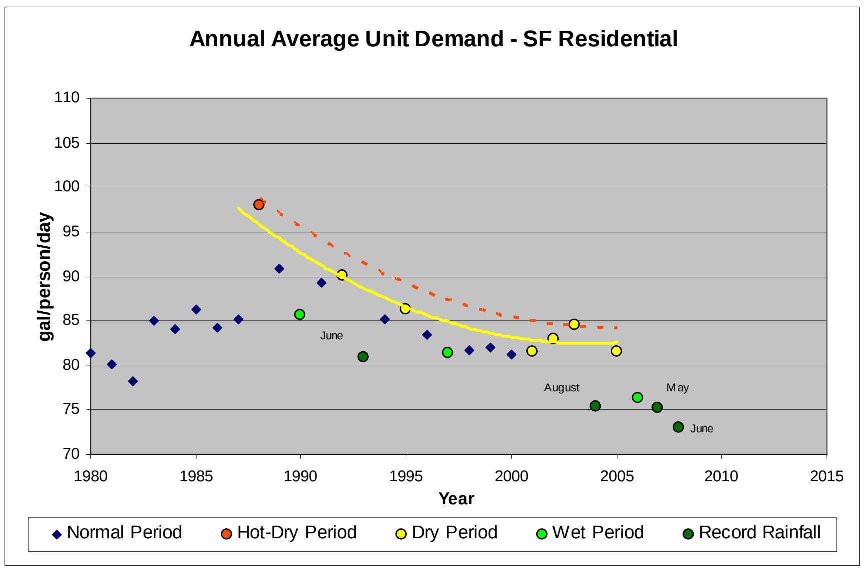


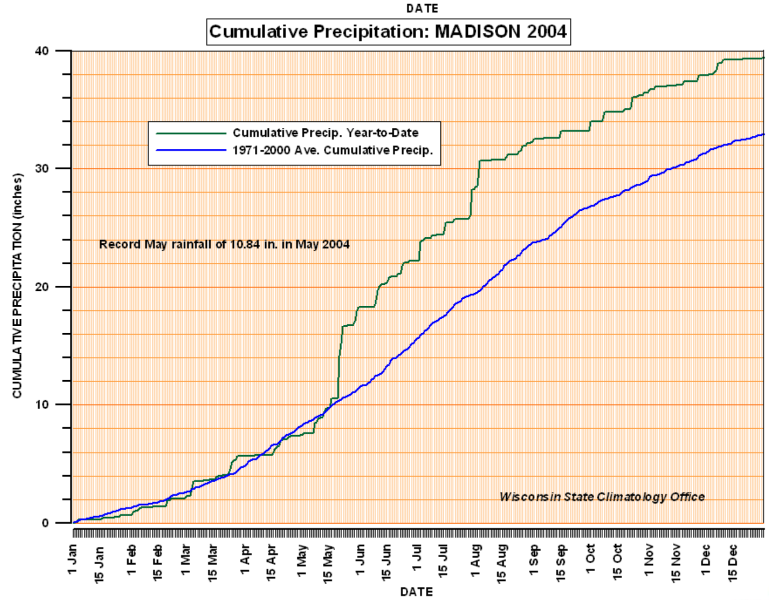
Unit Demand Update

Design Unit Demand Should Not Be Based On Cool-Wet Period Historic Usage

2004







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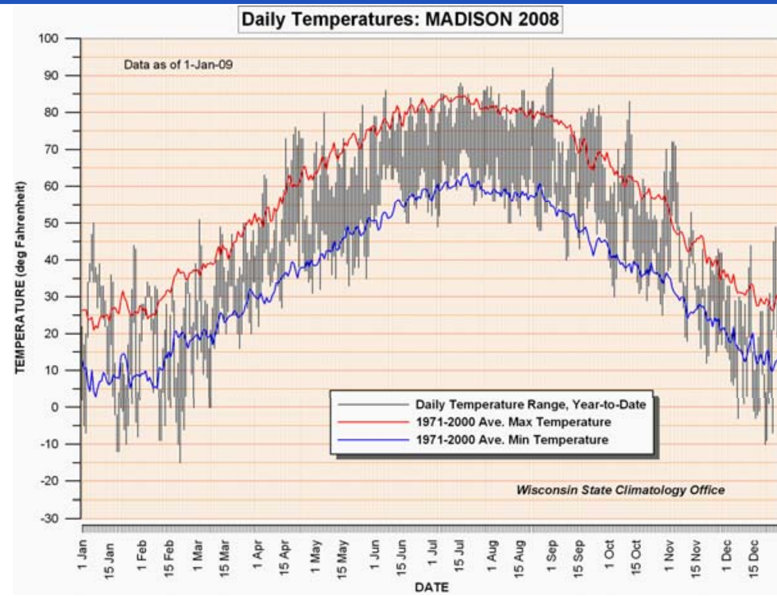
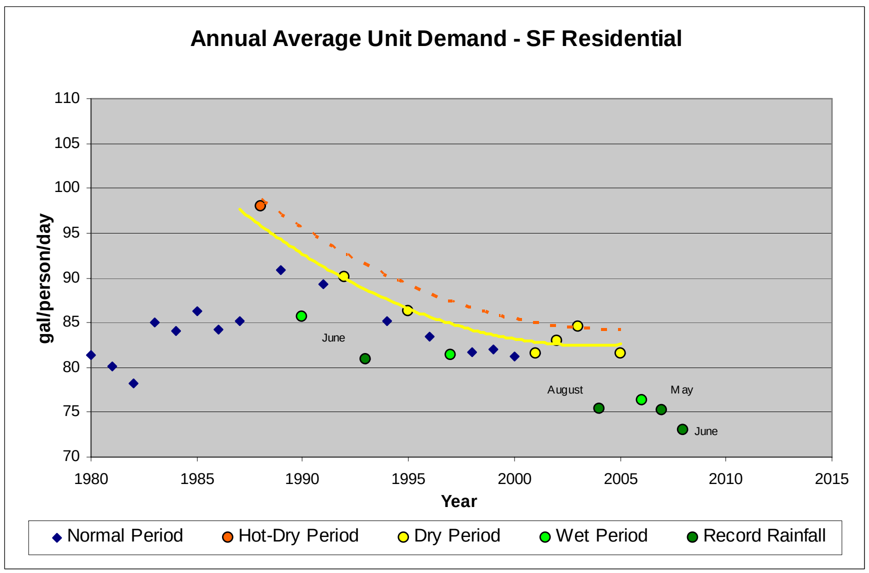
