Executive Summary

1.0 Introduction

1.1 Purpose

This Water Master Plan Update has been prepared to evaluate the Madison Water Utility's (MWU) water system and to develop a short-term (through year 2010) and a long-term (through year 2025) plan of improvements needed to correct current system deficiencies and to serve anticipated growth over the next 20 years for the City of Madison, Wisconsin. The product of this project is a 20-year capital improvements program (CIP).

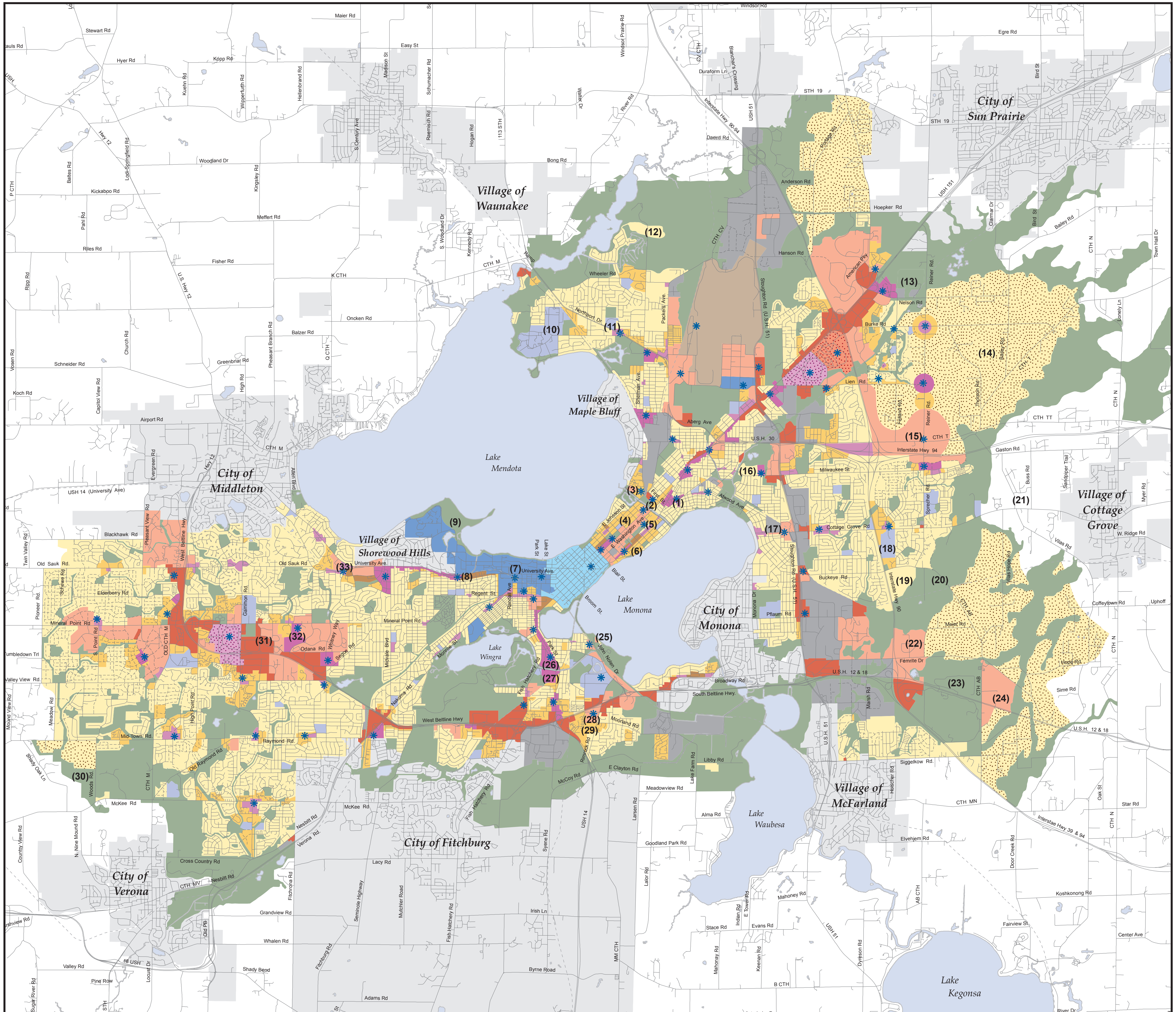
1.2 Scope

The Study Area for this report is the future boundaries of the City of Madison (City), and the Villages of Maple Bluff and Shorewood Hills. The Study Period for this report is from year 2006 through the year 2025. Water use was projected in five-year increments from year 2005 through 2025 and used as a basis for timing CIP projects. The CIP was developed to cover the last 19 years of the Study Period because the 2006 projects were in progress at the time of study preparation.

2.0 Study Area Characteristics

2.1 Study Area

The Study Area is shown on Figure ES-1, Generalized Future Land Use Plan, that was originally published as part of the 2005 City of Madison Comprehensive Plan. The Study Area encompasses approximately 79,183 acres (124 square miles), of which approximately 48,154 acres (75 square miles) are within the current city limits of the City of Madison. The Study Area is subdivided by 483 Traffic Analysis Zone (TAZ) areas. The TAZ areas and their associated demographics were defined by the Madison Area Metropolitan Planning Organization (MPO).



