City of Aurora

Final Document
March 2009

Water System Master Plan Update

Prepared By:

ASHLEY
ENGINEERING DESIGN

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Prepared for:

City of Aurora, Oregon

March 2009

Prepared by:

John Ashley, P.E.

Civil Engineer

ASHLEY ENGINEERING DESIGN

14785 SE Foster Road
Dayton, OR 97114

Foreword

This Water System Master Plan (WSMP) is organized into nine (9) different main sections, preceded with an Executive Summary and concluded by an Appendix. A brief summary of the objective of each section of the WSMP is provided below.

- **Executive Summary.** The Executive Summary provides a general summary of the WSMP with the intent to assist elected officials and other interested parties who would like to gain an overview of the WSMP before reading the more technical information further contained in the WSMP. The Executive Summary begins by discussing the purpose of the WSMP followed by the definitions of water use terms commonly used throughout the WSMP. The Executive Summary then briefly explains and provides recommendations on how the WSMP should be used and implemented followed by a brief summary of each of the main sections provided in the WSMP. Included with the Executive Summary are some of the more relevant figures and tables further discussed and presented in the WSMP.

- **Section 1 – Introduction.** Section 1 presents general information regarding the authorization, compliance, scope of work, past studies and reports, and acknowledgements of the WSMP.

- **Section 2 – Existing System Description.** Section 2 presents a basic inventory and summary of the existing water system including water supply sources, water rights, water treatment, pressure zone, storage facility, pump station, distribution system, and instrumentation and control system. Analysis of the existing system is further provided in Section 6.

- **Section 3 – Planning Considerations.** Section 3 presents the planning and study area, planning period, current land use, and population estimates. Population forecasts were developed using previous planning reports, current land use designations, regional information, and discussions with City staff.

- **Section 4 – Water Use and Projected Demands.** Section 4 presents historical and existing water demands, water consumption, and projected water demands based on population projections presented in Section 3. Projected water demand requirements are used to establish water system component adequacy and sizing needs.

- **Section 5 – Water System Design Criteria.** Section 5 presents the water system design criteria used for the analysis of the City's water system. The design criteria include water supply and treatment, storage facility volume, pump station capacities, and distribution system capacities. The establishment of water system design and operating criteria is important for the City to assure standardization and consistency of the water system as improvements are made.

- **Section 6 – Water System Analysis.** Section 6 presents an analysis of the existing water system based on the system criteria presented in Section 5. Population estimates from Section 3 and water use and projected demands from Section 4 were used in the analysis. A computer model was also developed and used to evaluate the adequacy of the distribution system to convey current and future projected demands.

- **Section 7 – Water Quality, Conservation, and Regulatory Review.** Section 7 presents a review of the Oregon Administrative Rules (OAR) Chapter 333, Division 61 regarding public water systems, the Federal drinking water regulations pursuant to the Safe Drinking Water Act (SDWA), and overall compliance status of the City's water system. In addition, anticipated regulations have been reviewed to assess future implications for the City. A review of current water treatment practices, water quality conditions, monitoring and waiver status, and non-compliance issues are also presented.

- **Section 8 – Recommendations and Capital Improvement Plan.** Section 8 presents recommendations for system improvements based on the findings presented in the previous sections and to summarize them in a 20-year capital improvement plan (CIP). The CIP is a very important aspect of system planning and includes a list of necessary projects, a cost associated with implementing the recommended project, the recommend projects ranked in order of priority or preference, and a timetable for the construction or completion of the project.

- **Section 9 – Financial Planning.** Section 9 presents a collection of funding mechanisms available to finance the recommended capital improvements including financial assistance programs that offer various grants and loans and local funding sources such as bonds, system development charges, and water rates.

- **Appendix.** The appendix section includes a compilation of pertinent reference documents which summarize and support the findings and recommendations presented in the above sections. The reference documents have been included with the intent to provide the City with a more complete compilation of water system information bound together in a single document.

Acknowledgments

The development of this Water System Master Plan is the result of the combined efforts of a number of individuals and agencies. The participation of these parties in collecting data, answering questions, reviewing drafts, and providing guidance for this WSMP is greatly appreciated.

I particularly wish to acknowledge the efforts of Ed Sigurdson/City Engineer for providing general guidance and invaluable insight, as well as, Bob Southard/Public Works, Laurie Boyce/City Recorder, and the rest of the City staff and interested parties who assisted in many ways. Mayor Donald, Major Meirow, the City Council, and the Planning Commission were instrumental in the development of this WSMP by providing support through the planning process.

The assistance and cooperation of the Oregon Department of Human Services-Drinking Water Program and to the Oregon Water Resources Department is also appreciated.

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List of Abbreviations and Acronyms

The following list of abbreviations and acronyms are commonly used throughout this Water System Master Plan.

AAGR	Average Annual Growth Rate
ACP	Asbestos Cement Pipe
ADD	Average Day Demand
ANSI	American National Standards Institute
APWA	American Public Works Association
As (III)	Arsenite
As (V)	Arsenate
ASR	Aquifer Storage and Recovery
AWWA	American Water Works Association
bgs	Below Ground Surface
CCI	Construction Cost Index
CCL	Contaminant Candidate List
CCR	Consumer Confidence Report
CDBG	Community Development Block Grant
CDC	Centers for Disease Control
cfs	Cubic Feet per Second
CIP	Capital Improvement Plan
COBU	Claim of Beneficial Use
CWRE	Certified Water Rights Examiner
CWS	Community Water System
DBP	Disinfection By-Products
DEQ	Oregon Department of Environmental Quality
DHS	Oregon Department of Human Services
DOH	Washington Department of Health
DWEL	Drinking Water Equivalent Level
DWP	Drinking Water Protection
DWPLF	Drinking Water Protection Loan Fund
EDU	Equivalent Dwelling Unit
ENR	Engineering News-Record
EPA	Environmental Protection Agency
EPANET	Environmental Protection Agency Water Modeling Public Software
ES	Executive Summary
ESB	Emergency Standby Storage
FDA	Food and Drug Administration
FmHA	Farmers Home Administration
FSRS	Fire Suppression Rating Schedule
ft	Feet, Foot
FY	Fiscal Year
GIS	Geographical Information System

gpcd	Gallons per Capita per Day
gpd	Gallons per Day
gpm	Gallons per Minute
gpy	Gallons per Year
GWR	Ground Water Rule
GWUDI	Ground Water Under the Direct Influence of Surface Water
HAA5	Sum of Five Haloacetic Acids
HGL	Hydraulic Grade Line
hp	Horsepower
I&I	Infiltration and Inflow
IDSE	Initial Distribution System Evaluation
IOC	Inorganic Chemicals
IRIS	Integrated Risk Information System
ISO	Insurance Services Office, Inc.
LCR	Lead and Copper Rule
LID	Local Improvement District
LRAA	Locational Running Annual Average
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDD	Maximum Day Demand
MG	Million Gallons
mg	Milligrams
mg/day	Milligrams per Day
mg/L	Milligrams per Liter
µg/L	Microgram per Liter
mgd	Million Gallons per Day
MMD	Maximum Monthly Demand
MRDL	Maximum Residual Disinfectant Levels
MSL	Mean Sea Level
NCOD	National Contaminant Occurrence Database
NCWS	Non-Community Water Systems
ND	None-Detected at the Specified Limit
NDWC	National Drinking Water Clearinghouse
NFPA	National Fire Protection Association
No.	Number
NPDWR	National Primary Drinking Water Regulations (Primary Standards)
NRWA	National Rural Water Association
NSDWR	National Secondary Drinking Water Regulations (Secondary Standards)
NSF	National Sanitation Foundation
O&M	Operation and Maintenance
OAR	Oregon Administrative Rules
ODOT	Oregon Department of Transportation
OECDD	Oregon Economic and Community Development Department
ORS	Oregon Revised Statues
OWRD	Oregon Water Resources Department
PRC	Population Research Center, PSU
PRV	Pressure Reducing Valve

psi	Pounds per Square Inch
PSU	Portland State University
PVC	Polyvinyl Chloride
RUS	Rural Utility Services
SCADA	Supervisory Control and Data Acquisition
SDC	System Development Charges
SDWA	Safe Drinking Water Act
SDWRLF	Safe Drinking Water Revolving Loan Fund
SFD	Single Family Dwelling
SWTR	Surface Water Treatment Rule
TCR	Total Coliform Rule
TTHM	Sum of four Trihalomethanes
UCMR	Unregulated Contaminant Monitoring Rules
UGB	Urban Growth Boundary
USACE	United States Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	United States Geological Survey
VFD	Variable Frequency Drive
VOC	Volatile Organic Chemicals
VSS	Very Small System Waiver
WDLF	Water Development Loan Fund
WSMP	Water System Master Plan
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

Executive Summary

Introduction

Objective

The Executive Summary provides a general summary of the Water System Master Plan (WSMP) with the intent to assist elected officials and other interested parties who would like to gain an overview of the WSMP before reading the more technical content further provided in the nine (9) different main sections of the WSMP. The Executive Summary begins by first discussing the purpose of the WSMP followed by the definitions of water use terms commonly used throughout the WSMP. The Executive Summary then briefly explains and provides recommendations on how the WSMP should be used and implemented followed by a brief summary of each of the main sections provided in the WSMP. Included with the Executive Summary are some of the more relevant figures and tables further discussed and presented in the WSMP.

Master Plan Purpose

The purpose of this WSMP is to evaluate and update the City of Aurora's (City) water system planning, operation, and improvements since the previous 1996 WSMP and to evaluate the adequacy of the system to serve current demands and future planning projections. This WSMP provides the City with a comprehensive planning document that presents detailed water system information, engineering assessment, and planning guidance necessary for the successful management and operation of its water system over the planning period.

This Water System Master Plan serves as an invaluable resource for the City for the following reasons:

- Summarizes and compiles all the basic information relevant to the water system into a single dynamic working document.
- Describes the basic functional parameters of the system.
- Provides water system design criteria and assists the City in evaluating the infrastructure needs of new developments.
- Graphically illustrates the distribution system deficiencies, recommended improvements, and proposed future expansions of the system.
- Presents an adoptable water system capital improvement plan (CIP) with estimated costs and assumptions to allow the City to plan and budget as needed.
- Serves as a basis for identifying priority needs and funding options.
- Serves as a tool for gaining public support for needed improvements.
- Provides a current planning document required by most funding agencies before grant or loan assistance will be considered.

Definitions of Common Water Use Terms

Discussions on water use and projected demands will refer to various terms relating to water use. It is necessary for the reader to first understand the meaning of a few of these basic water system terms before a full understanding of this study can be reached. The most critical of these terms are defined as follows:

- **Demand (Production)** – Demand is total water use; consumption plus system losses. Water demand is generally expressed in gallons per minute (gpm), gallons per day (gpd), or million gallons per day (mgd). Demands can be divided by the population, which results in a demand per person (per capita). This is typically expressed in gallons per capita per day (gpcd). Per capita demands can be multiplied by population projections to determine future water demands.

- **Consumption (Metered Use)** – The water actually delivered to the customers through metered service connections (residential, commercial, industrial, and City/Public). Consumption is less than the total demand with the difference being system loss.

- **System Loss** – The unaccounted-for water (unmetered use, leaks, meter inaccuracies). It is the difference between demand and consumption. All systems have an amount of leakage or loss that cannot be economically reduced or eliminated. However, system loss is not necessarily the same as leakage. The unaccounted-for water may be the result of leaks, meter inaccuracies, or other consumption tracking errors and unmetered uses such as fire fighting, hydrant flushing, park irrigation, system maintenance, etc.

- **Average Day Demand (ADD)** – The total volume of water delivered to the system over a period of one year, divided by 365 days. This results in an average use in a single day, expressed in gallons per day (gpd).

- **Maximum Day Demand (MDD)** – The largest volume of water delivered to the system in a single calendar day (24 hours), expressed in gallons per day (gpd). The MDD is commonly used to size facilities to provide capacity for periods of high demand. The MDD usually occurs during the warmest part of the year when lawn irrigation and recreational uses of potable water are at their greatest. This day is commonly associated with summer holidays, such as July 4th, or during City events. MDD is especially important for well production, as the wells must be capable of meeting the MDD. If the MDD exceeds the combined supply capacity on any given day, storage tank levels will decline. Consecutive days at or near MDD would result in a water shortage.

- **Peak Hour Demand (PHD)** – The largest volume of water delivered to the system in a single hour, expressed in gallons per day (gpd). Distribution systems should be designed at minimum to adequately handle the peak hour demand. During this peak usage, storage tanks or reservoirs supply the demand in excess of the maximum day demand. Peak hour demand is commonly experienced during the early morning hours when many water users are bathing, cooking, and engaging in other activities such as irrigation of landscaping, that require widespread water use.

How to Use and Implement this Master Plan

To better assist with the understanding and implementation of this WSMP, the following questions have been developed which are intended to summarize the primary deficiencies of the water system, identify the highest priority project, discuss the proposed Capital Improvement Plan and how it can be used, discuss the impacts of City growth and briefly address the current U.S. economic situation, and recommend how this WSMP should be implemented and how funding should be approached.

What are the City's primary water system deficiencies and how can they be resolved?

In general, the City's primary water system deficiencies, the recommended improvements necessary to correct them, and their estimated project costs including a 3 percent inflation factor to the proposed year of construction, consist of the following:

- **Well Arsenic Levels** – Due to the recent reduction of the arsenic maximum contaminant levels by the U.S. EPA (to 1/5 of the previous level and became effective in Oregon in 2006) both Well No. 4 and potentially in Well No. 5 are above State and Federal drinking water regulations and currently need to be blended with Well No. 3 to remain in compliance – Can be corrected with the addition of an arsenic water treatment system *($0.10 million for the preliminary study/pilot test (approx. year 2009-2010) and $0.51 million for the treatment system (year 2012-2013)).*

- **Distribution Piping Inadequacies** - Poor distribution system piping within the downtown core area and within other locations in the City consisting of old deteriorating, undersized, and asbestos-cement pipes – Can be corrected by replacing them with new 8-inch water mains *($0.90 million, over 20 year period).*

- **Distribution System Gridding** – Inadequate distribution system gridding necessary to provide required fire flows – Can be corrected with the installation of several sections of 10-inch and 12-inch transmission/distribution water mains *($1.3 million, over 20 year period).*

- **Finished Water Storage and Pump Station Capacity Inadequacies** – Inadequate storage volume and pump station capacity – Can be corrected with the addition of an estimated 1 million gallon storage tank facility and additional pump station. *($2.10 million (approx. year 2018-2019)).*

A summary of all the recommended improvements is presented in the Capital Improvement Plan, attached at the end of this Executive Summary. The total cost for all recommended projects identified throughout the planning period, including a 3 percent inflation factor to the proposed year of construction shown, is approximately $5.68 million. An implementation program has been established for the Capital Improvement Plan and is provided at the end of Section 8 in this Water System Master Plan.

What is the highest priority project that needs to be completed first?

The highest priority project relates to the City's ground water well supply and the need for water treatment in order to stay in compliance with State and Federal drinking water regulations for arsenic. The need for arsenic treatment is the result of the more stringent regulations established by the U.S. EPA which reduced the previous maximum contaminant level from 50 parts per billion (ppb) to 10 ppb. In Oregon, systems had to begin monitoring and be in compliance by January 2006. Prior to this reduction, the City could easily meet the old standards for arsenic and the need for treatment was not a concern.

Wells No. 3 and 4 are currently the only active wells in production that supply groundwater for the City. However, Well No. 4 can only be utilized 50 – 60 percent of the time since City staff has to blend the water produced with Well No. 3 to meet drinking water standards due to arsenic levels being just above the maximum contaminant levels. Preliminary testing has shown that Well No. 5 produces comparable arsenic levels to that of Well No. 4. Based on the projected demands, the City will no longer be able to stay in compliance with the State and Federal drinking water regulations unless some form of arsenic treatment system is installed by year 2013.

In addition, although it is not considered a health concern, both Well No. 4 and Well No. 5 have high levels of iron and manganese. This results in reddish-orange and black staining of plumbing fixtures and clothes if left untreated. This also tends to encourage the growth of iron and manganese bacteria in the supply transmission main, storage tank, and distribution system, resulting in sloughing of debris to the customers. Normal levels of disinfectant residuals are also difficult to achieve due to the chlorine demand of these bacteria.

An arsenic water treatment system is critical for maintaining compliance with drinking water regulations for the groundwater wells and should be the City's top priority for required short-term improvements.

What is a Capital Improvement Plan and how can it be used?

Public investments are required to be made annually to effectively provide for current and future water system needs. If the necessary system improvements are not made annually or within a reasonable timeframe, the condition of the City's water system infrastructure will deteriorate to the point that eventually it can no longer be ignored. It is at this point that a project cost will become much greater due to the size and scope of the needed improvements.

Since it is not possible to address all of the water system needs in one budget fiscal year, it is necessary to create a 20-year Capital Improvement Plan (CIP). A CIP presents the recommended projects ranked in order of priority or preference, the cost associated with implementing the recommended project, and a timetable for the construction or completion of the project. A CIP is an important tool for the City as it calls attention to the deficiencies of the City's water system and provides a systematic approach to dealing with the short-term and long-term infrastructure needs.

How will various growth rates affect this Master Plan and what impacts can be expected with the current economic situation?

In 2007, the Portland State University Population Research Center showed the City of Aurora as having the second highest growth rate experienced in Marion County at 6.3 percent from 2000 to 2007. This mostly can be attributed to the completion of the wastewater collection system and treatment plant in 2001, which stimulated development and annexations. With the development of numerous partitions and large subdivisions in 2004 and 2005, the City experienced an incredible increase in growth, substantially more than the City had ever experienced.

A cursory review of existing residential lots within the City limits that are not physically constrained and have the potential to be developed, as well as vacant lots in Keil Park, indicates that there are approximately 65 – 70 additional residential lots that will eventually be developed in the near future. In general, it is anticipated that Aurora will continue to experience a high growth rate within the next five years until complete infill within these lots occurs (dependant on the economy and the demand for housing). After this, it is anticipated that the growth rate will decline based on the need for major annexation and infrastructure upgrades.