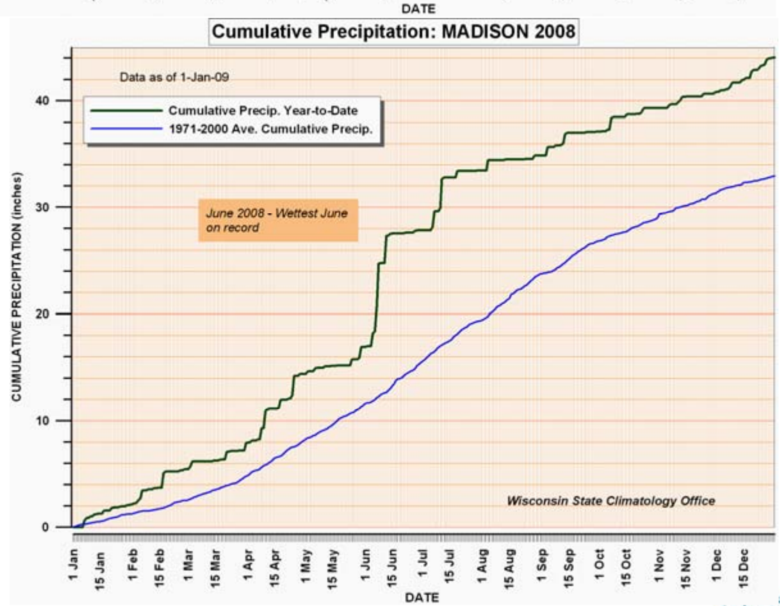
Unit Demand Update

Design Unit Demand Should Not Be Based On Cool-Wet Period Historic Usage

2008







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Supply capacity needs were assessed and a strategy of unit well additions devised for replacement, reserve capacity, and growth.