Generalized Future Land Use Plan

City of Madison

October 2005

RESIDENTIAL DISTRICTS
- LDR Low Density (0 - 15 units/acre)
- MDR Medium Density (16 - 40 units/acre)
- HDR High Density (41 - 60 units/acre)

MIXED USE DISTRICTS
- NMU Neighborhood Mixed Use
- CMU Community Mixed Use
- RMU Regional Mixed Use

COMMERCIAL/EMPLOYMENT DISTRICTS
- GC General Commercial
- RC Regional Commercial
- E Employment
- I Industrial

OPEN SPACE - AGRICULTURE DISTRICTS
- P Park and Open Space
- A Agriculture/Rural Uses

SPECIAL DISTRICTS
- SI Special Institutional
- AP Airport
- C Campus

Downtown Districts (See Volume II Map2-3)

NPA Neighborhood Planning Area (TND Encouraged)

SPECIAL OVERLAY DESIGNATIONS
- * TOD Transit Oriented Development (Conceptual Locations)
- Not Shown TND Traditional Neighborhood Development (May be applied to NPA and residential districts as specified in neighborhood and special area plans.)
- (0) Land Use Note Reference Number

Other Cities and Villages

Data Source:
City of Madison Department of Planning and Development, Planning Unit

0 1 2

Miles

City of Madison
COMPREHENSIVE PLAN
Madison

October 24, 2005 8:46am.

2.2 Methodology

Demographics for the Study Area were developed in five-year increments for years 2005 through 2025 based on planning agency data for years 2000 through 2030. Demographics at buildout were developed based on land area for each land use type and on planned development densities derived from the Comprehensive Plan. Historical demographics and water use patterns were the basis for projecting demographics and water use in five-year increments from year 2005 through 2025, and at buildout. The future land use types and boundaries were the basis for a conceptual long-range water system that could serve buildout conditions. Components of the long-range plan were then selected to define the CIP projects necessary at interim stages of development.

2.3 Demographics

Census data and past population estimates were combined with future population projections to define the trend for growth in residential water demand. Historical population and population projections are summarized in Table ES-1.

Table ES-1
Historical and Projected Populations

Year (1) (2) (3) (4)	Population					
	City of Madison	Village of Maple Bluff	Village of Shorewood Hills	Town of Madison	Expansion Area	Total Study Area
1980	170,616	1,351	1,837	-	-	-
1990	190,766	1,352	1,680	-	-	-
2000	208,054	1,358	1,732	6,029	8,482	225,655
2005	219,242	1,354	1,723	4,024	8,341	234,684
2010	228,154	1,337	1,697	3,019	8,199	242,407
2015	236,094	1,317	1,667	2,015	8,058	249,150
2020	245,079	1,304	1,646	1,010	7,917	256,955
2025	255,391	1,299	1,635	5	7,775	266,105
2030	264,850	1,295	1,625	0	7,634	275,404
Buildout	378,322	1,295	1,625	0	0	381,242

(1) Year 2000 data is based on *Final Official Census Counts for Wisconsin Municipalities, January 2004;* Demographics Services Center, Wisconsin Dept of Administration.

(2) Year 2005 through 2025 values are based on Final Official Population Projections for Wisconsin Municipalities, January 2004; Demographics Services Center, Wisconsin Dept of Administration.

(3) Year 2030 values are based on Year 2025 values projected at a growth rate approximately equal to that for the period from 2020 to 2025

(4) Buildout values are based on areas and development densities for the land use types presented in the draft Madison Comprehensive Plan, October 2005.

Enrollment at primary and secondary schools, and employment at Industrial, Commercial and Institutional (ICI) sites identifies a significant component of the population and where it creates most of its daytime water demand, when system demands are greatest. Enrollment trends were used to estimate student water use. Enrollment trends at UW-Madison were also used to project campus employment and its associated water demand. Excluding the 15 largest ICI customers, employment trends were used to project water use by ICI customers, whose water use is generally proportional to employment. Projections of enrollment and employment growth for the Madison area were found to generally parallel population growth.

2.4 Hydrogeology

The hydrogeology and aquifer characteristics for the Madison area have been investigated and reported by several agencies, including the Dane County Regional Planning Commission (DCPRC), the Wisconsin Geological and Natural History Survey, and the United States Geological Survey. According to these studies, the primary resource that supplies water to the Madison area is groundwater withdrawn from the Mount Simon aquifer. This aquifer is characterized by relatively high values for transmissivity and yield. In areas near Lakes Monona and Mendota, aquifer recharge is more rapid and long-term water withdrawal capacity is greater. The Mount Simon aquifer is the sole aquifer currently tapped by existing MWU wells, and the best candidate for withdrawal of substantial quantities of additional groundwater.

3.0 Water Requirements

3.1 Planning Criteria

The MWU must be able to supply water at rates that fluctuate over a wide range. The three most important demand rates for water system planning are as follows:

- Average Day Demand (ADD): The average day rate was used primarily as the basis from which to estimate maximum day and maximum hour demands.
- Maximum Day Demand (MDD): The maximum day rate was used to size water supply facilities, booster pumping stations, and equalization storage volume.
- Maximum Hour Demand (MHD): Since minimum distribution system pressures usually occur during the maximum hour rate, the sizes, capacities and locations of pipelines were generally determined on the basis of this condition.