Growth rate refers to the change in population over a unit time period, and is often expressed as a percentage of the number of individuals in the population at the beginning of that period. The estimated population growth rate is one of the most critical factors used in projecting future water demands. As a result, if the City experiences a higher growth rate over the planning period than projected in this WSMP, then the population at a given year will be higher than projected and the recommended growth related improvements will need to be made sooner than expected. With a slower growth rate, the population at a given year will be lower and the growth related improvements can then be made later than expected.

During the course of development of this WSMP, the City formally adopted an average annual growth rate of 2.8 percent per year to be used for all their current and near-future master planning documents. This growth rate follows the projections used in the City of Aurora's 2001 Comprehensive Plan and was used in this WSMP. However, not all recommended improvements listed in the Capital Improvement Plan (CIP) are growth related, especially those relating to the distribution system. Many of these improvements are needed for the replacement of old deteriorating, undersized pipes and to strengthen the system grid for high existing water demands and fire flows. These deficiencies are mainly in the downtown core area of the City, where small system pipes were installed some time ago when fire flow requirements and other water demands were much lower. To better assist the City in the future, the CIP notes which recommended improvement is impacted by growth.

It is recommended that the City review this WSMP and CIP annually to ensure that it accurately reflects anticipated growth. To serve as a comparison for future reference, Table ES-4 in this section compares the population, average day demand, and maximum day demand projections for various growth rates of 1 percent, 2 percent, and 4 percent. These values can be compared in the future to the actual growth experienced and any growth related recommended improvement cost and timetable shown in the CIP can be adjusted accordingly.

It should be noted that during the development of this WSMP, the U.S. economy entered into a recession in late spring of 2008 and has become even more severe during the fall of 2008. At the time of this writing, it is unclear whether the recession will be a mild downturn or a more serious one similar to what was experienced in the early 1980s. Economists expect the recession to last at least the next several quarters. As a result, the recession will have an impact on the City's short-term growth with actual future populations being slightly less than what was projected in this WSMP.

In general, the City's ability to obtain Federal and State grant and loan funding may be impacted by the recession. The current credit crisis may also negatively affect the City's ability to access credit markets if needed for short-and long-term borrowing. On the other hand, one of the most efficient set of mechanisms the Federal government can use to speed a national recovery is investments in existing Federal-State infrastructure programs in order to create new jobs. As a result, the Federal government may increase funding for both the clean water and drinking water state revolving loan funds to support these infrastructure improvements.

The City may already be experiencing the negative effects of the economic slowdown. Declining home values and increased foreclosures will have an affect on local finances. City revenue may also be declining as system development charges and other fees collected from the construction of homes slow to a halt. The extent of the economic impacts from the recession is difficult to predict.

How should this Master Plan be implemented?

It is recommended that this Water System Master Plan (WSMP) be viewed and implemented by the City under the following guidelines:

- **Master Plan Adoption** – This WSMP and the recommended water system improvements listed in the capital improvement plan (CIP) should be formally adopted by the City. This should be followed by the development and formal adoption by the City of a financial analysis, system rates, and fees study to implement the CIP.

- **Review and Update Master Plan** – This WSMP was completed as a comprehensive, but dynamic water system document that should be reviewed annually to ensure that it accurately reflects current development, anticipated growth, and system infrastructure needs. A more significant review of this WSMP should be performed every 5 years with a full comprehensive update to be completed no more than every 10 years.

- **Review and Update Capital Improvement Plan** – The CIP should be reviewed annually to prioritize, adjust, and budget accordingly to meet available City funding and water system needs. Annual minor updates are necessary to ensure that the proposed short-term projects follow the general guidelines presented in this WSMP. Future updates to the CIP should be balanced and prioritized so that system fees and rate increases are justified.

- **Review and Update Water System Mapping and Computer Model** – The water system mapping and hydraulic computer model developed as part of this WSMP should be updated annually or as necessary to reflect new waterline improvements, land development, and facility improvements.

- **Maintain Design and Operating Criteria** – This WSMP should be used as general guidance for the design and operation of the City's water system. Establishing and maintaining water system design and operating criteria is important for the City to assure standardization and consistency of the water system as improvements are made. The recommended general design and operating criteria presented, as well as other system criteria established by the City, should be reviewed annually to ensure compliance with any changes in State and Federal regulations.

- **Review Drinking Water Regulations** – Water quality regulations should be reviewed by the City on a quarterly basis, as several new or revised drinking water regulations are expected by year 2010 under the Safe Drinking Water Act (SDWA). It is important that the City remain informed of the development of these regulations and any possible new proposed regulations in order to strategically plan to meet them.

- **Review and Update Project Costs** – Proposed recommendations and their corresponding project costs presented in this WSMP should be considered conceptual. Potential alternatives, additional details, and updated cost estimates should be evaluated and performed in the preliminary engineering stages of any recommended improvement project. The costs shown are rough order-of-magnitude estimates and have been prepared for guidance in project evaluation and implementation from available planning level information. The final costs of the project will depend on actual labor and material costs, site conditions, competitive market conditions, regulatory factors, final project scope, implementation schedule, and other variable factors. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions.

- **Construction of the Recommended Improvements** – The cost estimates used in this WSMP are based on the assumption that the improvements will be performed using the standard design, bid, and construction phases more commonly associated with public works construction. It is understood that the City has a history of constructing improvements using City forces and working with local qualified contractors to complete construction at significantly lower costs. If this practice is used to reduce cost, it is critical that the City have the improvements properly engineered and carefully inspected by a qualified inspector to ensure that high quality water system improvements and facilities are constructed within the City.

Can the City afford to implement the CIP and how should funding be approached?

Depending on the financial qualifications of the City, there are several State and Federal assistance programs and local funding sources available. However, in order to effectively analyze the City's financial ability to meet infrastructure needs and to determine the feasibility of implementing this WSMP, a financial analysis, system rates and fees study will need to be completed on behalf of the City by a qualified economic and financial analyst.

This study should determine the actual costs of providing water service to customers, the required water system operating capital, and establish the recommended fees necessary to support the CIP. The study should include options for generating revenue for the City, including an update to the current water system rates and fee structure, service connection fees, impact fees, system development charges, and other available funding techniques as deemed appropriate.

It is recommended that this financial analysis, system rates and fees study be completed as soon as it can be funded. It is estimated that approximately $20,000 will be needed to fund this study.

Master Plan Summary

The remainder of this Executive Summary provides a brief overview of each of the main sections of the Water System Master Plan.

Existing Water System

Water Rights

The City uses groundwater for all of its municipal water supply needs and holds water rights that authorize the use of these water supply sources. The City appears to be in a favorable position with current water rights to meet current and near-future water demands. However, it is recommended that the City continue in its efforts to obtain additional water rights, in addition to fully developing unused capacity on existing water rights, to meet future anticipated demands. A summary of existing Water Rights is subsequently shown below in Table ES-5.

According to the Oregon Water Resource Department online database and City records, the City has water rights for three groundwater wells totaling approximately 774 gallons per minute (gpm) or 1.73 cubic feet per second (cfs), as shown below.

- Registration GR-659 - Well No. 1 for 200 gpm.
- Certificate 36316 - Well No. 3 for 224 gpm (Well No. 5 to share this right).
- Permit G-9890 - Well No. 4 for 350 gpm; however, Certificate 81591 – Well No. 4, Permit G-9890 was only partially perfected for only 251 gpm. (Well No. 5 to share this right).

Supply and Treatment

A total of two municipal groundwater wells operate in Aurora's water system. Wells No. 1 and No. 2 have previously been decommissioned and are no longer used. Wells No. 3 and No. 4 supply the main water production. Well No. 5 is a brand new well constructed in 2005 that has not yet been put into production, but City staff expects to be using the well starting early 2009.

The City provides chlorine disinfection of all its ground water sources as a barrier against microbial contamination. All water utilized from Wells No. 3 and Well No. 4 is chlorinated and stored at Well No. 3 using sodium hypochlorite supplied by local vendors. Water utilized by the new Well No. 5 will be chlorinated with its own sodium hypochlorite storage and injection system. The disinfectant is injected into the well discharge piping by means of a small chemical feed pump. The City currently maintains a minimum target residual of 0.2 to 0.3 milligrams per liter (mg/L) within its distribution system. The City does not currently conduct any other water treatment practices.

Pressure Zones

With ground elevations ranging from 100 feet to 180 feet, the City of Aurora is able to operate within a single pressure zone with a closed pump system. Constant system pressure is maintained by the booster pump station with typical system pressures throughout the majority of the City ranging between approximately 50 psi and 70 psi.

Storage Facilities

The City of Aurora currently has a single storage facility for finished water storage. The nominal 300,000 gallon above-ground, glass-fused bolted-steel storage tank was built in 1991. Prior to the construction of this storage tank, the City depended upon an elevated 25,000 gallon steel water tower. This tower is still standing, but has not been used due to its age.

Pump Station

The City's water system pressures are currently maintained by the use of two small 300 gpm booster pumps and one large 1,200 gpm fire pump, which run and cycle as needed to meet the system demands. The average system pressure is maintained at approximately 66 psi.

Distribution System

The distribution system consists of an estimated 8.2 miles of pipelines, ranging from 2-inch to 10 inches in diameter. The majority of the piping is PVC, asbestos-cement, steel, and ductile iron, with small sections of galvanized and cast iron. The backbone of the distribution system consists primarily of a 10-inch main from the booster pump station east along Ottaway Road to Liberty Street, then north along Liberty Street to Highway 99E.

Gridding of the system in the downtown area is provided primarily by smaller 2-inch, 4-inch, and 6-inch pipes. Although these smaller pipes may be adequate for normal domestic water service, they are not capable of providing for adequate fire flows, nor do they provide for proper gridding of the system. Gridding in the more recent subdivisions are provided by 8-inch diameter mains, which are adequate for both domestic water service and residential fire flows. Figure ES-6, attached at the end of this section, shows the existing water system for the City of Aurora and the area served.

Instrumentation and Controls

In 2005, the City completed installation of a new Supervisory Control and Data Acquisition (SCADA) system located in the booster pump station control building. This system is used to control and monitor the wells, storage tank, booster pumps, and other components of the water system.

Planning Considerations

Study Area and Planning Period

The study area for this master plan includes the area that lies within the City Limits and within the City of Aurora's Urban Growth Boundary (UGB). A review of existing land use and population growth trends indicates that the City's UGB may approach complete infill shortly after the planning period. Complete infill occurs when all existing developable land within the study area has been developed. The City's water system will be planned for 20 years, ending in year 2030. A 20-year period is short enough for current users to benefit from system improvements, yet long enough to provide reserve capacity for future growth and increased demand.

Current and Projected Population

A door-to-door survey was performed by Public Works in 2005, which resulted in the City of Aurora's most accurate population estimate to-date of 870 people. The 2005 population survey revealed that the City's population had increased by approximately 215 people since the 2000 U.S. Census (655 people). The survey showed that the City experienced a 32.8 percent increase over the 5 year period with an average annual growth rate of 6.6 percent per year. Growth in the City slowed between 2005 and 2008, but still experienced an increase over these 3 years with an average annual growth rate of 4 percent. The estimated 2008 population is approximately 975 people.

Recently, the City formally adopted an average annual growth rate of 2.8 percent per year to be used for all their current and near-future master planning documents. This growth rate follows the projections used in the City of Aurora's 2001 Comprehensive Plan. Using the average annual growth rate of 2.8%, Table ES-1 presents the corresponding population projections in five year increments throughout the planning period.

Table ES – 1
Population Projections

Year	Population Estimate	Additional Residents
2008	975	-
2010	1,030	55
2015	1,183	153
2020	1,358	175
2025	1,559	201
2030	1,790	231

Water Use and Projected Demands

Existing Water Use

There has been a steady increase over the years in the total amount of water that was produced by the City to accommodate the population growth. All water currently used by the City is provided by groundwater Wells No. 3 and 4, each supplied with individual flow meters for tracking flow. Table ES-2 below provides a summary of the City's monthly and annual water production based on the City's most current annual water use reports.

Table ES – 2
Water Production Summary

Year	2001 – 2002	2002 – 2003	2003 – 2004	2004 – 2005	2005 – 2006	2006 – 2007
Population	**660**	**660**	**660**	**870**	**920**	**955**
October	2,030,980	1,983,837	1,711,206	2,156,937	2,425,089	2,648,606
November	1,704,410	1,606,194	1,657,144	1,862,273	1,529,613	1,976,520
December	1,664,417	1,739,006	1,567,437	2,047,712	823,017	1,522,798
January	1,650,751	1,596,470	1,726,162	2,718,262	1,975,866	2,302,348
February	631,820	1,474,486	1,701,260	1,945,805	1,680,022	3,859,587
March	1,820,779	1,958,895	1,789,922	2,034,201	2,091,249	3,664,421
April	1,856,758	1,784,288	2,075,371	2,161,157	1,934,748	3,484,897
May	2,249,638	2,253,838	2,454,371	2,101,808	3,035,020	4,606,486
June	3,041,304	3,620,512	3,198,387	2,325,727	3,517,952	4,233,097
July	3,910,401	4,853,108	5,007,275	5,927,892	5,647,617	5,007,587
August	4,344,719	4,173,555	4,063,837	4,524,726	5,041,230	5,728,971
September	2,941,927	2,907,894	2,213,590	3,240,130	3,661,410	3,507,888
Total (gal)	**27,848,564**	**29,952,743**	**29,166,622**	**33,047,500**	**33,363,753**	**42,544,161**
Average Day Demand[(1)] (ADD) (gpd)	76,300	82,100	79,900	90,500	91,400	116,600
ADD Per Capita (gpcd)	116	124	121	104	99	122

(1) Rounded figures.

A summary of the City of Aurora's historical average day demands are shown in Figure ES-1 below. The information presented is based on the 1996 WSMP in addition to the current data from Table ES-2. To summarize, the 1996 WSMP showed an approximate range of average day demand between 71,000 gpd to 82,000 gpd from the years 1990 to 1995. Current calculations show that the City's average day demand has increased substantially, with the 2006-2007 information showing an average day demand of approximately 116,600 gpd.

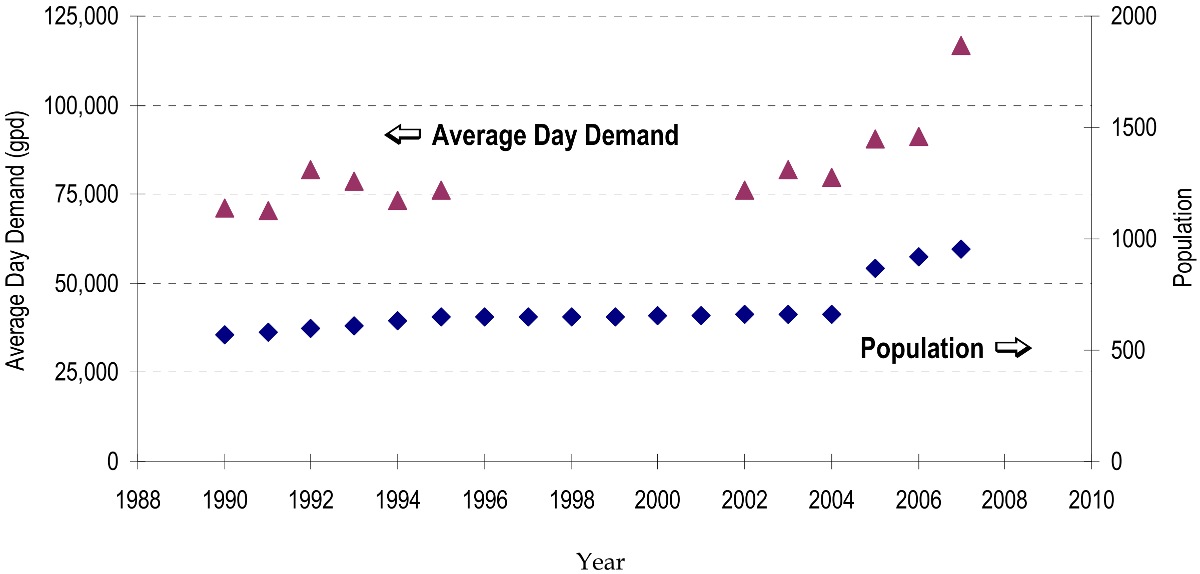

Figure ES – 1 Historical Average Day Demand Summary

Unaccounted-for Water

Water consumption information allows for determination of the amount of actual water consumed by the users and provides measurement of unaccounted-for water when compared with production information. The percentage of unaccounted-for water in the system is the total production minus the metered consumption, divided by the total production. Figure ES-2 below graphically shows the system loss information for the years 2005 to 2007.

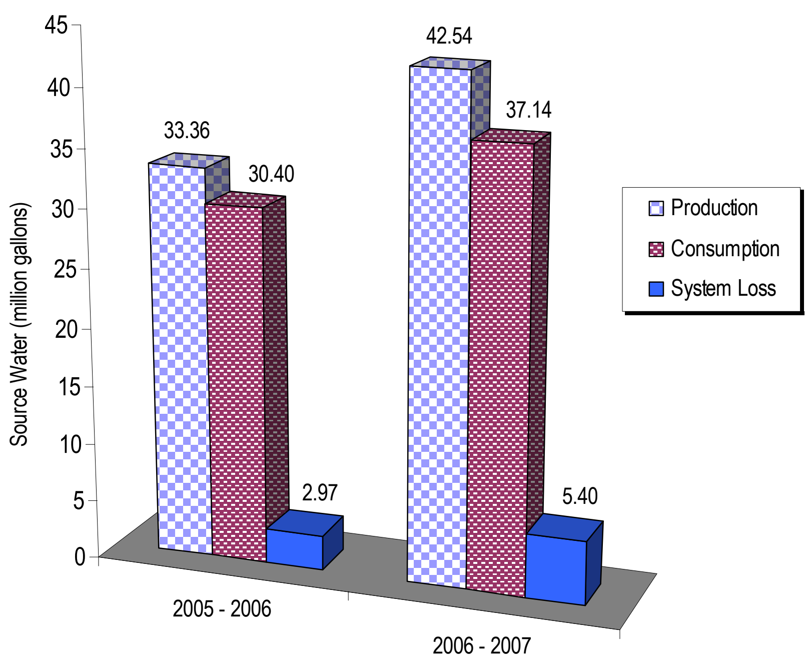

Figure ES – 2 Unaccounted-for Water (System Loss)

The average amount of unaccounted-for water in the City over the years has varied. The 1996 WSMP indicated that the percentage of unaccounted-for water within the City was reported as 13 percent in 1992, 27 percent in 1993, 8 percent in 1994, and 23 percent in 1995. Based on the most recent production and consumption information, the average system loss is approximately 11 percent. Potential sources for system losses include the following:

- System leakage.
- Inaccuracies of water meters.
- Inaccuracies in calculating total meter consumption.
- Unauthorized water use or connections without meters.
- Unmetered water for fire-fighting, City park irrigation, public car washing, and public works operations such as street cleaning, water main flushing, and fire hydrant testing.
- Other approved, but unmetered water uses (construction water main testing, water trucks, etc.).