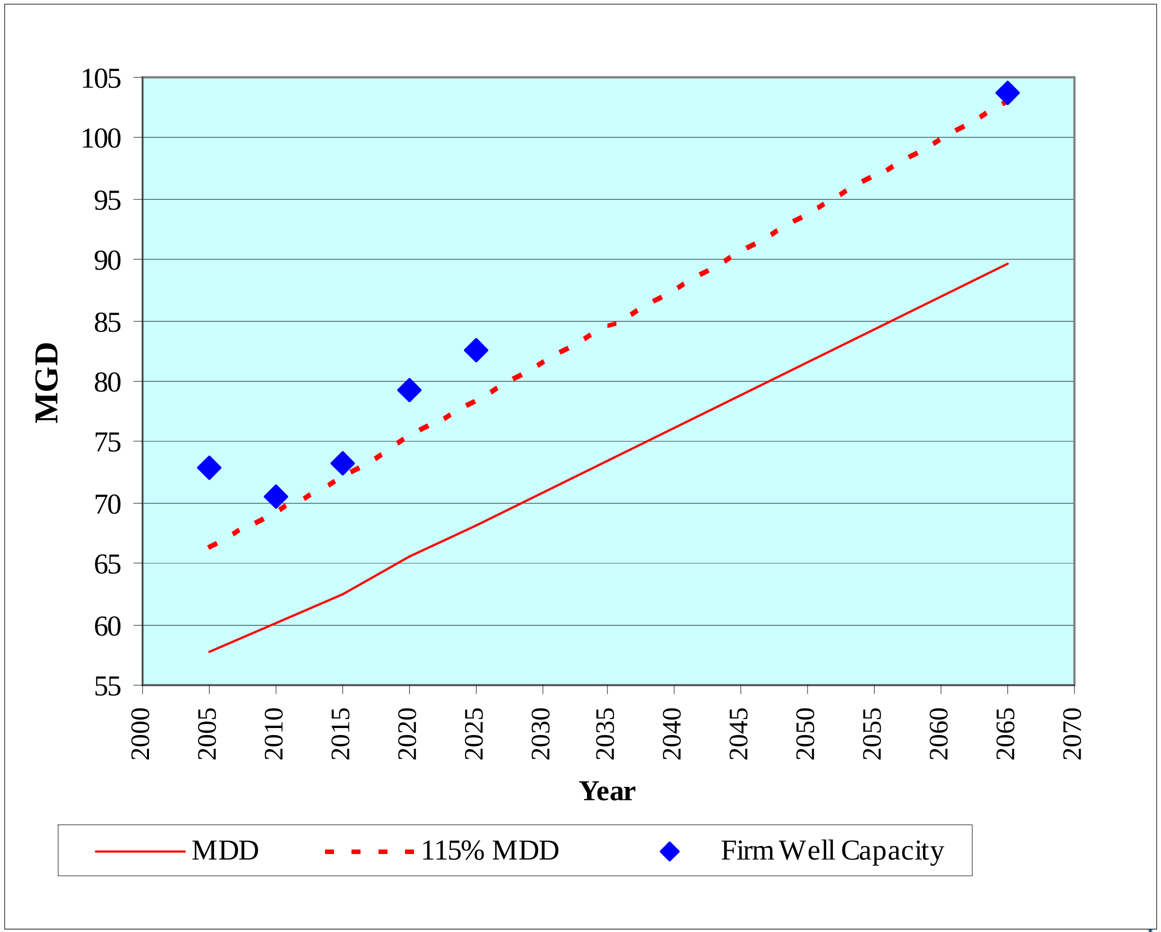
The master plan shows projected supply capacity in terms of rated well capacity.

Required rated capacity allows for:

Declining pump capacity as it ages
Declining well capacity before redevelopment
Reduced aquifer delivery capacity
- Drought
- Contaminants

Normal off-line time for well maintenance

Supply Expansion Schedule



Supply capacity projections can also be expressed as Design Well Capacity

Design Approach	Example	Explanation
Rated Well Capacity	10.0 mgd	Short-duration, new facility, normal conditions
x De-rating Factor	x 0.85	Allowance factor for non-optimal conditions
Design Well Capacity	8.5 mgd	Reduced capacity allows for: Decline in pump capacity as it ages Decline in well capacity before redevelopment Reduced aquifer delivery Drought Contaminants Normal off-line time for well maintenance