3.2 Historical Water Production

Water production is comprised of metered water use, and non-revenue water (NRW). Metered water use records show the quantity of water sold. NRW is the difference between the volume of water produced and the volume of water sold, and includes water lost through system leaks, water used for system operation, and water delivered but not recorded due to inaccurate service meters. Historical water production, metered water use and non-revenue water is shown in Table ES-2, which shows an average non-revenue water of about 10.1 % of production. This compares well with a goal of 10% considered economically feasible for good operation.

Table ES-2
Historical Average Day (AD)
Water Production and Metered Water Use

Year	Production (mgd)	Metered Use (mgd)	Non-Revenue Water (mgd)
1997	31.58	28.51	3.07
1998	33.21	29.91	3.30
1999	32.78	30.41	2.37
2000	32.08	29.21	2.87
2001	33.51	29.59	3.92
2002	32.79	29.14	3.65
2003	32.23	28.74	3.49
2004	30.47	27.08	3.39
Average	32.33	29.07	3.26

3.3 Demand Patterns

Planning and design of water works must consider short-term variations in demand that the water system components must be capable of serving. Production and metered sales records were assessed to define historical rates of water use, which were the basis for calculating historical unit demands and peaking factors. Values, patterns and trends for future demand rates are expected to be similar to those for historical rates.

3.4 Unit Demand

Unit demands based on average day water use were developed to facilitate calculation of future water demands, and allocation of those demands to the distribution system model. Historical demand trends were calculated for each of the 15 largest ICI customers, and the current water use trend for each customer is the basis for projected future demands. Historical unit demands were calculated for residential customers, primary/secondary schools, and the other ICI customers. Future unit demands are based on historical values.

3.5 Future Water Requirements

3.5.1 Total System Demand

Projections of future metered water use were calculated for five-year increments from 2005 through 2025, and for buildout. Recent non-revenue water use within the MWU system, equal to about 10 percent of production, is the basis for anticipated future non-revenue water use. The projected future metered water use plus the projected future non-revenue water equals the total future demand that must be produced by the source of supply. The projected total system demands under average day (AD) conditions are presented in Table ES-3.

Table ES-3
Future Total System AD Demand (mgd)

Year	Metered Water Use by Customer Category					Non-Revenue Water	Total Production
	Residential	Primary/ Secondary Schools	Largest ICI Customers	Other ICI Customers	Total		
2005	18.57	0.35	7.00	4.27	30.19	3.02	33.21
2010	19.16	0.36	7.50	4.43	31.45	3.15	34.60
2015	19.70	0.38	8.01	4.66	32.75	3.27	36.02
2020	20.45	0.39	8.51	4.96	34.32	3.43	37.75
2025	21.35	0.41	8.58	5.30	35.64	3.56	39.20
Buildout	31.15	0.58	8.58	7.13	47.44	4.74	52.18

The demand projections presented in Table ES-3 are estimates based on growth projections for the Study Area. No particular year has been identified at which buildout conditions may be reached. If population growth were to continue uniformly at the current rate of approximately 1 percent annually, Study Area buildout would be reached in about 60 years.

3.5.2 Service Zone Demand

The projected future demand at design years 2010 and 2025, subdivided by service zone, is reported in Table ES-4.

Table ES-4
Future Demand by Service Zone (mgd)

Service Zone	2005 Average Day (AD)	Design Year 2010 Average Day (AD)	Design Year 2010 Maximum Day (MD)	Design Year 2010 Maximum Hour (MH)	Design Year 2025 Average Day (AD)	Design Year 2025 Maximum Day (MD)	Design Year 2025 Maximum Hour (MH)
123	0.71	1.66	4.02	8.67	2.43	5.65	12.11
4	1.07	1.15	2.08	2.89	1.39	2.49	3.44
5	0.15	0.15	0.49	1.07	0.15	0.49	1.08
6 East	9.46	8.84	15.373	21.32	9.28	15.98	22.05
6 West	14.26	14.76	22.24	28.31	16.13	24.14	30.64
7	3.75	3.77	7.71	16.24	3.82	7.79	16.39
8	2.77	3.06	6.30	13.29	4.03	7.90	16.55
9	0.70	0.74	2.01	4.34	0.82	2.16	4.67
10	0.27	0.35	1.06	2.30	0.84	2.15	4.62
11	0.08	0.14	0.47	1.03	0.32	0.89	1.94
12	0	0	0	0	0.01	0.06	0.13
Total System	**33.21**	**34.60**	**60.16**	**74.80**(1)	**39.20**	**68.15**	**84.40**(1)

(1) Maximum hour values for the total system are not the sum of the individual service zone maximum hour demands, which do not occur simultaneously.

3.6 Fire Flow Requirements

The water volume used for firefighting is relatively small, but the rate of use is usually quite high. This imposes heavy concentrated demands on the transmission, pumping, and storage facilities, and therefore influence design criteria. The Insurance Services Office (ISO) grades municipal fire defense capabilities for insurance rating purposes. The fire insurance rating classification used by the ISO ranges from 1 to 10; with 1 being the best. In 2004 the ISO completed an evaluation of the fire defense systems for the City of Madison. The water supply system received 32.37 out of 40 possible points, and a 2 rating, which represents a decline from a 1 rating received in 1989. For this master plan four levels of municipal fire flow goals up to 3,500 gpm have been established based on ISO criteria, on the Distribution System Requirements for Fire Protection manual (AWWA M31 Manual), and on planned land use designations in the Comprehensive Plan.