Per Capita Demands

With the addition of the new water SCADA system in 2005, the City has been able to analyze the periods of peak demands. Based on the limited water system data that was obtainable from the SCADA system, the maximum day demand peaking factor averaged from 2005 to 2007 is approximately 2.5 times the average day demand. However, with greater emphasis being placed on conservation, it is reasonable to assume that future maximum day demands are likely to decrease. This should be emphasized by the City in the preparation of their Water Management and Conservation Plan.

The City also experiences peak hour demand factors of approximately 2 to 3 times the maximum day demand. Periods of peak hour use varies with typical highs occurring in the summer months between the hours of 5 and 7 am in the morning and between 6 to 9 pm in the evening. For the purposes of projecting future demands in this WSMP, the estimated average day, maximum day, and peak hour demands per capita will be based on the following:

- ADD per capita = 120 gpcd
    - *ADD to MDD peaking factor* = 2.4
- MDD per capita = 288 gpcd
    - *MDD to PHD peaking factor* = 2.5
- PHD per capita = 720 gpcd

Projected Water Demands

Future water demands are projected in order to analyze and evaluate the capability of the existing system to accommodate anticipated demands and to present information necessary to size system improvements and new facilities. These estimated projections are based on previous records of water produced, water consumed, estimated system peaking factors, and projected population estimates.

As previously mentioned, the estimated population growth rate is one of the most critical factors used in projecting future water demands. Another major factor is the role of water conservation measures on future water consumption. When completed and put into action, the

City's new Water Management and Conservation Plan may result in overall water savings, resulting in a decline of both water produced and consumed. The projected water demands are shown in Table ES-3 below.

Table ES – 3 Projected Water Demands at 2.8 Percent Growth				
		Projected Water Demands[1]		
Year	Population Estimate	Average Day Demand (gpd) *(based on 120 gpcd)*	Maximum Day Demand (gpd) *(based on 288 gpcd)*	Peak Hour Demand (gpd) *(based on 720 gpcd)*
2008	975	117,000	280,800	702,000
2010	1,030	123,600	296,600	741,600
2015[2]	1,183	142,000	340,700	851,800
2020	1,358	163,000	391,100	977,800
2025	1,559	187,100	449,000	1,122,500
2030	1,790	214,800	515,500	1,288,800

(1) Rounded figures.
(2) Approximate build-out year and population within current City Limits.

These projected water demands along with City historical values are presented in Figure ES-3 below.

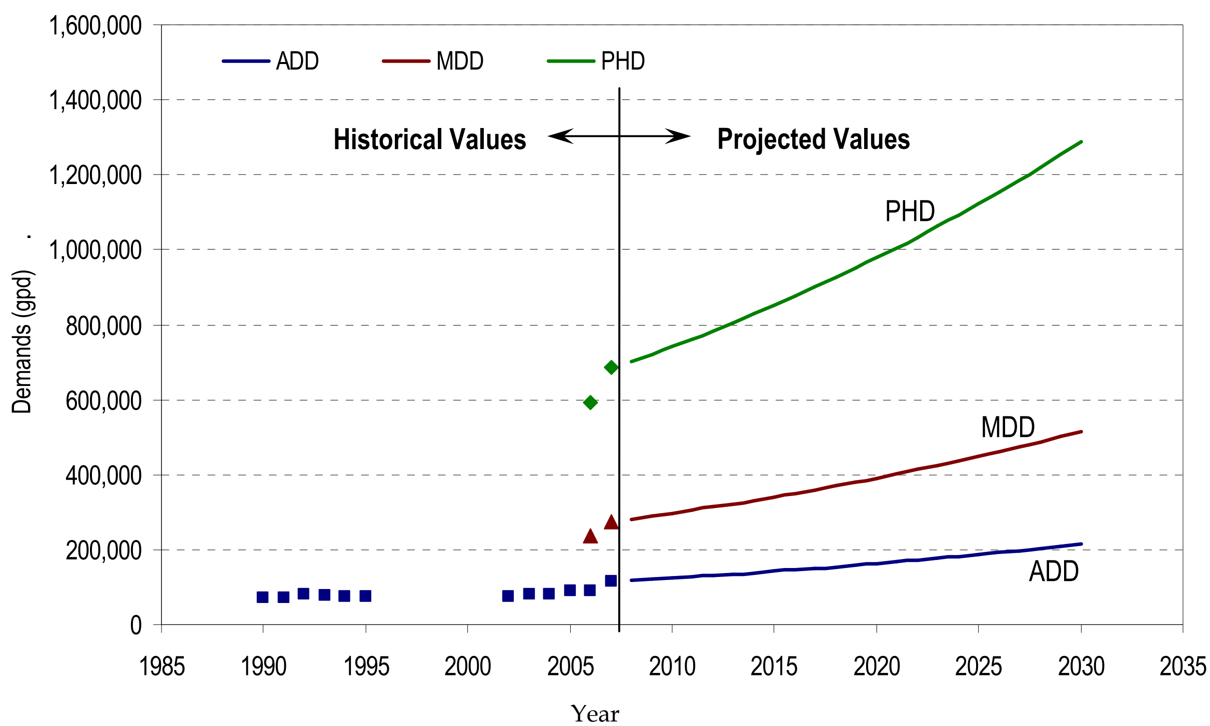

Figure ES – 3 Projected and Historical Water Demands

To serve as a comparison for future reference, the following Table ES-4 presents the population, average day demand, and maximum day demand projections for various growth rates of 1 percent, 2 percent, and 4 percent.

Table ES – 4
Projected Water Demands for Various Growth Rates

Year	Population Estimates for Various Growth Rates			Projected Water Demands[1] Average Day Demand (gpd) *(based on 120 gpcd)*			Projected Water Demands[1] Maximum Day Demand (gpd) *(based on 288 gpcd)*		
	1%	2%	4%	1%	2%	4%	1%	2%	4%
2008	975	975	975	117,000	117,000	117,000	280,800	280,800	280,800
2010	995	1,014	1,055	119,400	121,700	126,500	286,400	292,100	303,700
2015	1,045	1,120	1,283	125,400	134,400	154,000	301,100	322,600	369,500
2020	1,099	1,237	1,561	131,800	148,400	187,300	316,400	356,100	449,600
2025	1,155	1,365	1,899	138,600	163,800	227,900	332,600	393,200	547,000
2030	1,214	1,507	2,311	145,600	180,900	277,300	349,500	434,100	665,500

(1) Rounded figures.

Water System Design Criteria

The recommended design and operating criteria used in the analysis relate to water system design requirements, general guidance for evaluating design of water system improvements, and criteria relating to general maintenance of existing facilities. Detailed design and operating criteria is shown in Section 5, with a brief summary of the more general criteria provided below.

- Water supply sources and treatment systems must be able to reliably provide sufficient water to meet maximum day demands, based on the source's firm capacity. The source's firm capacity is defined as the total source's maximum production capacity with the largest source out of service.

- Water storage facilities should be sized to meet minimum equalization, emergency, and fire suppression storage requirements.

- For constant pressure pumping systems, which pump to a closed system with no gravity storage, should be sized for the larger of peak hour demand or maximum day demand plus fire flows at firm pumping capacity. A pump station's firm pumping capacity is the total pump station's maximum pumping capacity with the largest pump out of service.

- All wells should have emergency backup power connection capabilities. At minimum, a portable generator dedicated to the well supply shall be supplied with sufficient capacity to operate the well at its rated capacity.

- All pump stations should be equipped with an emergency generator of sufficient capacity to operate the pump station at its rated capacity.

- Distribution system mains should be sized to adequately convey the larger of peak hour demands at 40 psi residual pressure or maximum day demand plus fire flows at 20 psi residual pressure, measured at any service connection throughout the distribution system.

- Recommended minimum fire flows are 1,500 gpm for residential zones, 2,500 gpm for commercial zones, and 3,500 gpm for industrial zones.

- Distribution system mains should be 8-inch minimum diameter, configured in segmented grids and loops, and should be located within the established right-of-way or utility easement.

- The distribution system must have an adequate number of properly located valves to allow for the isolation of pipeline segments in the event of maintenance or new construction. Generally, valves should be installed at intersections with a maximum spacing of 500 feet in commercial, industrial, and multi-family areas, 500 feet in residential areas, 1/4 mile in transmission mains, and as necessary.

- A blow-off assembly or fire hydrant shall be installed on all dead-end runs and at designated points of low elevation to provide a means for adequate flushing of the system.

- Combined air-vacuum relief valves are to be installed at appropriate points of high elevation in the system with piping sloped to permit the release of any entrained air.

- Where the possibility of contamination of potable water exists, water services shall have appropriate backflow prevention devices in accordance with OAR 333-061-0070 and installed and tested in accordance with OAR 333-061-0071. To comply with this requirement, the City currently has a policy in place that requires that all services have backflow prevention devices installed.

Water System Analysis

Using the criteria presented in Section 5, a water system analysis was performed to determine the ability of the existing system to meet current and future demands and to identify system improvements needed to correct system deficiencies and meet anticipated growth. The analysis evaluated the City's water supply sources and associated water rights, storage and pumping facilities, and the distribution system using a developed hydraulic computer model. A brief summary of the more general issues and system needs are provided below.

Water Rights

Under currently held water rights, the City is authorized by OWRD to appropriate 675 gpm. A comparison of Wells No. 3 and 4 current pumping flow rates (approximately 305 gpm), to the authorized water right capacity of these wells (approximately 475 gpm), to the total amount of water authorized under currently held water rights (675 gpm), to the total available City water rights (774 gpm), is shown in Table ES-5.

Table ES – 5
Water Rights and Supply Comparison and Limitations

Well No.	City Water Rights/Groundwater Registrations				Well Production	
	Total Available (gpm)	Current Amount Authorized by OWRD (gpm)	Remaining Not Currently Authorized by OWRD (gpm)	Amount Authorized, but not currently useable (gpm)	Total Well Pumping Flowrate (gpm)	Current Well Pumping Flowrate (gpm)
1	200[1]	200	-	200	Not Used	Not Used
3	224	224	-	-	145	145
4	350	251	99[2]	-	160	160
5	-	-	-	-	170	Not yet in production
Totals	774	675	99	200	475	305

(1)Groundwater Registration.
(2) Water Right amount yet to be perfected.

The City recently performed a transfer of water rights to add additional points of appropriation and change the place of use for Wells No. 3 and 4 to include Well No. 5. As further shown in Table ES-4, even with this transfer, the City will not be able to maximize the City's full potential of available water rights. Once Well No. 5 is placed online, the total well production capacity that can collectively be used between Wells No. 3, 4, and 5 will only be 475 gpm (224 gpm + 251 gpm).

Since water rights are restricted to the terms and conditions described in the water right certificate for the place of use, point of diversion, and type of use, this means that the 200 gpm of rights associated with Well No. 1 will remain unusable unless a transfer of right is granted by OWRD. Including the additional 99 gpm from Well No. 4 that has yet to be perfected, a total of 299 gpm (774 gpm – 475 gpm), or approximately 40 percent of available rights will be unusable after Well No. 5 is put into production.

Well No. 1 was constructed in 1920, and as such, this City well has a groundwater registration rather than a water right certificate. Ground water registrations are claims for rights to use ground water established prior to 1955 and for which the OWRD has issued certificates of registration. The OWRD may recognize a change in use, place of use, or point of appropriation for a ground water registration if the OWRD determines that the change will not injure other water rights.

With the recent transfer of rights for Well No. 5, the City still needs to "prove up" the water use in order to fulfill the permit requirements. The City must submit proof by hiring a Certified Water Rights Examiner (CWRE) to complete a survey of water use and submit to OWRD a map and report detailing how and where water is being applied. When the report of beneficial use, called a Claim of Beneficial Use (COBU) is approved by OWRD, a water right certificate will be issued confirming the status of the right. **The City has until October 1, 2011 to submit the COBU. The difficulty of this is that the City is limited on their production capabilities because Well No. 4 and Well No. 5 are above the maximum contaminant levels for arsenic. An extension of this deadline may be necessary to be obtained by the City from the OWRD so that a water treatment system can be in place and full production of the wells can be established, prior to submitting a COBU.** Obtaining a water right certificate is the best way to ensure the protection of the use, and as such, it is recommended that all current water right processes be diligently tracked and completed by the City to ensure the protection of its water rights.

Based on these issues, it is recommended that further research by a Certified Water Rights Examiner be performed and a water rights strategic plan be put together for the City to identify all the issues associated with their water rights, appropriately prioritize certification of their water rights, possibly apply for an extension for the COBU, identify activities necessary to secure Well No. 4's remaining rights, and provide a complete analysis of future water rights that may be obtainable by the City.

Supply and Treatment

In general, the existing wells currently in operation have consistently provided the City with a reliable long-term public water supply. The aquifer that provides groundwater to the City's wells appears to show some long-term decline in water level based on recent calculated static water level trends provided in Section 2. Summer demands and long pumping of the wells within the area is shown to be strenuous on the aquifer. Additionally, the quality of groundwater produced is relatively good but there are some current water quality concerns associated with iron, manganese, and arsenic with Well No. 4 and potentially with Well No. 5.

Wells No. 3 and 4 are currently the only active wells in production that supply groundwater for the City. However, Well No. 4 can only be utilized 50 – 60 percent of the time since City staff has to blend the water produced with Well No. 3 due to arsenic levels being just above maximum contaminant levels. Since Well No. 5, which is not currently in production, also contains arsenic with similar levels to that of Well No. 4, these two wells cannot be utilized at the same time or without blending each with Well No. 3. Essentially, Well No. 3 serves as the City's supply lifeline and without having Well No. 3 to blend with the other wells, the City cannot meet the system demands and still be in compliance with drinking water standards for arsenic.

The well capacity chart shown in Figure ES-4 below, illustrates that under current well operations, an arsenic water treatment system is needed to be installed sometime before the year 2013 in order to comply with drinking water regulations and still meet maximum day demands. The need for arsenic treatment is the result of the more stringent regulations established by the U.S. EPA which reduced the previous maximum contaminant level from 50 parts per billion (ppb) to 10 ppb.

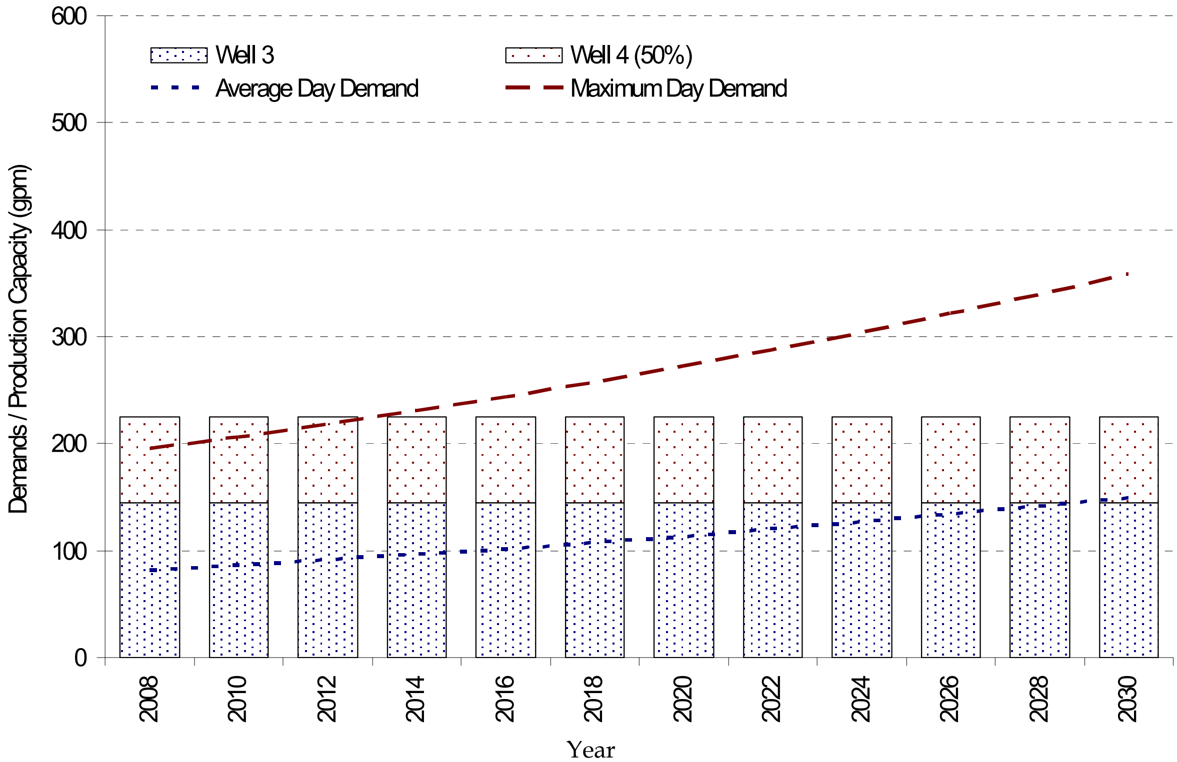

Figure ES – 4 Current Well Capacity Chart

Figure ES-5 below shows the City's potential well production capacities if an arsenic water treatment system capable of treating the capacity of the wells is provided.