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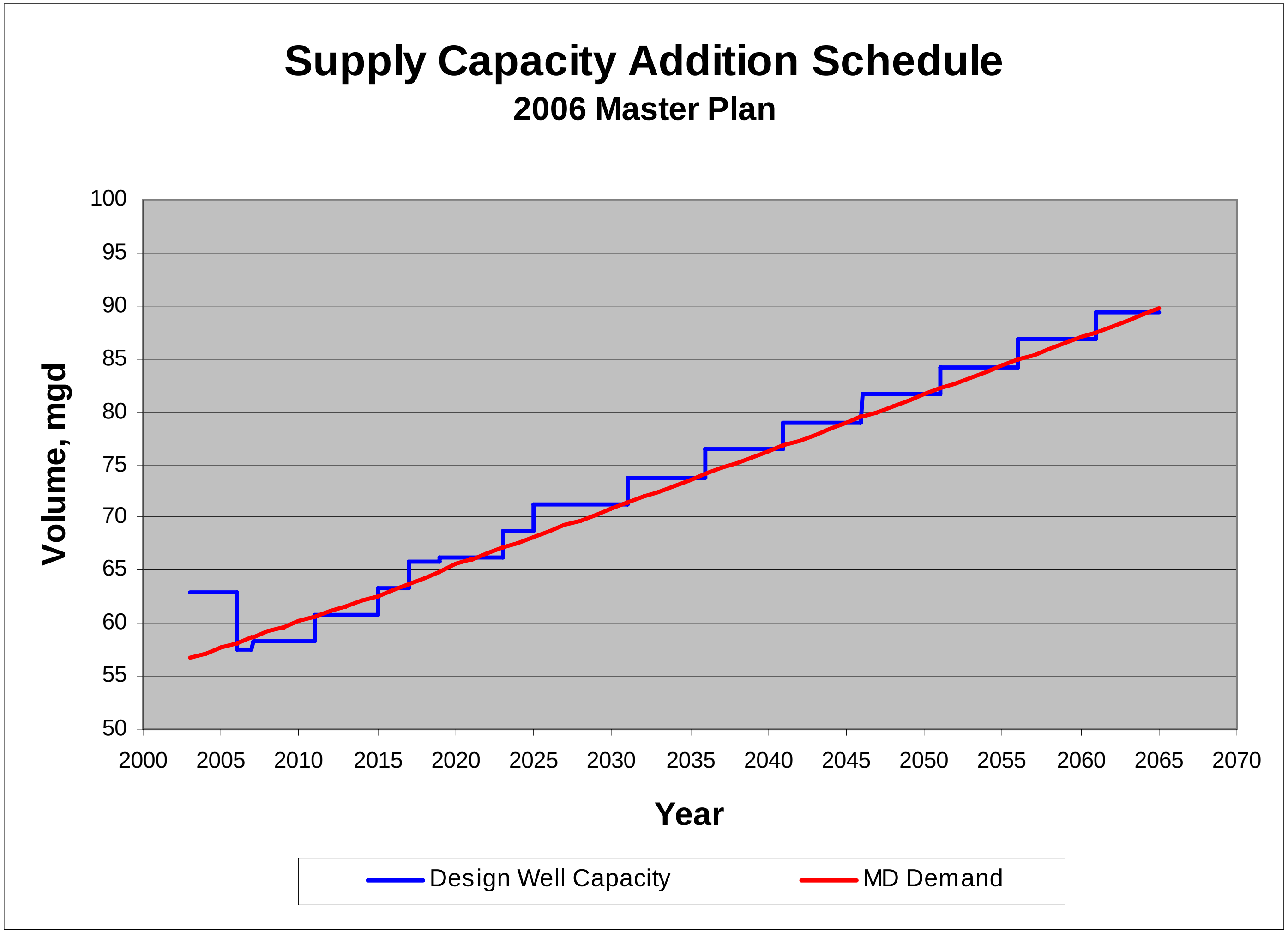
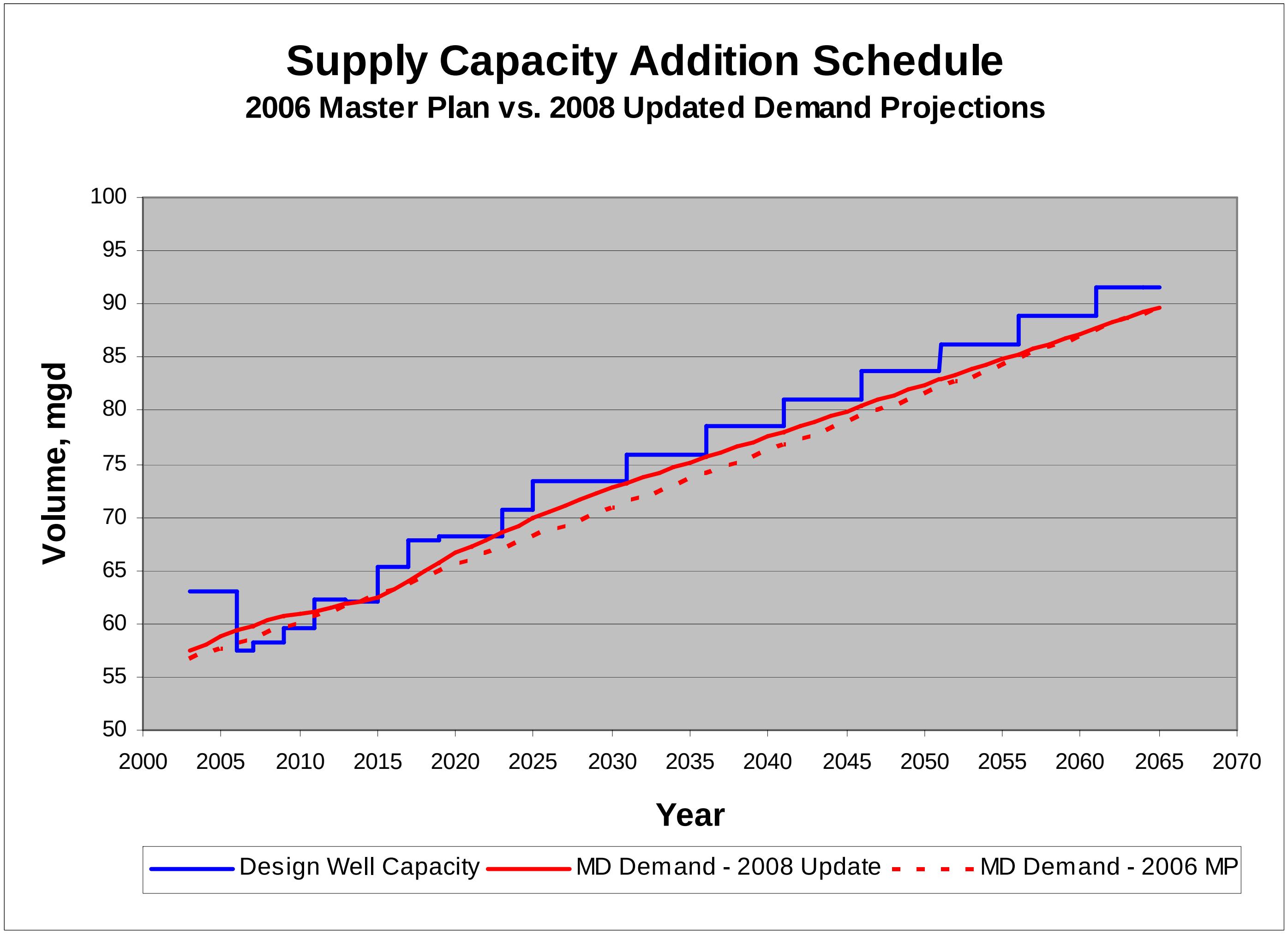
Supply Capacity Master Plan