4.0 Existing Water System

The major components that make up the existing MWU water system include 24 active wells, 31 pumping stations, 31 storage facilities, and over 800 miles of water pipeline ranging in size from 1-1/2 to 24 inches in diameter. The existing water system is described more thoroughly in the 2005 Infrastructure Management Plan. Figure ES-2, located at the end of this chapter, shows the locations of the facilities and major pipelines which comprise the existing MWU distribution system. The existing water system is divided into 11 pressure zones, as identified in Table ES-5, so that water pressures throughout the system can be controlled to within acceptable limits.

Table ES-5 Pressure Zones	
Number	**Name**
1	East Zone
2	Glacier Heights Zone
3	Richmond Hill Zone
4	Southeast Zone
5	Lake View Zone
6	Main Zone
7	Southwest Zone
8	Northwest Zone
9	Smith Zone
10	West Zone
11	(Unnamed)

5.0 Water System Evaluations

5.1 Service Standards

Service standards establish the minimum requirements for water quantity, quality, and pressure, and define the degree of fire protection and reliability that the system should provide. The service standards for this master plan have been established by primarily three agencies and two organizations. In Wisconsin the minimum standards are set forth in administrative rules and regulations established by the Wisconsin Department of Natural Resources and the Wisconsin Public Service Commission, developed to be coordinated with Environmental Protection Agency (EPA) regulations. Other standards of practice for various aspects of the water system have been established by the American Water Works Association (AWWA) and the Insurance Services Office (ISO).

5.2 General Assessment and Hydraulic Analyses

An assessment was completed to determine the size, capacity and approximate location of supply, storage, pumping facilities and the transmission pipeline network necessary to serve current and future demands based on planning criteria described previously. This was followed by hydraulic modeling to refine the system improvements to optimally progress toward meeting water service standards at each stage of development. Also, a computer hydraulic analysis of the existing system was conducted to assess current fire flow capacity. The analysis identified areas throughout the Service Area in which fire flow capacity did not meet fire flow goals. To reduce these deficiencies over time, recommended system improvements include increased fire storage, increased pumping capacity, and completion of a continuous transmission pipeline network with enhanced hydraulic capacity.

5.2.1 Service Zones

The existing MWU service area is divided into eleven service zones numbered consecutively 1 through 11. The existing service zones are not able to meet pressure range service standards at all locations within the Service Area, and need to be modified to the extent practical to meet service standards. The modified service zone boundaries should then be extended to cover to the entire future service area. Except for Service Zone 11 and a future Service Zone 12, the hydraulic grade for all service zones has been established by existing reservoir overflow elevations, and would be too costly to adjust. Therefore, improvements to operating pressure ranges within the service zones will need to be accomplished by changing the range of ground elevations served (adjusting service zone boundaries), and by the use of pressure reducing valves (PRVs) on service lines in areas where pressure cannot be feasibly reduced below 90 psi. The recommended future service zone layout for the MWU water system is presented in Figure ES-2, bound at the end of this chapter. To reduce required reservoir cost and increase system reliability, existing Service Zones 1, 2 and 3 will be consolidated to form a single service zone.

5.2.2 Supply

The water supply expansion program will consist of adding new unit wells in a manner similar to MWU's existing unit wells. The Mount Simon aquifer will be tapped; the capacity of each unit well will be about 3.0 million gallons per day, and well spacing will range from 1 to 2 miles. Because the central area aquifer recharge is more rapid, and water level draw-down less, where practical, opportunities will be sought to arrange and time system improvements so they can also transfer water from central area wells to outer portions of the Service Area.

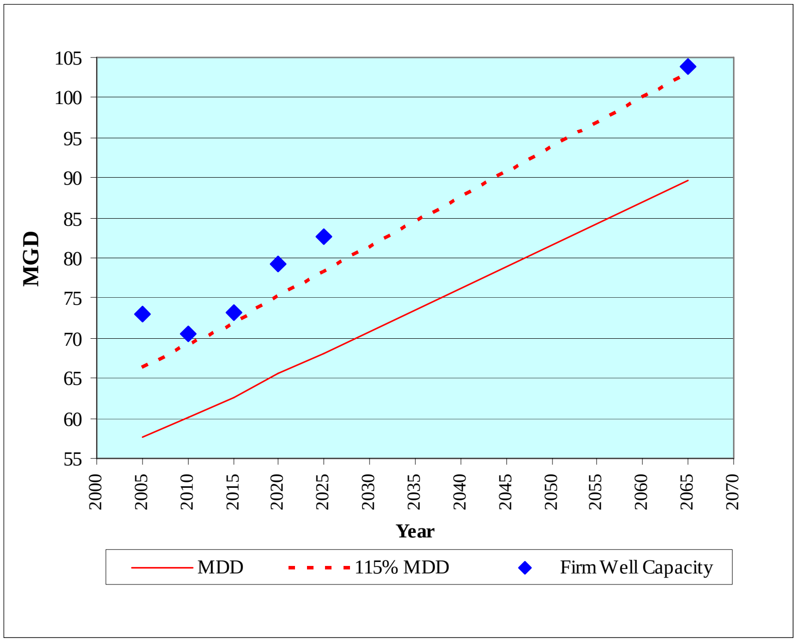
The 24 existing wells will form the core of the future water supply for the MWU. During the study period a few existing wells will likely need to be either rehabilitated or replaced to sustain current capacity. Ground water quality from existing wells was considered in developing the CIP. The planned approach for existing wells is as follows:

- Well No. 3 is near the end of its economical life and produces undesirable water quality, making it a candidate for near-term retirement and replacement.
- Wells No. 8 and 10 provide good capacity but produce marginally acceptable water quality. At strategic times during the Study Period these wells should be replaced as service wells and converted to reserve capacity. This will improve water quality, increase firm supply capacity and reliability, and take advantage of the investment of surrounding transmission capacity.
- Well 29 provides good capacity but produces manganese above regulatory limits. Either its water should be treated, or it should be replaced to obtain acceptable water quality.

- All other wells produce good capacity and acceptable water quality. As they decline in production and condition, they should be rehabilitated and continue in normal service to take advantage of the investment of land and surrounding transmission capacity. A separate well rehabilitation program would be identified by future facility assessments.

Additional wells that tap the Mount Simon aquifer will need to be added over time to supply water that meets projected demand. It is presumed that the MWU has or will acquire water rights for the groundwater withdrawal from the Mount Simon Aquifer at rates necessary to supply future demand. To provide routine maintenance time, the firm capacity of the supply wells should be at least 15 percent greater than the projected maximum day demand (MDD). Figure ES-3 shows the projected total system MDD, and the minimum recommended firm supply capacity equal to 115% of MDD.

Figure ES-3 Supply Expansion Schedule



Until buildout, the installed firm supply capacity will be somewhat greater than 115% of MDD. The margin will allow for growth, and will compensate for supply/demand imbalances within service zones and limitations in cross-system water transfer capability. The future installed firm supply capacity shown on Figure ES-3 is the basis for well additions to keep pace with projected growth in demand. Additional wells will be needed as replacement for decommissioned wells, and for reserve capacity. To meet all supply needs, the MWU will need to construct a new 3 mgd well about every two years. To provide a reliable emergency supply, a standby emergency power generator should be installed at strategically-selected unit wells.

5.2.3 Storage

The existing MWU water storage facilities consist of 23 ground-level tanks located at unit wells (unit well tanks) and 10 ground-level or elevated tanks out in the distribution system (distribution tanks). Except for tanks at future decommissioned well(s), these will form the core future storage for the MWU system. As the existing tanks decline in condition, they should be rehabilitated and continue in normal service to take advantage of the investment of land and surrounding transmission capacity. A separate storage rehabilitation program would be identified by future facility assessments.

An assessment was completed to determine current and future storage volumes needed to meet service standards. The optimum arrangement was found to consist of locating equalization and fire storage in distribution tanks, and emergency storage in unit well tanks. Figure ES-4 presents for each service zone the existing and future required storage volume for equalization and fire, located at distribution storage sites. Figure ES-4 shows current deficiencies in equalization and fire storage volume that are scheduled to be corrected early in the CIP as follows:

- For Zone 6E, the 6.0 MG Felland Road reservoir (RES129) will satisfy equalization and fire storage needs until buildout.
- For Zones 123 and 4, RES129 via booster or PRV stations will provide interim storage volume until reservoirs within the zone are constructed near the end of the study period.
- For Zone 5, the storage deficiency will be corrected by TWR113 in Year 2012. As an interim measure, pumping capacity from Zone 6E to Zone 5 will be increased.
- For Zone 9, the storage deficiency will be corrected by TWR216 in Year 2008.
- For Zone 10, the storage deficiency will be corrected by TWR137 in Year 2011.
- For Zone 11, the storage deficiency will be corrected by TWR228 in Year 2010.

Additional equalization and fire storage will be needed later in the CIP for growth.

Figure ES-4 Equalization and Fire Storage Volumes

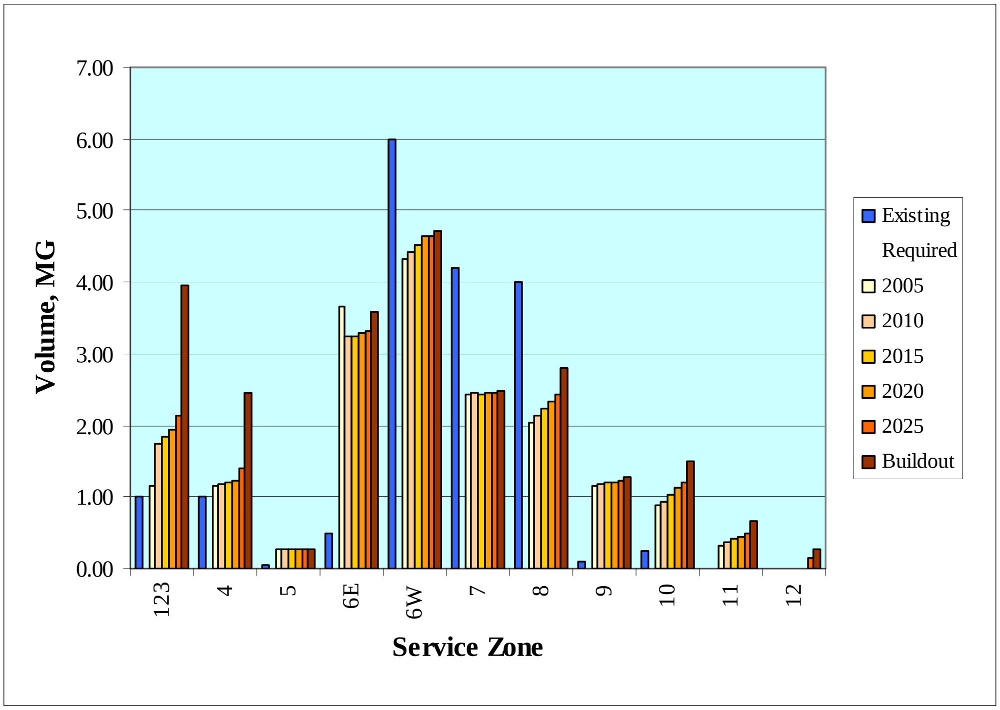
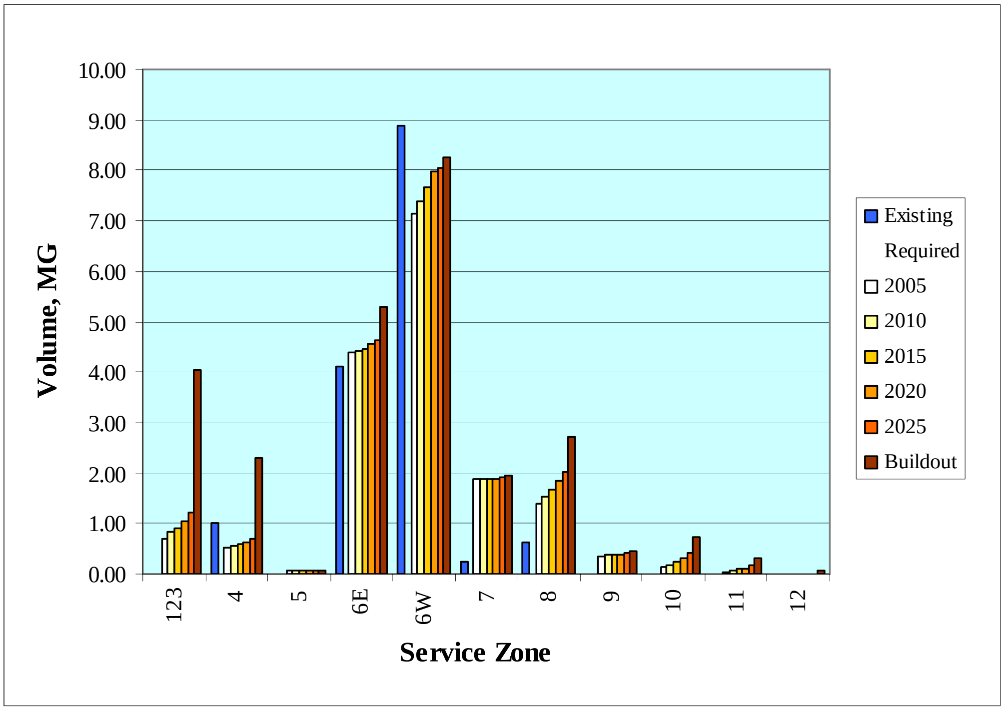


Figure ES-5 presents for each service zone the existing and future required storage volume for emergency supply, located mostly at unit well sites. Figure ES-5 shows current deficiencies in emergency storage volume that are scheduled to be corrected over time as unit wells are constructed in response to supply needs, as follows:

- For Zones 123, 5 and 6E, RES129 will cover the shortfall until additional storage volume is constructed at unit wells in Years 2009, 2011, 2015, 2017, 2023 and 2025. Delivery to Zones 123 and 5 will be via booster stations.
- For Zones 7 and 8, available storage in distribution tanks within those zones will satisfy emergency storage needs until additional storage volume is constructed at unit wells in Years 2013, 2019, 2021 and 2025.
- For Zones 9, 10 and 11, available storage in Zones 6, 7 and 8 will satisfy some of the emergency storage needs until additional storage volume is constructed at unit wells in Years 2019, 2021 and 2025.

Figure ES-5 Emergency Storage Volumes



5.2.4 Pumping

Pumping facilities within the MWU system currently and will continue to accomplish two primary functions: high-service pumping that delivers water from ground-level tanks into one of the service zones, and booster pumping that transfers water from a lower service zone to the next higher service zone. A strategic program of pumping improvements has been developed to provide the capability to transfer water as needed to equalize imbalances in demand, supply and storage volumes within the service zones. Because imbalances due to growth will develop incrementally and system improvements that reduce pumping need will occur in stages, the timing and degree of pumping need will be dynamic. Current deficiencies in pumping capability are scheduled to be corrected early in the CIP by improvements at Booster Station 106 (BS106), BS113, BS115, BS118, BS120, and BS129. A brief description of improvements and the purpose of the improvements is presented in Table ES-6 at the end of this chapter.

Additional booster stations will be built later in the CIP to meet the needs caused by growth in demand and service area expansion. During lower demand months when the booster stations become little needed to correct imbalances in supply capacity and high demand, the booster stations could transfer some water from central wells to outer portions of the Service Area.

5.2.5 Transmission Network

An adequately sized and continuous network of transmission pipelines will be needed to transfer water from the supply, pumping and storage facilities to the demand centers. The CIP was developed to strategically correct deficiencies found in the current transmission network by coordinating pipeline improvements with facilities improvements to:

- Provide hydraulically adequate connections between facilities and the existing transmission piping.
- Enhance the hydraulic capacity and continuity of the transmission network in selected areas for the purpose of improving cross-system water transfer to achieve:
  - Improved system pressures during high demand.
  - Improved fire flow capacity.
  - Greater water delivery reliability.
  - Transfer of water from central wells to outer portions of the Service Area.

6.0 Capital Improvements Program

6.1 General

This section presents the long-range master plan for water works required to serve the needs of the Study Area at buildout development, and identifies a phased capital improvements program (CIP) for the necessary improvements during the last nineteen years of the 20-year study period, from 2007 through 2025. The timing of the phased improvements is keyed to the projected growth rates and development patterns defined in the 2005 City of Madison Comprehensive Plan. Actual growth rates and development patterns, along with resulting demand and system performance, should be monitored regularly and the timing of future improvements adjusted to fit future conditions. Improvements identified for installation after year 2025 are conceptual in nature, are presented primarily to provide long-term facility site guidance and to give context to the improvements defined for the study period, and should be re-assessed in future master plan updates. The improvements identified in this report do not include improvements needed to repair, rehabilitate or replace deteriorated existing facilities, which are defined in the 2005 Infrastructure Management Plan.

6.2 Long-Range Plan

This section describes the waterworks recommended to serve the water needs of the Madison area at build-out development. Improvements to the existing distribution system that are necessary to form the buildout water works system will be added as needed to first alleviate current deficiencies and then to satisfy growth in demand and service area. The long-range master plan for capital improvements to the MWU water system is shown on Figure ES-2, bound at the end of this chapter. The locations shown for new facilities and pipelines are approximate, provide layout concept for evaluation, and will have to be refined as part of preliminary design for each project.

6.3 Improvement Phases

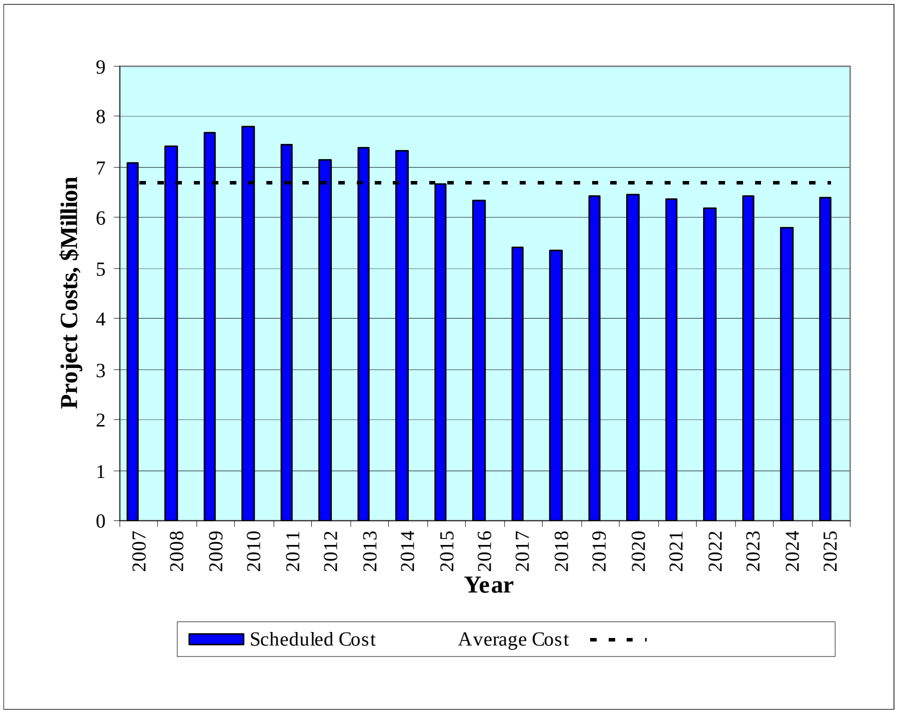
A phased, long-term plan for adding the improvements needed during the 20-year study period has been prepared to guide the MWU. Priorities have been set for the improvements according to importance and immediacy of need. The high-priority improvements are those required to meet current fire flows and system pressure needs. The improvements needed to meet future growth are the next level down in priority and should be implemented as growth occurs. The high priority improvements should be implemented as much as possible during the first five years of the capital improvements program.

A short-term plan, identified as Phase I, has been prepared to define construction projects for each year from 2007 through 2010, years 2 through 5 of the study period. The remainder of the long-term plan, identified as Phase II, has been prepared to define construction projects for each five-year period from 2011 through 2025. The improvements scheduled for construction after year 2025, collectively identified as Phase III, are conceptual in nature and should be reassessed in future master plan updates.

6.4 Summary of Costs

The yearly total capital costs for the 20-year CIP are shown graphically in Figure ES-6.

Figure ES-6 Yearly Capital Costs for CIP



Over the study period, the scheduled capital costs range from about $5.5 to 7.5 million per year. The total yearly costs are generally uniform because for those pipelines for which the year of installation is flexible, projects are strategically timed. By monitoring system performance and performing predictive hydraulic modeling, the MWU may be able to further adjust the installation year of some pipelines and further attenuate year-to-year variations in overall capital costs.

A summary of annual capital costs for Phase I, Years 2007 through 2010, plus the first year of Phase II, Year 2011, are shown in Table ES-6 to represent a Five-Year CIP.

Table ES-6
Five-Year Capital Improvement Program

Description	Purpose	Capital Cost, $ (1)
Year 2007 Improvements		
Wells		
Well31: New deep well	Replace capacity lost to reduced use of UW10.	1,300,000
Unit Wells		
UW29: Treatment or replace	Provide treatment or replace well at new location	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		2,160,000
	Year 2007 Subtotal	**7,090,000**
Year 2008 Improvements		
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		5,550,000
	Year 2008 Subtotal	**7,400,000**
Year 2009 Improvements		
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**

Table ES-6 (continued)
Five-Year Capital Improvement Program

Description	Purpose	Capital Cost, $ [1]
Year 2010 Improvements		
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**
Year 2011 Improvements		
Unit Wells UW3: Abandon UW45: New unit well	Groundwater contamination renders well unusable Replace UW3. Maintain Zone 6W supply capacity	50,000 3,000,000
PRV Stations (booster station) @ BS125 @ BS215	Improve reliability; supply transfer during abnormal conditions Improve reliability; supply transfer during abnormal conditions	30,000 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**

[1]All capital costs reported in 2005 dollars for consistency with 2005 Infrastructure Management Plan

6.5 Current System Challenges Addressed by Five-Year CIP

In addition to providing new facilities and pipelines for community growth, the MWU has faced a number of challenges serving current customers. Three primary challenges are related to low system pressure on the east side of Service Zone 6; low fire flow capacity in several areas; and unacceptable water quality from a few wells. These challenges are addressed by the Five-Year CIP improvements.

- **Low east-side pressure.** Low service pressures currently occur on the east side of existing Service Zone 6, in an area west of and within 2,000 to 4,000 feet of Interstate 39/90, south of Lien Road, and north of E. Buckeye Road. This land lies above elevation 988 feet above sea level, the upper limit that Service Zone 6E could reliably provide water pressure that meets service standards. Adjacent to existing Service Zones 2 and 3, this area will become part of the new Service Zone 123, as described in Section 5.2.1. Improvements that consolidate this area with Service Zones 1, 2 and 3 include:

- Transmission pipelines that connect existing pipelines in these areas.
- Selected valve closures that isolate the new Service Zone 123 from Zone 6E.
- Transmission pipeline enhancements along the east edge of Zone 6E that replace the north-south transmission capacity that is converted to Zone 123 service.
- Supply dedicated to Service Zone 123 by converting existing UW25 pumps.
- Increased transfer capacity from Zone 6E to 123 by converting one pump at BS115 and by constructing new BS129 on Felland Road.

- **Low fire flow capacity.** Most of the fire flow deficiency identified by distribution modeling is in pockets throughout the Service Area and will be corrected over time as storage is constructed and transmission network capacity is enhanced. The first projects targeting improved fire flow capacity relate to areas of greatest capacity deficit and risk, and to widespread areas that can be corrected with modest improvements. The Five-Year CIP improvements that will improve fire flow capacity include:

  - For the Arbor Hills area, a transmission pipeline placed along the south side of Highway 14/151/18, which with BS118 will be used to transfer supply from Service Zone 6W to Service Zone 7.
  - For Service Zone 123, fire storage will be located in RES129, and transferred by BS115 and BS129.
  - For Service Zone 4, a transmission pipeline will enhance the connection between RES9/BS9 and existing transmission pipelines, and UW33 will provide additional supply.
  - For Service Zone 5, increased pumping capacity at BS113 as an interim measure until RES113 can be built in 2012, and transmission pipeline enhancements.
  - For Service Zone 9, fire storage in TWR216.
  - For Service Zone 10, fire storage in TWR137.
  - For Service Zone 11, fire storage in TWR228.

- **Water quality.** Three existing wells produce water with elevated manganese concentrations, and one well has produced detectable levels of carbon tetrachloride. The location and capacity of these wells are considered in the strategy of new well addition to achieve timely replacement or limited future use. Described in more detail in Section 5.2.2 of this Chapter, the Five-Year CIP includes system improvements that allows management of these wells for improved water quality as follows:

  - UW3 is currently offline and will be abandoned in 2011 when UW45 is constructed.
  - UW8 will remain in service until 2021 when it will be converted to reserve capacity.

- UW10 will provide reserve capacity until 2023 when it will be replaced.
- UW29 will provide reserve capacity until either treatment is provided for it's water, or it is replaced. Although assessment and selection of the preferred approach is outside the scope of this study, an allowance of $2,400,000 is included in the CIP to implement the selected approach.