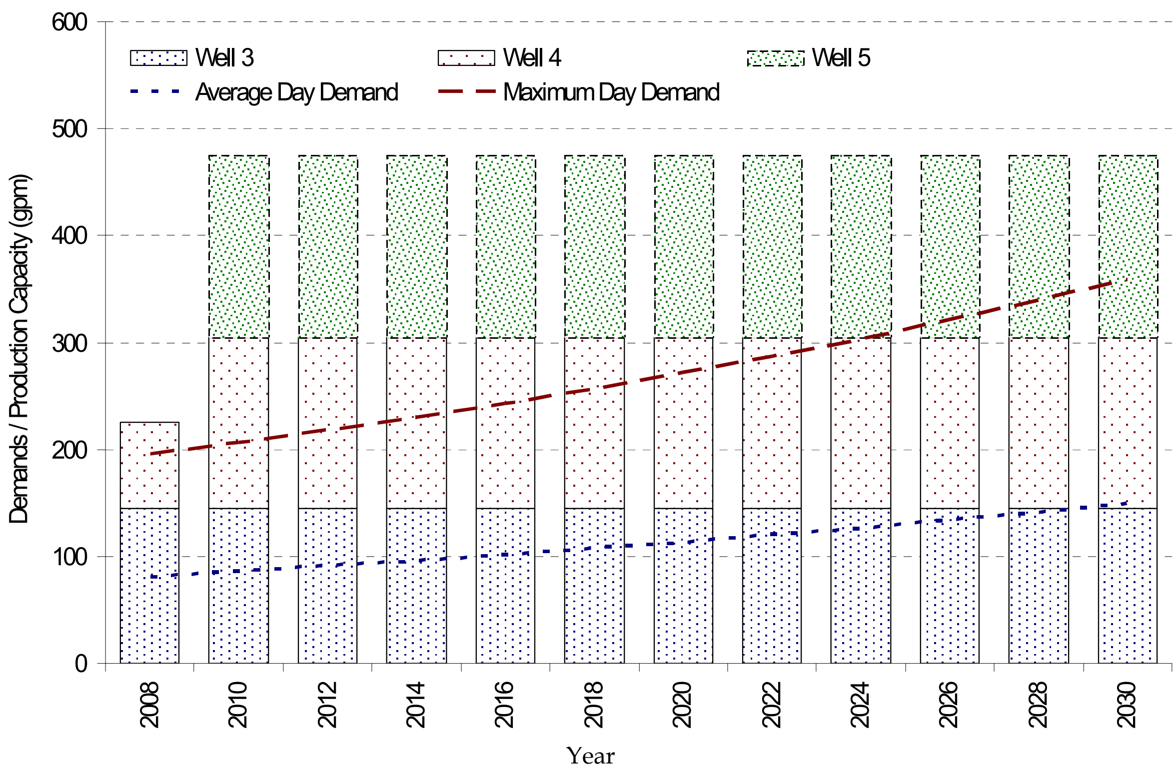

Figure ES – 5 Well Capacity Chart with Arsenic Treatment

As also illustrated in Figure ES-5, the City will need to plan to incrementally expand its source as system demands increase. With a firm capacity of 305 gpm (with the largest well out of service, Well No. 5), the City's supply capacity will need to be expanded before year 2024.

Storage Analysis

Existing water storage is currently accomplished by the use of a nominal 300,000 gallon above ground bolted-steel. The result of the storage analysis indicates that the capacity of the existing storage tank is inadequate for both current and future conditions. The capacity for current finished water storage needs is more than double (0.68 MG) the existing storage tank capacity and for future needs at the end of the planning period, it is more than three times (1 MG) the existing storage tank capacity.

It is recommended that a nominal 1 million gallon (MG) storage tank be constructed as part of the water system improvements to account for future storage needs through the planning period. It is further recommended that the City plan for a new storage tank and new pump station on the north end of the City, which will greatly improve system pressures at this higher elevation, as well as provide greater redundancy and reliability for the system. Larger water mains will be needed along Airport Road and along Ehlen Road in order to develop the capacity of the new storage tank.

Pump Station Analysis

The City's water system pressures are currently maintained by the use of two small booster pumps and one large fire pump, which run and cycle as needed to meet the system demands. The two small lag and lead pumps currently meet average day demands, but struggle to meet maximum day demands during the summer months. Peak hour demands and residential fire flows are currently provided by the single fire pump.

The existing fire pump does not have the capacity to meet commercial and industrial fire flows. In addition, the existing pump station severely lacks redundancy and reliability for fire protection. If the existing fire pump is out of service, the City has no capacity to provide for required peak hour demands or fire flows. Normally, this type of system is used to supply only very small residential areas. With the current pumping limitations and with the more recent interest by developers to develop the City's industrial and commercial areas, it is recommended that at minimum, the pump station be expanded to meet the needs of commercial fire flows.

With a projected maximum day demand of 360 gpm at the end of the planning period and commercial fire flow 2,500 gpm, it is recommended that the City plan to expand the existing pump station capacity needed to provide 2,860 gpm at firm capacity.

With the addition of a new storage tank and second booster pump station, the overall system pumping capacity requirements needed by the existing pump station can be reduced accordingly. It is recommended that when the preliminary planning and engineering stages of the future pump station occur, that consideration also be given to the necessary improvements needed for the existing pump station, so that in combination, they can provide the required pumping capacity to meet system needs.

Distribution System Analysis

The distribution system was evaluated under existing and future conditions using a computer model. The model was used to predict flows, pipe friction losses, pressures, and hydraulic grades at different points within the system.

Based on the analysis, the City has two main barriers to the movement of water within the system. The first and most significant is the lack of flow to the higher elevated north end of the City near Kasel Court. The City currently has an 8-inch ductile iron crossing over Mill Creek Bridge tied to a 6-inch steel water line along Ehlen Road and Airport Road, which does not provide adequate flow capacity. This also greatly affects future development, which has been targeted for this northwesterly area of the City. In addition, it is understood from talking with City staff that the 6-inch steel waterline in Ehlen Road is nearing its useful design life and may possibly have been partially damaged during the installation of the Mill Creek Bridge**.** With the addition of the new storage tank and pump station, coupled with a new proposed 12-inch distribution main along Ehlen Road and Airport Road, flows will be greatly enhanced, as well as provide additional redundancy for the City.

The second restriction is the downtown core of the City, which contains older deteriorating pipelines that are undersized since they were installed when fire flow requirements and demands were much lower. The pipeline grid in this area will be strengthened by a new north-south main along Highway 99E and some localized 8-inch pipe replacement improvements.

In order to provide the required fire flows, the identified existing waterlines will need to be upsized accordingly.

Fire Hydrant Placement Analysis

A review of fire hydrant placement throughout the distribution system shows some deficiencies. There are a number of areas within the system that exceed the 500 feet maximum spacing requirement between hydrants for residential areas and 200 feet to 500 feet within commercial/industrial areas. In addition, some hydrants have exceeded their useful design life and need to be replaced. Some hydrants are being supplied by 4-inch laterals, which does not provide for adequate fire flows.

It is recommended that the City establish a fire hydrant replacement plan to inventory and update the existing hydrants and laterals to comply with current standards.

Recommended Distribution System Improvements

The distribution system evaluation indicates that the City needs a number of system improvements to the storage, pumping, and distribution system in order for the system to provide the needed fire flows. The Capital Improvement Plan attached at the end of this section presents recommended improvement projects that are proposed over the planning period that will enable the City to provide reliable service to their customers.

Water Quality, Conservation, and Regulatory Review

Water Quality and Regulatory Review

National primary drinking water regulations were established in 1974 with the signing of the Safe Drinking Water Act (SDWA). The Environmental Protection Agency (EPA) was authorized to set standards and implement the SDWA. Since its inception, the SDWA and associated regulations have been amended a number of times. Public water systems are governed by rules developed by the EPA for implementation of the SDWA.

Since 1986, the Oregon Department of Human Services (DHS) has exercised primary responsibility for administering the Federal SDWA in Oregon, an arrangement called "Primacy". DHS adopts and enforces standards that are no less stringent than the Federal standards, and in return, the EPA gives DHS the regulatory responsibility for public drinking water systems and partial financial support for the Oregon program operation.

In practice, the Oregon drinking water standards match the national standards established under the SDWA by the EPA. This is because setting maximum levels for drinking water contaminants to protect human health involves considerable development of health effects information and other scientific research that is best carried out at the national level. DHS concentrates its efforts on implementing the national standards at Oregon public water systems. The Oregon standards are outlined in the Oregon Administrative Rules (OAR) Chapter 333, Division 61.

Per the OARs, the City of Aurora is responsible for taking all reasonable precautions to assure that the water delivered to water users does not exceed maximum contaminant levels, to assure that water system facilities are free of public health hazards, and to assure that water system operation and maintenance are performed as required by these rules.

In addition to the more routine regulatory water quality analysis parameters, the City will need to continue to monitor and comply with the more recently adopted changes to the regulations. These include such items as the Stage 2 Disinfectants and Disinfection Byproducts Rule, Ground Water Rule, and additional lead reporting requirements for the Consumer Confidence Reports. Furthermore, several new or revised regulations further discussed in Section 7 of this WSMP are expected by 2010 under the SDWA. It is important that the City remain informed of the development of these regulations and any possible newly proposed regulations in order to strategically plan to meet them.

Proposed Water Treatment System

The current well capacity chart in Figure ES-4 shows that the City will no longer be able to meet maximum day demands and still comply with State and Federal drinking water regulations unless some form of arsenic treatment system is installed by year 2013. The following provides a brief summary of the various iron, manganese, and arsenic forms commonly found in drinking water, as well as available arsenic treatment alternatives.

Iron and Manganese forms

The forms of iron and manganese commonly found in drinking water are ferrous, ferric, organic, and iron bacteria. The two predominant forms of iron are either the soluble ferrous iron or the insoluble ferric iron. Water containing ferrous iron is clear and colorless because the iron is completely dissolved. When exposed to air, the water turns cloudy and a reddish brown substance begins to form, which then becomes oxidized or the ferric form of iron that will not dissolve in water.

The presence of iron and manganese in water is not considered a health concern. However, high concentrations of iron and manganese may give the water an unpleasant metallic taste while still being safe to drink. When iron and manganese combines with beverages such as tea or coffee, it produces a black appearance and a harsh, offensive taste. Some vegetables cooked in iron and manganese-laden water will turn dark that may appear unappetizing.

Arsenic Forms

Arsenic usually exists in two different forms, or valence states, in a natural setting depending on the amount of oxygen available in groundwater. In shallow aquifers with higher levels of oxygen, arsenic will usually exist as arsenate, As(V). In deeper, anoxic groundwater, arsenic usually occurs as arsenite, As(III).

In the pH range of 4 to 10, the predominant As(III) compound is neutral in charge, while As(V) species are negatively charged. Removal efficiencies for As(III) are significantly less than those of As(V) because As(V)'s negative charge allows for it to be attracted to positively charged coagulants and adsorptive media.

Pretreatment of As(III) to oxidize it to As(V) is generally necessary to effectively remove arsenic from drinking water. Common oxidants include liquid chlorine (bleach), hydrogen peroxide (H2O2), ozone, or potassium permanganate. In addition, the ratio of arsenic species may not always be constant in the wells throughout the year and pre-oxidation may be required in some months and not others.

Applicable Arsenic Treatment Alternatives

With any water treatment process, there are variables that are unique to a specific system. The presence of naturally occurring iron may prove to be beneficial for the City in the removal of arsenic. Some applicable water treatment alternatives associated with arsenic removal is provided below and further described in Section 7.

- Non-Treatment Alternatives
- Iron Oxidation/Filtration
- Coagulation/Filtration
- Adsorptive Media

It is recommended that the selected arsenic treatment alternative be pilot tested to verify suitability of the technology. Pilot testing the potential mitigation strategies is a normal procedure to optimize treatment variables and avoid implementing a strategy that may not work for unforeseen reasons.

Pilot testing consists of setting up and operating a small-scale system to verify its performance using the actual field conditions and raw water that will be treated at full-scale. Pilot testing is generally necessary for most large treatment applications. However, in some cases, where the cost of pilot testing would approach the cost of installing the full-scale equipment, the pilot-testing phase may generally be included in the start-up process for the technology. With many smaller systems such as Aurora's, pilot testing may sometimes be performed by the vendor.

Due to the water quality issues with arsenic, iron and manganese, and other water quality concerns, a water treatment system is recommended.

Water Management and Conservation

The need for a Water Management and Conservation Plan in Aurora is becoming more and more apparent and is most noticeable during the water restrictions experienced during the summer periods the last few years. To address this need, a Water Management and Conservation Plan is currently planned to be prepared by City staff.

Recommendations and Capital Improvement Plan

Improvements since Last Plan

Major system improvements that were completed since the 1996 WSMP are summarized below.

- Well No. 1 was disconnected from the distribution system in 2004. The City stopped using this well long before it was formally disconnected from the system.
- Submersible pumps for Wells No. 3 and 4 were replaced in 2004.
- Installation of a new SCADA system was completed in 2005.
- Construction of a new Well No. 5 was completed in 2005.
- Approximately 4 miles of distribution system piping was added to the system mainly consisting of 8-inch and 10-inch mains where residential development has occurred.

Cost Estimating Data

The project cost estimates have been prepared for general guidance in project evaluation and implementation from available information. The final costs of the project will depend on actual labor and material costs, site conditions, competitive market conditions, regulatory factors, final project scope, implementation schedule, and other variable factors. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions.

Since construction costs frequently change, the Engineering News-Record (ENR) Construction Cost Index (CCI) is a common method used to make adjustments for future costs. The closest city CCI provided by ENR is for Seattle, Washington. However, ENR states on their website that the 20-City average index is generally more appropriate to use because it takes into account more elements and results in a smoother trend. Indexes for individual cities, such as for Seattle, are more susceptible to price spikes. The 20-City average ENR-CCI for September 2008 is

8556.72. Cost adjustments can be made in the future by taking the current ENR CCI divided by the September 2008 ENR CCI.

Recommended Improvements and Capital Improvement Plan

To assist the City in its planning efforts, the recommended improvements have been categorized based on project importance and project type, and assigned a project number, project cost, and anticipated year of construction. Given the fact that growth may be faster or slower than what is anticipated in this plan, the project improvement schedule is subject to change. Some projects may be implemented prior to their anticipated date, while others may be constructed after the date established in this plan.

The various capital improvements projects with higher priorities are scheduled to be implemented by 2020. For those specific projects that were not identified by the City as planned for construction in the immediate future, the priority for earliest construction is given to those projects that are needed to meet current demands and to comply with drinking water regulations, followed by those that improve or address fire flow deficiencies, followed by improvements for growth, pipe networking, and other system needs.

The recommended improvements and the proposed Capital Improvement Plan are shown in Figure ES-8 attached at the end of this section.

Financial Planning

A review of available alternatives to finance the recommended capital improvements was performed, which discussed the various financial assistance programs offering grants and loans, as well as alternatives using local funding sources such as bonds, system development charges, and water rates. The collection of various financing mechanisms that can be used to fund the construction and maintenance of water system infrastructure and related water quality protection initiatives are outlined below.

Financial Assistance Programs

- Safe Drinking Water Financing Program
  - Safe Drinking Water Revolving Loan Fund (SDWRLF)
  - Drinking Water Protection Loan Fund (DWPLF)
- Oregon Economic & Community Development Department
  - Water/Wastewater Fund
  - Special Public Works Fund
  - Community Development Block Grant (CDBG)
- U.S. Department of Agriculture (USDA) – Rural Development
  - Rural Utilities Service – Water and Waste Disposal Loans and Grants
- Oregon Water Resources Department (OWRD)
  - Water Development Loan Fund (WDLF)

Local Funding Sources

- General Obligation Bonds
- Revenue Bonds

- Local Improvement Districts
- Ad Valorem Taxes
- Capital Construction (Sinking) Fund
- System Development Charges
- Service Connection Fees
- Water Rate Charges
- Others, as determined by the financial analysis and water system fees study.

Funding Recommendations

Depending on the financial qualifications of the City, there are several State and Federal assistance programs and local funding sources available. However, in order to effectively analyze the City's financial ability to meet infrastructure needs and to determine the feasibility of implementing this WSMP, a financial analysis, system rates and fees study will need to be completed on behalf of the City by a qualified economic and financial analyst.

The various financial assistance programs and local funding sources each have advantages and disadvantages. All of these will need to be considered as the City reviews and makes decisions regarding the available alternatives to finance the recommended capital improvements.