2008 Update - Supply Capacity Master Plan is reaffirmed



Supply Capacity Plan – What If?

Can
Dry Period Maximum Day Demand
be reliably reduced?

PERHAPS

Supply Capacity Plan – What If?

Did Waukesha reduce Dry Period MD Demand by 11% From 2005 to 2008?

Waukesha cuts water use 11%, seeks more restrictions

By Darryl Enriquez of the Journal Sentinel

Posted: Jan. 29, 2009

Waukesha - Water use in Waukesha dropped more than 11% in a three-year water conservation push, and the city is seeking state permission for further rate-structure changes to penalize high-use residential water customers.

Conservation and rates are important to Waukesha for two reasons. The city needs costly reductions of radium levels in its water supply; and to eventually receive Lake Michigan water as a new clean source, Waukesha needs to have effective conservation measures in place.

Customers most affected by rate charges would be owners of single-family homes and duplexes. The new rate structure could be in place as early as April 1, Waukesha Water Utility General Manager Dan Duchniak said.

Residential customers now pay $1.95 per 1,000 gallons when quarterly usage is 30,000 gallons or less. Surpass that threshold, and the rate rises to $2.20 per 1,000 gallons.

The utility wants to slash the quarterly threshold for the higher rate in half to 15,000 gallons, Duchniak said.

Utility figures show that water use in Waukesha stood at about 3 billion gallons in 1999. The nearly 12% drop between 2005 and 2008 - from about 2.84 billion gallons to about 2.5 billion - coincided with lawn sprinkling restrictions enacted in 2005.

Water use between May 1 and Sept. 30, when sprinkling is restricted, dropped 16% in 2008 compared with the same period in 2005.

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Duchniak said he hopes that summer usage continues to drop. The utility is aiming for a 20% drop in overall use by 2020.

Quality and Reliability since 1882
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Supply Capacity Plan – What If?

Did Waukesha reduce Dry Period MD Demand by 11% From 2005 to 2008?

Waukesha cuts water use 11%, seeks more restrictions

By Darryl Enriquez of the Journal Sentinel

Posted: Jan. 29, 2009

Waukesha - Water use in Waukesha dropped more than 11% in a three-year water conservation push, and the city is seeking state permission for further rate-structure changes to penalize high-use residential water customers.

Conservation and rates are important to Waukesha for two reasons. The city needs costly reductions of radium levels in its water supply; and to eventually receive Lake Michigan water as a new clean source, Waukesha needs to have effective conservation measures in place.

Customers most affected by rate charges would be owners of single-family homes and duplexes. The new rate structure could be in place as early as April 1, Waukesha Water Utility General Manager Dan Duchniak said.

Residential customers now pay $1.95 per 1,000 gallons when quarterly usage is 30,000 gallons or less. Surpass that threshold, and the rate rises to $2.20 per 1,000 gallons.

The utility wants to slash the quarterly threshold for the higher rate in half to 15,000 gallons, Duchniak said.