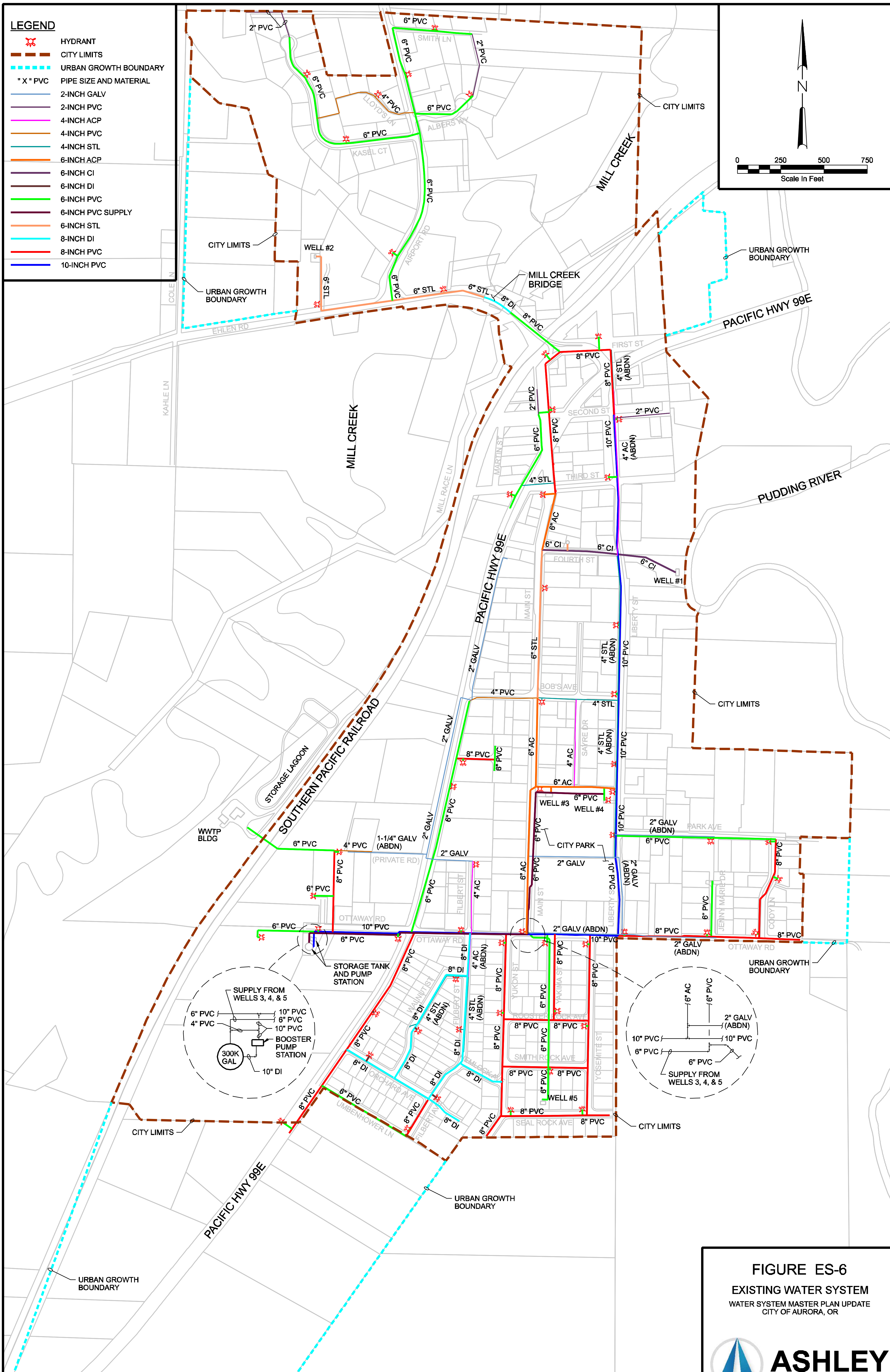

FIGURE ES-6

EXISTING WATER SYSTEM

WATER SYSTEM MASTER PLAN UPDATE
CITY OF AURORA, OR

ASHLEY ENGINEERING DESIGN

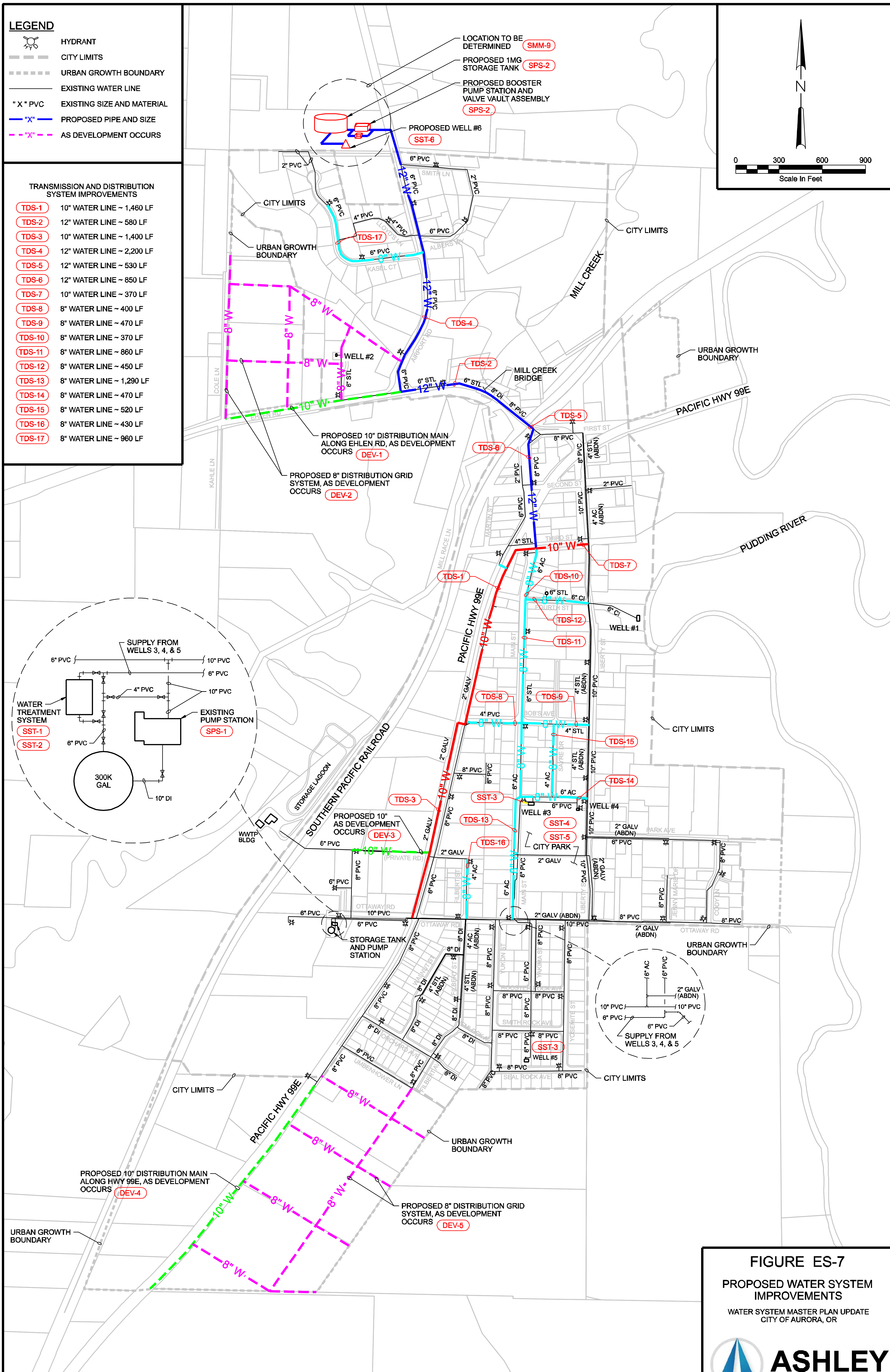

FIGURE ES-7
PROPOSED WATER SYSTEM IMPROVEMENTS
WATER SYSTEM MASTER PLAN UPDATE
CITY OF AURORA, OR
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ASHLEY ENGINEERING DESIGN

Water System Capital Improvement Plan

Project Priority and Schedule[1]

Cost in 2008 dollars and escalated at an average inflation rate of 3 percent per year.

Project Category		Project Number	Project Description	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2009 - 2015 0 - 5 years	2015 - 2020 5 - 10 years	2020 - 2025 10 - 15 years	2025 - 2030 15 - 20 years	Total Estimated Project Cost[2]	Comments & Notes
			Budget Fiscal Year…..												
SST	Supply Source and Treatment Improvement Projects	*SST-1	Preliminary Arsenic Water Treatment Study / Pilot Testing	$ 100,000						$ 100,000	$ -	$ -	$ -	$ 100,000	Needed for study and testing for arsenic water treatment system.
		*SST-2	New Arsenic Water Treatment System				$ 510,000			$ 510,000	$ -	$ -	$ -	$ 510,000	Needed for compliance with Drinking Water Regulations.
		SST-3	Wells No. 3 and 5 Emergency Backup Generator Connections		$ 11,100					$ 11,100	$ -	$ -	$ -	$ 11,100	Needed for emergency preparation for water supply.
		SST-4	Well Emergency Backup Generator			$ 26,200				$ 26,200	$ -	$ -	$ -	$ 26,200	Needed for emergency preparation for water supply.
		SST-5	Wells No. 3 and 4 Casing Seal Replacement					$ 92,700		$ 92,700	$ -	$ -	$ -	$ 92,700	Needed for compliance with Drinking Water Regulations.
		*SST-6	Future Groundwater Well No. 6							$ -	$ -	$ 521,900	$ -	$ 521,900	Construct new well as necessary to meet City growth and demands.
			SST PROJECTS SUB-TOTAL	**$ 100,000**	**$ 11,100**	**$ 26,200**	**$ 510,000**	**$ 92,700**	**$ -**	**$ 740,000**	**$ -**	**$ 521,900**	**$ -**	**$ 1,261,900**	Total SST project improvement costs including inflation to year shown.
SPS	Storage and Pump Station Improvement Projects	*SPS-1	Existing Pump Station Improvements					$ 86,900		$ 86,900	$ -	$ -	$ -	$ 86,900	Pump station capacity and reliability improvements.
		*SPS-2	New Storage Tank and Pump Station							$ -	$ 2,104,600	$ -	$ -	$ 2,104,600	Current and future water storage needs, redundancy, and pump capacity improvement.
			SPS PROJECTS SUB-TOTAL	**$ -**	**$ -**	**$ -**	**$ -**	**$ 86,900**	**$ -**	**$ 86,900**	**$ 2,104,600**	**$ -**	**$ -**	**$ 2,191,500**	Total SPS project improvement costs including inflation to year shown.
TDS	Transmission and Distribution System Improvement Projects	TDS-1	10-inch - Hwy 99E from Third and Main Street to Bobs Avenue	$ 229,000						$ 229,000	$ -	$ -	$ -	$ 229,000	Fire flow improvement, undersized galv pipe, gridding of 10-inch main.
		*TDS-2	12-inch - Ehlen Road from Airport Road east to Mill Creek Bridge			$ 85,200				$ 85,200	$ -	$ -	$ -	$ 85,200	Additional storage tank supply main and fire flow improvements for NW area.
		TDS-3	10-inch - Hwy 99E from Bobs Avenue to Ottaway Road						$ 187,500	$ 187,500	$ -	$ -	$ -	$ 187,500	Fire flow improvement, undersized pvc pipe, gridding of 10-inch.
		*TDS-4	12-inch - Airport Road from Ehlen Road to new Storage Tank							$ -	$ 364,000	$ -	$ -	$ 364,000	Additional storage tank supply main and fire flow improvements for NW area.
		*TDS-5	12-inch - Ehlen Road from Mill Creek Bridge east to Main Street							$ -	$ 177,300	$ -	$ -	$ 177,300	Additional storage tank supply main and fire flow improvements for NW area.
		*TDS-6	12-inch - Main Street from Ehlen Road to Third Street							$ -	$ 208,800	$ -	$ -	$ 208,800	Additional storage tank supply main and fire flow improvements for NW area.
		TDS-7	10-inch - Third Street from Main Street to Liberty Street							$ -	$ 56,800	$ -	$ -	$ 56,800	Fire flow improvement, gridding of 10-inch distribution main.
		TDS-8	8-inch - Bobs Avenue from Hwy 99E to Main Street							$ -	$ -	$ 51,300	$ -	$ 51,300	Fire flow improvement, undersized pvc pipe.
		TDS-9	8-inch - Bobs Avenue from Main Street to Liberty Street							$ -	$ -	$ 59,900	$ -	$ 59,900	Fire flow improvement, undersized, and poor condition steel pipe.
		TDS-10	8-inch - Main Street from Third Street to Fourth Street							$ -	$ -	$ 48,500	$ -	$ 48,500	Fire flow improvement, undersized, and poor condition asbestos-cement pipe.
		TDS-11	8-inch - Main Street from Fourth Street to Bobs Avenue							$ -	$ -	$ 116,500	$ -	$ 116,500	Fire flow improvement, undersized, and poor condition steel pipe.
		TDS-12	8-inch - Fourth Street from Main Street to Liberty Street							$ -	$ -	$ 64,200	$ -	$ 64,200	Fire flow improvement, undersized, and poor condition steel pipe.
		TDS-13	8-inch - Main Street from Bobs Avenue to Ottaway Road							$ -	$ -	$ -	$ 191,700	$ 191,700	Fire flow improvement, undersized, and poor condition asbestos-cement pipe.
		TDS-14	8-inch - North of City Park from Main Street to Liberty Street							$ -	$ -	$ -	$ 71,500	$ 71,500	Fire flow improvement, undersized, and poor condition asbestos-cement pipe.
		TDS-15	8-inch - Sayre Drive from Bobs Avenue to City Park							$ -	$ -	$ -	$ 82,400	$ 82,400	Fire flow improvement, undersized, and poor condition asbestos-cement pipe.
		TDS-16	8-inch - Filbert Street from Ottaway Road north to existing hydrant							$ -	$ -	$ -	$ 70,400	$ 70,400	Fire flow improvement, undersized, and poor condition asbestos-cement pipe.
		TDS-17	8-inch - Kasel Court from Airport Road west to furthest existing hydrant							$ -	$ -	$ -	$ 160,000	$ 160,000	Needed fire flow improvement, undersized pvc pipe.
			TDS PROJECTS SUB-TOTAL	**$ 229,000**	**$ -**	**$ 85,200**	**$ -**	**$ -**	**$ 187,500**	**$ 501,700**	**$ 806,900**	**$ 340,400**	**$ 576,000**	**$ 2,225,000**	Total TDS project improvement costs including inflation to year shown.
			CAPITAL IMPROVEMENT PROJECTS TOTAL	**$ 329,000**	**$ 11,100**	**$ 111,400**	**$ 510,000**	**$ 179,600**	**$ 187,500**	**$ 1,328,600**	**$ 2,911,500**	**$ 862,300**	**$ 576,000**	**$ 5,678,400**	Total cost of improvements including inflation to year shown.
			5-YEAR ANNUAL AVERAGE							**$ 265,720**	**$ 582,300**	**$ 172,460**	**$ 115,200**		Average annual cost over each 5-year period.
			TOTAL PLANNING PERIOD ANNUAL AVERAGE											**$ 283,920**	Average annual cost over the planning period.
SST	Supply Source and Treatment O&M	SST-O&M-1	Supply Source Operation and Maintenance	$ 32,000	$ 33,000	$ 34,000	$ 35,000	$ 36,100	$ 37,200	$ 207,300	$ 203,200	$ 235,700	$ 273,200	$ 919,400	Needed for system operation and maintenance.
		SST-O&M-2	Water Treatment Operation and Maintenance				$ 13,000	$ 13,400	$ 13,800	$ 40,200	$ 75,300	$ 87,500	$ 101,500	$ 304,500	Needed for system operation and maintenance.
			SST O&M SUB-TOTAL	**$ 32,000**	**$ 33,000**	**$ 34,000**	**$ 48,000**	**$ 49,500**	**$ 51,000**	**$ 247,500**	**$ 278,500**	**$ 323,200**	**$ 374,700**	**$ 1,223,900**	Total SMM project improvement costs including O&M and inflation to year shown.
SPS	Storage and Pump Station O&M	SPS-O&M-1	Storage Tank Repairs and Operation and Maintenance	$ 23,000	$ 8,200	$ 8,400	$ 8,700	$ 9,000	$ 9,300	$ 66,600	$ 51,000	$ 58,800	$ 68,500	$ 244,900	Needed for system operation and maintenance.
		SPS-O&M-2	Pump Station Operation and Maintenance	$ 24,000	$ 24,700	$ 25,400	$ 26,200	$ 27,000	$ 27,800	$ 155,100	$ 152,000	$ 176,300	$ 204,600	$ 688,000	Needed for system operation and maintenance.
			SPS O&M SUB-TOTAL	**$ 47,000**	**$ 32,900**	**$ 33,800**	**$ 34,900**	**$ 36,000**	**$ 37,100**	**$ 221,700**	**$ 203,000**	**$ 235,100**	**$ 273,100**	**$ 932,900**	Total SMM project improvement costs including O&M and inflation to year shown.
TDS	Distribution System O&M	TDS-O&M-1	Transmission and Distribution System Operation and Maintenance	$ 25,000	$ 25,800	$ 26,600	$ 27,400	$ 28,200	$ 29,000	$ 162,000	$ 158,800	$ 184,100	$ 213,300	$ 718,200	Needed for system operation and maintenance.
			TDS O&M SUB-TOTAL	**$ 25,000**	**$ 25,800**	**$ 26,600**	**$ 27,400**	**$ 28,200**	**$ 29,000**	**$ 162,000**	**$ 158,800**	**$ 184,100**	**$ 213,300**	**$ 718,200**	Total SMM project improvement costs including O&M and inflation to year shown.
			SYSTEM OPERATION AND MAINTENANCE TOTAL	**$ 104,000**	**$ 91,700**	**$ 94,400**	**$ 110,300**	**$ 113,700**	**$ 117,100**	**$ 631,200**	**$ 640,300**	**$ 742,400**	**$ 861,100**	**$ 2,875,000**	Total cost of O&M including inflation to year shown.
SMM	System Management and Miscellaneous Projects	SMM-1	Annual Consumer Confidence Reports	$ 1,500	$ 1,550	$ 1,600	$ 1,650	$ 1,700	$ 1,750	$ 9,800	$ 9,600	$ 11,100	$ 13,000	$ 43,500	Needed for compliance with Drinking Water Regulations.
		SMM-2	Water Quality Monitoring and Testing	$ 1,500	$ 1,550	$ 1,600	$ 1,650	$ 1,700	$ 1,750	$ 9,800	$ 9,600	$ 11,100	$ 13,000	$ 43,500	Needed for compliance with Drinking Water Regulations.
		SMM-3	Water Rights Strategic Plan	$ 7,500						$ 7,500	$ -	$ -	$ -	$ 7,500	Necessary for tracking of existing and plan for obtaining new water rights
		SMM-4	Financial Analysis, Rates, and Fees Study	$ 20,000						$ 20,000	$ 18,400	$ 21,400	$ 24,800	$ 84,600	Necessary for identifying funding needs and establishing system fees.
		SMM-5	Update Water Billing Software	$ 15,000						$ 15,000	$ 3,500	$ 3,500	$ 6,000	$ 28,000	Necessary for tracking and reporting of water billing and consumption.
		SMM-6	Storage Tank Seismic and Condition Assessment		$ 15,900					$ 15,900	$ -	$ -	$ -	$ 15,900	Necessary to determine structural integrity of tank.
		SMM-7	Water Management and Conservation Plan - Implementation		$ 2,700	$ 1,100	$ 1,130	$ 1,160	$ 1,190	$ 7,300	$ 6,600	$ 7,600	$ 8,800	$ 30,300	Necessary of implementing the new WMCP.
		SMM-8	Drinking Water Protection Program		$ 5,300					$ 5,300	$ 6,500	$ 7,700	$ 4,400	$ 23,900	Necessary for establishing plan for protection of drinking water
		*SMM-9	Additional Storage and Pump Station Study			$ 16,400				$ 16,400	$ -	$ -	$ -	$ 16,400	Necessary for identifying land acquisition needs and new PS capacity requirements.
		SMM-10	Update Water System Design and Construction Standards				$ 16,900	$ 580	$ 600	$ 18,100	$ 3,300	$ 3,800	$ 4,400	$ 29,600	Necessary for design and construction of water system improvements.
		SMM-11	GIS System and Update Water System Mapping						$ 23,900	$ 23,900	$ 3,300	$ 7,500	$ 9,000	$ 43,700	Necessary for existing and future mapping needs of water system.
		SMM-12	Water Meter Strategic Plan						$ 4,200	$ 4,200	$ -	$ -	$ -	$ 4,200	Necessary for standardizing and updating water meters.
		SMM-13	Update Water System Master Plan							$ -	$ 69,200	$ -	$ 93,000	$ 162,200	Necessary for updating water system master plan.
		*SMM-14	New Supply Source Study							$ -	$ -	$ 21,400	$ -	$ 21,400	Necessary to identify possible well locations and land acquisition needs.
			SYSTEM MANAGEMENT AND MISCELLANEOUS PROJECTS TOTAL	**$ 45,500**	**$ 27,000**	**$ 20,700**	**$ 21,300**	**$ 5,100**	**$ 33,400**	**$ 153,200**	**$ 130,000**	**$ 95,100**	**$ 176,400**	**$ 554,700**	Total cost of management including inflation to year shown.
			WATER SYSTEM CAPITAL IMPROVEMENTS, O&M, AND MANAGEMENT TOTAL	**$ 478,500**	**$ 129,800**	**$ 226,500**	**$ 641,600**	**$ 298,400**	**$ 338,000**	**$ 2,113,000**	**$ 3,681,800**	**$ 1,699,800**	**$ 1,613,500**	**$ 9,108,100**	Total cost of improvements, O&M, and system management.