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NOT NECESSARILY

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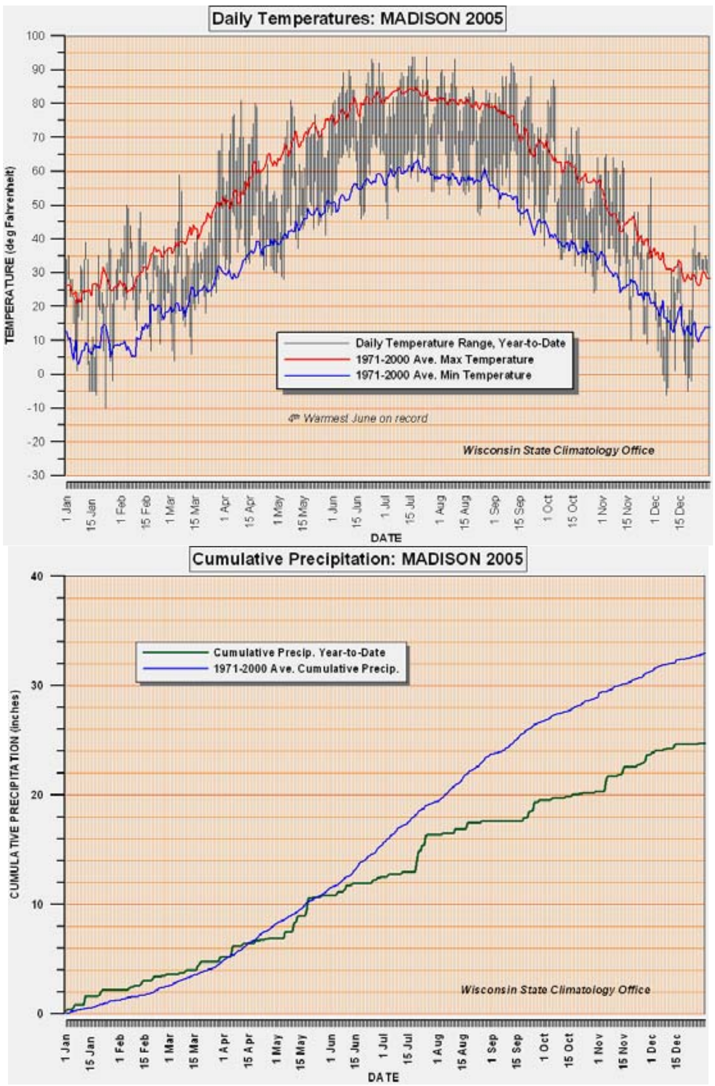
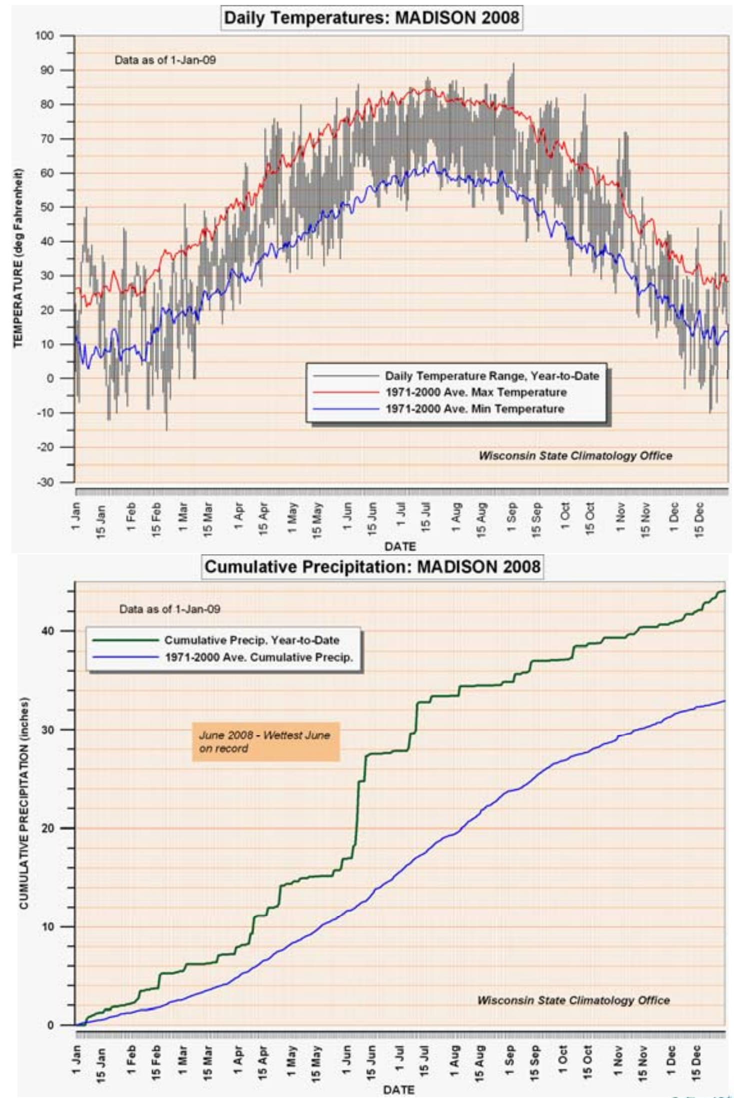
Summer 2005 was a Warm-Dry Period



Summer 2008 was a Cooler-Wet Period



Madison Water Utility

Water Usage / Production Comparisons

Utility	2005	2008	% Change
Annual Use/Production, million gallons			
Waukesha	2,840	2,520	-11%
Madison	11,966	10,907	-9%
Summer (May1-Sep30) Use/Production, million gallons			
Waukesha	- -	- -	-16%
Madison	5,703	5,036	-12%

Water production volumes at Madison suggest that most of the reduction in water use at Waukesha may have been weather-induced, not rate-induced or conservation-induced.

Supply Capacity Plan – What If?

Therefore…

Another Warm-Dry Summer similar to 2005 will be needed to document whether and to what extent Dry Period Maximum Day Demand has been reliably reduced at Waukesha.

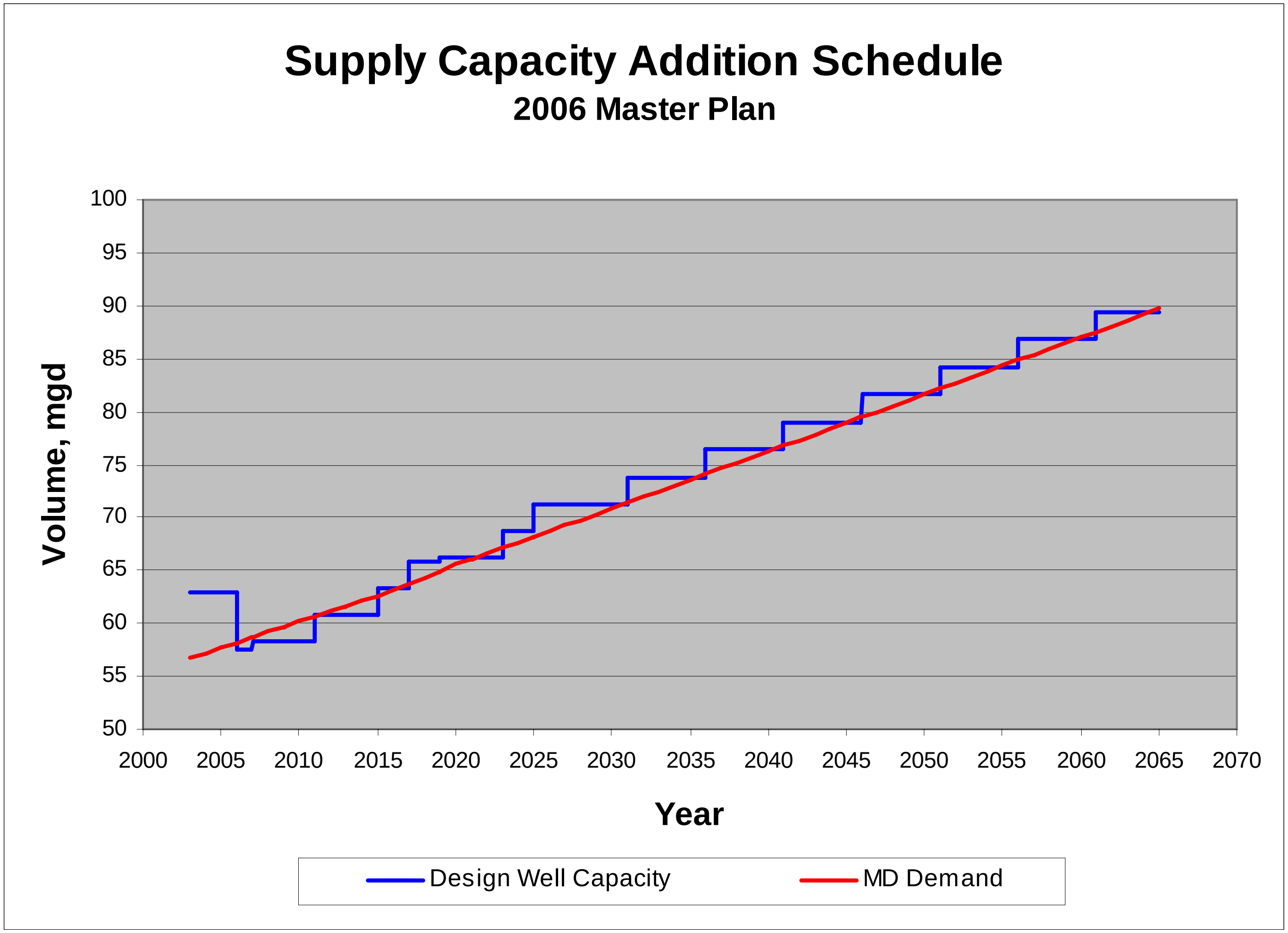
Resist over-anticipating the impact of planned conservation and rate structure measures on water consumption.

Potential changes to the Madison Master Plan supply improvement schedule should follow documented reductions in Dry Period Maximum Day Demand and not precede anticipated reductions.

Supply Capacity Plan – What If?

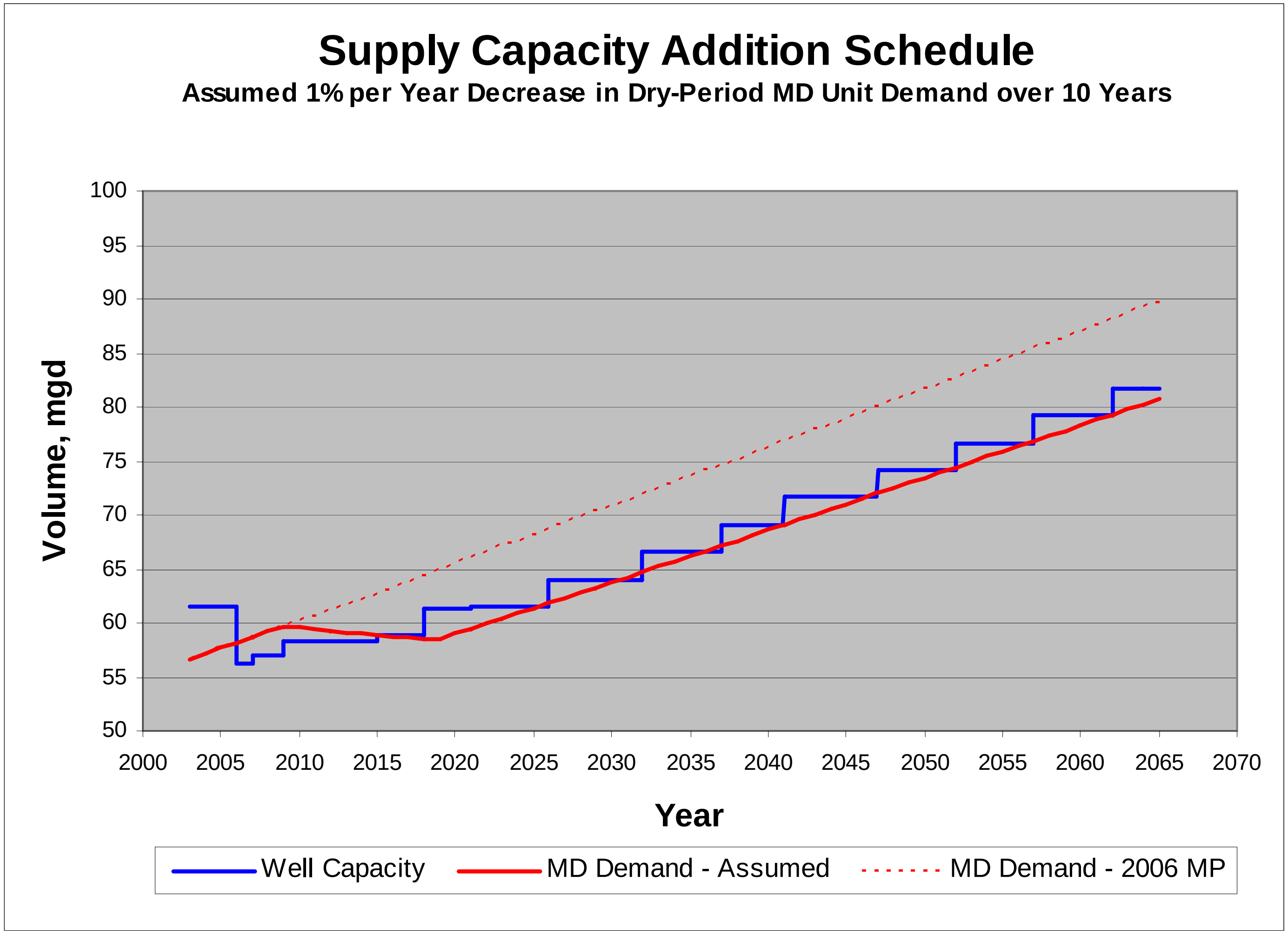
How would the supply capacity plan change if
Dry Period Maximum Day Demand
was reliably reduced?

Supply Capacity Master Plan



Madison Water Utility

Supply Capacity Plan – Example Reduced MD Demand



Madison Water Utility