Notes:

* Project or a portion of the project is influenced by City growth.

(1) Project priority and schedules are proposed. Exact timing of improvements is uncertain and will depend on growth and available City funding.

(2) Costs include estimated construction costs in 2008 dollars (September 2008 20-City Avg ENR-CCI = 8556.72) plus 40 percent allowance for contingencies, engineering, legal, administration, and other project related costs plus 3 percent inflation to anticipated year of project. Costs do not include costs for bonds, financing, right-of-way, easement, or land acquisition.

SECTION 1

Introduction

SECTION 1

Introduction

Authorization

Authorization for the preparation of this Water System Master Plan (WSMP) was provided by the City of Aurora in December 2007.

Compliance

This WSMP has been written to comply with the master plan requirements established under the Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 061 (Effective 2-15-2008).

The rules pertaining to master plans (OAR 333-061-0060(5)), are shown below. A Water Management and Conservation Plan is currently planned to be prepared separately by the City of Aurora.

- ❖ Community water systems with 300 or more service connections shall maintain a current master plan. Master plans shall be prepared by a professional engineer registered in Oregon and submitted to the Department for review and approval.

- ❖ Each master plan shall evaluate the needs of the water system for at least a twenty year period and shall include but is not limited to the following elements:

    - A summary of the overall plan that includes the water quality and service goals, identified present and future water system deficiencies, the engineer's recommended alternative for achieving the goals and correcting the deficiencies, and the recommended implementation schedule and financing program for constructing improvements.

    - A description of the existing water system which includes the service area, source(s) of supply, status of water rights, current status of drinking water quality and compliance with regulatory standards, maps or schematics of the water system showing size and location of facilities, estimates of water use, and operation and maintenance requirements.

    - A description of water quality and level of service goals for the water system, considering, as appropriate, existing and future regulatory requirements, non-regulatory water quality needs of water users, flow and pressure requirements, and capacity needs related to water use and fire flow needs.

- An estimate of the projected growth of the water system during the master plan period and the impacts on the service area boundaries, water supply source(s) and availability, and customer water use.

- An engineering evaluation of the ability of the existing water system facilities to meet the water quality and level of service goals, identification of any existing water system deficiencies, and deficiencies likely to develop within the master plan period. The evaluation shall include the water supply source, water treatment, storage, distribution facilities, and operation and maintenance requirements. The evaluation shall also include a description of the water rights with a determination of additional water availability, and the impacts of present and probable future drinking water quality regulations.

- Identification of alternative engineering solutions, environmental impacts, and associated capital and operation and maintenance costs, to correct water system deficiencies and achieve system expansion to meet anticipated growth, including identification of available options for cooperative or coordinated water system improvements with other local water suppliers.

- A description of alternatives to finance water system improvements including local financing (such as user rates and system development charges) and financing assistance programs.

- A recommended water system improvement program including the recommended engineering alternative and associated costs, maps or schematics showing size and location of proposed facilities, the recommended financing alternative, and a recommended schedule for water system design and construction.

- If required as a condition of a water use permit issued by the Water Resources Department, the Master Plan shall address the requirements of OAR 690-086-0120 (Water Management and Conservation Plans).

❖ The implementation of any portion of a water system master plan must be consistent with OAR 333-061 (Public Drinking Water Systems, DHS), OAR 660-011 (Public Facilities Planning, Department of Land Conservation and Development) and OAR 690-086 (Water Management and Conservation Plans, Water Resources Department).

Plan Scope of Work

The overall scope of work for this WSMP includes the following tasks:

❖ **System Inventory and Evaluation** – Prepare an inventory of existing water system information including supply, transmission, distribution, storage, pump stations, and telemetry and control systems.

- **Study Area Characteristics** – Identify applicable study area characteristics, land use, and population trends and projections.

- **Document Historical and Future Demands** – Review historical and project future water demands. Establish average daily demand rates per capita, maximum day demands, peak hour demands, and unaccounted-for flows in the system using historical information.

- **Develop System Analysis Criteria** – Develop system performance criteria for storage, distribution, pump stations, and other water system parameters.

- **Perform Water System Analysis** – Perform a detailed analysis of storage, distribution, pump stations, and other water system parameters. Identify improvements to correct existing system deficiencies. Evaluate the adequacy of the existing service levels to meet anticipated growth and recommend improvements as necessary.

- **Develop Capital Improvement Plan** – Prepare a CIP to include a 20-year plan to aid the City in scheduling and planning improvements in a phased manner. Outline the CIP in a manner that will allow the City to monitor growth and implement the improvement as growth is realized.

Past Studies and Reports

Various past studies and reports that discuss the City's water system and related facilities were used in the preparation of and analysis in this WSMP. A list of these studies and reports is shown below.

- *Water System Master Plan, City of Aurora*. JMS Engineering, July 1996.
- *Systems Development Charge Study.* Balfour Consulting, Inc. and EAS Engineering, June 2000.
- *Water System Design and Construction Standards.* City of Aurora Public Works Department, April 2002.
- *Source Water Assessment Report for City of Aurora PWS#4100067.* Oregon Department of Human Services-Drinking Water Program and Oregon Department of Environmental Quality, December 2002.
- *City of Aurora Production Well Evaluation.* Groundwater Solutions, Inc., November 2004.
- *City of Aurora Hydrogeologic Characterization, Well Site Evaluation, and Water Rights Review.* Groundwater Solutions, Inc., January 2005.
- *Water and Sewer Systems Capacity Report.* EAS Engineering, December 2005.
- *Sanitary Survey PWS #4100067.* Marion County, Oregon - Health Department, June 2006.

ASHLEY ENGINEERING DESIGN

SECTION 2

Existing Water System Description

SECTION 2

Existing Water System Description

Objective

The objective of this section is to provide general information on the City of Aurora's existing water system. A basic inventory is presented of the existing water system including water supply source, water rights, treatment, pressure zones, storage, booster pump station, distribution system, and instrumentation and control system.

Ownership and Management

The City of Aurora owns and operates its municipal water system. The City of Aurora is governed by a Mayor/Council non-partisan form of government. All represent the community, rather than individual districts or areas within the City. The City's current address is as follows:

CITY OF AURORA
21420 Main Street, NE
Aurora, OR 97002
Phone: (503) 678-1283
Fax: (503) 678-2758

The vicinity and location maps for the City of Aurora are shown in Figures 2-1 and 2-2, respectively.

Water System Classification

The City of Aurora water system is currently classified by the Oregon Department of Human Services (DHS) as a "*Community Water System*". A Community Water System is defined as a public water system that has 15 or more service connections used by year-round residents, or that regularly serves 25 or more year-round residents.

As a result of this classification, the City is responsible for taking all reasonable precautions to assure that the water delivered to the users does not exceed maximum contaminant levels, to assure that the water system facilities are free of public health hazards, and to assure that water system operation and maintenance are performed, as required by the Oregon Administrative Rules (OAR) Chapter 333, Division 61.

The Oregon Public Water System Identification Number for the City is PWS#4100067.

Water System Summary

The City of Aurora uses groundwater for all of its municipal water supply needs. The City's overall water system primarily consists of five groundwater wells (only two of which are currently used in production), a nominal 300,000 gallon bolted-steel above-ground storage tank, a booster pump station, distribution piping, and a supervisory control and data acquisition (SCADA) system.

The SCADA system serves as the central focus for all of the operational, emergency, and monitoring functions of the water system. Well operation is automatically controlled at the central control station located next to the storage tank in the booster pump station building. Each well is set to turn on or off based on tank water levels. Prior to 1994, the City's water system pressures were maintained by water being pumped directly to an elevated 25,000 gallon water tower. Although still standing today, the elevated tank was decommissioned shortly after construction of the new tank and booster pump station completed in 1992.

A total of two municipal groundwater wells operate in Aurora's water system. Wells No. 1 and No. 2 have previously been decommissioned and are no longer used. Wells No. 3 and No. 4 supply the main water production. Well No. 5 is a brand new well that has not yet been put into production. All water utilized from Wells No. 3 and Well No.4 is chlorinated at Well No. 3 using sodium hypochlorite. Water utilized by the new Well No. 5 will be chlorinated with its own sodium hypochlorite system.

The City's water system pressures are currently maintained by the use of two small booster pumps and one large fire pump, which run and cycle as needed to meet the system demands. The entire distribution system is served by a single pressure zone with typical system pressures throughout the majority of the City ranging between approximately 50 psi and 70 psi. The existing water system for the City of Aurora and the area served is shown in Figure 2-3. A schematic of the existing water system is illustrated in Figure 2–4.

Groundwater Supply Source

Groundwater Basics

Groundwater is part of the hydrologic cycle that controls the distribution of water on the surface of the Earth. It is therefore linked to other sources of water such as streams, rivers, and lakes. Ultimately, groundwater originates as precipitation at the surface, which then gets absorbed into and through the soil.

Groundwater wells are constructed by first drilling through a distance of soil, sediments, and/or bedrock immediately below the ground surface where the open spaces (pores) in the geological formation contain both water and air, but are not totally saturated with water. Plant roots can capture the moisture passing through this zone, but it cannot provide water for wells (known as vadose zone). Further progression of the well will eventually encounter a depth in which the pores are saturated with water. It is at this depth that establishes the water table. Any underground geological formation able to store and yield water is an aquifer.

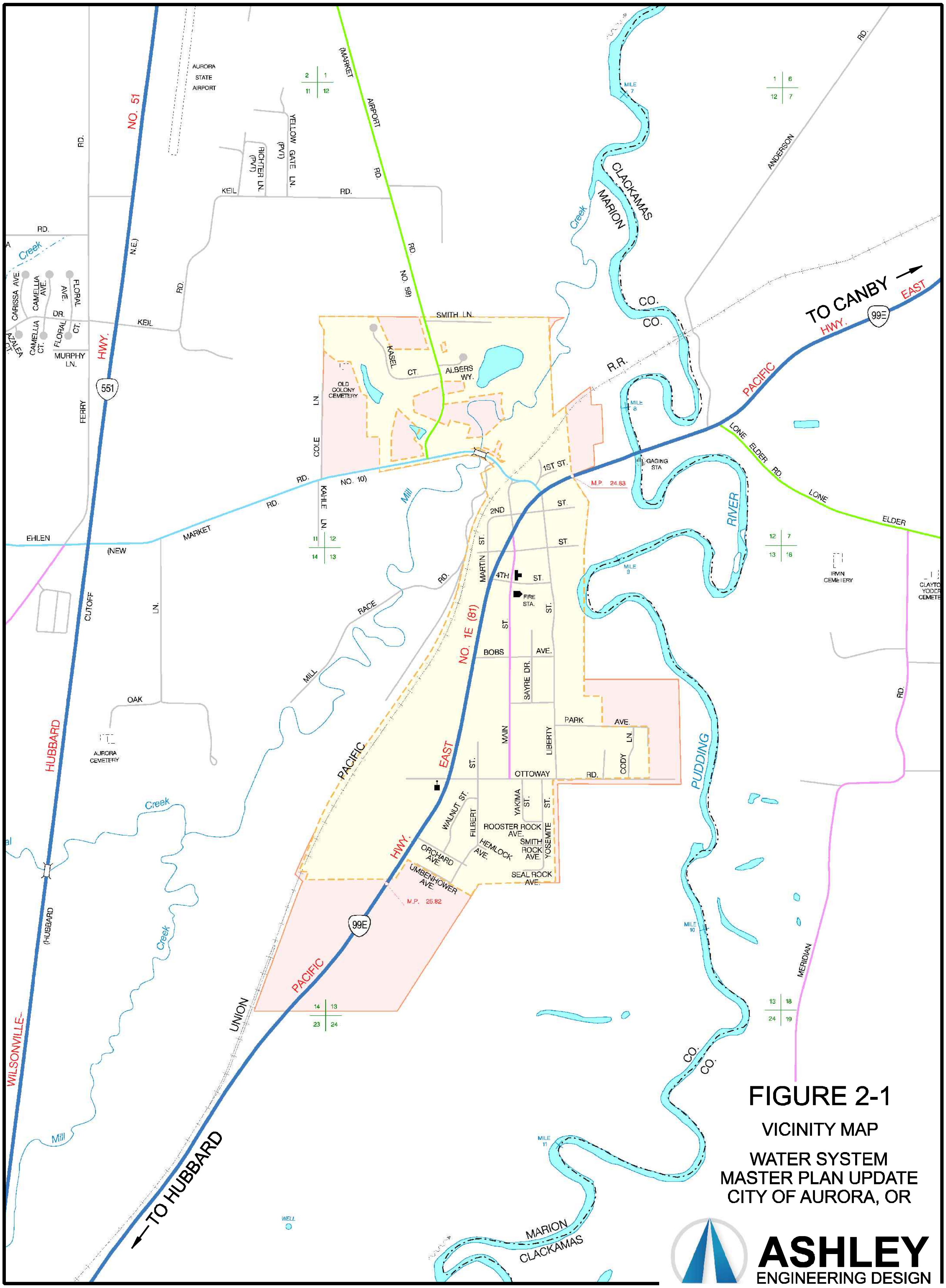

FIGURE 2-1

VICINITY MAP

WATER SYSTEM
MASTER PLAN UPDATE
CITY OF AURORA, OR

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FIGURE 2-2
LOCATION MAP
WATER SYSTEM MASTER PLAN UPDATE
CITY OF AURORA, OR

ASHLEY
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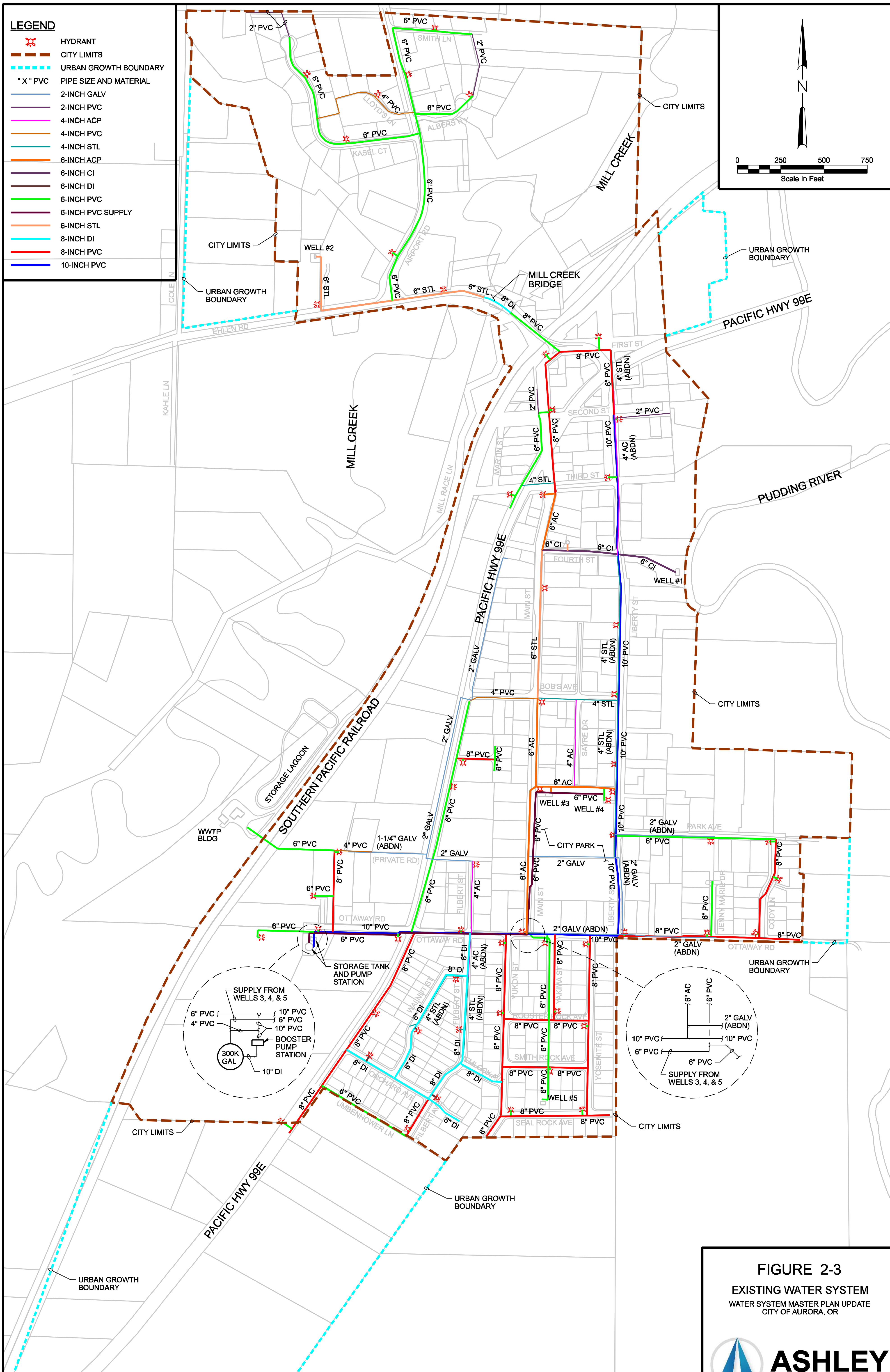

FIGURE 2-3

EXISTING WATER SYSTEM

WATER SYSTEM MASTER PLAN UPDATE
CITY OF AURORA, OR

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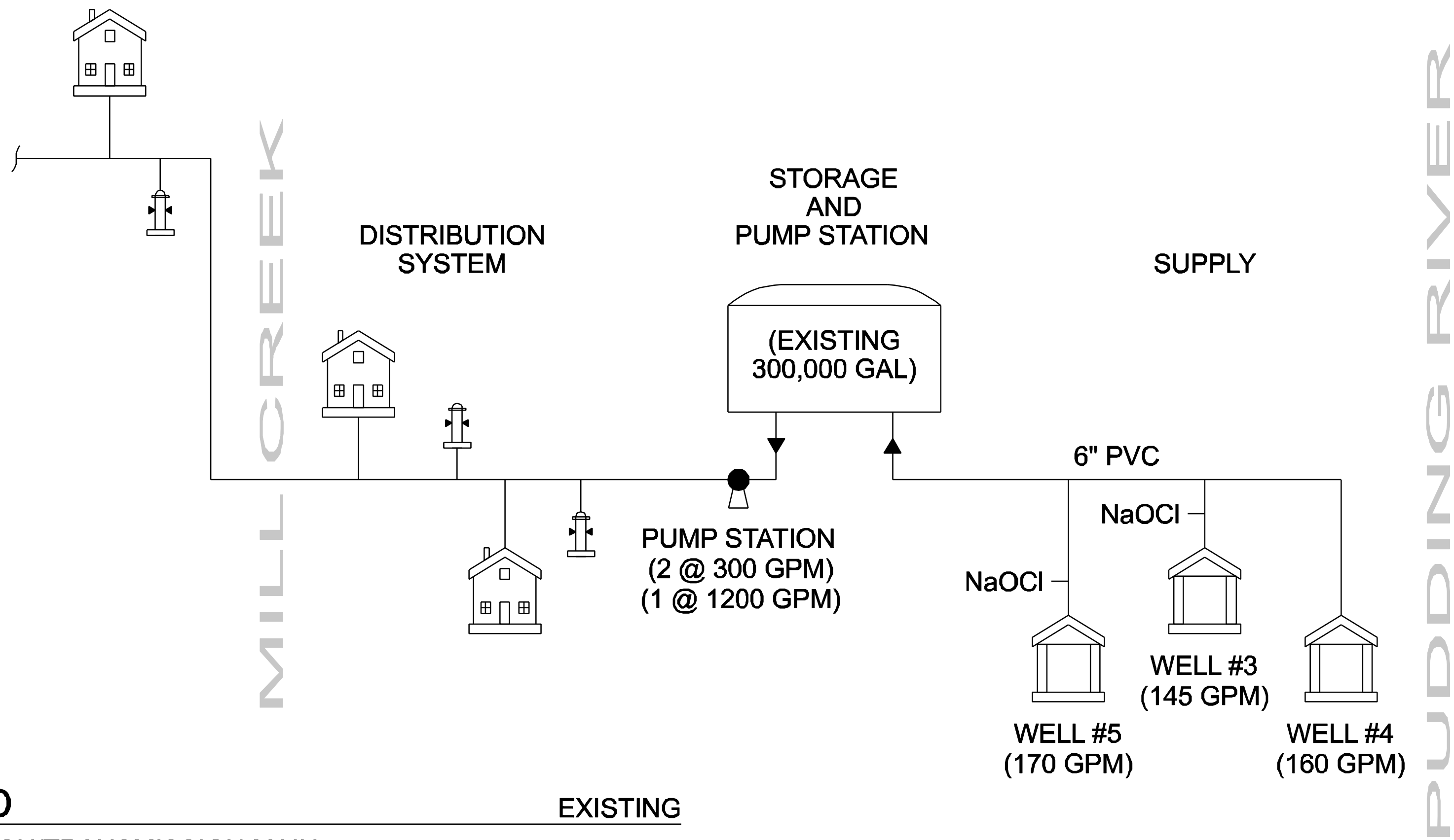
ABBREVIATIONS

GAL	GALLONS
GPM	GALLONS PER MINUTE
NaOCl	SODIUM HYPOCHLORITE DISINFECTION



LEGEND

EXISTING

- DISTRIBUTION/TRANSMISSION MAIN
- WELL SUPPLY (CAPACITY IN GPM)
- STORAGE TANK (CAPACITY)
- PUMP STATION (# AND CAPACITY OF EACH PUMP)
- WATER SERVICE USERS
- DISTRIBUTION SYSTEM FIRE HYDRANTS

FIGURE 2-4

EXISTING WATER SYSTEM SCHEMATIC

WATER SYSTEM MASTER PLAN UPDATE
CITY OF AURORA, OR

ASHLEY
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The direction and speed in which groundwater can move is controlled by the slope of the water table, which has high and low areas similar to the ground surface, and the permeability of the aquifer. In general, groundwater moves at a velocity of inches to a few feet per day. The pumping of a well can significantly influence the movement of groundwater by drawing down the water table in the vicinity.

Oregon's agricultural, municipal, and industrial economy is heavily dependent on the use of groundwater. In some areas, use of that resource is threatened by high rates of extraction and inadequate recharge, or by contamination of aquifers as a result of land use practices. Management of groundwater resources is more complex than management of surface water resources, because groundwater is not visible.

The Oregon Water Resources Department (OWRD) is the State agency charged with administration of the laws governing surface and groundwater resources. OWRD manages the State's water resources to protect existing water rights, facilitate voluntary stream flow restoration, increase the understanding of the demands on the State's water resources, provide accurate and accessible water resource data, and facilitate water supply solutions.

Aquifer and Geological Information

The following excerpt on aquifer and geological information in the Aurora area is from a detailed hydrogeological evaluation completed on behalf of the City of Aurora by Groundwater Solutions, Inc (GSI) in January, 2005, for development of the new City Well No. 5.

"The geology of the Aurora area consists of a relatively thick sequence (approximately 900 ft thick) of fine and course-grained sediment overlying basalt of the Columbia River Basalt Group. The sediment package consists of two units: an upper fine-grained unit, a relatively thin course-grained unit, and an underlying fine-grained unit. The upper stratigraphic unit consists of silt and clay with several sand interbeds. This unit, called the Willamette Silt, is approximately 100 ft thick locally. Underlying the Willamette Silt is a package of silt with interbeded sand and gravel layers. The coarse-grained portion of this unit is 20 to 50 feet thick and is referred to regionally as the Willamette Aquifer. This unit has been referred to in the past as the Troutdale Formation, which originated from the ancestral Missoula Floods that inundated this area between 12,000 to 22,000 years ago (O'Conner, et. al., 2001). Underlying the Willamette Aquifer is another fine grained unit called the Willamette Confining Unit, which is approximately 600 feet thick locally and consists of primarily silt and clay (O'Conner, et. al., 2001). Below the Willamette Confining Unit is the Columbia River Basalt Group.

Wells in the Aurora area primarily tap two water-bearing zones within the Willamette Silt and Willamette Aquifer. A number of smaller yielding domestic wells tap the upper unit within the upper 100 feet. Wells 3 and 4 are completed in the lower of the two water-bearing zones, from approximately 200 to 275 feet below ground surface. This deeper zone appears to extend across most of the area inside the Aurora Urban Growth Boundary (UGB) and ranges from around 35 feet thick in the north to approximately 75 feet thick at the southern end of town. This aquifer (coarse-grained portion of the Willamette Aquifer) will yield water to wells at rates similar to Wells 3 and 4 and appears to be utilized by at least 4 other wells inside or near the Aurora UGB. Wells that tap the entire thickness of this aquifer appear to yield up to 350 gpm."

Well Summary

The two main wells, Well No. 3 and Well No. 4, are located in the City Park adjacent to one another (park wells). Combined, they provide the main source of water for the system. Figure 2-3, Existing Water System shows the City's well locations. Much of the following groundwater well summaries are based on information presented in well reports and water rights information from the Oregon Water Resources Department (OWRD) and from the City's Source Water Assessment Report, completed by the Oregon Department of Human Services – Drinking Water Program (DHS) and the Oregon Department of Environmental Quality (DEQ) in December 2002.

A brief summary of each well is presented below. Water quality information on the wells is presented in Section 7. Water rights associated with each well is discussed under the Water Rights subsection below. Well logs and well pump information data sheets are provided in Appendix A.

Well No. 1

Well No. 1 (river well) is located 524.04 feet south and 154.44 feet east from the northwest corner of Section 13, Township 4 South, Range 1 West of the Willamette Meridian. Access to the well is provided by a gravel drive at the east end of 4th Street, towards the Pudding River. This well is Aurora's oldest well with logs indicating that the well was constructed for municipal use in 1920. The well was constructed with a 6-inch steel casing to a depth of approximately 190 feet. Aurora has not used this well as a regular municipal groundwater source since 1992. Since discontinuing its regular use, it was used only for emergencies due to its taste and odor issues, as well as from its close proximity to the Pudding River. Current drinking water regulations prohibit the use of this well and it was disconnected from the water distribution system in 2004.

Well No. 2

Well No. 2 (J.T. Miller well) is located 1270 feet north and 800 feet east from SW corner, Section 12, Township 4 South, Range 1 West of the Willamette Meridian. Access to the well is provided by an easement road north from Ehlen Road, just west of Airport Road. Well logs indicate that the well was originally constructed for irrigation use in 1952, with a 10-inch steel casing to a depth of 68 feet. In 1985, the City was permitted to use the well for municipal use until the right was cancelled in 1987. This well was no longer used by the City.

Well No. 3

Well No. 3 (1966 park well), shown in Figure 2–5 below, is located 795.27 feet north and 410.25 feet west from the center of Section 13, Township 4 South, Range 1 West of the Willamette Meridian. The well is located on the west side of the City Park, with access to the well from Main Street. This well is used year-round and is the main groundwater supply for Aurora.

Well logs indicate that the well was constructed for municipal use in 1966 by drilling a 20-inch hole to a depth of 35 feet and then continuing a 16-inch hole to a depth of 184 feet, then continuing a 12-inch hole to a depth of 244 feet. A 16-inch casing extends from the surface to 226 feet below ground surface (bgs) and a 12-inch casing was placed from 184 feet bgs to 244 feet bgs. The annular space between the casing and the 20-inch hole was filled with bentonite, an expanding clay, from the surface to 35 feet bgs. This casing seal is intended to provide protection from surface and near surface water from gaining access the well bore and migrating down to the aquifer. The well is perforated from 206 feet to 242 feet bgs. The 2002 State's assessment notes that it is at this interval that the bulk of water enters the well; however shallower water-bearing zones do occur in the 90 foot to 114 foot interval. Because the casing seal extends to only 35 feet bgs and not to this shallower water-bearing zone depth, these shallower zones are in communication with the main water-bearing zone.

Well No. 3 is equipped with a Lakos ILB-0250 strainer system, which operates within a normal flow range of 95 gpm to 155 gpm to remove sand and solid particles. The strainer uses centrifugal action to remove the particles, with the separated particles accumulating on the bottom. The strainer is located in the well house and must be purged manually on a regular basis to remove the separated solids from the temporary collection chamber.

Well No. 3 has power supplied with a three-phase 240 volt delta connection system with no backup power connection capabilities.

Figure 2 – 5 Well No. 3 (1966 Park Well)

Well No. 4

Well No. 4 (1981 park well), shown in Figure 2–6 below, is located 1900 feet south and 2570 feet east from the northwest corner of Section 13, Township 4 South, Range 1 West of the Willamette

Meridian. The well is located on the east side of the City Park approximately 300 feet from Well No. 3, with access to the well from Liberty Street. Well logs indicate that the well was constructed for municipal use in 1981 by drilling an 18-inch hole to a depth of 30 feet bgs, then continuing a 12-inch hole to a depth of 205 feet bgs, and then continuing a 10-inch hole to a depth of 266 feet bgs. A 12-inch casing extends from the surface to 205 feet bgs. It was assumed in the Source Water Assessment Report that the 30-foot deep annular space between the casing and the 18-inch hole was filled with Cement grout since the test well, originally drilled to 389 feet, was sealed with Cement grout. The well was supplied with a well screen.

The well was reconditioned in 1982 by installing a 10-inch casing to a depth of 200 feet bgs, and then continuing a 8-inch casing to a depth of 203 feet bgs. Similar to Well No. 3, the shallower zones are in communication with the main water-bearing zones at Well No. 4. This well is typically used year-round; however, as further discussed in Section 7, since the reduction of the arsenic MCL in 2006, City staff has had to vary its use in order to keep the blended levels of arsenic below the maximum contaminant level (MCL).

Well No. 4 has power supplied with a three-phase 240 volt wye connection system and unlike Wells No. 3 and No. 5 it does have outside backup power connection capabilities. The City currently is equipped with a 75 kilowatt portable generator to power Well No. 4 should a power outage occur; however, the generator is well past its useful life expectancy and the City is in need of a replacement.

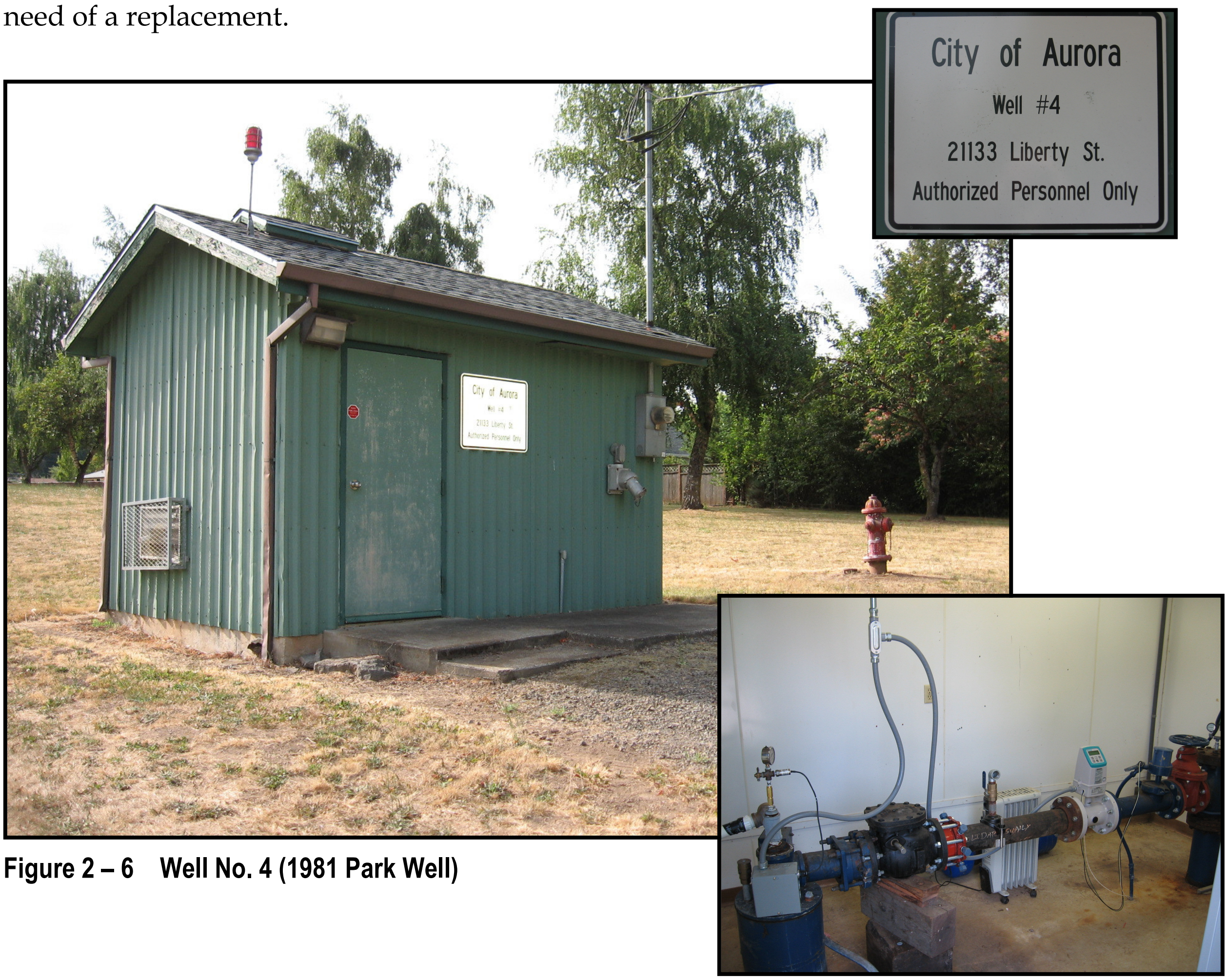

Figure 2 – 6 Well No. 4 (1981 Park Well)

Well No. 5

Well No. 5 (new well), shown in Figure 2–7, is located 1700 feet north and 2170 feet east from the southwest corner of Section 13, Township 4 South, Range 1 West of the Willamette Meridian. Access to the well is from Seal Rock Avenue. Well No. 5 is the newest well having been constructed in 2005, but is still in the preliminary stages and has not yet been put into production.

Design information and construction details indicate that the well was constructed for municipal use by drilling a 20-inch hole to a depth of 95 feet bgs, then continuing a 16-inch hole to a depth of 315 feet bgs, and then backfilled bentonite and gravel to a depth of 273 feet bgs. A 16-inch x 3/8-inch thick casing was extended to a depth of 165 feet bgs with a 10-inch stainless steel screen extended from a depth of 150 bgs to a depth of 273 feet bgs. A grout casing seal between the 20-inch bore hole and 16-inch casing was installed to a depth of 95 feet bgs.

Well No. 5 has power supplied with a three-phase 480 volt connection system with no backup power connection capabilities.



Figure 2 – 7 Well No. 5 (New Well)

Well Characteristics

In 2004, Well No. 3 and Well No. 4 had their pumps replaced with new submersible pumps. Both of these wells were equipped with identical 140 gpm pumps and motors. Together, they have a total combined pumping capacity of 280± gpm at their respective design total dynamic head. Current short term pump flow rates vary, but are approximately 145 gpm for Well No. 3 and 160 gpm for Well No. 4, which are controlled by manually operated valves at each well. During the summer months, the wells are worked approximately 12-14 hours per day and are rested about 10-12 hours per day. With a short term pumping capacity of 280 gpm and pumping over a 14 hour period results in approximately 235,000 gallons per day (gpd) of available water to the system.

A production well evaluation completed on behalf of the City of Aurora by Groundwater Solutions, Inc (GSI) in 2004 was performed for Wells No. 3 and 4. Production data from July 2004 through mid November 2004 and water level data from mid August 2004 though mid November 2004 was analyzed. The following production and static water level data was identified for Well No. 3:

- *Well No. 3 yield ranged from 140 gpm to 100 gpm in 2004. Short term (12-hour) yield when the well was drilled was 275 gpm with 100 feet of drawdown. The aquifer does not appear to be capable of supporting this rate for extended periods of time.*
- *Static water level in the summer of 2004 has declined approximately 30 feet since the well was drilled in November 1966.*
- *There is approximately 50 feet of available drawdown (water above the pump intake) during peak summer pumping.*
- *Well performance drops off significantly when the well is operated for long periods during the summer (specific capacity drops from 3.5 gpm to 2.5 gpm per foot of drawdown.*
- *The pump intake is at the top of the perforations and so it is not advisable to lower the pump.*
- *A sustainable pumping volume seems to be 100,000 gallons per day.*

The following production and static water level data was identified for Well No. 4:

- *Well No. 4 yield ranged from 225 gpm to 75 gpm in 2004. Rate declined substantially with longer pumping period. The reported short term yield when the well was tested in 1992 was greater than 275 gpm. The aquifer does not appear to be capable of supporting this rate for extended periods of time.*
- *Static water level in the summer of 2004 has declined approximately 35 feet since the well was drilled in October 1981.*
- *There is no available drawdown (water above the pump intake) during peak summer pumping. The water level appears to be at the intake.*
- *Well performance drops off significantly when the well is operated for long periods during the summer (specific capacity drops from 5gpm to 1gpm per foot of drawdown. The pump intake is at the top of a constriction at the top of the screen and so it is not possible to lower the pump.*
- *Pumping the well for longer periods causes significant drawdown. A sustainable pumping volume seems to be 50,000 gallons per day.*
- *The well was repaired in August 1982 to correct a seal problem between the casing and the screen. A liner was installed on top of the screen that included a smaller diameter casing that fit*

inside the top of the screen to align the liner (causing a constriction to 8-inches). This prevents deepening the pump or rehabilitating the screen.

For Well No. 5, preliminary constant-rate pumping tests performed shortly after construction in 2005 indicated that a short-term production rate of 200 gpm and a long-term production rate of 170 gpm can be anticipated.

Each well is equipped with a MAGFLO MAG 5000 electromagnetic flow meter for tracking source production. Existing well data and pump information are shown in Table 2-1. The location of each well is shown in Figure 2-3 – Existing Water System. Well logs and well pump information data sheets are provided in Appendix A.

All three current City wells are connected to a common 6-inch C-900 PVC supply main separate from the distribution system. The well water is disinfected through the addition of sodium hypochlorite at Well No. 3 as it is being pumped directly to the storage tank. With a distance of approximately 2,250 feet between Well No. 3 and the storage tank, this allows for adequate chlorine detention time before being delivered to the customers. Well No. 5 is equipped with its own sodium hypochlorite system located at the well. The well is connected to the 6-inch PVC supply main between the park wells and storage tank. With a total distance of approximately 2,350 feet between Well No. 5 and the storage tank, this allows for adequate chlorine detention time before being delivered to the customers.

Table 2 – 1
Well Characteristics

Well No.	Year Well Constructed	Pump Design Flowrate (gpm)	Current Pump Flowrate (gpm)	Pump Design Total Dynamic Head (ft)	Approx. Pump Set Depth (ft)	Discharge Pipe Diameter (in)	Motor
1	1920	Decommissioned					
2	1952	Decommissioned					
3	1966	140	145	382	205	3	20 hp 3450 rpm
4	1981	140	160	382	197	4	20 hp 3450 rpm
5	2005	Well No. 5 pump information is not currently available.					

Groundwater Fluctuations and Water Level Trends

Groundwater levels in the aquifer naturally fluctuate in response to seasonal variations in precipitation and long-term variations in climate. In managing the groundwater resource, it is important that water level trends be evaluated to identify whether groundwater levels are remaining stable or declining. Declining groundwater levels may indicate that groundwater removed from the aquifer (discharge) exceeds water entering the aquifer (recharge), which could affect the long-term sustainability of the groundwater supply.

Based on the summer 2004 production evaluation by GSI, the measured static water levels from Well No. 3 during the aquifer showed a decline of approximately 30 feet since the well was drilled in November 1966. For Well No. 4, the aquifer had showed a decline of approximately 35 feet since the well was drilled in October 1981. Based on these summer values, the aquifer is showing a long-term decline of approximately 9 to 18 inches per year.

More recent static water levels obtained by City staff in March 2008 are summarized in Table 2-2. A linear trend of these static water levels for each well indicates that the aquifer is showing a long-term decline of approximately 3 to 4 inches per year over the winter months.

Table 2 – 2
Aquifer Static Water Level Trend

Well No.	Static Water Level at Well Construction		Recent Static Water Levels		Overall Static Water Level Trend	
	Depth to Water Level (feet bgs)	Date	Depth to Water Level (feet bgs)	Date	Declined (ft/yr)	Declined (in/yr)
3	67	Nov. 1966	78	Mar. 2008	0.27	3.2
4	70.5	Oct. 1981	80	Mar. 2008	0.36	4.3

Notes: bgs = below ground surface.

As can be seen, the different months of water level data collected, the possible different methods and techniques used in collecting the data, the various drawdown impacts from neighboring wells, and other interfering factors may not necessarily result in comparable water level data. Having adequate water level data on a continuous basis is important for accurately tracking the aquifer. Otherwise, it is difficult to make any reasonable conclusion regarding its long-term sustainability.

In any case, it is apparent that the summer demands and long pumping of the wells within the area is becoming strenuous on the aquifer. The available drawdown of the wells is a very critical element that should be monitored on a continuous basis, especially for Well No. 4, as it was previously noted that there was no available drawdown (water above the pump intake) during the peak summer pumping in 2004.

It is strongly recommended that the City establish a groundwater monitoring program and continue to monitor the wells static and pumping levels on a continuous basis. The more recent addition of the SCADA system will greatly assist the City in performing the monitoring. It should be noted that there are several factors that must be observed in order to maximize the accuracy of the water level data obtained. These include, but are not limited to, the following factors:

- Ensure that the well being monitored for water level has not been in use for at least 24 hours prior to measuring.
- If possible, ensure that the water level measurement is recorded to the tenth of a foot.
- Account for any factors that may lead to measurement error, such as the measuring point above or below ground surface, etc.
- If possible, identify and note the status of nearby pumping wells and approximate distances.

Groundwater Quality

Overall groundwater quality of each well, including current drinking water regulations is further discussed in Section 7. In addition, a Source Water Assessment Report for the City was completed in December 2002 by the Oregon Department of Human Services Drinking Water Program and Oregon Department of Environmental Quality Water Quality Division. This report provides information on the wells and aquifer conditions that are used to reach conclusions about the susceptibility of the drinking water source to contamination.

The findings indicate that the aquifer is considered highly sensitive based on the observation that the park wells casing seals do not adequately seal out shallower groundwater. Moderately sensitive criteria met include the presence of Nitrate in Well No. 3 at levels above what can reasonably be assigned to natural sources, the potential for commingling of aquifers in both wells, the age of Well No. 3, a moderate infiltration potential score for both wells, and the highly permeable soils that occur over part of the Drinking Water Protection Area for Well No. 1. Approximately 25 wells occur in the section containing the system’s wells and at the time of the assessment, did not pose a significant risk to the system.

Water Rights Summary

Oregon Water Law

Under Oregon law, all water is publicly owned. The use of public water requires a water right or permit from the Oregon Water Resources Department (OWRD), with some exceptions. In general, landowners with water flowing past, through, or under their property do not automatically have the right to use that water without a permit from the OWRD. The administration of water rights by OWRD is based on the principle of prior appropriation. Under this principle, the first person to have obtained a water right or permit (senior appropriator) is the last to be limited in times of shortage. The date of application for the water right permit usually establishes the "priority date".

In times of water shortage, the senior appropriator can demand the full amount of their water specified in their water right, regardless of the needs of junior appropriators. If there is surplus beyond the needs of the senior appropriator, the next most senior appropriator can take as much as needed to satisfy their right and so on down the line until there is no surplus or until all rights are satisfied.

In addition to monitoring water uses to protect senior water rights, OWRD seeks to conjunctively manage the state's surface water and groundwater users. In many areas, groundwater and surface water interact. The use of one source may impact the use of another. Where a junior groundwater appropriator may impact a senior surface water appropriator, OWRD may have authority to regulate the junior groundwater appropriator.

Water rights are obtained from OWRD in a three-step process. The right to use water is first granted in the form of a water use permit. The water use permit generally describes the priority date, the amount of water that can be used, the location and type of water use, and often a number of water use conditions. Obtaining a water use permit allows the permit holder to then proceed to the second step of developing the infrastructure needed to put the water to full beneficial use.

Once the infrastructure is in place and being used, the third step is "proving up" the water use. The permit holder must then submit proof of water use by hiring a Certified Water Rights Examiner (CWRE) to complete a survey of water use and submit to OWRD a map and report detailing how and where water is being applied. When this report of beneficial use, called a Claim of Beneficial Use (COBU), is approved by OWRD, a water right certificate is issued confirming the status of the right. Obtaining a water right certificate is the best way to ensure the protection of the use.

Typically, a water right certificate will continue to be valid as long as the water is used according to the provisions of the water right and at least once every five years. Except for municipal rights, if a water right is not used for five or more consecutive years, that portion of the right is presumed to have been forfeited and is subject to cancellation. Municipal rights have certain privileges regarding forfeiture of water rights due to non use, as long as it can be shown that the water had been used at one point in time and that not having access to the water right would impair the City's ability to serve its residents.

A timeline for making full beneficial use of the water is typically associated with the water right permit. Permits generally require the water user to develop the water use within four or five years. A COBU is required to be submitted by a CWRE within one year after the deadline for completion and full beneficial use of the water. If more time is needed than provided in the permit, the permit holder may request an extension from OWRD. Each request of extension is considered on a case-by-case basis. If there is good cause for not completing the water use in a timely manner and the permit holder has shown diligence in trying to meet the requirements of the permit, an extension may be granted.

The use of water under a water right is restricted to the terms and conditions described in the water right certificate: place of use, point of diversion, and type of use. For example, if a water right holder establishes the right to irrigate a particular 20-acre tract of land, the water cannot be diverted from a different point or source, nor can it be used to irrigate other land. It cannot be used for any other purpose than the type of use indicated in the water right. The water right holder must file a transfer application with OWRD to change a point of diversion, point of appropriation, type of use, place of use, or any combination of these.

There are two different processes that allow modification of a water right or permit. When a water right is in the permit phase, through an application for a permit amendment, the permit holder may modify the water use by changing the location of use and the point where water is appropriated. Under a water right certificate, through an application for a water right transfer, the water right holder can modify the point where water is diverted, point of appropriation, place of use, and the type of use made under the water right.

The City's existing municipal use groundwater registrations, permits, and water right certificates vary in priority date from December 1920 to May 1982. The City's oldest well, Well No. 1, was constructed in 1920. Because of the age of this well, Well No. 1 does not have a water right certificate, rather a groundwater registration. Ground water registrations are claims for rights to use ground water established prior to 1955 and for which the OWRD has issued certificates of registration.

The OWRD may recognize a change in use, place of use, or point of appropriation for a ground water registration if the OWRD determines that the change will not injure other water rights. Recognition of a modification in a ground water registration does not confirm the right, which can only be confirmed in a future adjudication proceeding. Pending that determination, the holder of a registration may use ground water as described in the certificate of registration, or as modified by OWRD's recognition of changes.

Existing Water Rights

The City uses groundwater for all of its municipal water supply needs and holds water rights that authorize the use of these water supply sources. The following existing water rights information is based on City records, available water rights information from OWRD, and from a water rights meeting held in December 2007, between the City of Aurora and OWRD.

According to the OWRD online database and City records, the City has rights for three groundwater wells totaling approximately 774 gallons per minute (gpm) or 1.73 cubic feet per second (cfs), as shown below.

- Registration GR-659 - Well No. 1 for 200 gpm.
- Certificate 36316 - Well No. 3 for 224 gpm.
- Permit G-9890 - Well No. 4 for 350 gpm (Certificate 81591 – Well No. 4, Permit G-9890 was partially perfected for only 251 gpm).

Table 2-3 below provides a summary and status of the City's current groundwater registrations and water rights. Copies of the well groundwater registrations and previous water right certificates and their final transfer orders are included in Appendix B.

<table>
<tr><th colspan="9">Table 2 – 3
Water Rights Summary</th></tr>
<tr><th rowspan="2">Well No.</th><th rowspan="2">Beneficial Use</th><th colspan="3">Water Right</th><th rowspan="2">Priority Date</th><th colspan="3">Quantity Authorized</th></tr>
<tr><th>Application</th><th>Permit</th><th>Certificate</th><th>cfs</th><th>gpm</th><th>mgd</th></tr>
<tr><td>1</td><td>Municipal</td><td>GR-659</td><td>GR-634</td><td>-</td><td>Dec 31, 1920</td><td>0.45</td><td>200</td><td>0.29</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Municipal</td><td>G-11334</td><td>G-10458</td><td>-</td><td rowspan="2">Jan 4, 1985</td><td rowspan="2">~~0.11~~</td><td rowspan="2">~~50~~</td><td rowspan="2">~~0.07~~</td></tr>
<tr><td colspan="3">Water right appears to have been CANCELLED on April 2, 1987, further research by a CWRE is recommended.</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Municipal</td><td>G-3732</td><td>G-3526</td><td>36316</td><td rowspan="2">Nov 25, 1966</td><td rowspan="2">0.50</td><td rowspan="2">224</td><td rowspan="2">0.32</td></tr>
<tr><td>T-9927</td><td colspan="2">Certificate was CANCELLED upon approval of T-9927, adding Well No. 5.

DEADLINES - Permit to be developed by Oct 1, 2010 & COBU by Oct 1, 2011</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Municipal</td><td>G-10722</td><td>G-9890</td><td>81591</td><td rowspan="3">May 19, 1982</td><td>0.56</td><td>251</td><td>0.36</td></tr>
<tr><td rowspan="2">T-9944</td><td colspan="2" rowspan="2">Certificate was CANCELLED upon approval of T-9944, adding Well No. 5.

DEADLINES - Permit to be developed by Oct 1, 2010 & COBU by Oct 1, 2011</td><td colspan="3">Permit was only partially perfected at the above quantity. The remaining quantity below has not yet been perfected and therefore not approved to be used.</td></tr>
<tr><td>0.22</td><td>99</td><td>0.14</td></tr>
<tr><td>5</td><td>Municipal</td><td colspan="3">New certificate will be issued upon approval. DEADLINES - Permit to be developed by Oct 1, 2010 & Claim of Beneficial Use (COBU) submitted by Oct 1, 2011.</td><td></td><td colspan="3">Quantity will be shared between Wells No. 3, 4, & 5. (~475 gpm)</td></tr>
<tr><td colspan="6">Total City Water Rights authorized to be used</td><td colspan="3">675 gpm</td></tr>
<tr><td colspan="6">Total Water Rights that may be available to the City</td><td colspan="3">774 gpm</td></tr>
</table>

(1)Groundwater Registration

It appears under currently held municipal use groundwater permits and certificates, that the City is only authorized to appropriate 1.51 cfs or 675 gpm. Apparently, Well No. 4 was only partially perfected. Further review of Well No. 4's permit and its corresponding August 18, 2005 final order (vol. 66, pg. 114), shows that Permit G-9890 allows for the use of 0.78 cubic foot per second (cfs) of groundwater from a well in the Willamette Basin for municipal use. An excerpt discussing the partial perfection of water right from this well's final order is shown below: