City of Roseburg, Oregon
July 2010

# WATER SYSTEM MASTER PLAN

Murray, Smith & Associates, Inc.
Engineers/Planners

In association with:
Cascade Corrosion Consulting Services, Inc.
Integrated Consulting Services, Inc.

# WATER SYSTEM MASTER PLAN
# PROJECT NO. 08WA14

# FOR

# CITY OF ROSEBURG, OREGON

**July 2010**

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## EXECUTIVE SUMMARY

### Introduction

The City of Roseburg (City) provides potable water to approximately 29,000 people in the City's current water service area including land within the Urban Growth Boundary (UGB) and areas outside the UGB including the Charter Oaks Area and the Dixonville area. The City withdraws and treats water from the North Umpqua River at Winchester just downstream of the Winchester Dam. The raw water supply for the Winchester Water Treatment Plant (WTP) is withdrawn from the river by an intake on the south bank of the river. The planning period for this master plan is 20 years. Water demands are developed for this planning period and to the year 2058 in 10-year increments.

### Purpose

The purpose of this study is to perform a comprehensive analysis of the City's water system, to identify system deficiencies, to determine future water distribution system supply requirements, to establish uniform design criteria for system facilities and to recommend water system facility improvements that correct existing deficiencies and that provide for future system expansion. The planning and analysis efforts include consideration of the ultimate integration of recommended distribution system improvements with the City's long-term water source and supply decisions. This plan replaces the City's 1993 Water System Master Plan.

### Study Area

The study area for this plan includes the City's current water service area and lands inside the City's current UGB as well as the Dixonville Water Association's (DWA) service area. In 2007, the City acquired ownership of DWA facilities. The City also currently provides water service to certain limited areas outside the UGB. The study area is illustrated on the Existing System Map included as Plate 1 in Appendix A. Plate 1 illustrates the City's water system service area limits, water system facilities and distribution system piping. Plate 1 is also a digital representation of the computerized distribution system hydraulic model used for water system analyses.

### Water Supply, Treatment and Transmission

The City is currently supplied water from the Winchester WTP located approximately five miles north of the City. The City's three primary rights on the North Umpqua River total 31.0 cubic feet per second (cfs) or approximately 20.0 million gallons per day (mgd). The treatment plant occupies a site on the south bank of the North Umpqua River directly downstream of the Winchester Dam. The original pressure filter water treatment plant was constructed in 1935, was replaced under a phased plant replacement program completed in 1992 and is planned to be expanded in the near future.

## Pressure Zones

The existing water distribution system has 22 separate pressure zones. The largest of these zones, the Main Pressure Zone, contains approximately 10,800 services. Each remaining pressure zone contains less than 350 services. These zones are all located in the upper elevation periphery of the distribution system, and all but one are located above the maximum service elevation of the Main Pressure Zone, at approximately 610 feet above mean sea level (msl).

## Storage Reservoirs

The City has 13 storage facilities currently in service located throughout the service area. The total capacity of these storage facilities is approximately 10.7 million gallons (MG). The Main Pressure Zone contains six of the system's 13 storage facilities. The storage reservoirs within this pressure zone are: Reservoir Nos. 5, 6 and 7, Fairhill Drive, Kline Street and Boyer. A brief description of each storage reservoir is provided in Section 2 with additional information about the City's reservoirs is presented in tabular form in Table B-1 in Appendix B.

## Pumping Stations

The City's water system includes 15 pump stations located throughout the distribution network. A brief description of each station is provided in Section 2. There are also six additional pump stations located in the former DWA service area which are not described in this Plan. Included in the pump station evaluations is a detailed description of various pump station types within the water service area.

## Piping Systems

The water distribution system is composed of various pipe materials in sizes up to 30 inches in diameter. The majority of distribution system mains are 6-inch and 8-inch diameter. The pipe materials include asbestos cement, cast iron, ductile iron, copper, steel, polyvinyl chloride, polyethylene and galvanized iron. Over half of the system piping is cast iron and asbestos cement. Existing cast iron pipe was primarily installed in the 1950s and 1960s, asbestos cement was installed in the 1960s and 1970s, ductile iron and polyvinyl chloride (PVC) piping was installed in the 1980s and 1990s and steel was installed from the 1930s through the 1960s. The City is actively replacing older galvanized and cast iron piping.

## Telemetry and Supervisory Control System

The City's telemetry and supervisory control system consists of a central control panel located in the control room of the Winchester WTP and remote telemetry units (RTUs) at 15 locations in the distribution system. Communication between these units and the central control panel is by leased telephone lines. The RTUs are located at major reservoirs, pump stations and solenoid valves. The system presently monitors the water levels at nine reservoirs, controls the operation of four pump stations which pump to reservoirs, monitors the discharge pressure at five continuous operation or hydropneumatic pump stations and controls the operation of two control valves in the distribution system.

### Water Demand Forecast

Forecasts of future water demands are determined based on population forecasts and the present per capita water use characteristics. Included within these per capita rates are all water uses including residential, commercial, municipal, industrial, institutional and unaccounted-for water. Water demand are presented as average daily water demand (ADD) which is used to forecast water quantities on an annual basis and is used to estimate annual revenue or average annual power costs. Maximum daily demand (MDD) is used to size the capacities of supply source, treatment plant, transmission system, pumping and finished water storage facilities. Peak hour demand (PHD) is used to size portions of the water system, including pumping and distribution facilities. MDD and PHD are often expressed as a factor multiplied by ADD. Forecasts of water demands within the 50-year planning period are summarized Table ES -1.

**Table ES-1**
**Water Demand Forecast**

| Year | Population Forecast | Water Demand (mgd) | | |
|---|---|---|---|---|
| | | Average Daily | Maximum Daily | Peak Hour |
| 2013 | 34,290 | 6.4 | 12.8 | 19.2 |
| 2018 | 37,860 | 7.1 | 14.2 | 21.3 |
| 2023 | 41,800 | 7.9 | 15.8 | 23.7 |
| 2028 | 46,150 | 8.7 | 17.4 | 26.0 |
| 2033 | 50,950 | 9.6 | 19.2 | 28.7 |
| 2038 | 56,250 | 10.6 | 21.2 | 31.7 |
| 2043 | 62,100 | 11.7 | 23.3 | 35.0 |
| 2048 | 68,580 | 12.9 | 25.8 | 38.7 |
| 2053 | 75,710 | 14.2 | 28.4 | 42.7 |
| 2058 | 83,600 | 15.7 | 31.4 | 47.2 |

### Water System Analysis Criteria Summary

The criteria developed in this plan are used to assess the system's ability to provide adequate water service under existing conditions and to guide improvements needed to provide service for future water needs. Planning criteria for the City's pump stations, distribution system, pressure zones and storage facilities are summarized as follows:

- ***Distribution System Criteria:*** The distribution system should be capable of supplying the peak hourly demand while maintaining minimum service pressures of not less than approximately 75 percent of normal system pressures.

- ***System Pressure Criteria:*** Minimum dynamic pressures, at the fixture, within each pressure zone should be at least 30 pounds per square inch (psi), with a recommended upper limit of approximately 100 psi.

- ***Storage Volume Criteria:*** Recommended storage volume for the City is the sum of the operational, fire and emergency storage components.

- ***Pump Station Capacity:*** When pumping to storage facilities, a firm capacity equal to the pressure zone's maximum day demand is recommended. Pump stations supplying constant pressure service without the benefit of storage should have sufficient firm capacity to meet maximum day demands while simultaneously supplying the largest fire flow demand in the pressure zone.

- ***Fire Flow Criteria:*** The distribution system should be capable of supplying the recommended fire flows while maintaining minimum pressures of 20 psi throughout.

**Distribution System Analysis and Findings**

A hydraulic network analysis computer program was used to evaluate the performance of the existing distribution system and to aid in the development of proposed system improvements. The computerized model of the City's water system uses a geographical information systems (GIS) base map of the distribution system and InfoWater hydraulic network analysis software. For modeling purposes, the water distribution system was digitized onto a base map derived from GIS data provided by the City. This file and its supporting database were then used to perform the system analysis and to illustrate recommended improvements. A map of the proposed system improvements discussed in this section is presented as Plate 2 in Appendix A. The hydraulic model should be kept current and maintained to assist in designs of future water system replacements, upgrades and extensions.

The calibrated distribution system model is used to evaluate the system's ability to supply various demands while meeting the system performance criteria. The analysis found that under existing conditions the system generally performed adequately under all four of the demand conditions except under MDD and fire flow conditions. Under both MDD and PHD conditions, a small number of services over elevation 610 feet experience pressures below 30 psi. The system was also analyzed under future conditions and improvements developed and evaluated to serve new areas within the UGB and expansion areas where increased demands associated with infill development resulted in system deficiencies and to correct the deficiencies found through the analysis of the existing system presented above. Improvements were not identified for developable areas outside the UGB and potential expansion areas.

**Transmission System Analysis**

The results of the hydraulic network analysis indicate that the capacity of the major transmission system piping in the system is generally adequate for current conditions. Under future demand conditions, the hydraulic capacity of transmission piping between the Water Treatment Plant and the Main Reservoir complex will experience velocities in excess of five feet per second (fps), which is the maximum recommended velocity in a transmission main under normal operation and demand conditions. In addition, the hydraulic capacity of other transmission piping in the Main pressure zone is inadequate to maintain balanced reservoir cycling throughout the Main pressure zone under maximum day demand conditions with the future construction of Starmer Reservoir and development in the Charter Oaks area.

**Corrosion Protection Systems Analysis**

The City currently protects the existing steel pipeline portions of its transmission system with corrosion protection systems (CP). The City's water system includes two major steel transmission mains referred to as Transmission Main Nos. 1 and 2. Transmission No. 1 includes 20- and 24-inch diameter steel piping extending from the Winchester WTP south to the Main Zone reservoir complex on NE Bellview Court installed in the late 1930s and early 1960s. Transmission Main No. 2 is a 30-inch diameter steel pipe installed in 1981. This main runs from Hooker Road and the northerly end of the Airport. The system's existing corrosion protection systems were also evaluated. Based on the age, condition and hydraulic limitations of the 20-inch diameter Transmission Main No. 1 it is recommended that the City begin a phased replacement of this transmission main with new 24-inch diameter transmission piping. Upgrade and installation of a new Impressed Current Cathodic Protection system on the southerly segments of this transmission main that are not scheduled for replacement in the next one to five years should be completed to preserve the remaining life of segments of the transmission main to remain in service. A preliminary engineering study is recommended to establish a detailed program for replacement of the CP system and analysis of the most appropriate CP system on both steel transmission mains.

**Pressure Zone Analysis**

An analysis and evaluation of the system's pressure zone was completed as part of the comprehensive system analysis. Recommendations were developed to correct existing deficiencies and to provide for system expansion. These recommendations are integrated into storage, pumping, transmission and distribution system improvements. As part of this analysis recommendations are made for new, proposed zones and modifications to existing zones.

**Storage Capacity Analysis**

The total volume of storage required for the City's distribution system includes the combined components of equalization storage, emergency storage and storage for fire suppression. The existing distribution system was analyzed using these storage criteria under existing and future conditions. The analysis found that under existing conditions a number of existing pressures zones have inadequate storage capacities while the system's overall storage capacity is adequate. Recommendations to correct existing deficiencies were developed and these improvements are included in this plans recommended capital improvement plan.

Storage capacity needs were also evaluated for the 20-year planning horizon to determine water storage needs by pressure zone in order to meet future water demands. The storage capacity analysis under future conditions was completed in coordination with the previously presented pressure zone analysis which combined, expanded and added pressure zones to provide for ultimate service to the City's future water service area. As previously presented a number of smaller existing pressure zones are proposed to be combined into larger consolidated pressure zones. The analysis determined the storage capacity needs for these zones as well as existing pressure zones. It is recommended that seven storage reservoirs, with a total volume of approximately 4.35 MG be constructed in the 20-year planning horizon to meet forecasted storage deficits and provide service to additional high elevation areas within the City. The timing of these reservoir improvements will depend on actual population growth rates and development patterns within the City's water service area. A visual assessment of the coating systems for the City's existing water storage reservoirs was completed and the findings of the assessment documented in Section 2. Recommendations to correct observed deficiencies is included in the capital improvement plan included in Section 7.

**Pump Station Capacity Analysis**

The City's water system consists of 22 existing pressure zones. Pumping facilities supply 19 of these pressure zones either with or without the benefit of gravity storage. The recommended system improvements discussed previously in this section include modifications to pressure zone boundaries and the creation of new pressure zones. Recommended construction of new pumping facilities and abandonment or upgrade of existing pumping facilities associated with restructuring of pressure zones or supply to new gravity storage facilities were outlined in the distribution system analysis. Based on demand projections in 2058, it is anticipated that some pump stations will need additional capacity beyond the 20-year planning horizon. The capital improvement plan presented in Section 7 includes recommended pump station improvements to correct existing deficiencies and to provide for system expansion. It is also recommended that these pump station buildings, manifolds and piping be sized to allow future expansion with additional pumps. A summary of 2058 forecasted pump station capacity requirements is included as Table 2 in Appendix F.

**Pressure Reducing Valve Analysis**

The City's water distribution system contains a number of pressure reducing valve stations which reduce service pressures to acceptable levels for pressure zones that are at elevations below the level serviceable by adjacent gravity storage facilities. Recommended guidelines and configuration standards are developed and presented as part of the comprehensive capital improvement plan.

**Telemetry and Controls**

The City's water system telemetry, or Supervisory Control and Data Acquisition (SCADA) system consists of a central control panel at the Winchester Water Treatment Plant and remote telemetry units (RTUs) at pump station and reservoir facilities throughout the distribution system. The age of the RTUs varies with the age of the facility, ranging from early 1990s to less than five years old. The oldest elements of the system are approaching 20 years old. Typically, SCADA system hardware can be expected to have a life of between 10 and 15 years. Due to the rapidly evolving electronic technology associated with these systems, hardware and software, equipment and systems beyond this age typically become difficult to support, troubleshoot and maintain. It is recommended that the City plan for the renewal and upgrade of the SCADA system on a 10 to 15 year cycle. Recommendations for capital improvement program budgeting are presented in Section 6.

**Unaccounted-for Water Analysis**

An evaluation of unaccounted-for water was completed and found that from 2005 through 2009, the City's unaccounted-for water is estimated to be approximately 16.7 percent and has shown a generally declining trend over this time period as the City has taken action to reduce levels of unaccounted-for water. Unaccounted-for water is the difference between water production and water consumption. Generally, a distribution system is considered to be in good condition when unaccounted-for water is 10 percent or less. Recommendations related to the reduction of unaccounted-for water are included as part of the capital improvement plan.

**Recommended Water System Improvements**

Detailed recommendations for water distribution system, pump stations, storage reservoirs, pressure reducing facilities and distribution system piping improvements are presented in Section 6. Project cost estimates are presented for all recommended improvements. The recommendations are presented by project type and prioritized as short, medium and long-term recommendations. Short-term recommendations are those suggested to be completed in the next one (1) to five (5) years, medium-term in the next six (6) to 10 years and long-term in the next 11 to 20 years. The timing of some of the recommended improvements is entirely dependent on continued development within the UGB and outside of the current water system service area, and should be coordinated with land development. These improvements, defined as growth driven, are recommended for completion beyond the long-term time period and are anticipated to be developer scheduled and funded. The estimated costs included in this plan are planning-level budget estimates presented in 2010 dollars. Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News Record (ENR) Construction Cost Index (CCI) is a commonly used index for this purpose. For purposes of future cost estimate updating the recent ENR CCI for Seattle, Washington is 8647 (March 2010).

**Additional Recommendations**

It is recommended that additional engineering studies be conducted to advance the planning work completed in this Master Plan to the preliminary engineering level. Periodic updating of the cost-of-service (water rate) and System Development Charge (SDC) analysis should be budgeted and conducted. Updates to the Water Management and Conservation Plan, as well as this Master Plan, will also be required within the 20-year planning horizon. A budget level cost of $100,000 every 10 years should be anticipated for Master Plan updates.

### *Water Management and Conservation Plan*

The Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 690, Division 86 requires water systems with water rights to submit a Water Management and Conservation Plan (WMCP) that documents current water conservation measures, provides a water curtailment plan, evaluates long-term water supply planning and provides a water rights implementation schedule. It is recommended that the City complete a WMCP in the next ten years to comply with Oregon Water Resources Department (OWRD) requirements (see OAR 690-086-0125). The estimated project cost for this plan is approximately $50,000 with updates every 10 years.

### *Water Rates and SDC Analysis*

Charges and rates for utility services are typically structured to direct the costs of providing service to those benefitting by the service. Developers building subdivisions and commercial complexes are required to construct the initial capital improvements required for water supply and service. Costs for maintenance and operation of the facilities are paid for by the City from ongoing monthly charges for service, as well as allowances for replacement of depreciated facilities. Where a major facility is constructed to supply a large number of non-associated developers, the initial cost is often fronted by the utility and collected as a reimbursement in the form of a SDC. It is recommended that the City complete a detailed water rate and SDC analysis with the completion of this Master Plan to determine specific funding needs and potential funding sources associated with the adopted Capital Improvement Program. It is recommended that these studies also provide guidance to the City on the best use of available funding options.

## Water System Capital Improvement Program

In 1977 the City purchased the water system from Oregon Water Corporation for six million dollars and since has added approximately 42 million dollars of improvements, upgrades and extensions resulting in an approximate annual capital investment of 1.3 million dollars per year.

A detailed summary of recommended improvements identified in this plan is presented Section 6 for short-term, medium-term and long-term improvement recommendations. The total estimated project cost of these improvements is approximately 54 million dollars for the 20-year planning horizon, with approximately 31 million dollars to be funded by the City. Of the improvements required in the 20-year planning horizon, the total project cost of the improvements required in the next 10 years is approximately 28.1 million dollars. Table ES-2 presents a summary of capital improvement costs for each time period. Approximately 1.9 million dollars per year should be budgeted over the next 10 years for funding of the City's share of these projects which is approximately 19 million dollars. Financial planning and analysis is recommended to evaluate overall water system financial needs and to identify funding options and alternatives

**Table ES-2**
**Capital Improvement Summary**

| Improvement Category | Short-Term (2010-2015) | Medium-Term (2016-2020) | Long-Term (2030 +) | Total |
|---|---|---|---|---|
| Pumping Facilities | -- | 2,150,000 | 1,850,000 | 4,000,000 |
| Storage Facilities | $500,000 | 2,500,000 | 6,300,000 | 9,300,000 |
| Distribution System Piping | 11,006,350 | 11,527,000 | 16,927,500 | 36,460,850 |
| Telemetry | 150,000 | 50,000 | 100,000 | 300,000 |
| Planning Studies | 50,000 | 170,000 | 190,000 | 410,000 |
| **Total** | **$11,706,350** | **$16,397,000** | **$25,367,500** | **$53,470,850** |

## Recommendations

It is recommended that the City of Roseburg take the following actions:

1. Formally adopt this study as the City's Water System Master Plan.

2. Adopt the prioritized recommended system improvements described in Section 6 and specifically listed in tables 6-4, 6-5 and 6-6 as the formal Capital Improvement Program for the water service area.

3. Review and update this plan within a 10-year period to accommodate changes or new conditions.

## SECTION 1
## INTRODUCTION

### Authorization

In November 2008, the firm of Murray, Smith & Associates, Inc. was authorized by the City of Roseburg (City) to prepare this Water System Master Plan (WSMP).

### Purpose

The purpose of this study is to perform a comprehensive analysis of the City's water system, to identify system deficiencies, to determine future water distribution system supply requirements, to establish uniform design criteria for system facilities and to recommend water system facility improvements that correct existing deficiencies and that provide for future system expansion. The planning and analysis efforts include consideration of the ultimate integration of recommended distribution system improvements with the City's long-term water source and supply decisions. This plan replaces the City's 1993 Water System Master Plan.

### Planning Period

The planning period for this master plan is 20 years. Water demands are developed for this planning period and to the year 2058 in 10-year increments.

### Study Area

The study area for this plan includes the City's current water service area and lands inside the City's current Urban Growth Boundary (UGB) as well as the Dixonville Water Association's service area. In 2007 the City acquired ownership of Dixonville Water Association facilities. The City also currently provides water service to certain limited areas outside the UGB. The study area is illustrated on the Existing System Map included as Plate 1 in Appendix A.

### Compliance

This plan complies with water system master planning requirements established under Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 61.

### Scope

The scope of work for this study includes the following work tasks:

- ***Data Compilation and Review*** -- Compile and review existing maps, drawings, plans, studies and reports.

- ***Complete an Inventory and Condition Assessment of Existing Facilities*** -- Complete site visits to existing water system facilities. Prepare an inventory and condition assessment of existing water system facilities including supply, transmission and distribution piping, storage reservoirs, pumping stations, and control systems.

- ***Develop Water Demand Forecasts*** -- Review information related to service area, land use, population distribution, and historical water demands. Develop water demand forecasts for existing and undeveloped areas within the City's water service area.

- ***Establish System Analysis Criteria*** -- Develop system performance criteria for distribution and transmission systems and storage and pumping facilities. Develop analysis and planning criteria for pressure zone service pressure limits, for emergency fire suppression water needs, as well as other system performance parameters.

- ***Develop and Calibrate Water System Hydraulic Model*** -- Prepare of a computerized water distribution system hydraulic network analysis model compatible with the City's existing Geographical Information Systems (GIS) data.

- ***Perform Water System Analysis*** -- Perform a detailed analysis of the City's transmission and distribution system, analyze storage and pumping capacity needs, evaluate pressure zone limits and complete an assessment of un-accounted for water. Included in this work will be an assessment of service and supply options for the area north of the North Umpqua River currently served by the Umpqua Basin Water Association.

- ***Develop Recommended System Improvements*** -- Develop recommended water system facilities improvements which correct existing deficiencies and provide for future system expansion.

- ***Prepare Capital Improvement Plan*** -- Develop estimated project costs for recommended improvements, recommend project sequencing and develop a Capital Improvement Program.

- ***Prepare Water System Master Plan*** -- Prepare a water system master plan that documents and describes the planning and analysis work efforts, including a water system plan map identifying all existing and proposed water system facilities. The preparation of this master plan is intended to serve as a companion document to recently completed long-term water supply planning work and documentation. These documents combined represent a comprehensive distribution and supply system master planning work program.

# SECTION 2
# EXISTING WATER SYSTEM

## General

This section describes and inventories the City of Roseburg's (City) water service area and water system facilities. Included in this section is a discussion of existing supply and transmission facilities, treatment processes, water rights, pressure zones, storage and pumping facilities and distribution system piping.

## Background

The City provides potable water to approximately 29,000 people in the City's current water service area. The City withdraws and treats water from the North Umpqua River at Winchester just downstream of the Winchester Dam. The raw water supply for the Winchester Water Treatment Plant (WTP) is withdrawn from the river by an intake on the south bank of the river.

The City's water system was purchased from the Oregon Water Corporation in December 1977. At the time of this purchase, the water system served customers in the City of Roseburg, the Three Pines Water Association and the Dixonville Water Association (DWA). In 1984, the Three Pines Water Association was dissolved and incorporated into the City of Roseburg. In 2007 Roseburg acquired ownership of the DWA facilities and the City continues to supply these customers through facilities on the eastern edge of Roseburg. References in this report to DWA facilities will refer to the portion of the City facilities previously owned by DWA. The City maintains emergency interties with the Roberts Creek Water District through a metered connection at the south end of the distribution system and with the Umpqua Basin Water Association at the western edge of the study area on Garden Valley Boulevard. Figure 2-1 illustrates the existing water service area, the current Urban Growth Boundary (UGB) and potential UGB growth areas during the study period.

Plate 1 in Appendix A illustrates the City's water system service area limits, water system facilities and distribution system piping. Plate 1 is also a digital representation of the computerized distribution system hydraulic model used for water system analyses.

## Service Area

The City is the provider of urban services within the UGB and areas outside the UGB including the Charter Oaks Area, and to the Dixonville area. As service provider, the City ensures the levels of water service for domestic flows, fire protection, reservoir storage, emergency backup and other factors, as well as regulating water service to ensure logical extensions to the city limits concurrent with growth. ORS Chapter 195.065 requires a coordinated program for delivery of urban services. The City is currently studying potential areas to add to its UGB shown on Figure 2-1 and Plate 1.

By Urban Service Agreement dated April 21, 2008, the Umpqua Basin Water Association (UBWA) has been designated as the provider of water service to certain areas within the UGB, generally being UGB areas north of the North Umpqua River and areas along West Military Avenue and Lookingglass Road. The existing UBWA system borders the westerly edge of the existing UGB and provides existing service into areas being studied as potential areas to add to the City's UGB. This study will review options to serve areas of joint interest, but the selection of the provider of water service to any particular area will be accomplished by future negotiation between the City, UBWA and Douglas County.

In addition to areas within the UGB where UBWA is currently designated as the provider of water service, other areas within the UGB and potential UGB expansion areas exist where UBWA may be able to provide water service in a more economical manner. These areas are the potential UGB expansion area north of Garden Valley Boulevard/Melrose Road and possibly existing UGB areas on Stacie Court and south of Moorea Drive.

Factors affecting which system is the best provider of water service to any particular area of joint interest include, (1) cost to develop, operate and maintain water distribution and storage systems, (2) the need to develop funding for capital expansion through loans, grants or L.I.D. processes, (3) effective utilization of existing assets, (4) efficient and secure utilization of existing water rights, (5) City's ability to regulate levels of domestic and fire service, and (6) City's ability to ensure logical growth to the City limits with development within the UGB and other factors.

Notwithstanding the above, for study purposes, the Master Plan was prepared based on a presumption that the City would be provider of water service to all areas within the UGB, potential UGB expansion areas, and the Dixonville area, except within the existing excluded area along West Military Avenue and areas of potential UGB expansion north of Garden Valley Boulevard/Melrose Road.

### Treatment, Supply and Transmission

The City is currently supplied water from the Winchester WTP located approximately five miles north of the City. The treatment plant occupies a site on the south bank of the North Umpqua River directly downstream of the Winchester Dam. The original pressure filter water treatment plant was constructed in 1935, was replaced under a phased plant replacement program completed in 1992 and is planned to be expanded in the near future.

In 2001, the City implemented some additional improvements to the plant. An on-site sodium hypochlorite generation system was installed to replace the existing gaseous chlorine system. A fourth raw water pump was installed in the river intake and a new magnetic flow meter was installed on the raw water pipeline between the river intake and the rapid mix basins. In 2005, the City proceeded with implementation of the upgrading of the plant's washwater and solids handling system. That project was completed and placed in service in

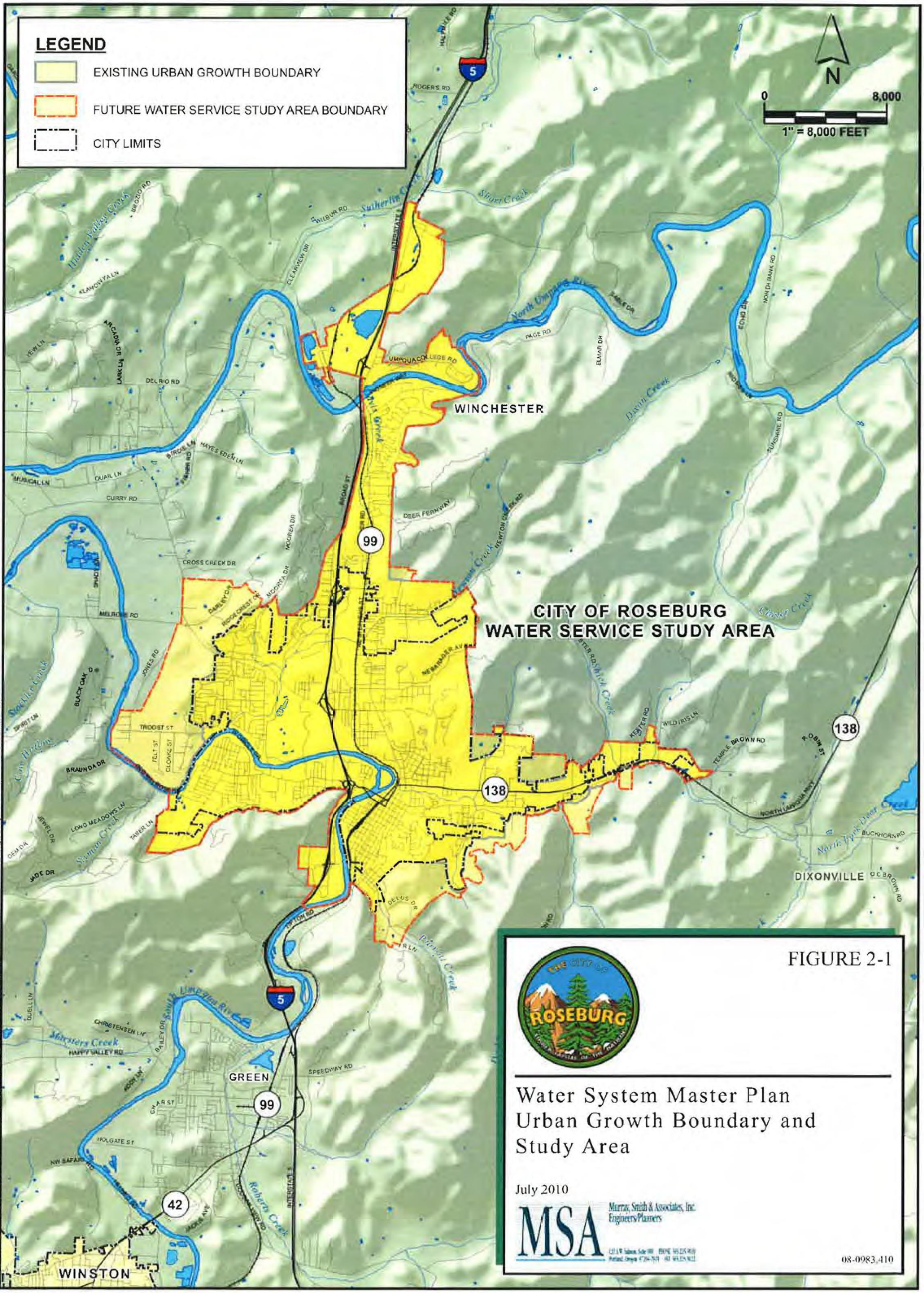



FIGURE 2-1

Water System Master Plan
Urban Growth Boundary and Study Area

July 2010

G:\PDX_Projects\08\0983\410\GIS\Improve_Map\08-0983-410-OR-VICINITY MAP.mxd Wednesday, July 7, 2010 10:48:34 AM DKH the fall of 2006. Additional improvements to add capacity to the hypochlorite system are currently being implemented along with the installation of two new variable frequency pump drives, one on a raw water intake pump and one on a high service pump.

The treatment plant has a nominal peak capacity of 12 million gallons per day (mgd). The water treatment plant is located on a 3.5-acre site at an elevation of approximately 454 feet. Treated water is pumped from the plant clearwell by the plant high service pumps. The plants raw water and finished pumping facilities were recently upgraded with the installation a variable frequency drive unit in each of these stations. The plant can be expanded through installation of two additional filters, additional pumping capacity, and a second flocculation and sedimentation basin. Finished water is pumped from the water treatment plant to the City's distribution system and storage reservoirs through 20-, 24- and 30-inch diameter transmission mains.

**Water Rights Summary**

The City's three primary rights on the North Umpqua River total 31.0 cubic feet per second (cfs) or approximately 20.0 mgd. The City also had a secondary or supplemental right on the North Umpqua River whose purpose was to provide water supply to the Roberts Creek Water District and the Winston-Dillard Water District in the event that their primary water supplies are insufficient. This permit is only usable under those conditions and within the service area of the two water districts and was assigned to them in 2008.

Table 2-1 presents a summary of the City's water rights on the North Umpqua River at the WTP location. The table summarizes information on the rights including the application, permit and certificate identification numbers as assigned by the Oregon Water Resources Department (OWRD), the priority date, the type of use and status of the right, the water body and river mile at the point of diversion, the permitted withdrawal rate, and comments.

**Pressure Zones**

The existing water distribution system has 22 separate pressure zones. The largest of these zones, the Main Pressure Zone, contains approximately 10,800 services. The Main Pressure Zone contains six of the system's 13 storage facilities. The storage reservoirs within this pressure zone are: Reservoir Nos. 5, 6 and 7, Fairhill Drive, Kline Street and Boyer. Each remaining pressure zone contains less than 350 services. These zones are all located in the upper elevation periphery of the distribution system, and all but one are located above the maximum service elevation of the Main Pressure Zone, at approximately 610 feet above mean sea level (msl). The one exception is the Broccoli Pressure Zone which is served from the West Military Avenue Reservoir with a maximum service elevation of approximately 583 feet above msl. Of the smaller, higher elevation pressure zones, five are supplied by gravity from reservoirs, eight are pressurized by hydropneumatic tanks or continuous operation booster pump stations, four are pressurized by continuous operation variable frequency drive (VFD) controlled pump stations and three are served by pressure reducing valve (PRV)

**Table 2-1**
**Existing Water Rights Summary**
**North Umpqua River**

| REF NO. | APP. NO. | PERMIT NO. | CERTIFICATE NO. | PRIORITY DATE | TYPE | STATUS | DIVERSION LOCATION | | PERMITTED WITHDRAWAL RATE | | | COMMENTS/RECOMMENDED ACTIONS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | WATER BODY | RIVER MILE | CFS | GPM | MGD | |
| 1 | 24798 | 19329 | 45930 | 6/1/1950 | MU | C | North Umpqua River | 7.0 | 12.0 | 5,386 | 7.76 | This certificate supersedes Certificate No. 24412 so as to correctly describe the place of use. Action: None. |
| 2 | 31576 | 24914 | 84826 | 5/21/1957 | MU | C | North Umpqua River | 7.0 | 13.0 | 5,835 | 8.40 | Permit extension granted by OWRD for completion of construction by October 1, 2004 and application of water by October 1, 2004. City demonstrated full beneficial use on October 15, 2003. OWRD issued a certificate to the City in September 2008. Action: None. |
| 3 | 58356 | 44018 | | 2/22/1979 | MU | P | North Umpqua River | 7.0 | 6.0 | 2,693 | 3.88 | Permit extension granted by OWRD for completion of construction by October 1, 2001, and completion of application of water by October 1, 2001. Application for extension of time to October 1, 2032 for completion of construction and application of water submitted in November 2006. OWRD currently processing application. Action: Monitor extension of time application processing. File a COBU on a portion of or all of right when beneficial use can be demonstrated. |
| | | | | | | | | **Totals** | **31.0** | **13,914** | **20.0** | |
| 4 | 55991 | 41514 | | 5/31/1977 | MU | P | North Umpqua River | 7.0 | 3.0 | 1,346 | 1.94 | Permit is for supplemental water supply to the Winston-Dillard Water District (2.0 cfs) and the Roberts Creek Water District (1.0 cfs) through interties. Place of use under this permit is the service areas of both districts. Permit extension granted by OWRD for completion of construction by October 1, 1998, and completion of application of water by October 1, 1998. Permit assigned to Districts in April 2008 since permit has no value to City. Action: No further actions recommended. |

Abbreviations:
MU=Municipal, P=Permit, C=Certificate
CFS=cubic feet per second, GPM=gallons per minute, MGD=million gallons per day

stations. A summary of existing pressure zones is presented in Table 2-2. A summary of PRV settings and configurations is included as Table B-2 in Appendix B.

**Table 2-2**
**Existing Pressure Zone Summary**

| Name | Type[1] | Pumping Facility | Storage Facility | Existing Number of Services[2] | Static Hydraulic Grade (ft.)[3] |
|---|---|---|---|---|---|
| Rocky Ridge PRV | P | Garden Valley PS via Alameda, Lincoln and Beulah PRVs | Rocky Ridge | 325 | 850 |
| Dogwood | H | Dogwood PS | -- | 3 | 796 |
| Fairhill | V | Fairhill PS | -- | 10 | 885 |
| Crystal Vista | H | Frontier Lane PS (1st Stage) | -- | 20 | 1,022 |
| Ventura | G | Ventura St. PS | Frontier | 35 | 920.5 |
| Golden Eagle | V | Golden Eagle PS | -- | 20 | 820 |
| Kane PRV | P | Hawthorne PS via Hawthorne PRV and Reservoir Ave. PRV | Terrace | 75 | 850 |
| Gibby | H | Frontier Lane PS (2nd Stage) | -- | 1 | 1162 |
| Isabell | H | Isabell PS | -- | 4 | 820 |
| Joanne | B | Joanne Drive PS | -- | 72 | 887 |
| Kane PS | V | Kane Street PS | -- | 1 | 960 |
| Main | G | Winchester Water Treatment Plant High Service Pump Station | Reservoir Nos. 5, 6 and 7, Kline, Fairhill and Boyer Reservoirs | 10,800 | 710 |
| West Military | B | West Military PS | -- | 15 | 780 |
| Broccoli | G | | West Military | 70 | 683.4 |
| Rifle Range | H | Rifle Range PS | -- | 3 | 854 |
| Rocky Drive PRV | P | Garden Valley PS via Rocky Drive PRV | Rocky Ridge | 25 | 850 |
| Rocky Ridge | G | Garden Valley PS | Rocky Ridge | 160 | 1,015 |
| Stacie Ridge | G | Umpqua Basin Water Association meter connection | Master meter supply | 13 | 1027 |
| Warewood | G | Kline Street PS | Stacie Court | 130 | 937.25 |
| Summit | H | Terrace PS | -- | 45 | 1,198 |
| Terrace | G | Hawthorne PS | Terrace | 145 | 1,016.1 |
| Winchester Creek | H | Winchester Creek P.S. | -- | 15 | 837 |

Notes:
1. See text for type definition.
2. City of Roseburg system only. Does not include Dixonville service area.
3. Static hydraulic grade is based on overflow elevation of supply reservoir, outlet setting of PRV station, or high discharge pressure set point of pump station.

Figure 2-2 presents a hydraulic schematic of the water system and identifies all supply, storage and pumping facilities, and the approximate range of service elevations for each zone.

### *Pressure Zone Types*

For the purposes of this study pressure zones are classified and defined by the following types:

- Gravity Supply (G-type): This pressure zone is served by gravity from one or more storage reservoirs. The hydraulic grade of the pressure zone is determined by the water level in the reservoir.

- Variable Frequency Drive (V-type): This pressure zone is served by a continuous operation pump station with VFD control. The hydraulic grade of the pressure zone is determined by the discharge head of the pump station.

- Hydropneumatic (H-type): This pressure zone is served by a booster pump station with a hydropneumatic tank. The hydraulic grade of the pressure zone is determined by the discharge pressure of the hydropneumatic tank.

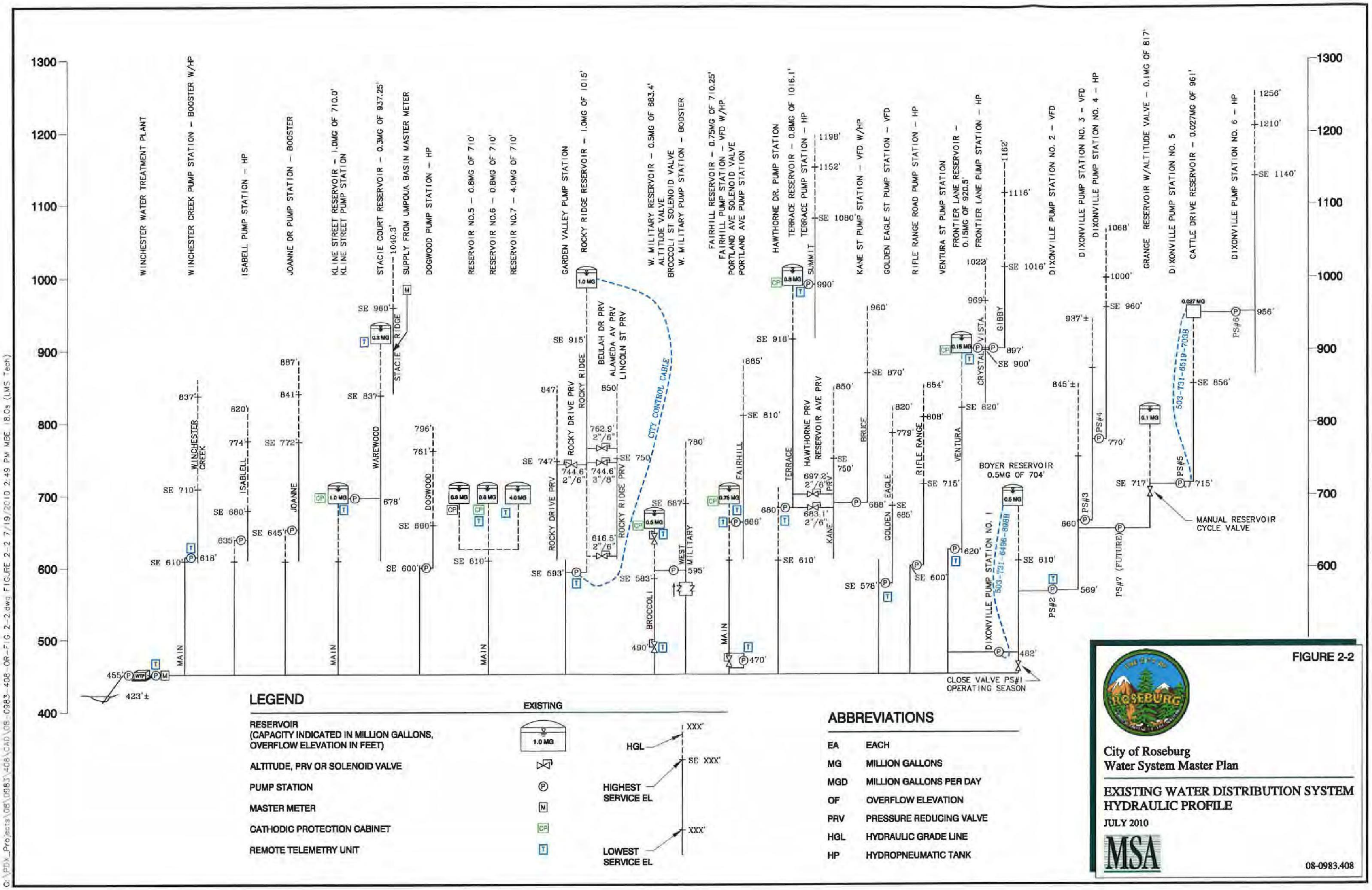
- Pressure Reducing Valve (P-type): P-type pressure zones are supplied through a pressure reducing valve or valves. The hydraulic grade of the pressure zone is determined by the outlet settings of the pressure reducing valve.

- Booster Station (B-type): These pressure zones are supplied by pump stations that operate continuously or have automated controls. The hydraulic grade of these zones is determined by the discharge head of the pump station.

## Storage Reservoirs

### *General*

The City has 13 storage facilities currently in service located throughout the service area. The total capacity of these storage facilities is approximately 10.7 million gallons (MG). A summary of storage facilities is presented in Table 2-3. This table also indicates which reservoirs currently have cathodic protection systems. On February 19, 2009, site visits to several of the City's reservoirs were conducted with City staff in order to provide a cursory assessment of general reservoir conditions. A brief description of each storage reservoir is provided below. Additional information about the City's reservoirs is presented in tabular form in Table B-1 in Appendix B.



WINCHESTER WATER TREATMENT PLANT
WINCHESTER CREEK PUMP STATION – BOOSTER W/HP
ISABELL PUMP STATION – HP
JOANNE DR PUMP STATION – BOOSTER
KLINE STREET RESERVOIR – 1.0MG OF 710.0'
KLINE STREET PUMP STATION
STACIE COURT RESERVOIR – 0.3MG OF 937.25'
SUPPLY FROM UMPQUA BASIN MASTER METER
DOGWOOD PUMP STATION – HP
RESERVOIR NO.5 – 0.8MG OF 710'
RESERVOIR NO.6 – 0.8MG OF 710'
RESERVOIR NO.7 – 4.0MG OF 710'
GARDEN VALLEY PUMP STATION
ROCKY RIDGE RESERVOIR – 1.0MG OF 1015'
W. MILITARY RESERVOIR – 0.5MG OF 683.4'
ALTITUDE VALVE
BROCCOLI ST SOLENOID VALVE
W. MILITARY PUMP STATION – BOOSTER
FAIRHILL RESERVOIR – 0.75MG OF 710.25'
FAIRHILL PUMP STATION – VFD W/HP
PORTLAND AVE SOLENOID VALVE
PORTLAND AVE PUMP STATION
HAWTHORNE DR. PUMP STATION
TERRACE RESERVOIR – 0.8MG OF 1016.1'
TERRACE PUMP STATION – HP
KANE ST PUMP STATION – VFD W/HP
GOLDEN EAGLE ST PUMP STATION – VFD
RIFLE RANGE ROAD PUMP STATION – HP
VENTURA ST PUMP STATION
FRONTIER LANE RESERVOIR – 0.15MG OF 920.5'
FRONTIER LANE PUMP STATION – HP
DIXONVILLE PUMP STATION NO. 2 – VFD
DIXONVILLE PUMP STATION NO. 3 – VFD
DIXONVILLE PUMP STATION NO. 4 – HP
GRANGE RESERVOIR W/ALTITUDE VALVE – 0.1MG OF 817'
DIXONVILLE PUMP STATION NO. 5
CATTLE DRIVE RESERVOIR – 0.027MG OF 961'
DIXONVILLE PUMP STATION NO. 6 – HP
ROCKY DRIVE PRV
ROCKY RIDGE PRV
BEULAH DR PRV
ALAMEDA AV PRV
LINCOLN ST PRV
CITY CONTROL CABLE
HAWTHORNE PRV
RESERVOIR AVE PRV
BOYER RESERVOIR 0.5MG OF 704'
DIXONVILLE PUMP STATION NO. 1
503-731-6496-8988
503-731-6519-7038
MANUAL RESERVOIR CYCLE VALVE
CLOSE VALVE PS#1 OPERATING SEASON
PS#7 (FUTURE)
LEGEND
EXISTING
RESERVOIR (CAPACITY INDICATED IN MILLION GALLONS, OVERFLOW ELEVATION IN FEET)
ALTITUDE, PRV OR SOLENOID VALVE
PUMP STATION
MASTER METER
CATHODIC PROTECTION CABINET
REMOTE TELEMETRY UNIT
HGL
HIGHEST SERVICE EL
LOWEST SERVICE EL
ABBREVIATIONS
EA EACH
MG MILLION GALLONS
MGD MILLION GALLONS PER DAY
OF OVERFLOW ELEVATION
PRV PRESSURE REDUCING VALVE
HGL HYDRAULIC GRADE LINE
HP HYDROPNEUMATIC TANK
FIGURE 2-2
City of Roseburg
Water System Master Plan
EXISTING WATER DISTRIBUTION SYSTEM
HYDRAULIC PROFILE
JULY 2010
MSA
08-0983.408

**Table 2-3**
**Active Reservoir Summary**

| Reservoir Name | Capacity (MG) | Overflow Elevation (feet) | Cathodic Protection |
|---|---|---|---|
| Reservoir No. 5 | 0.8 | 710.0 | Yes |
| Reservoir No. 6 | 0.8 | 710.0 | Yes |
| Reservoir No. 7 | 4.0 | 710.0 | Yes |
| Kline Street Reservoir | 1.0 | 710.0 | Yes |
| Fairhill Reservoir | 0.75 | 710.25 | Yes |
| Boyer Reservoir[1] | 0.5 | 704.0 | No |
| W. Military Reservoir | 0.5 | 683.4 | Yes |
| Grange Reservoir[1] | 0.1 | 817.0 | No |
| Frontier Lane Reservoir | 0.15 | 920.5 | Yes |
| Stacie Court Reservoir | 0.3 | 937.25 | No |
| Rocky Ridge Reservoir | 1.0 | 1015.0 | No |
| Terrace Drive Reservoir | 0.8 | 1016.1 | Yes |
| Cattle Drive Reservoir[1] | 0.027 | 961.0 | No |
| **Total** | **10.7** | | |

Note: 1. Reservoir serves the former DWA service area.

***Bellview Court Reservoirs (Reservoir Hill)***

The City's main reservoir complex is located on Bellview Court, on a hill in central Roseburg known locally as "Reservoir Hill". The site consists of three reservoirs in service (Reservoir Nos. 5, 6 and 7) and an out of service reservoir structure (Reservoir Nos. 1 and 2).

***Reservoir Nos. 5 and 6***

Reservoir Nos. 5 and 6 are both covered, above-ground welded steel tanks which were constructed in 1962. Each reservoir has a capacity of 0.8 MG with an overflow elevation of 710 feet and a floor elevation of 694.8 feet. Reservoir Nos. 5 and 6 are both supplied through transmission mains directly from the treatment plant.

Both reservoirs appeared in good condition during site inspection. Their exterior urethane coating system, though showing signs of fading from ultra violet (UV) radiation, is generally in satisfactory condition. The reservoir interiors were not inspected. The exterior access ladder and roof access hatch railing system appeared to provide adequate fall protection. The reservoirs' wall and foundation joints were obscured by vegetation which should be cleared to determine if any sealant is present. Joint sealant should be installed if not present to prevent water from migrating under the steel floor.

### *Reservoir No. 7*

Reservoir No. 7 is the City's largest storage facility. It is also located at the City's main reservoir complex on Bellview Court. Reservoir No. 7 is a covered above-ground welded steel tank constructed in 1982. The reservoir has a capacity of approximately 4.0 MG with an overflow elevation of approximately 710.0 feet and a floor elevation of approximately 690.0 feet. Reservoir No. 7 is supplied through transmission mains from the WTP. This reservoir's water level is recorded and monitored at the WTP. The reservoir supplies the Main Pressure Zone.

Similar to Reservoir Nos. 5 and 6, the reservoir's exterior vinyl coating showed signs of fading from UV but overall appeared generally in satisfactory condition. From observations through the reservoir's roof access hatch, interior coating system had minor corrosion but overall appeared in fair condition. In February 2009, a diving service cleaned and inspected the interior of the reservoir. The interior coating system appeared to be in fair condition with evidence of rust on the floor and roof. The City has a current capital improvement project underway to recoat the interior and exterior of Reservoir No. 7.

The exterior access ladder and roof access hatch railing system appeared to provide adequate fall protection. The wall and foundation joint appears to have no sealant. It can be anticipated that without joint sealant, moisture will migrate under the steel reservoir floor, which can lead to corrosion.

### *Frontier Lane Reservoir*

The Frontier Lane Reservoir is located off of Frontier Lane on the eastern limits of Roseburg. The reservoir is a covered, above-ground welded steel tank constructed in 1983. The reservoir has a capacity of approximately 0.15 MG, an overflow elevation of approximately 920.5 feet and a floor elevation of approximately 897.0 feet. The reservoir is supplied from the Ventura Pump Station located south of the reservoir near the intersection of Denn Avenue and Ventura Street. The reservoir level is monitored and recorded at the WTP.

The reservoir's exterior urethane and interior epoxy coating systems appeared generally in satisfactory condition though some minor corrosion was observed in the interior through the reservoir's roof access hatch. Access ladder, railing and hatch appeared adequate. A portion of the existing wall and foundation joint sealant was observed to be deteriorating.

### *Fairhill Drive Reservoir*

The Fairhill Drive Reservoir is located on Fairhill Drive west of the Douglas County Fairgrounds at the southern end of the study area. The reservoir, constructed in 1969, is a covered above-ground, welded steel tank. The reservoir has a capacity of approximately

0.75 MG, an overflow elevation of approximately 710.2 feet and a floor elevation of approximately 670.7 feet. Supply to the reservoir is provided through the Main Pressure Zone distribution mains and the Portland Avenue (Fairgrounds) control valve. The solenoid valve at the Portland Avenue Pump Station site is operated to control reservoir filling. The reservoir is then isolated from the Main Zone distribution system and cycled to maintain adequate chlorine residual levels. When the reservoir is isolated from the Main Pressure Zone it drains in order to meet peak demands. During normal demand periods, the reservoir "floats" on the Main Zone distribution system. The reservoir level is monitored and recorded at the WTP.

The reservoir's exterior urethane coating system appeared generally in satisfactory condition. Through the reservoir's roof access hatch corrosion was observed on the painter's rail, though all other interior surfaces appeared adequately coated and in good condition. The access ladder, railing and hatch appeared adequate. The reservoir's wall and foundation joint had extensive moss and debris present with little to no sealant observed.

### *Kline Street Reservoir*

The Kline Street Reservoir is located north of Garden Valley Boulevard on Kline Street near the western limits of the study area. The reservoir is a covered, above-ground steel tank. Construction was completed in 1976. The tank has a capacity of approximately 1.0 MG, an overflow elevation of approximately 710.0 feet, and a floor elevation of approximately 678.5 feet. Supply to the reservoir is provided through the Main Pressure Zone distribution system. The reservoir level is monitored and recorded at the WTP.

The reservoir's exterior urethane coating system appeared generally in satisfactory condition. Through the reservoir's roof access hatch corrosion was observed on the roof framing members, though overall the interior coating system appeared in good condition on all other interior surfaces. The access ladder is equipped with a landing half way up. The ladder, railing and hatch appeared to be adequate. The reservoir wall and foundation joint appears to have no sealant present.

### *Stacie Court Reservoir*

The Stacie Court Reservoir, constructed in 1992, is a covered, above-ground welded steel tank with an overflow elevation of approximately 937.0 feet, a capacity of approximately 0.3 MG and a floor elevation of approximately 917.0 feet. The Stacie Court Reservoir is supplied by the Kline Street Pump Station. The reservoir level is monitored and recorded at the WTP.

The exterior coating system appeared overall to be in good condition. In February 2009, a diving service cleaned and inspected the interior of the reservoir. The interior coating appeared to be in acceptable condition. The exterior access ladder, roof railing and hatch all appeared adequate.

### *Terrace Drive Reservoir*

The Terrace Drive Reservoir is located in southeast Roseburg at the south end of Terrace Drive. The reservoir is a covered, above-ground welded steel tank and was constructed in 1998. The reservoir has a capacity of approximately 0.8 MG, an overflow elevation of approximately 1,016.1 feet and a floor elevation of approximately 990.7 feet. The reservoir is supplied from the Hawthorne Drive Pump Station.

Though areas of the exterior coating are covered with moss and biological growth, the coating system appears to be performing adequately. From observation through the roof hatch, interior coating also appears to be satisfactory though some corrosion was noted on the roof framing members and ceiling plates. The access ladder, access hatch and landing, and railing appear to be in good condition.

### *West Military Avenue Reservoir*

The West Military Avenue Reservoir is located in southwest Roseburg near the intersection of Broccoli Street and West Military Avenue. The reservoir is a covered, above-ground welded steel tank which was constructed in the late 1950s. The tank has a capacity of approximately 0.5 MG, an overflow elevation of approximately 683.4 feet and a floor elevation of approximately 648.4 feet. The West Military Avenue Reservoir is supplied from the Main Pressure Zone through an automatic control valve near the intersection of Lorraine Avenue and Broccoli Street. The valve is telemetry controlled to maintain the water level in the West Military Avenue Reservoir. The valve supplies the reservoir as well as services between the reservoir and the valve. A system of closed valves is used in conjunction with the automatic control valve to separate this zone from the surrounding Main Pressure Zone. There is also an altitude valve adjacent to the reservoir which prevents reservoir overflow. The reservoir level is monitored and recorded at the WTP.

Similar to the Terrace Drive reservoir, though covered with moss and other biological growth, the exterior coating system appears to be performing satisfactorily. Based on observations made by looking through the roof hatch, the interior coating also appears to be satisfactory though some minor corrosion was noted on the roof framing members and bolted connections. The access ladder, hatch, and railing appear to be in good condition and adequate.

### *Rocky Ridge Reservoir*

The Rocky Ridge Reservoir is located in northeast Roseburg, north of NE Rocky Drive. The reservoir is a glass-fused coated bolted steel tank with an aluminum geodesic dome roof system constructed in 2002 and has a capacity of approximately 1.0 MG. The reservoir overflow elevation is approximately 1,015 feet and the floor elevation is approximately 987 feet. The Rocky Ridge Reservoir is supplied by the Garden Valley Pump Station.

Overall the reservoir appears to be in good condition. It was noted that the reservoir base has been leaking. City staff indicated that there have been efforts in the past to stop the leakage using grout injection methods with apparently unsatisfactory results. The reservoir has a telemetry link to the WTP through the Garden Valley Pump Station RTU.

***Dixonville Reservoirs***

The Dixonville reservoirs are located in an area east of the City that was formally the DWA service area. The reservoirs were constructed prior to the City acquiring the DWA facilities. A brief summary of these facilities is presented below.

*Grange Reservoir*

The Grange Reservoir is a small covered, above-ground welded steel tank with a capacity of approximately 0.1 MG constructed in 1966. The reservoir overflow elevation is approximately 817.6 feet and the floor elevation is approximately 793.8. The reservoir is supplied by Dixonville Pump Station No. 2.

In February 2009, a diving service cleaned and inspected the interior of the reservoir. The exterior and interior coating systems appear to be in good condition and it is anticipated that they have significant service life remaining. The reservoir wall and foundation joint appears to have no sealant present.

*Cattle Drive Reservoir*

The Cattle Drive Reservoir is a rectangular reinforced concrete reservoir with a capacity of approximately 27,000 gallons (0.027 MG), an overflow elevation of approximately 966.2 feet and a floor elevation of approximately 954.9 feet. The reservoir was constructed in 1976 and is supplied from the Dixonville Pump Station No. 5 located near the Grange Reservoir.

*Boyer Reservoir*

The Boyer Reservoir is located at the eastern edge of the study area, south of Highway 138 off of Buckhorn Road. The reservoir is an above-ground, circular welded steel tank constructed in 1966. The reservoir has a capacity of approximately 0.5 MG at an overflow elevation of approximately 704 feet with a floor elevation at approximately 672.1 feet. Supply to the reservoir is provided through the Main Pressure Zone distribution mains. It can also be supplied through the Dixonville Pump Station No. 1 which pumps from the City's Main Pressure Zone into the Dixonville system during high demand periods when the hydraulic grade in the Main Pressure Zone is inadequate to fill the Boyer Reservoir. During low demand periods the Boyer Reservoir fills by gravity from the Main Pressure Zone.

Overall, the exterior and interior coating systems appeared to be in good condition as the coating system was relatively new at the time of observation. All reservoir appurtenances were in good condition.

*Abandoned Reservoir*

Since the completion of the City's last Water System Master Plan in 1992 a number of reservoirs have been abandoned and/or replaced. These are briefly summarized as follows:

- Reservoir Nos. 1 and 2 – abandoned in place
- Reservoir Nos. 3 and 4 at Reservoir Avenue – dismantled
- Winter Street Reservoir – dismantled
- 0.1 MG Terrace Drive Reservoir – dismantled and replaced

## Pumping Stations

The Roseburg water system includes 15 pump stations located throughout the distribution network. A brief description of each station is provided below and a summary and is presented in Table 2-4. There are also six additional pump stations located in the former DWA service area which are not described in this Plan.

*Pump Station Types*

The pump stations described below fit into one of the following pump station types:

- *Booster Station (B):* A station that typically pressurizes a zone serving 100 customers or less. These stations can house continuous operation pumps or pumps that have automated controls. These stations have no hydropneumatic tanks or VFD controllers.

- *Hydropneumatic Station (H)*: A pump station with a hydropneumatic tank to provide constant system pressure.

- *Variable Frequency Drive Station (V)*: A pump station that operates continuously to maintain constant pressure with a hydropneumatic tank and at least one pump controlled by a VFD.

- *Reservoir Supply Pump Station (R):* A pump station that operates to fill a higher level reservoir from a lower elevation reservoir or pressure zone.

**Table 2-4**
**Existing Pump Station Summary**

| Pump Station Name | Storage Facility Supplied | Number of Pump Units and Horsepower (HP) | Nominal Capacity (gpm) | Type of Station and Comments |
|---|---|---|---|---|
| Winchester Creek | None | 3 (3,7.5, 7.5) | 100, 200, 200 | H |
| Isabell | None | 1 (1) | 50 | H |
| Joanne Drive | None | 2 (3, 7.5) | 75, 230 | B |
| Kline Street | Stacie Court | 2 (15, 15) | 60, 60 | R |
| Dogwood | None | 1 (1) | 50 | H |
| Garden Valley | Rocky Ridge | 2 (25, 25) | 50, 50 | R |
| West Military | None | 2 (3,5) | 45, 90 | B |
| Fairhill | None | 4 (2@7.5, 2@20) | 2 @ 125, 2 @ 440 | V |
| Portland Avenue | Fairhill | 1 (50) | 750 | Out of service |
| Hawthorne Drive | Terrace | 2 (2 @ 50) | 2 @ 300 | R |
| Terrace | None | 2 (10, 30) | 100, 300 | H |
| Kane Street | None | 1 (1½) | 20 | V |
| Golden Eagle | None | 2 (2 @ 3) | 2 @ 60 | V |
| Rifle Range Road | None | 2 (2 @ 1½) | 2 @33 | H |
| Ventura Street | Frontier Lane | 2 (2@20) | 2 @ 150 | R |
| Frontier Lane | None | 2 (1.5, 5)<br>1 (3/4) | 75,250<br>20 | H<br>B |
| Dixonville No. 1 | Boyer | 3 (3, 5, 10) | 100, 200, 200 | R |

***Winchester Creek Pump Station***

The Winchester Creek Pump Station is a hydropneumatic station located at 387 Winchester Creek Avenue in northern Roseburg. The pump station supplies the Winchester Creek Pressure Zone from the Main Pressure Zone distribution system. The station supplies a limited number of services in the Winchester Creek subdivision, approximately 25 at build-out of the subdivision. The pump station is a small, concrete masonry unit (CMU) building on a concrete slab. It houses three pumps; one 3-horsepower (hp) jockey pump and two 7.5-hp pumps with nominal capacities of approximately 100 gpm and 200 gpm each, respectively. Pump operation is controlled to maintain a discharge pressure set point of approximately 95 psi. A hydropneumatic tank supplies water during low flow demand periods. This pump station has a telemetry link to the WTP.

***Isabell Pump Station***

The Isabell Pump Station is a hydropneumatic station located within the right-of-way at 170 Isabell Street. The pump station supplies a limited number of high elevation services in the Isabell Pressure Zone from the Main Pressure Zone distribution system. The pump station is a small, CMU building on a concrete slab that houses one 1-hp pump with a nominal capacity of approximately 50 gpm. Pump operation is controlled to maintain a discharge pressure between approximately 65 psi and 85 psi. The pump operates to maintain pressure in a hydropneumatic tank that supplies customer demands. This pump station does not have a telemetry link.

### *Joanne Drive Pump Station*

The Joanne Drive Pump Station is a booster station in northeast Roseburg located within an easement at 3061 Joanne Drive. The pump station is a continuously operating booster station which serves approximately 49 services from the Main Pressure Zone. The pump station is a cast-in-place concrete structure that contains two pumps; a 3-hp pump with a nominal capacity of approximately 75 gpm and a 7.5-hp pump with a nominal capacity of approximately 230 gpm. The pump station operates on a continuous basis throughout the year with the 3-hp pump operating in the winter and the 7.5-hp operating during the summer months. Pump operation is manually switched, depending on demand conditions. No telemetry or control link exists at this pump station.

### *Kline Street Pump Station*

The Kline Street Pump Station is a reservoir supply station located next to the Kline Street Reservoir north of Garden Valley Boulevard at 2843 NW Kline Street. The pump supplies the Stacey Court Reservoir from the Kline Street Reservoir. The pump station is of concrete block construction on a concrete foundation with a composite shingle roof. It houses two pumps; both are 15-hp with a nominal capacity of 60 gpm each. Pump operation is controlled by the water level at the Stacey Court Reservoir. This pump station has a telemetry link to the WTP.

### *Dogwood Pump Station*

The Dogwood Pump Station is a hydropneumatic station located within the right-of-way at 1926 NW Dogwood Street. The pump station supplies approximately three, high-elevation services from the Main Pressure Zone with one 1-hp pump with a nominal capacity of approximately 25 gpm housed in a small CMU building on a concrete slab. Pump operation is controlled to maintain a discharge pressure between approximately 65 psi and 85 psi. The pump operates to maintain pressure in a hydropneumatic tank that supplies customer demands. This pump station does not have a telemetry link.

### *Garden Valley Pump Station*

The Garden Valley Pump Station is a reservoir supply station located at 1111 NE Garden Valley Boulevard. It supplies the Rocky Ridge Reservoir which serves the Rocky Ridge, Rocky Ridge PRV and the Rocky Drive PRV Pressure Zones. The pump station is a CMU structure on a concrete foundation with a composite shingle roof that houses two pumps. Both pumps are 25-hp pumps with a nominal capacity of 50 gpm each. A third gasoline engine driven fire flow pump, installed prior to construction of the Rocky Ridge Reservoir, is located at the station but is no longer used. Pump operation is controlled by the water level at the Rocky Ridge Reservoir. This pump station has a telemetry link to the WTP.

### *West Military Avenue Pump Station*

The West Military Avenue Pump Station is located in the right-of-way at 2574 West Military Avenue on the north side of the avenue across from the West Military Reservoir. It is a booster pump station which supplies approximately 11 services along West Military Avenue from the West Military Avenue Reservoir. The building is of CMU construction on a concrete foundation with a metal roof. It contains two pumps; a 3-hp pump with a capacity of approximately 45 gpm and a 5-hp pump with a capacity of approximately 90 gpm. Pump operation is controlled by discharge flow sensors which activate pumps as required. No telemetry or control link exists at this station.

### *Fairhill Pump Station*

The Fairhill Pump Station is located near the Fairhill Reservoir at 1823 Fairhill Drive. It is a VFD station designed to ultimately supply approximately 25 homes above the service elevation of the Fairhill Reservoir. The pump station is supplied from the Fairhill Reservoir distribution piping. The building is of CMU construction on a concrete foundation and a composite roof. It is a skid-mounted package pump station with four pumps and a hydropneumatic tank. Two 7.5-hp duty pumps have a nominal capacity of approximately 125 gpm each and two 20-hp fire flow pumps have a nominal capacity of approximately 440 gpm each. All four pumps are controlled with VFDs. Pump operation is controlled by discharge pressure sensors which activate pumps as required. This pump station has a telemetry link to the WTP.

### *Portland Avenue Pump Station*

The Portland Avenue Pump Station (also referred to as the Fairgrounds Pump Station) at 760 Portland Avenue is located just east of Interstate 5 in southern Roseburg. This station is currently out of service. Previously, the pump station boosted water from the Main Pressure Zone to fill the Fairhill Drive Reservoir during high demand periods. The building is constructed with concrete block on a concrete slab and has a wood frame roof with wooden shingles. One 50-hp pump with a capacity of approximately 750 gpm is housed within the pump station. The pump is abandoned in place. A solenoid valve in the station currently operates to fill the Fairhill Reservoir on a cycle from the Main Pressure Zone distribution system. This pump station has a telemetry link to the WTP.

### *Hawthorne Drive Pump Station*

The Hawthorne Drive Pump Station is reservoir supply pump station located at 1317 SE Hawthorne Drive in southeast Roseburg on Hawthorne Drive east of the intersection of Hawthorne Drive and Kane Street. The station pumps water from the Main Pressure Zone to the Terrace Reservoir. The building is of CMU construction on a concrete foundation with a metal roof. It contains two 50-hp pumps with a nominal capacity of approximately 300 gpm each. A PRV station located in the pump station building supplies the Hawthorne PRV zone from the Terrace Reservoir hydraulic grade along with a second PRV station 1615 Reservoir Avenue. This pump station has a telemetry link to the WTP.

### *Terrace Pump Station*

The Terrace Pump Station is located at 1500 SE Terrace Drive adjacent to the Terrace Reservoir near the intersection of Parkwood and Terrace Drives. The pump station is a hydropneumatic system which serves approximately 45 services from the Terrace Drive Reservoir. The building is of CMU construction on a concrete base with a metal roof. It contains two pumps; a 30-hp pump with a capacity of approximately 300 gpm and a 10-hp pump with a capacity of approximately 100 gpm. Pump operation is controlled by pressure sensors on the hydropneumatic tank. This pump station has a telemetry link to the WTP.

### *Kane Street Pump Station*

The Kane Street Pump Station is located within the right-of-way at 1501 SE Kane Street. It is a VFD station supplying one service at the end of Kane Street from a single 1.5-hp pump with a nominal capacity of approximately 20 gpm. The pump station building is a CMU structure on a concrete slab with metal roofing. The pump operates to maintain pressure in the hydropneumatic tank. This pump station has no telemetry link.

### *Golden Eagle Pump Station*

The Golden Eagle Pump Station is located at 994 Golden Eagle Avenue. This VFD station serves the approximately 18 customers in the Eagle View development. The pump station building is wood frame construction with a concrete slab foundation and a composite roof. The station contains two 3-hp VFD-controlled vertical centrifugal pumps with a nominal capacity of approximately 60 gpm each. The pump station controls vary pump operation and pump speed to maintain a discharge pressure set point.

### *Rifle Range Road Pump Station*

The Rifle Range Road Pump Station is located at 1361 Rifle Range Road north of the intersection of Schick Street and Rifle Range Road north of Diamond Lake Highway. The pump station is a hydropneumatic system which serves three customers from the Main Pressure Zone with two 1.5-hp pumps each with a capacity of approximately 33 gpm. The building is of concrete block construction. Pump operation is controlled by pressure sensors on the hydropneumatic tank. No telemetry or control link exists at this pump station.

### *Ventura Street Pump Station*

The Ventura Street Pump Station is located in an easement at 580 NE Ventura Street. The reservoir supply station pumps water from the Main Pressure Zone to the Frontier Lane Reservoir. The building is an above-grade wood frame structure on a concrete foundation that houses two 20-hp pumps, each with a nominal capacity of approximately 150 gpm. Pump operation is controlled to maintain the level in the Frontier Lane Reservoir. This pump station has a telemetry link to the WTP.

### *Frontier Lane Pump Station*

The Frontier Lane Pump Station is located adjacent to the Frontier Lane Reservoir. The station is a small hydropneumatic system with a second pumping system in series which serves 20 customers, 19 immediately below the reservoir and one east of the pump station. The building is of CMU construction on a concrete slab with a metal roof. The station is supplied from the Frontier Lane Reservoir and contains three pumps. Pump No.1 is a 5-hp pump with a capacity of approximately 250 gpm, Pump No.2 is a 1.5-hp pump with a capacity of approximately 75 gpm and Pump No. 3 is a 0.75-hp pump with an approximate capacity of 20 gpm. Pumps No.1 and 2 serve to pressurize the hydropneumatic tank located in the pump station. Pump No. 3 is a booster pump on the hydropneumatic tank discharge serving a customer located east of the pump station. Pump Nos. 1 and 2 are controlled by pressure sensors on the hydropneumatic tank. Pump No. 3 operates to maintain constant pressure in the service line. This pump station has a telemetry link to the WTP.

### *Dixonville Pump Station No. 1*

The Dixonville Pump Station is located at 3314 SE Douglas Avenue east of the intersection of Douglas Avenue and Lombard Drive. This station is a reservoir supply station that pumps to the Boyer Reservoir during the summer months when the hydraulic grade in the Main Pressure Zone is inadequate to fill the reservoir. The pump station building is of wood frame construction with a metal roof on a concrete foundation. The station houses three pumps; a 3-hp pump with a nominal capacity of approximately 100 gpm, a 5-hp pump with a nominal capacity of approximately 300 gpm and a 10-hp pump with a nominal capacity of approximately 200 gpm. No telemetry or control link exists at this pump station.

Five additional booster pump stations located within the Dixonville service area are not discussed in this Master Plan. The water and wastewater facilities serving the former DWA service area are the subject of a current study.

## Piping Systems

The water distribution system is composed of various pipe materials in sizes up to 30 inches in diameter. The majority of distribution system mains are 6-inch and 8-inch in diameter. The pipe materials include asbestos cement, cast iron, ductile iron, copper, steel, polyvinyl chloride, polyethylene and galvanized iron. Over half of the system piping is cast iron and asbestos cement. Existing cast iron pipe was primarily installed in the 1950s and 1960s, asbestos cement was installed in the 1960s and 1970s, ductile iron and polyvinyl chloride (PVC) piping was installed in the 1980s and 1990s and steel was installed from the 1930s through the 1960s. The City is actively replacing older galvanized and cast iron piping. A summary of system piping by material type is presented in Table 2-5.

**Table 2-5**
**Distribution Piping Summary**

| 2008 INVENTORY | | | | 1993 INVENTORY | |
|---|---|---|---|---|---|
| **Pipe Material, Diameter, Date Installed** | **Length (feet)** | **Length (miles)** | **%** | **Length (miles)** | **%** |
| Asbestos Cement (AC), 4"-12", 1965-1980 | 255,677 | 48.4 | 25% | 38.3 | 28% |
| PVC, 2"-12", 1965-present | 214,969 | 40.7 | 21% | 19.1 | 14% |
| Cast Iron (CI), 4"-12", 1940-1975 | 171,302 | 32.4 | 17% | 41.8 | 31% |
| Ductile Iron (DI), 6"-30", 1965-present | 259,473 | 49.1 | 26% | 9.3 | 7% |
| Polyethylene (PE), 1"-2", 1970-2000 | 7,506 | 1.4 | 1% | 1.5 | 1% |
| Iron - Std Galvanized, 1"-2", 1930-1960 | 20,546 | 3.9 | 2% | 15.5 | 11% |
| OD Steel – D&W, 6"-24", 1935-1961 | 23,314 | 4.4 | 2% | 8.3 | 6% |
| OD Steel – other, 12"-30", 1980-present | 8,562 | 1.6 | 1% | | |
| Unknown | 49,851 | 9.4 | 5% | 1.6 | 1% |
| **Grand Total** | 1,011,200 | 191.5 | 100% | 135.4 | 100% |

**Telemetry and Supervisory Control System**

The City's telemetry and supervisory control system consists of a central control panel located in the control room of the Winchester WTP and remote telemetry units (RTUs) at 15 locations in the distribution system. Communication between these units and the central control panel is by leased telephone lines. The RTUs are located at major reservoirs, pump stations and solenoid valves. The system presently monitors the water levels at nine reservoirs, controls the operation of four pump stations which pump to reservoirs, monitors the discharge pressure at five continuous operation or hydropneumatic pump stations and controls the operation of two control valves in the distribution system. The four pump stations currently controlled by the system are the Kline Street, Garden Valley, Hawthorne and Ventura Pump Stations. The two control valve stations are for the Fairhill and Military Reservoirs. The system provides for system monitoring and manual or automatic system control from the treatment plant. In the automatic mode, system control is by a programmable logic controller specifically programmed for the City's system. The system also includes a computerized graphic display console to visually display system status and operation as well as a data management system. The central control panel includes circular charts for a permanent paper record of system status and performance. The proprietary telemetry system was designed and built by the City's system integrator, S & B, Inc., of Bellevue, Washington who is also involved in system maintenance, replacement and expansion.

### Summary

This section presents a summary of the City's existing water system, including the transmission and supply system, storage and pumping facilities, and distribution system piping. Also included is a discussion of existing supply and treatment, water rights and pressure zones. Section 3 provides a summary of population and water demand forecasts and Section 4 presents the planning and analysis criteria used to test the system's ability to adequately meet these water needs.

## SECTION 3
## POPULATION AND WATER DEMAND FORECASTS

### General

This section presents population projections and water demand forecasts for the City of Roseburg's (City) water service area. Population and water demand forecasts are developed from recently completed long-range water supply planning work completed by the City. The water demand estimates presented in this section will be used as the basis for the water system analyses presented in Section 5.

### Water Service Area Population

The current water service area population includes the population within the City limits, the population in the former Dixonville Water Association (DWA) and those served outside of the existing City limits. Table 3-1 presents the estimated historical service area population of the water system between 2000 and 2008. Table B-3 in Appendix B summarizes current and historical water service counts by meter size and customer type.

**Table 3-1**
**Water Service Area Population Estimate Summary**

| Year | Estimated Population Within City Limits | Estimated Former DWA Population[1] | Estimated Population Outside City Limits | Total Estimated Water Service Area Population |
|---|---|---|---|---|
| 2000 | 20,125 | 920 | 6,661 | 27,706 |
| 2001 | 20,200 | 920 | 6,706 | 27,826 |
| 2002 | 20,170 | 920 | 6,751 | 27,841 |
| 2003 | 20,480 | 920 | 6,796 | 28,196 |
| 2004 | 20,530 | 920 | 6,842 | 28,292 |
| 2005 | 20,790 | 920 | 6,889 | 28,599 |
| 2006 | 21,050 | 920 | 6,935 | 28,905 |
| 2007 | 21,255 | 920 | 6,982 | 29,157 |
| 2008 | 21,235 | 920 | 7,029 | 29,184 |

Note: 1. Estimated as 400 dwelling units at 2.3 persons per dwelling unit.

### Population Forecasts

Long-term forecasts of a community's population are essential in determining anticipated long-term water demands and in identifying, acquiring and developing new water sources to meet those demands. While the planning period for this master plan is 20 years, the City's recently completed long-range water supply planning work analyzed current water demands and developed population and water demand estimates to the year 2058. The Long-Range Water Supply Plan estimated 2008 to 2028 population growth rate at 2.5 percent and 2028 to

2058 growth rates at 1.5 percent, 2.0 percent and 2.5 percent with 2 percent growth rate adopted for the purposes of the study.

In December 2009 the Douglas County Board of Commissioners adopted a Roseburg Urban Area growth rate of 2 percent for planning purposes. For the purposes of this master plan, the populations within the service area projected at 2 percent growth rate for 2008 to 2058 in accordance with the newly adopted policy will be used as the basis for water demand estimates.

The 2008 water service area population is estimated to be 29,184 as shown in Table 3-1 above. The 2008 population within the Urban Growth Boundary (UGB) is estimated to be 31,057. The difference of approximately 1,875 people is the estimated number of residents within the City's UGB who are not currently provided with City water. This plan assumes that the City's water system will ultimately serve all customers within the UGB. Table 3-2 presents the population forecasts adopted for this study for the 50-year planning horizon from 2008 to 2058. These population forecasts include all customers within the City's UGB.

**Table 3-2**
**Adopted Population Forecast Years 2008 to 2058**

| Year | Forecast Population |
|---|---|
| 2008 | 31,057 |
| 2013 | 34,290 |
| 2018 | 37,860 |
| 2023 | 41,800 |
| 2028 | 46,150 |
| 2033 | 50,950 |
| 2038 | 56,250 |
| 2043 | 62,100 |
| 2048 | 68,580 |
| 2053 | 75,710 |
| 2058 | 83,600 |

The water service area population forecasts presented and recent historical water demand characteristics for the service area will be used to develop forecasts of future water demands to the year 2058.

## Past and Present Water Demands

The term "demand" refers to all of the water requirements of the system including residential, commercial, municipal, institutional and industrial as well as unaccounted-for water. Demands are discussed in terms of gallons per unit of time such as gallons per day (gpd), million gallons per day (mgd), or gallons per minute (gpm). Demands may also be expressed in gallons per capita per day (gpcd). Unaccounted-for water is the difference between total metered flows into the system from the source of supply and the total metered flows leaving the system.

Table 3-3 summarizes the system demand characteristics based on Water Treatment Plant production records from 2000 through 2008. The table contains all of the demands within the water distribution system including DWA customers, water services outside of the current city limits and unaccounted-for water.

**Table 3-3**
**Historical Water Demand Summary**

| Year | Estimated Service Area Population | Average Day Demand (mgd) | ADD per Capita (gpcd) | Maximum Daily Demand (mgd) | MDD per Capita (gpcd) |
|---|---|---|---|---|---|
| 2000 | 27,706 | 5.27 | 190 | 9.67 | 349 |
| 2001 | 27,826 | 5.17 | 186 | 9.18 | 330 |
| 2002 | 27,841 | 5.34 | 192 | 10.10 | 363 |
| 2003 | 28,196 | 5.41 | 192 | 10.62 | 376 |
| 2004 | 28,292 | 5.28 | 187 | 10.01 | 354 |
| 2005 | 28,599 | 5.14 | 180 | 10.01 | 350 |
| 2006 | 28,905 | 5.40 | 187 | 10.32 | 357 |
| 2007 | 29,157 | 5.40 | 185 | 10.31 | 354 |
| 2008 | 29,184 | 5.53 | 190 | 9.72 | 333 |

**Water Demand Forecast**

Forecasts of future water demands are determined based on the previously developed population forecasts and the present per capita water use characteristics. Included within these per capita rates are all water uses including residential, commercial, municipal, industrial, institutional and unaccounted-for water.

Average daily water demand (ADD) is used to forecast water quantities on an annual basis and is used to estimate annual revenue or average annual power costs. Maximum daily demand (MDD) is used to size the capacities of supply source, treatment plant, transmission system, pumping and finished water storage facilities. Peak hour demand (PHD) is used to size portions of the water system, including pumping and distribution facilities. MDD and PHD are often expressed as a factor multiplied by ADD.

Average per capita water use in the system during the period 2000 through 2008 ranged from 180 to 192 gpcd. There is no apparent trend in average per capita water use for this six-year period. For the purposes of this study, the average daily per capita demand in the future is assumed to be 188 gpcd, the average over the period 2000 to 2008.

Maximum daily per capita demands in the system during the same period ranged from 330 to 376 gpcd. The highest demand day, July 28, 2003, occurred during a heat wave that City staff indicates is representative of current maximum daily system demands under extreme high temperature conditions. For the purposes of this study, the conservative demand of 376 gpcd will be used to forecast future MDD.

To provide an estimate of peak hour demand usage, a factor of 1.5 was applied to estimated MDD. This is consistent with meter usage patterns of similar communities in the region. Forecasts of water demands within the 50-year planning period, based on the demand characteristics presented above, are summarized Table 3-4.

**Table 3-4**
**Water Demand Forecast**

| Year | Population Forecast | Water Demand (mgd) | | |
|---|---|---|---|---|
| | | Average Daily[1] | Maximum Daily[2] | Peak Hour[3] |
| 2013 | 34,290 | 6.4 | 12.8 | 19.2 |
| 2018 | 37,860 | 7.1 | 14.2 | 21.3 |
| 2023 | 41,800 | 7.9 | 15.8 | 23.7 |
| 2028 | 46,150 | 8.7 | 17.4 | 26.0 |
| 2033 | 50,950 | 9.6 | 19.2 | 28.7 |
| 2038 | 56,250 | 10.6 | 21.2 | 31.7 |
| 2043 | 62,100 | 11.7 | 23.3 | 35.0 |
| 2048 | 68,580 | 12.9 | 25.8 | 38.7 |
| 2053 | 75,710 | 14.2 | 28.4 | 42.7 |
| 2058 | 83,600 | 15.7 | 31.4 | 47.2 |

Notes: 1. Based on an average day per capita use of 188 gpcd
2. Based on a maximum day per capita use of 376 gpcd.
3. Based on a peak hour to maximum daily ratio of 1.5.

## Summary

The City's water system currently serves a population of approximately 29,184 people. It is anticipated that that by the year 2058 this population will more than triple. Current water demands will also correspondingly increase. The water demand forecasts developed in this section will be used for the system analyses presented in Section 5 which will in turn be the basis for recommendations of the capital improvement program presented in Section 6.

## SECTION 4
## PLANNING AND ANALYSIS CRITERIA

### General

This section presents the planning and analysis criteria used for the City of Roseburg's (City) water system analysis. Criteria are presented for distribution system piping, service pressures, storage and pumping facilities. Recommended water needs for emergency fire suppression are also presented. These criteria are used in conjunction with the water demand forecasts developed in Section 3 to complete the analysis of the City's water distribution system presented in Section 5.

### Planning Period

Oregon Administrative Rule (OAR) 333-061-0060(5) requires master plan documents to evaluate the needs of the system for at least a 20-year period. The actual design life of major system components including water mains, reservoirs, and pump stations can approach 50 to 75 years. Actual facility life can also be shortened by zoning and land use changes, surrounding infrastructure changes, regulatory changes, maintenance history and other factors. The planning period for this water system analysis is 20 years. The sizing of some distribution facilities and water supply capacity will be based on a 50-year planning horizon consistent with the City's recently completed Long-Range Water Supply Study (Murray, Smith & Associates, Inc., 2008).

### Distribution System

The water distribution system should be capable of operating within certain system performance limits, or guidelines, under several varying demand and operational conditions. The recommendations of this plan are based on the following performance guidelines, which have been developed through a review of State requirements, American Water Works Association (AWWA) acceptable practice guidelines, Insurance Services Office, Inc. (ISO) guidelines and operational practices of similar water providers. The recommendations are as follows:

- The distribution system should be capable of supplying the peak hourly demand while maintaining minimum service pressures of not less than 75 percent of normal system pressures. The system should meet this criterion with reservoir levels approximately 10 feet below overflow.

- The distribution system should be capable of providing the recommended fire flow to a given location while, at the same time, supplying the maximum daily demand (MDD) and maintaining a minimum residual service pressure at any meter in the system of 20 pounds per square inch (psi). This is the minimum water system pressure required by the State of Oregon Department of Human Services, Drinking

Water Program under OAR 333-061-0050(8)(e). The system should meet this criterion with reservoir levels approximately 10 feet below overflow.

- The distribution and transmission system must be capable of refilling the reservoirs during periods of low demand. Pipelines between pump stations and storage reservoirs must be adequately sized to limit friction losses and to avoid excessive pressures in the lower elevations of a service zone while pumps are operating. Pump station discharge pressures should not exceed 125 psi.

The following pipe materials are recommended for use in the distribution system:

- Ductile iron, cement mortar lined and coated 4-inch to 16-inch diameter mains. (AWWA C104)

- Polyethylene encased ductile iron, cement mortar lined and coated, 18-inch to 30-inch diameter mains. (AWWA C105)

- Welded steel, cement mortar lined and coated, large diameter transmission mains. (AWWA C200 and C205)

In certain circumstances, the City may consider the use of PVC pipe (AWWA C900/C905) where potentially corrosive soils and stray currents are a concern.

New distribution mains should provide adequate capacity to meet domestic and fire flow demands. Typically, this results in a minimum pipe diameter of 6 inches within a developed grid where the system is well looped and 8 inches for dead-end mains. Commercial and industrial areas with higher fire flow requirements will require larger diameter piping. Certain domestic-use water mains which are less than 200 feet long and are not anticipated to be extended in the future may be less than 6 inches in diameter. For example, on a cul-de-sac street less than 200 feet in length where fire hydrants are connected to larger diameter mains on adjacent streets. Water service to elevations approaching the upper limits of a pressure zone or in other areas where energy losses must be minimized may require the use of larger diameter mains to prevent excessive pressure loss during high flow events.

In general, distribution system piping flow velocities should not exceed 10 feet per second (fps) under fire flow conditions and 5 fps under normal demand conditions. Other design velocities may be used when a complete pipe design; including consideration of operating pressures, surge pressures, depth of bury, corrosion allowance and other factors in accordance with AWWA C150 and M41, is submitted to and approved by the City. All system piping should be designed in accordance with the manufacturer's recommendations for flow and pressure limits and other design parameters.

## Service Zones Pressure

As discussed in Section 2, water distribution systems are typically separated into pressure zones or service levels to provide water pressures within an acceptable range to all customers. The existing water distribution system is divided into numerous service levels or pressure zones. Pressure zones are usually defined by ground topography and designated by overflow elevations of water storage facilities or outlet settings (discharge pressure) of pressure reducing facilities or booster pump stations serving the zone. Typically, water from a reservoir will serve customers by gravity within a specified range of ground elevations so as to maintain acceptable minimum and maximum water pressures at individual service connections. When it is not feasible or practical to have a separate reservoir serving each pressure zone, pumping facilities or pressure reducing facilities are used to serve customers in different pressure zones from a single reservoir.

Generally, 100 psi is considered the desirable upper pressure limit and 30 psi the lower limit. Whenever feasible, it is desirable to achieve the 30 psi lower limit under dynamic conditions at the point of the highest fixture within a given building being served. Dynamic conditions is defined as system performance under peak hour demands. This service pressure goal is normally accomplished by assuring that the static system head at the meter connection is at least 100 feet. Conformance to this pressure range may not always be possible or practical due to topographical relief, existing system configurations and other special circumstances. While 100 psi is generally considered the upper limit of allowable service pressures, in some cases it is acceptable to have system pressures of up to 125 psi. The International Plumbing Code (IPC) requires customers to install individual pressure reducing valves (PRVs) in cases where system pressures exceed 80 psi. Table 4-1 summarizes the service pressure criteria used in the analysis of the City's water system.

**Table 4-1**
**Recommended Service Pressure Criteria**

| Condition | Pressure(psi) |
|---|---|
| Minimum Service Pressure Under Fire Flow Conditions[1] | 20 |
| Minimum Normal Dynamic Pressure at Highest Fixture | 30 |
| Maximum Service Pressure | 125 |

Note: 1. As required by OAR 333-061-0050(4)(b)(D)(iii) and OAR 333-061-0050(8)(R)

## Storage Volume

Water storage facilities are typically provided for three purposes: equalization storage, fire storage, and emergency storage. A brief discussion of each storage element is provided below. This three component criteria for storage volume is commonly used by other water providers and is an analysis approach consistent with AWWA practice. Water storage facilities should be provided in each pressure zone except in cases where operation of a constant pressure, continuously operating pump station can be justified. A discussion of constant pressure pumping follows later in this section.

### *Equalization Storage*

Equalization storage is required to meet water system demands in excess of delivery capacity from the supply source to system reservoirs. It represents the normal operating level fluctuations of the reservoirs. Equalization storage volume should be sufficient to supply demand fluctuations throughout the day resulting from typical customer water use patterns and is generally considered as the difference between peak hour demand and MDD (on a 24-hour duration basis). In other words, equalization storage is the volume of water available to meet system demands when demands exceed the capacity of the supply source. Equalization storage also includes the volume of water needed to accommodate pump cycling if a reservoir is used as a pump suction supply and the storage volume needed to allow reservoir cycling to maintain water quality. Equalization storage is generally less expensive to provide than increased pumping and distribution system capacity beyond that required to meet MDD. Standard industry practice indicates that equalization storage equal to approximately 25 percent of a system's MDD is typically sufficient for analysis and planning purposes.

### *Fire Storage*

Fire storage should be provided to meet the single most severe fire flow demand within each pressure zone. The fire storage volume is determined by multiplying the recommended fire flow rate by the expected duration of that flow. Specific fire flow and duration recommendations are discussed later in this section.

### *Emergency Storage*

Emergency storage is often provided to supply water from storage during emergencies such as pipeline failures, equipment failures, power outages or natural disasters. The amount of emergency storage provided can be highly variable depending on an assessment of risk and the desired degree of system reliability. Provisions for emergency storage in other systems vary from none to a volume that would supply a maximum day's flow or higher. Considering the excellent capabilities of City personnel and the resources available locally to respond to emergency situations, a reasonable volume for emergency storage for the water service area is approximately 25 percent of MDD. This amount of storage volume for emergency purposes is consistent with accepted water industry practices and guidelines.

Recommended system wide storage is the sum of the equalization, fire and emergency storage volume components.

## Pump Station Capacity

Pumping capacity requirements vary depending on how much storage is available and the number of pumping facilities serving a particular pressure zone. Firm pumping capacity is defined as a pump station's capacity with the largest pump out of service. Specific criteria for pump stations are presented below based on the number of customers served and whether gravity storage exists for the zone.

### *Pumped Pressure Zone with Gravity Storage*

For pump stations supplying pressure zones with gravity storage available, the station must have adequate firm capacity, which is defined as the capacity of the station with the largest pump out of service, to supply MDD for the zone.

### *Pumped Pressure Zone*

For small pressure zones, typically up to 30 lots, where no opportunity for further water system expansion exists and ultimate development of gravity storage is not feasible; a variable frequency drive (VFD) controlled pump station continuously operating to maintain a constant discharge pressure is recommended. These VFD stations must be capable of supplying peak hour demands to the pressure zone while simultaneously supplying the largest required fire flow in the zone. A typical configuration for this type of station includes three to four pumps as listed below:

- Low-flow Pump (VFD controlled)
- Duty Pump 1 (VFD controlled)
- Duty Pump 2 (VFD controlled)
- High Capacity Pump (for fire flow)

In addition, a hydropneumatic tank may be required for very small pressure zones, typically zones with less than 10 lots, to supply night-time demands without a pump starting. This type of pump station could also be used in locations where future reservoirs will ultimately supply the pressure zone. Pump station control logic should be designed to accommodate this future change. Phasing of pump station improvements that allow for the conversion of constant pressure pump stations to reservoir supply booster pump stations will be presented as part of capital improvement recommendations in Section 6.

### *Backup Pumping*

Backup pumping facilities are needed for continuous operation stations and for pump stations serving pressure zones with inadequate emergency storage capacities. Backup pumping capacity may be in the form of backup power generation with automatic switchover or automatic engine powered pumps.

Pump station design guidelines, including a tool for determining preliminary pump station capacity needs and minimum pump station configuration and appurtenant component designs is included in Appendix C.

**Fire Flow Recommendations**

While the water distribution system provides water for domestic uses, it is also expected to provide water for fire suppression. The amount of water recommended for fire suppression purposes is typically associated with the local building type or land use of a specific location within the distribution system. Fire flow recommendations are typically much greater in magnitude than the maximum day demand present in any local area. Adequate hydraulic capacity must be provided for these potentially large fire flow demands.

Fire protection for the City's service area is provided by the City of Roseburg Fire Department. The fire department has adopted fire flow requirements as defined in the 2007 State of Oregon Fire Code. A summary of fire flow recommendations based on the state fire code, fire flow criteria adopted by similar communities and fire flow guidelines as developed by the AWWA and the Insurance Services Office (ISO) is presented in Table 4-2. Figure D-1 in Appendix D illustrates recommended fire flow requirements throughout the water service area. Water stored for fire suppression is typically provided to meet the single most severe fire flow demand within each zone. The recommended fire storage volume is determined by multiplying the fire flow rate by the duration of that flow. Table 4-3 summarizes fire flow durations recommended by the Oregon State Fire Code.

Table 4-4 summarizes major fire flow requirements at specific locations which were modeled in the distribution system hydraulic analysis of this Master Plan. Further discussion of the computerized hydraulic network analysis of the distribution system is provided in Section 5.

**Table 4-2**
**Summary of Recommended Fire Flows**

| Land Use Type | Required Fire Flow [1] (gpm) |
|---|---|
| Public | 3,000 |
| Parks/Open Space and Hazard Areas | 3,000 |
| Residential Open Space (RO) | 1,500 |
| Low Density Residential | 1,000 |
| Medium Density Residential | 2,000 |
| High Density Residential | 2,500 |
| Professional Office (PO) | 2,500 |
| Private and Semi-Private | 2,500 |
| Commercial | 3,000 |
| Industrial | 3,000 |

Note: 1. Required fire flow based on typical construction type and size for the general zoning designation. Actual fire flow requirements for individual developments may vary.

**Table 4-3**
**Fire Flow Duration Summary**

| Recommended Fire Flow (gpm) | Duration (hours) |
|---|---|
| Less than 3,000 | 2 |
| 3,000 to 3,750 | 3 |
| 4,000 or Greater | 4 |

**Table 4-4**
**Major Fire Flow Requirements at Specific Locations**

| Location | Required Fire Flow (gpm) |
|---|---|
| Schools | 2,500 |
| Hospitals[1] | 3,000 |
| County Fairgrounds | 3,000 |
| Airport | 3,000 |

Note: 1. Per the Roseburg Fire Marshal, the VA Hospital currently requires only 1,500 gpm fire flow, however, as a hospital it is included in this plan with a 3,000 gpm requirement. This increased fire flow did not result in additional recommended improvements during the distribution system analysis.

## Summary

The criteria developed in this section are used in Section 5 to assess the system's ability to provide adequate water service under existing conditions and to guide improvements needed to provide service for future water needs. Planning criteria for the City's pump stations, distribution system, pressure zones and storage facilities are summarized as follows:

- ***Distribution System Criteria:*** The distribution system should be capable of supplying the peak hourly demand while maintaining minimum service pressures of not less than approximately 75 percent of normal system pressures.

- ***System Pressure Criteria:*** Minimum dynamic pressures, at the fixture, within each pressure zone should be at least 30 psi, with a recommended upper limit of approximately 100 psi.

- ***Storage Volume Criteria:*** Recommended storage volume for the City is the sum of the operational, fire and emergency storage components.

- ***Pump Station Capacity:*** When pumping to storage facilities, a firm capacity equal to the pressure zone's maximum day demand is recommended. Pump stations supplying constant pressure service without the benefit of storage should have sufficient firm capacity to meet maximum day demands while simultaneously supplying the largest fire flow demand in the pressure zone.

- ***Fire Flow Criteria:*** The distribution system should be capable of supplying the recommended fire flows while maintaining minimum pressures of 20 psi throughout.

# SECTION 5
# DISTRIBUTION SYSTEM ANALYSIS

## General

This section describes the analysis of the City of Roseburg's (City) water distribution system. The analysis is based on water demands presented in Section 3 and the planning and analysis criteria outlined in Section 4. This section includes a detailed evaluation of the City's distribution system and presents findings of a computerized hydraulic network analysis of the system. Included in the analysis is an evaluation of the system's existing pressure zones, pump stations and storage facilities. The findings and recommendations of this water system analysis are developed into a capital improvement program which is summarized in Section 6.

## Distribution System Analysis

A hydraulic network analysis computer program was used to evaluate the performance of the existing distribution system and to aid in the development of proposed system improvements. The computerized model of the City's water system uses a geographical information systems (GIS) base map of the distribution system and InfoWater hydraulic network analysis software. The purpose of the model is to determine pressure and flow relationships throughout the distribution system for a variety of water system demand and hydraulic conditions. System performance and adequacy is then evaluated on the basis of planning criteria presented in Section 4.

### *Computerized Hydraulic Network Analysis Model*

For modeling purposes, the water distribution system was digitized onto a base map derived from GIS data provided by the City. This file and its supporting database were then used to perform the system analysis and to illustrate recommended improvements. A map of the proposed system improvements discussed in this section is presented as Plate 2 in Appendix A.

All pipes are shown as "links" between "nodes" which represent pipeline junctions or pipe size changes. Pipes and nodes are numbered to allow for easy system updating and revision. These numbers have not been shown on Plate 2 for drawing clarity but are available within the computer model for future use. Diameter and length are specified for each pipe although only pipe diameters are illustrated for drawing clarity. Pipe lengths are drawn to approximate scale. An approximate ground elevation is specified for each node using ground elevation data from available United States Geological Survey (USGS) 10-foot contours for the City's Urban Growth Boundary (UGB) and surrounding area. Hydraulic elements, such as pressure reducing valves, pump stations and reservoirs, are also illustrated and operating parameters are incorporated into the model database. The hydraulic model should be kept current and maintained to assist in design of future water system replacements, upgrades and extensions.

### *Modeling Conditions*

The analysis of the existing and proposed system was performed to assess the distribution system's ability to provide recommended fire flows throughout the system during maximum day demand (MDD) conditions. The system's adequacy under existing demand conditions was evaluated first. Existing water demands for the year 2008, as presented in Section 3, were allocated among the existing water system model nodes based on water customer billing records and service address. The percentage of total water usage allocated to a given node was then used to distribute forecasted average day, maximum day and peak hour demands. 20- and 50-year planning horizons were used in the forecasted demand analysis.

All hydraulic modeling conditions assume that the City's storage reservoir water levels are approximately 10 feet below overflow and that pump stations are operating at firm capacity. Fire flow scenarios test system performance in providing the recommended fire flow to a given location while simultaneously supplying the system-wide MDD and maintaining a minimum residual service pressure of 20 pounds per square inch (psi) at all service meters in the system. Under non-fire flow conditions minimum service pressures should be maintained at 30 psi or greater.

### *Model Calibration*

For a hydraulic network model to provide accurate results under test conditions the model is calibrated with field measured data to ensure that modeled conditions reflect actual system operation. Model calibration was performed using fire hydrant flow test data gathered by City staff. Data from the fire hydrant flow tests were compared to pressure and flow results obtained from modeled demands placed at the same location. Calibration is generally considered successful when pressures measured during hydrant flow tests are within five to 10 percent of the hydraulic model. A detailed overview of the model calibration process is presented in Appendix E.

### *Distribution System Hydraulic Analysis Findings*

The calibrated distribution system model is used to evaluate the system's ability to supply various demands while meeting the criteria presented in Section 4. Customer demand and usage characteristics in the City's water distribution system will vary both over the course of a day and throughout the year. Four demand conditions are used to evaluate the system in meeting the criteria presented under both existing and future conditions. These demand conditions are:

1. Average day demand (ADD)
2. Maximum day demand (MDD)
3. Maximum day demand plus fire (MDD+FF)
4. Peak hour demand (PHD)

These demand conditions were developed and presented in Sections 3 and 4 and will be used to evaluate the distribution system for existing deficiencies and to analyze system expansion needs.

*Existing Conditions*

The analysis found that under existing conditions the system generally performed adequately under all four of the demand conditions except under MDD+FF conditions. Under both MDD and PHD conditions, a small number of services over elevation 610 feet experience pressures below 30 psi. A discussion of specific system performance deficiencies under the MDD+FF condition is presented as follows:

Main Pressure Zone – North of Downtown

While the analysis found that the distribution system in the Main Pressure Zone generally maintained a minimum system residual pressure of 20 psi or greater and flow velocities less than 10 feet per second (fps) it was found that distribution main improvements are needed to maintain minimum system pressures under MDD + FF conditions. Services in the Main Zone above 610 feet in elevation will experience pressures below 20 psi under MDD+FF conditions in the north end of the system.

Broad Street

The analysis found that some services on Broad Street above 610 feet in elevation experience pressures below 20 psi under MDD + FF conditions. In addition, this area has a single 8-inch diameter main connecting it to the Main pressure zone.

South Downtown

Recent completed distribution system improvements to SE Booth Avenue improved the system's ability to maintain adequate system pressures under MDD+FF conditions. The analysis did find system pressures below 20 psi still occur and that the hydraulic capacity of the distribution piping to the area is inadequate. Similarly, the distribution system between SE Arizona Street and SE Parrott Street cannot provide the 3,000 gpm fire flow need while maintaining adequate system pressures.

Golden Eagle Pressure Zone

Water for emergency fire suppression to the Golden Eagle pressure zone is currently supplied from hydrants connected to the Main pressure zone. The analysis found that the distribution system cannot provide the recommended fire flow from the Main pressure zone in this area while maintaining adequate residual pressures. Additionally, a single water main serves this area, leaving it vulnerable to loss of service if a break occurs on this line.

A number of smaller existing pressure zones served by pump stations without the benefit of gravity storage supply domestic demands at adequate pressure but do not have adequate fire flow capacity. Most of these small pressure zones receive fire service from nearby hydrants located in the Main pressure zone. These include:

- Golden Eagle
- Dogwood
- Isabell
- Kane PS
- Winchester Creek
- Joanne Street

Improvements to correct these specific pressure zone deficiencies are presented and discussed in the pressure zone analysis findings. Generally, these small pressure zones will be incorporated into the larger service area of existing or new pressure zones.

*Future Demand Conditions*

For the analysis of the system under future conditions the estimated future water demand developed in Section 3 were spatially distributed according to zone size over the City's ultimate water service area within the UGB and identified potential expansion areas. Improvements were then developed and evaluated to serve new areas within the UGB and expansion areas where increased demands associated with infill development resulted in system deficiencies and to correct the deficiencies found through the analysis of the existing system presented above. Improvements were not identified for developable areas outside the UGB and potential expansion areas.

In order to analyze and plan for future development throughout the UGB and expansion areas, modifications to existing pressure zones, including adjustment of pressure zone boundaries, merging of adjacent boundaries and establishment of new pressure zones were evaluated and recommendations for reconfiguring existing zones and adding new zones presented. These improvements are developed based on the technical system performance criteria presented in Section 4 and achieve the following objectives:

- Provide reliable service to all customers
- Assure adequate pressures under all demand conditions
- Maximize the efficient use of existing facilities

Piping improvements developed through the analysis of the distribution system under estimated future demand conditions generally are intended to perform with flow velocities of less than 10 fps under fire flow conditions. To achieve the system performance criteria presented in Section 4 proposed distribution mains are sized at a minimum of 8 inches in diameter and connected or looped whenever possible. Similarly, where a pressure zone is served only by a pressure reducing valve (PRV), PRV stations should be located at both ends of the zone for reliability and redundancy.

Where water system piping is being planned for currently undeveloped areas and the details of future developments, such as the location of future roads, is not currently known proposed pipeline alignments are illustrated in a conceptual manner anticipating that as development occurs the planned alignments will become more defined. It is recommended that proposed developments undergo a review process in which the actual fire flow requirement and proposed pipelines are further evaluated to confirm that the proposed system improvements meets the system performance criteria presented in Section 4.

**Transmission System Analysis**

An analysis of the City of Roseburg's transmission system was completed to assess the capacity and condition of these existing critical pipelines in the water system. Transmission piping in the City's water system is generally pipes larger than 12-inches in diameter with few or no service connections whose primary purpose is to transmit water from the Winchester Water Treatment Plant to the storage reservoirs in the Main pressure zone and similar piping throughout the Main pressure zone extending from the Main Reservoir complex in the center of town south, east and west to the edges of the water service area.

***Capacity Analysis***

The results of the hydraulic network analysis indicate that the capacity of the major transmission system piping in the system is generally adequate for current conditions. Under future demand conditions, the hydraulic capacity of transmission piping between the Water Treatment Plant and the Main Reservoir complex will experience velocities in excess of 5 feet per second (fps). As stated in Section 4, 5 fps is the maximum recommended velocity in a transmission main under normal operation and demand conditions. In addition, the hydraulic capacity of other transmission piping in the Main pressure zone is inadequate to maintain balanced reservoir cycling throughout the Main pressure zone under maximum day demand conditions with the future construction of Starmer Reservoir and development in the Charter Oaks area.

***Corrosion Protection Systems Analysis***

As presented in Section 2 the City's water system includes two major steel transmission mains referred to as Transmission Main Nos. 1 and 2. Transmission No. 1 includes 20-inch and 24-inch diameter steel piping extending from the Winchester Water Treatment Plant south to the Main Zone reservoir complex on NE Bellview Court installed in the late 1930s and early 1960s. Transmission Main No. 2 is a 30-inch diameter steel pipe installed in 1981. This main runs from Hooker Road and the northerly end of the Airport. The system's existing corrosion protection systems were also evaluated. A discussion of these analyses and findings is presented as follows.

*Pipeline Corrosion*

All buried metal structures may be susceptible to corrosion due to the properties of the surrounding soil, differences in material or coating of adjacent buried metal structures and possible stray currents in the soil. Corrosion of a metal is an electrochemical reaction between the metal and its environment whereby electrons are transferred from the metal through an electrolyte, such as soil or water, and back to the metal thereby making a complete circuit. The area where the electrons leave the metal is called an anode, over time this area will be consumed or corroded. The area where the electrons re-enter the metal after traveling through the soil is called the cathode, this area is protected in a corrosion reaction. Corrosion protection of a buried pipeline generally consists of a pipe coating to prevent soil and water contact with the metal surface of the pipe and a cathodic protection system.

*Cathodic Protection Systems*

As described in Section 2 the City's existing water transmission mains, Nos. 1 and 2, have existing corrosion protection (CP) systems. The CP system uses an electrochemical method of reducing or preventing corrosion of a metal by making the metal a cathode to its environment. This can be accomplished by providing direct current (DC) flow to the metal surface from expendable or inert materials (sacrificial anodes).

The two methods of applying cathodic protection are galvanic anodes (GACP) and impressed current (ICCP) systems. GACP systems use the electrochemical difference between two metals to generate DC electrical current. In these systems sacrificial anodes of zinc or magnesium are connected to the metal structure being protected to create a circuit. The sacrificial anodes are designed to corrode preferentially so that the protected structure remains free of corrosion. ICCP systems use an external source of DC electrical current to make the protected structure a cathode relative to another metal buried in the soil.

In order for CP systems to work effectively on buried water mains, they require electrical continuity of the protected pipe, electrical isolation from metal structures not intended to be protected and test stations to monitor CP system performance. Electrical continuity is created between bell and spigot or mechanical pipe joints using joint bonds, welded steel pipes are electrically continuous.

*Transmission Main No. 1*

The 20-inch and 24-inch diameter sections of the this transmission main were constructed in 1934-1936 and 1953-1955 respectively with a 40 mil thick coal tar enamel coating and felt wrap. The 40 mil thick felt wrap is primarily used to protect the coating from rock chips. A GACP system was installed on this transmission main between 1981 and 1986. The section of 24-inch diameter main from Garden Valley Boulevard to the reservoir complex was replaced with polyethylene encased ductile iron pipe and no CP system between 1999 and 2000. All interconnections, such as distribution mains and services, are electrically isolated from the transmission main. The CP system on the Transmission Main No. 1 is divided into five sections using isolation joints to simplify troubleshooting if one section of the pipeline loses protection.

*Transmission Main No. 2*

Transmission Main No.2 was installed with a 40 mil thick coal tar enamel coating, felt wrap and a GACP system. In 2005, a 560-foot section of this main was relocated and replaced with a polyethylene encased ductile iron pipe with a GACP system. The pipe encasement is 4 mil-thick cross-laminated high density polyethylene. All interconnections, such as distribution mains and services, are electrically isolated from the transmission main. A section north of the airport was also replaced with 30-inch outside diameter steel pipe with a polyken wrap.

Approximately 200 feet of coated steel pipe from the treatment plant to Pioneer Way does not have a CP system. Between Pioneer Way and Hooker Road, the transmission main is ductile iron, this section of main does not have a CP system.

*Transmission Main CP Assessment Findings*

Overall the existing corrosion protection on the City's transmission mains is in fair condition. The existing test stations are in need of maintenance and it is recommended that the anode system be upgraded as soon as possible. The anodes on the 20/24-inch diameter Transmission Main No. 1 appear to have reached the end of their service life. Although some of the anodes can remain in service for a few more years, they are not adequate to protect the full length of the pipe. If the City continues with plans to relocate and replace 24-inch diameter transmission mains at the reservoir complex in the future, anodes protecting this existing line would not need to be replaced. The anodes on the 30-inch diameter Transmission Main No. 2 will continue to be adequate for approximately 3 to 5 years before requiring replacement. An ICCP system would likely be the most economical replacement as it could be installed and used protect both transmission mains.

***Transmission System Recommendations***

Based on the age, condition and hydraulic limitations of the 20-inch diameter Transmission Main No. 1 it is recommended that the City begin a phased replacement of this transmission main with new 24-inch diameter transmission piping. Upgrade and installation of a new ICCP system on the southerly segments of this transmission main that are not scheduled for replacement in the next one to five years should be completed to preserve the remaining life of segments of the steel transmission main to remain in service.

Additional transmission system improvements in the Main pressure zone to facilitate reservoir fill and balanced cycling under future peak demand conditions are presented on Plate 2.

It is recommended that the existing CP systems on both transmission mains be tested annually to monitor the level of pipe protection. Additional testing is also needed to determine the amount of current needed to bring the CP system up to adequate protection levels. It is recommended that a ICCP system be installed on both the ductile iron pipe installed in 1999 between Garden Valley Boulevard and the reservoir complex and on the 30-inch diameter steel main at the treatment plant. The ductile iron main is encased in polyethylene but the joints are not bounded. A preliminary engineering study is recommended to establish a detailed program for replacement of the CP system and analysis of the most appropriate CP system on both transmission mains.

**Pressure Zone Analysis**

The proposed pressure zone modifications and additions are tabulated in Table 5-1 which provides a general overview of the relationship between existing pressure zones and recommended future pressure zones. Also presented is a brief discussed of each of the proposed or modified zones. Recommended pumping and storage facilities to serve the proposed and modified pressure zones are discussed later in this section.

***East Hills Nos. 1 and 2 Pressure Zones***

It is recommended that the upper service fixture elevation limit for the Main pressure zone be 610 feet. Areas that have developed above this elevation should be incorporated into existing or future higher elevation pressure zones that serve adjacent hillside areas. As shown on Plate 2, these areas on the east side of the Main pressure zone should be consolidated and incorporated into the proposed East Hills pressure zones. These proposed pressure zones extend south from the Winchester Creek area along the eastern limits of the existing water system and include proposed transmission mains that connect the existing Rocky Ridge Reservoir and the proposed Newton Creek Reservoir and East Hills Reservoir. The overflow elevation of these proposed storage facilities should be the same as the Rocky Ridge Reservoir. The maximum hydraulic grade line (HGL) of the proposed East Hills pressure zones will be approximately 1,015 feet. The higher elevation pressure zone, East Hills No. 1, will serve elevations between approximately 755 and 915 feet. The East Hills No. 2 pressure zone will be supplied by PRV stations from the East Hills No. 1 pressure zone at an approximate HGL of 847 feet and will serve elevations ranging from approximately 610 feet to 755 feet. Supply to existing and proposed storage facilities serving this pressure zone will be by the Garden Valley Pump Station and, the proposed Newton Creek Pump Station. The proposed East Hills pressure zones will supply the existing Rifle Range, Isabell and Joanne pressure zones, allowing the pumping station serving these pressure zones to be abandoned. The Rocky Ridge, Rocky Ridge PRV and Rocky Drive PRV pressure zones will also be incorporated into these new pressure zones.

A portion of the undeveloped area north of the existing Joanne Zone is at a higher elevation than can be served by the East Hills Pressure Zones. It is recommended that these areas be served by a new VFD-type station. It is anticipated that pumping facilities will be sited and funded with future residential development in this area.

The areas above an elevation of 610 feet north of Davis Creek Way along the eastern edge of the UGB extending to the North Umpqua River cannot practically or economically be connected with transmission piping to the East Hills pressure zones. As such, service to these areas should be provided by local pumping stations similar to the existing Winchester

**Table 5-1**
**Proposed Pressure Zone Summary**

| Existing Pressure Zone | Proposed or Modified Pressure Zone | Static HGL (feet) | Comment |
|---|---|---|---|
| Winchester Creek | Winchester Creek | 837 | Area north of East Hills pressure zones served by local pumping facilities |
| Rocky Ridge | East Hills Nos. 1 and 2 | 1: 1,015<br>2: 847 | Recommend consolidation of existing zones into one zone |
| Rocky Ridge PRV | | | |
| Rocky Drive PRV | | | |
| Joanne | | | |
| Isabell | | | |
| Rifle Range | | | |
| Main | | | |
| Broccoli | Main | 710 | Recommend consolidation of existing zones into one zone |
| Fairhill | | | |
| Dogwood | Fairhill Nos. 1 and 2 | 1:1,015<br>2:847 | |
| West Military | Dogwood | 819 | |
| Warewood | West Military | 830 | |
| Crystal Vista/Gibby | Stacie Ct. Nos. 1 and 2 | 1: 938<br>2: 798 | Recommend Expand and Restructure |
| | West Ridge Nos. 1 and 2 | 1: 1,200<br>2: 1,056 | |
| Ventura | Crystal Vista(CV)/ Gibby(G) | G: 1,175<br>CV: 1,004 | |
| Summit | Ventura | 920 | |
| Terrace | Summit Nos. 1 and 2 | 1: 1,270<br>2: 1,120 | |
| Golden Eagle | Terrace Nos. 1 and 2 | 1: 1,018.7<br>2: 850 | Recommend consolidation of existing zones into one zone |
| Kane PRV | | | |
| Kane PS | | | |
| No Existing Service | Mt. Rose Nos. 1 and 2 | 1: 1,280<br>2: 1,132 | |
| | West A and B (may be combined) | A: 760<br>B: 760 | |
| | SE Hills Nos. 1 and 2 | 1: 900<br>2: 800 | |
| | Hooker Nos. 1 and 2 | 1: 978<br>2: 900 | |
| | Charter Oaks Hill | 860 | |
| | South Hills | 910 | |

Creek service area where possible, transmission piping should be installed and pump stations configured for service to more than one development.

### *Main Pressure Zone*

It is recommended that the closed valves isolating the Broccoli pressure zone from the Main pressure zone be opened and this area incorporated into the Main pressure zone to allow for improved distribution and fire flows. This pressure zone modification should be completed in coordination with abandonment of the Military Reservoir, which provides gravity service to the Broccoli pressure zone and after construction of proposed Main pressure zone storage. The ultimate timing of the abandonment of the Military Reservoir should be based on limiting anticipated future maintenance costs.

#### *Charter Oaks Area*

The largest future growth in the Main pressure zone is anticipated in the Charter Oaks area on the western border of the UGB, just north of the South Umpqua River. Required fire flows in this area are assumed to be 2,500 gpm in order to serve a proposed school. Construction of additional Main pressure zone storage facilities is recommended to serve this area as it develops. The proposed Charter Oaks Reservoir would be located on one of three hills in the area with an overflow elevation of 710 feet to match the other Main pressure zone storage reservoirs.

The potential UGB expansion area located west of the current UGB and north of Garden Valley Boulevard is currently being served by the Umpqua Basin Water Association (UBWA) system by its Ware Reservoir (0.75 MG, O.E. 702.6'). It is proposed that UBWA continue serving this area by IGA as the area is taken into the UGB and developed, subject to the service requirements listed in Section 4.

#### *Supply to Dixonville Service Area*

On the eastern edge of the Main pressure zone, the City has made recent improvements to the distribution system and valves. Based on observations by City staff and the findings of this analysis, these improvements allow the Boyer Reservoir to fill adequately under peak demand conditions by gravity from the Main pressure zone without the use of Dixonville Pump Station No. 1. If the system continues to perform adequately without the use of the Dixonville Pump Station No. 1 to fill the Boyer Reservoir for two or more high-demand seasons, the City should plan to abandon this pump station.

### *Fairhill Pressure Zones*

As development occurs against the northern limits of the UGB in the Fairhill pressure zone, this zone should be split into two service levels, Fairhill Nos. 1 and 2. Fairhill No. 2 pressure zone will be supplied from Fairhill No. 1 through PRV connections. The Fairhill Pump Station will require upgrades to pump to the higher elevation Fairhill No. 1 pressure zone.

### *Dogwood Pressure Zone*

As infill development occurs above 610 foot elevation around the existing Dogwood pressure zone, the boundary of this zone should be expanded to serve this entire higher elevation area within the Main pressure zone. It is recommended that the Dogwood Pump Station be abandoned and replaced with a new VFD-type pump station, the proposed Vermillion Court Pump Station, supplied from the Main pressure zone distribution system piping to the northeast of the Dogwood pressure zone.

### *Warewood and Proposed Stacie Court and West Ridge Pressure Zones*

It is recommended that the existing Warewood pressure zone be expanded and reorganized into two zones, Stacie Court Nos. 1 and 2 to achieve pressures closer to the pressure zone planning criteria limits. The Stacie Court No. 1 pressure zone will serve customers between approximately 710 and 837 feet at a maximum HGL of approximately 938 feet. The Stacie Court No. 2 pressure zone will serve customers with an HGL of approximately 798 feet between the upper limit of the Main pressure zone at approximately 610 feet and 710 feet. The existing Stacie Court Reservoir will supply gravity service to Stacie Court No.1 with supply from the existing Kline Pump Station and PRV connections will reduce the HGL from Stacie Court No. 1 pressure zone to Stacie Court No. 2.

In order to serve higher elevation areas along the ridge above the Stacie Court No. 1 pressure zone service area, two new pressure zones are recommended, West Ridge Nos. 1 and 2. West Ridge No. 1 will serve customer between approximately 964 and 1,090 feet in elevation with a maximum hydraulic grade of 1,200 feet. West Ridge No. 2 will serve customers between approximately 837 and 964 feet through PRV connections from West Ridge No. 1 at an HGL of approximately 1,056 feet. New pumping facilities, the proposed West Ridge Pump Station at the Stacie Court Reservoir site and new storage facilities, the proposed West Ridge Reservoir, with an overflow elevation of 1,200 feet will serve these proposed pressure zones.

An alternative for service to this area is to develop a supply agreement with UBWA for supply. The UBWA has three storage reservoirs located near to the proposed West Ridge Reservoir, the 0.75 million gallon (MG) concrete Ware Reservoir, the 0.063 MG steel Ridgeview Reservoir and the 0.20 MG Moorea Reservoir. These reservoirs, shown on Plate 2 in the Appendix A, have overflow elevations of 702.6 feet, 1,040.3 feet and 1,292 feet, respectively. Service to this area could be supplied from existing UBWA facilities with slight upgrading. For the purposes of this plan it is assumed that the City of Roseburg will construct new pumping and storage facilities to serve the proposed West Ridge pressure zones.

The existing services west of Broad Street to the UGB that are above approximately 610 feet in elevation should ultimately be served by the Stacie Court No. 2 pressure zone. Construction of the distribution main needed to serve this area may be challenging due to land ownership and topography. Further development in this area should be restricted to fixture elevations below 610 feet unless future development plans incorporate extension of distribution piping from the Stacie Court No. 2 pressure zone for water service.

*Ventura, Gibby and Crystal Vista Pressure Zones*

The boundary of the Ventura pressure zone should be expanded to serve surrounding areas at fixture elevations above the upper limit of the Main pressure zone, approximately 610 feet. One PRV connections from this zone to the Main pressure zone is proposed to improve fire flow capacity locally in the Main pressure zone near to the existing Rifle Range Pump Station.

*Summit and Terrace Pressure Zones*

At the southern end of the system are the existing Terrace, Summit, Bruce and Kane PRV pressure zones. It is recommended that the boundaries of these zones be adjusted to achieve pressures closer to the service pressure criteria range recommendations in Section 4 and also incorporate the Golden Eagle and Bruce pressure zones, allowing the undersized Golden Eagle Pump Station and Kane Street Pump Station to be abandoned.

The expanded Summit pressure zones will be served by an upgraded Terrace Pump Station, with increased pumping head to deliver water to a higher HGL, and the proposed Powerline Reservoir with an overflow elevation 1,270 feet. Summit No. 1 pressure zone will serve customers at ground elevations between 1,054 feet and 1,170 feet from the proposed Poweline Reservoir with a maximum hydraulic grade of 1,150 feet. Summit No. 2 pressure zone will serve customers at elevations between 920 and 1,054 feet from PRV connections to Summit No. 1 at a reduced HGL of 1,120 feet.

The Terrace pressure zone should be split into Terrace Nos. 1 and 2 and the boundary of these two pressure zones expanded to include the areas within the Bruce, Kane PRV and Golden Eagle pressure zones. A new segment of dedicated pump station discharge transmission main will be required to connect the upgraded Hawthorne Pump Station with the Terrace Drive No. 1 pressure zone and the existing Terrace Reservoir. The Terrace No. 1 pressure zone will serve customers between approximately 920 and 754 feet at a maximum HGL of approximately 1,016 feet. The Terrace No. 2 pressure zone will serve customers with an HGL of approximately 850 feet between the upper limit of the Main pressure zone at approximately 610 feet and 754 feet.

*West Pressure Zones*

Two small, high-elevation areas exist north of the Charter Oaks area in the Main pressure zone, referred to as West A and West B pressure zones. It is recommended that these areas be served by VFD-type pump stations, the proposed West A Pump Station and the proposed West B Pump Station, with suction supply from the Main pressure zone. Both pressure zones will serve customers above 610 feet in elevation with the maximum discharge hydraulic grade of the pump stations designed to provide a minimum static pressure at the highest service in the pressure zone of 30 psi. Based on topographic data available, the maximum hydraulic grade will be approximately 760 feet, allowing for a maximum service elevation of 690 feet. Depending on the actual development, configuration, and detailed topographic information, fire flow to the west pressure zones may be provided from nearby hydrants located in the Main pressure zone.

### *Mt. Rose Pressure Zones*

The proposed high-elevation Mt. Rose pressure zones in the hills to the east of the existing City system will serve elevations above approximately 915 feet. The proposed Mt. Rose Reservoir will serve the Mt. Rose No. 1 pressure zone by gravity with an overflow elevation of approximately 1,280 feet. Mt. Rose No. 1 will serve customers at elevations between approximately 1,170 and 1,040 feet. The proposed reservoir will be filled by the proposed Mt. Rose Pump Station that will draw suction supply from the proposed Newton Creek Reservoir. The Mt. Rose No. 2 pressure zone will reduce the HGL to approximately 1,132 feet through PRV stations to serve customers between approximately 1,040 and 915 feet.

### *SE Hills Pressure Zones*

A small, high-elevation area exists in the south of the system, referred to as SE Hills Nos. 1 and 2 pressure zones. It is recommended that these areas be served by a VFD-type pump station, the proposed SE Hills Pump Station, with suction supply from the Main pressure zone. The SE Hills No. 1 pressure zone will serve customers between approximately 730 and 830 feet at a maximum HGL of approximately 900 feet. The SE Hills No. 2 pressure zone will serve customers at a reduced HGL of approximately 800 feet through PRV connections between the upper limit of the Main pressure zone at approximately 610 feet and 730 feet.

### *Hooker Pressure Zones*

There are two alternatives to serve the higher elevation area west of Hooker Road, referred to as Hooker Nos. 1 and 2. A high pressure East Hills No. 1 pressure zone pipeline can be extended west across the Main pressure zone to serve this area or a VFD-type station can be constructed to serve this area supplied from the Main pressure zone. For the purposes of this analysis it is recommended that a VFD-type pump station, the proposed Hooker Pump Station, be constructed to serve the proposed Hooker Nos. 1 and 2 pressure zones. The Hooker No. 1 pressure zone will serve customers between approximately 830 and 908 feet at a maximum HGL of approximately 978 feet. The Hooker No. 2 pressure zone will serve customers with an HGL of approximately 900 feet between the upper limit of the Main pressure zone at approximately 610 feet and 830 feet.

### *Charter Oaks Hill Pressure Zone*

A new VFD-type pump station, the proposed Charter Hills Pump Station located at the site of the proposed Charter Hills Reservoir, is recommended to serve the Charter Oaks Hill area within the Main pressure zone in the Charter Oaks area. The Charter Oaks Hill pressure zone will serve customers with an HGL of approximately 860 feet between the upper limit of the Main pressure zone at approximately 610 feet and 754 feet.

### *South Hills Pressure Zone*

A small, high-elevation area exists in the south of the system, referred to as the South Hills pressure zone. It is recommended that this area be served by a VFD-type pump station, the proposed South Hills Pump Station, with suction supply from the Terrace No. 2 pressure zone. The South Hills pressure zone will serve customers between approximately 754 and 842 feet at a maximum HGL of approximately 910 feet. It is anticipated that improvements to serve this small, high-elevation area will be entirely developer funded and such improvements are not included in the CIP presented in Section 6.

### *North UGB Area – Main Pressure Zone*

The area within the City's existing UGB, north of the North Umpqua River is currently within the UBWA service boundary. By agreement dated May 2008 entitled URBAN SERVICE AGREEMENT between City of Roseburg, Douglas County, and Umpqua Basin Water Association, the City has provided for water service to this area by recognizing UBWA as the water service provider.

Alternatives for long-term supply of urban domestic and fire service to the industrial UGB area north of the North Umpqua River include:

(1) UBWA continuing to provide water service on long-term basis. UBWA would need to construct transmission, storage and distribution system improvements to provide sufficient domestic and fire flows for industrial development. The area would be supplied by UBWA water, supply transmission and storage facilities providing a static HGL of 699 feet.

(2) The City of Roseburg could construct transmission, storage, distribution and control system improvements to provide sufficient domestic and fire flows for industrial development. A brief summary of the improvements required was addressed in Long Range Water Supply Program Report (MSA, July 2009), and is shown on Plate 2 of this master plan. The area would be supplied by City source and treatment facilities under city water rights,. If the area is served directly by the City with no storage on the north side of the river, dual redundant transmission mains under the river are recommended to provide reliability in the event that one main is out of service.

(3) City and UBWA can jointly supply the area with UBWA transmission, storage facilities, and a backup redundant connection to City piping as a backup intertie for emergencies.

Regardless of which system distributes water to the area north of the North Umpqua River, the City's current policy uses water service as an incentive for annexation to the City and regulation of development. The City can continue this policy if UBWA is the actual provider of water service by agreement with the City. Also, the City's standards for service are more restrictive than those of UBWA, and should apply to this area regardless of the actual water service provider. The City also has abilities not available to UBWA to finance improvements, such as local improvement districts, grants, bonds or other types of participation, and may contribute towards improvements as it would if it were served by the City's system.

Approximately 25 acres within the UGB north of the river are between approximately 610 feet and 755 feet in elevation. This area identified as the North pressure zone could be served by a new VFD-type pump station, the proposed North Pump Station, if service is provided from the City System.

Recommendations and proposed capital improvement projects presented in Section 6 reflect ultimate water service to this area by the City of Roseburg. It is understood that the area boundary modifications and timing of improvements to extend water service to this area will be further refined outside of this master plan.

**Storage Capacity Analysis**

As discussed in Section 4, the total volume of storage required for the City's distribution system includes the combined components of equalization storage, emergency storage and storage for fire suppression. The existing distribution system was analyzed using these storage criteria under existing and future conditions.

The analysis found that under existing conditions a number of existing pressures zones have inadequate storage capacities while the system's overall storage capacity is adequate. Table 5-2 summarizes storage requirements for the existing system by pressure zone.

Storage capacity needs were also evaluated for the 20-year planning horizon to determine water storage needs by pressure zone in order to meet future water demands. Table 5-3 summarizes the findings of the storage analysis for the 20-year planning horizon. The storage capacity analysis under future conditions was completed in coordination with the previously presented pressure zone analysis which combined, expanded and added pressure zones to provide for ultimate service to the City's future water service area. As previously presented a number of smaller existing pressure zones are proposed to be combined into larger consolidated pressure zones. The analysis determined the storage capacity needs for these zones as well as existing pressure zones. Table 5-3 presents a summary of recommended storage reservoirs. For those zones where service from more than one storage reservoir is not practical given the limited size of the zone, recommended storage reservoir capacities are based on the year 2058 demand for the pressure zone to ensure that facilities are not undersized for the ultimate pressure zone need. A summary of year 2058 storage volume requirements by pressure zone is included as Table 1 in Appendix F. It is recommended that seven storage reservoirs, with a total volume of approximately 4.35 MG be constructed in the 20-year planning horizon to meet forecasted storage deficits and provide service to additional high elevation areas within the City. The timing of these reservoir improvements will depend on actual population growth rates and development patterns within the City's water service area.

Recommended storage for areas north of the North Umpqua River within the UGB, Main North and North pressure zones, is excluded from the evaluation of total storage system-wide because it is currently part of the Umpqua Basin Water Association service area.

### *Storage Reservoir Coating Systems*

#### *Existing Conditions Summary*

A visual assessment of the coating systems for the City's existing water storage reservoirs was completed and the findings of the assessment for each reservoir presented in Section 2. The City has 10 existing welded steel reservoirs with interior and exterior coating systems. In general, coating systems have a life expectancy of 10 to 15 years depending on exposure, quality of installation and other environmental factors. If a cathodic protection system is place, typically in the form of impressed current, the expected life of coating systems can by extended an additional five to 10 years. Seven of the 10 welded steel reservoirs in the City's system have existing cathodic protection systems. The existing condition of the reservoir coating systems varies from new and in good condition to satisfactory condition with some signs of coating degradation and rust.

#### *Assessment Findings*

A list of key findings from the assessment is presented below:

- The coating systems on the existing welded steel storage reservoirs are all generally in good condition. General preventative maintenance should be completed at several of the reservoirs to remove moss growth and repair the sealant between the footing and reservoir floor.
- Cathodic protection systems have been shown to extend the life of coating systems significantly and should be considered as improvements at the remaining three welded steel reservoirs, Stacie Court, Boyer, and Grange Reservoirs, in coordination with future re-coating projects. All new welded steel reservoirs should include cathodic protection systems.
- The City should plan for routine re-coating of reservoirs and maintenance of the cathodic protection systems. It is recommended that the City plan to complete a reservoir re-coating project every two years, allowing for the complete replacement of all coating systems on a 20-year cycle. The actual timing of specific re-coating projects will depend on actual coating performance and should be based on inspections of drained tanks or by use of sanitized drivers every three to five years.

## Pump Station Capacity Analysis

As discussed previously, the City's water system consists of 22 existing pressure zones. Pumping facilities supply 19 of these pressure zones either with or without the benefit of gravity storage. The recommended system improvements discussed previously in this section include modifications to pressure zone boundaries and the creation of new pressure zones. Recommended construction of new pumping facilities and abandonment or upgrade of existing pumping facilities associated with restructuring of pressure zones or supply to new gravity storage facilities were outlined in the distribution system analysis.

Based on the criteria presented in Section 4, an analysis of the required capacity of the existing and proposed pumping facilities is presented in Table 5-4. As outlined in Section 4, firm pumping capacity is defined as a pump station's capacity with the largest pump out of service. A firm pumping capacity equal to the MDD of the pressure zone served by that pump station is recommended for pump stations that are pumping to a storage facility. The recommended firm pumping capacity for pump stations that provide service to pressure zones without the benefit of gravity storage is equal to the MDD of the pressure zone served by that pump station plus the largest required fire flow within the zone. Based on demand projections in 2058, it is anticipated that some pump stations will need additional capacity beyond the 20-year planning horizon. It is recommended that these pump station buildings, manifolds and piping be sized to allow future expansion with additional pumps. A summary of 2058 forecasted pump station capacity requirements is included as Table 2 in Appendix F.

**Pressure Reducing Valve Analysis**

PRV stations in the Roseburg system are located to reduce service pressures to acceptable levels for pressure zones that are at elevations below the level serviceable by adjacent gravity storage facilities. As the City expands service to new areas above the Main pressure zone, it is anticipated that several small zones above the service elevation of the Main pressure zone but below larger, high-elevation zones with gravity storage facilities will be served through PRVs. As development of these new pressure zones occurs, the City should consider the following guidelines for pressure reducing valve station configuration:

- A pressure zone served solely through PRVs from a higher level pressure zone should be supplied from two PRV stations with the same flow capacity to provide redundant supply to the zone.
- Each PRV station should be configured with at least two globe-style PRVs.
    - The first valve is a small "bypass" valve sized to adequately reduce pressure to the desired level while supplying pressure zone demands ranging from night-time minimum flows up to peak season demands. Typically, a 2- to 3-inch diameter valve.
    - The second "main" valve should be sized to supply demands in excess of maximum day demand, including peak hour demand and the required fire flow for the pressure zone. Typically, a 6- to 10-inch diameter valve.
    - If the range of flows cannot be supplied from two valves, the station should be configured with three valves to cover the full range of flows expected.

**Table 5-2**
**Existing System Storage Analysis Summary under Current Conditions**

| Pressure Zone (Existing Storage) | Storage Component (gallons) | | | Storage Required (mg)[4] | Existing Storage (mg) | Zone Surplus / (Deficit) (mg) | Current Storage Need (mg) |
|---|---|---|---|---|---|---|---|
| | Operational | Fire | Emergency | | | | |
| Winchester Creek[1,5] | 3,041 | -- | 3,041 | 0.19 | -- | -- | 0.19 |
| Isabell[1] | Pressure zone serves only three homes | | | -- | -- | -- | - |
| Joanne[2] | 14,596 | 120,000 | 14,596 | 0.15 | -- | -- | 0.15 |
| Main (Nos. 5, 6, 7, Fairhill, Kline) | 2,189,372 | 1,080,000 | 2,189,372 | 5.46 | 7.35 | 1.89 | -- |
| Warewood (Stacie Ct.) | 26,354 | 180,000 | 26,354 | 0.23 | 0.30 | 0.07 | -- |
| Dogwood[1,5] | 608 | -- | 608 | -- | -- | -- | -- |
| Rocky PRV (Rocky)<br>Rocky Tank (Rocky)<br>Rocky Ridge PRV (Rocky) | 103,387 | 630,000 | 103,387 | 0.84 | 1.00 | 0.16 | -- |
| Broccoli (Military) | 14,190 | 180,000 | 14,190 | 0.21 | 0.50 | 0.29 | -- |
| W. Military[2,5] | 3,041 | -- | 3,041 | 0.01 | -- | -- | 0.01 |
| Fairhill[3,5] | 2,027 | 120,000 | 2,027 | -- | -- | -- | - |
| Kane PS[3] | 203 | 120,000 | 203 | 0.12 | -- | -- | 0.12 |
| Terrace (Terrace)<br>Kane PRV (Terrace) | 44,598 | 240,000 | 44,598 | 0.33 | 0.80 | 0.47 | -- |
| Golden Eagle[3,5] | 4,054 | -- | 4,054 | 0.01 | -- | -- | 0.01 |
| Summit[1] | 9,122 | 120,000 | 9,122 | 0.14 | -- | -- | 0.14 |
| Rifle Range[1] | 608 | 120,000 | 608 | 0.12 | -- | -- | 0.12 |
| Ventura (Frontier Lane) | 7,095 | 120,000 | 7,095 | 0.13 | 0.15 | 0.02 | -- |
| Crystal Vista[1,6]/Gibby[2,6] | 4,257 | -- | 4,257 | 0.01 | -- | -- | 0.01 |
| Stacie Ridge | Served by master meter connection from Umpqua Basin Water Association | | | -- | -- | -- | -- |
| **Total (Cumulative Basis)** | | | | **7.95** | **10.10** | -- | -- |

Notes:
1. Pressure zone served by H-type station. See Section 2 for definition.
2. Pressure zone served by B-type station. See Section 2 for definition.
3. Pressure zone served by V-type station. See Section 2 for definition.
4. Storage required is not calculated for small pressure zones, those with less than 50 services that are currently served without gravity storage. Storage needs are included in the system-wide storage surplus/(deficit) column.
5. Fire flow is provided from the Main pressure zone.
6. Fire flow is provided from the Ventura pressure zone (Frontier Lane Reservoir).

## Table 5-3
## Storage Analysis Summary – Future Conditions (2028)

| Proposed Pressure Zone (Existing Storage) | Storage Component (gallons) Operational | Fire | Emergency | Storage Required (mg) | Existing Storage (mg) | Zone Surplus / (Deficit) (mg) | Storage Need (mg) | Recommended Storage Facilities and Capacity (mg) |
|---|---|---|---|---|---|---|---|---|
| East Hills 1 and 2 (Rocky Ridge) | 508,200 | 240,000 | 508,200 | 1.26 | 1.00 | (0.26) | 0.26 | East Hills: 0.50 |
| Main[5] (Nos. 5, 6, 7, Fairhill, Kline) | 3,592,600 | 540,000 | 3,592,600 | 7.73 | 7.85 | 0.12 | 0.0 | Starmer: 1.0<br>Charter Oaks: TBD[4] |
| Dogwood[1,2] | | | | | | | | |
| West Military[1,2] | | | | | | | | |
| Fairhill 1 and 2[1,2] | | | | | | | | |
| Hooker 1 and 2 | | | | | | | | |
| West A and B | | | | | | | | |
| SE Hills 1 and 2 | | | | | | | | |
| Charter Oaks/Charter Oaks Hill | | | | | | | | |
| Stacie Ct. 1 and 2 (Stacie Ct.) | 108,800 | 240,000 | 108,800 | 0.46 | 0.30 | (0.16) | 0.16 | West Ridge: 0.40[3] |
| West Ridge 1 and 2 | | | | | | | | |
| Terrace 1 and 2 (Terrace) | 263,700 | 240,000 | 263,700 | 0.77 | 0.80 | 0.03 | | -- |
| South Hills | | | | | | | | |
| Summit 1 and 2 | 80,500 | 240,000 | 80,500 | 0.40 | - | (0.40) | 0.40 | Powerline: 0.6[3] |
| Ventura (Frontier Lane) | 84,100 | 240,000 | 84,100 | 0.41 | 0.15 | (0.26) | 0.26 | Frontier Lane 2: 0.4[3] |
| Crystal Vista/Gibby[1,2] | | | | | | | | |
| Mt Rose 1 and 2 | 137,000 | 180,000 | 137,000 | 0.45 | - | (0.45) | 0.45 | Mt Rose: 0.70[3] |
| | | | **Total (mg)[6]** | **11.47** | **9.60** | | **1.53** | **Year 2028: 4.35** |
| Main North | 494,900 | 540,000 | 494,900 | 0.49 | - | (0.49) | (0.49) | Main North: 1.0[3,6] |
| North 1 | | | | | | | | |

Notes:
1. Pressure zone is recommended to continue to be served without the benefit of gravity storage. See Note 2.
2. Storage need for smaller, isolated pressure zones referenced under Note 1 is included in the system-wide storage surplus/(deficit) column.
3. Recommended storage volume is based on ultimate (2058) demands for pressure zones where a single reservoir will best meet the gravity storage needs of the zone and construction of additional future reservoirs is unlikely.
4. Projected maximum day demands in 2058 indicate an additional large storage facility will be needed in the Main pressure zone. The Charter Oaks proposed reservoir is included here to aid the City in their long-term planning efforts.
5. Abandon existing Military Reservoir in future Main pressure zone.
6. Main North and North pressure zones and Main North Reservoir are not included in system-wide totals because it is anticipated that this area will continue to be served by the Umpqua Basin Water Association.
7. Due to site constraints at the Stacie Ct. Reservoir site, the storage deficit in the Stacie Ct. Nos. 1 and 2 pressure zones will be met by proposed storage in the higher level West Ridge pressure zones.

## Table 5-4
## Pump Station Capacity Analysis Summary – Year 2028

| Pump Station | Storage Facility Supplied | Pressure Zone Served[1] | Firm Capacity Required (gpm) | Existing Firm Capacity (gpm) | Required Pump Station Capacity Need (gpm) | Recommended Improvements - Capacity (gpm) |
|---|---|---|---|---|---|---|
| Fairhill | - | Fairhill 1 and 2 | 2,098 | 690 | 1,408 | Fairhill (Upgrade): 1,500 |
| Hawthorne | Terrace | Terrace 1 and 2, Summit 1 and 2 | 956 | 300 | 656 | Hawthorne (Upgrade): 700 |
| Terrace | *Powerline* | Summit 1 and 2 | 224 | 100 | 124 | Terrace (Replace): 150 |
| Ventura | Frontier Lane / *Frontier Lane 2* | Frontier, Crystal Vista, Gibby | 234 | 150 | 84 | Ventura (Upgrade): 100 |
| Frontier Lane | - | Crystal Vista, Gibby | 2,078 | 95 | 1,983 | Frontier Lane (Replace): 2,000 |
| Garden Valley[2] | Rocky Ridge | East Hills 1 and 2 | 941 | 50 | 891 | Garden Valley (Upgrade): 900 |
| *Newton Creek*[2,4] | *Newton Creek* | East Hills 1 and 2, Mt. Rose 1 and 2 | 851 | - | 851 | Newton Creek (New): 900 |
| Winchester Creek | - | Winchester Creek | 300 | 300 | | |
| *Mt. Rose* | *Mt. Rose* | Mt. Rose 1 and 2 | 381 | - | 381 | Mt. Rose (New): 400 |
| Kline Street | Stacie Ct. | Stacie Ct. 1 and 2 | 237 | 60 | 177 | Kline Street (Upgrade): 200 |
| *West Ridge* | *West Ridge* | West Ridge 1 and 2 | 65 | 0 | 65 | West Ridge (New): 100 |
| *Vermillion Ct.* | - | Dogwood | 2,038 | 0 | 2,038 | Dogwood (Replace): 2,100 |
| West Military | - | West Military | 2,063 | 45 | 2,018 | West Military (Replace): 2,100 |
| *Hooker 1* | - | Hooker 1 and 2 | 2,139 | - | 2,139 | Hooker 1 (New): 2,200 |
| *SE Hills* | - | SE Hills 1 and 2 | 2,036 | - | 2,036 | SE Hills (New): 2,100 |
| *South Hills* | - | South Hills | 2,012 | - | 2,012 | South Hills (New): 2,100 |
| *West* | - | West A and B | 2,026 | - | 2,026 | West (New): 2,100 |
| *Charter Oaks Hill* | - | Charter Oaks Hill | 2,046 | - | 2,046 | Charter Oaks (New): 2,100 |
| *North* | - | North | | - | | North (New): 3,100 |

Notes:
1. Where higher level pressure zones are served from the discharge of the pump station or from gravity storage supplied by the pump station, the higher level pressure zone demands are included in the required capacity of the pump station.
2. The East Hills 1 and 2 pressure zones are supplied from the Garden Valley and Newton Creek Pump Stations.
3. Facility names shown in italics are proposed facilities.
4. Suction supply for the proposed Mt. Rose Pump Station will be from the proposed Newton Creek Reservoir. Recommended capacity of the Newton Creek Pump Station reflects the demand of the Mt. Rose pressure zones.

- The recommended preliminary valve setting is as follows:
    - Primary bypass valve: Set at desired hydraulic grade line (HGL) for the pressure zone.
    - Primary main valve: Set at 5psi below the Primary bypass valve
    - Secondary bypass valve: Set at 3 psi below the Primary bypass valve
    - Secondary main valve: Set at 5psi below the Secondary bypass valve

- To calculate the pressure setting for a valve:
  *(Desired HGL – Elevation of the valve)/2.31 = Pressure setting (psi)*

**Telemetry and Controls**

The City of Roseburg water system telemetry, or Supervisory Control and Data Acquisition (SCADA) system was originally installed by the City's system integrator, S&B, Inc. of Bellevue, Washington as part of construction of the Winchester Water Treatment Plant project completed between 1985 and 1992. The system consists of a central control panel at the Winchester Water Treatment Plant and remote telemetry units (RTUs) at pump station and reservoir facilities throughout the distribution system. The age of the RTUs varies with the age of the facility, ranging from early 1990s to less than five years old. The oldest elements of the system are approaching 20 years old. Typically, SCADA system hardware can be expected to have a life of between 10 and 15 years. Due to the rapidly evolving electronic technology associated with these systems, hardware and software, equipment and systems beyond this age typically become difficult to support, troubleshoot and maintain. It is recommended that the City plan for the renewal and upgrade of the SCADA system on a 10 to 15 year cycle. Recommendations for capital improvement program budgeting are presented in Section 6.

**Unaccounted-for Water Analysis**

Unaccounted-for water is the difference between water production and water consumption. Generally, a distribution system is considered to be in good condition when unaccounted-for water is 10 percent or less. Terms used in this section to describe unaccounted-for water are defined as follows:

- ***Water production*** is the amount of water produced by the treatment plant and delivered to the distribution system. Water used for backwash and other operations at the water treatment plant is excluded from this quantity.
- ***Water consumption*** is the amount of metered water use billed to customers by the City. This is also referred to as customer usage.
- ***Unaccounted-for water*** includes system leakage, or water loss, and estimated accounted uses for hydrant flushing, reservoir cleaning, bulk water sales, etc.

From 2005 through 2009, the City's unaccounted-for water is estimated to be approximately 16.7 percent and has shown a generally declining trend over this time period as the City has taken action to reduce levels of unaccounted-for water. Specifically, a metering correction at the water treatment plant finished water flow meter has been implemented, improving the reliability of production data. Table 5-5 summarizes annual water production, water consumption and unaccounted-for water estimates. Table B-4 in Appendix B includes a detailed tabulation of monthly unaccounted-for water analysis for the year 2009.

**Table 5-5**
**Unaccounted-for Water Summary**

| Year | Annual Production (mg) | Annual Metered Consumption (mg) | Annual Estimated Unmetered Usage (mg) | Unaccounted-for Water (gpm) | Percent Unaccounted-for Water |
|---|---|---|---|---|---|
| 2005 | 1,869.4 | 1,517.2 | 34.4 | 604 | 17.0% |
| 2006 | 1,970.1 | 1,645.9 | 36.6 | 547 | 14.6% |
| 2007 | 1,957.5 | 1,548.6 | 39.0 | 703 | 18.9% |
| 2008 | 1,998.7 | 1,564.9 | 37.4 | 754 | 19.8% |
| 2009 | 1,973.9 | 1,674.7 | 38.0 | 497 | 13.2% |
| **Average** | **1,953.9** | **1,590.3** | **37.1** | **621** | **16.7%** |

**Summary**

This section developed and presented an analysis of the City of Roseburg's water distribution system. The distribution system analysis found that pressure zone modifications, transmission piping improvements, pumping and storage improvements are needed to adequately meet system demands and fire flow requirements, and to provide for system expansion. Upgrades to the City's existing corrosion protection measures are also needed. Section 6 presents recommendations and a capital improvement plan including project sequencing and project cost estimates to accomplish the recommendations presented in this section.

# SECTION 6
# CAPITAL IMPROVEMENT PROGRAM

## General

This section presents recommended water system improvements based on the analysis and findings presented in Sections 5. These improvements include proposed storage reservoir, pump station, pressure reducing valve (PRV) stations and water line improvements. Also presented is a capital improvement program (CIP) schedule for all recommended improvements. Supply source improvement recommendations are included in the City's recently adopted Long Range Water Supply Program Report (MSA, 2009). All proposed distribution system improvements are illustrated on Plate 2 in Appendix A. Figure 6-1 presents a hydraulic profile with the recommended system improvements.

## Cost Estimating Data

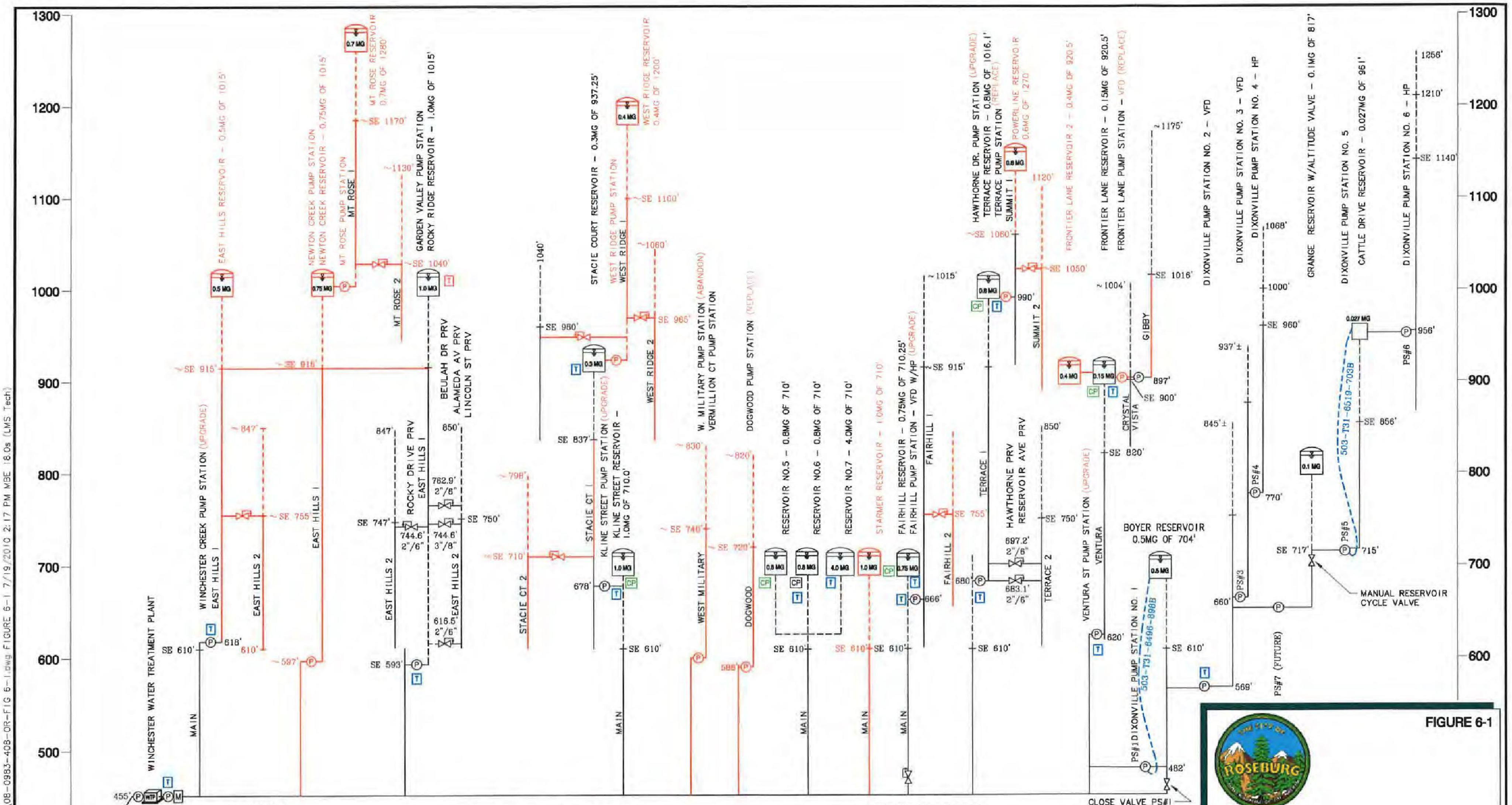
An estimated project cost has been developed for each improvement project recommendation presented in this section. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The Association for the Advancement of Cost Engineering (AACE) classifies cost estimates depending on project definition, end usage and other factors. The cost estimates presented here are considered Class 4 with an end usage being a study or feasibility evaluation and an expected accuracy range of -30 percent to +50 percent. As the project is better defined the accuracy level of the estimates can be narrowed. Appendix G includes a cost data summary for recommended water main improvements developed on a unit cost basis. Estimated project costs include approximate construction costs and an allowance for administrative, engineering and other project related costs.

The estimated costs included in this plan are planning-level budget estimates presented in 2010 dollars. Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News Record (ENR) Construction Cost Index (CCI) is a commonly used index for this purpose. For purposes of future cost estimate updating the recent ENR CCI for Seattle, Washington is 8647 (March 2010).

## Recommended Water System Improvements

### *General*

Presented below are recommended water distribution system improvements for pump stations, storage reservoirs, pressure reducing facilities and distribution system piping. Project cost estimates are presented for all recommended improvements. The recommendations are presented by project type and prioritized as short, medium and long-term recommendations. Short term recommendations are those suggested to be completed in




## LEGEND

| | EXISTING | PROPOSED |
|---|---|---|
| RESERVOIR (CAPACITY INDICATED IN MILLION GALLONS, OVERFLOW ELEVATION IN FEET) | 1.0 MG | 1.0 MG |
| ALTITUDE, PRV OR SOLENOID VALVE | | |
| PUMP STATION | P | P |
| MASTER METER | M | M |
| CATHODIC PROTECTION CABINET | CP | CP |
| REMOTE TELEMETRY UNIT | T | T |

HGL — XXX'
HIGHEST SERVICE EL — SE XXX'
LOWEST SERVICE EL — XXX'

NOTE: SMALL PROPOSED PRESSURE ZONES SERVED BY VFD-TYPE PUMP STATIONS NOT SHOWN FOR CLARITY.

## ABBREVIATIONS

| | |
|---|---|
| EA | EACH |
| MG | MILLION GALLONS |
| MGD | MILLION GALLONS PER DAY |
| OF | OVERFLOW ELEVATION |
| PRV | PRESSURE REDUCING VALVE |
| HGL | HYDRAULIC GRADE LINE |
| HP | HYDROPNEUMATIC TANK |

**FIGURE 6-1**

City of Roseburg
Water System Master Plan

PROPOSED WATER DISTRIBUTION SYSTEM HYDRAULIC PROFILE

JULY 2010

MSA

08-0983.408

G:\PDX_Projects\08\0983\408\CAD\08-0983-408-OR-FIG 6-1.dwg FIGURE 6-1 7/19/2010 2:17 PM MBE 18.0s (LMS Tech) the next one to five years, medium-term in the next six to 10 years and long-term in the next 11 to 20 years. The timing of some of the recommended improvements is entirely dependent on continued development within the UGB and outside of the current water system service area, and should be coordinated with land development. These improvements, defined as growth driven, are recommended for completion beyond the long-term time period and are anticipated to be developer scheduled and funded.

***Storage Reservoirs***

As presented in Section 5, overall storage capacity in the City's water system is sufficient to meet current needs for equalization, emergency and fire suppression storage. Additional storage facilities are recommended to meet future storage needs associated with growth, fire suppression storage needs and the reorganization of high elevation pressure zones above the Main Zone. For those pressure zones where service from more than one storage reservoir is not practical given the limited size and steep topography of the zone, recommended storage reservoir capacities are based on the year 2058 demand for the pressure zone to ensure that facilities are sized for the ultimate pressure zone need. A summary of proposed storage reservoirs, capacities, recommended construction timing and estimated project costs is presented in Table 6-1.

**Table 6-1**
**Recommended Reservoir Improvement Summary**

| Proposed Reservoir Name | Capacity (mg) | Recommended Timeline | Estimated Project Cost |
|---|---|---|---|
| Powerline | 0.6 | Medium Term | $1,200,000 |
| West Ridge | 0.4 | Medium Term | $800,000 |
| Starmer | 1.0 | Long Term | $2,000,000 |
| East Hills | 0.5 | Long Term | $1,000,000 |
| Frontier Lane 2 | 0.4 | Long Term | $800,000 |
| Main North | 1.0 | Future Service | $2,000,000 |
| Mt. Rose | 0.7 | Growth Driven | $1,400,000 |
| Newton Creek | 0.75 | Growth Driven | $1,500,000 |
| Charter Oaks | TBD | Growth Driven | - |
| Reservoir Coating | | Continuous | $100,000 /yr |
| **TOTAL (20-year planning horizon)** | | | **$5,800,000** |

Proposed reservoirs recommended for completion in the medium term serve areas which are already partially developed. Many of the proposed reservoirs, such as Charter Oaks Reservoir, are largely land development dependent and are recommended for completion beyond the 20-year planning horizon.

A life cycle cost analysis should be completed to determine the most appropriate material type for new reservoirs where site conditions don't favor one type. It is recommended that the City consider welded steel (AWWA D100) or pre-stressed circular concrete reservoirs (AWWA D110) as the two allowable material/construction types. The life cycle analysis should consider recoating and cathodic protection needs as well.

In addition to the recommended new reservoir construction projects, it is also recommended that the City budget approximately 100 thousand dollars per year for completion of reservoir coating maintenance projects every other year. This budget allows for complete replacement of all reservoir coating systems and maintenance of cathodic protection systems on a 20-year cycle. The actual timing of recoating needs may be shorter or longer depending on a number of factors, but the recommended budget will provide for an appropriate level of funding based on current coating system performance. The budget for these ongoing projects should be reviewed and updated every five years based on observed conditions.

***Pump Station Improvements***

As presented in Section 5, a number of pumping improvements are required to meet existing pumping deficits for fire flow needs and forecasted pumping deficits to meet future demands. In addition, construction of new pumping facilities, replacement of an existing pump station or upgrade of an existing pump station is recommended for facilities serving proposed new pressure zones and modified pressure zone configurations. A summary of proposed pump station improvements, upgraded or new capacities, recommended construction timing and estimated project costs is presented in Table 6-1. Pump stations are classified into two categories:

- *Variable Frequency Drive Station (V)*: A pump station that operates continuously to maintain constant pressure with a hydropneumatic tank and at least one pump controlled by a VFD.

- *Reservoir Supply Pump Station (R):* A pump station that operates to fill a higher level reservoir from a lower elevation reservoir or pressure zone.

Recommended pump station improvements are identified as New, Replacement or Upgrade projects with the type of pump station configuration, as defined in Section 4, identified. Six pump station improvement projects are recommended in the medium-term with one new pump station recommended for completion and the replacement or upgrade of five other pump stations with a total estimated project cost of 2.3 million dollars between the year 2015 and 2020. These improvements are generally sequenced for construction in the same time frame as proposed storage improvements supplied by the new or upgraded pump station, to address existing deficiencies in fire flow availability, or are minor capacity increases to meet needs through the 20-year planning horizon.

Five pump station improvements are recommended in the long-term with the construction of two new pump stations and the replacement or upgrade of three other pump stations with a total estimated project cost of 1.95 million dollars between the year 2020 and 2030. Two of these improvements, upgrade of the Winchester Creek Pump Station and construction of the Newton Creek Pump Station, are part of the establishment of the East Hills Pressure Zone. The Mt. Rose Pump Station is required to supply the future Mt. Rose pressure zone as future development occurs in this high elevation area on the west side of the UGB. The other two pump station improvements address future pumping capacity deficiencies associated with growth in higher elevation pressure zones.

**Table 6-2**
**Recommended Pump Station Improvement Summary**

| Pump Station Name | Proposed Station Type[1] | Upgrade, New or Replace | Added Capacity (gpm) | Recommended Timeline | Estimated Project Cost |
|---|---|---|---|---|---|
| Hawthorne Drive | R | Upgrade | 700 | Medium Term | $500,000 |
| Terrace | R | Replace | 150 | Medium Term | $100,000 |
| Kline Street | R | Upgrade | 200 | Medium Term | $100,000 |
| West Ridge[3] | R | New | 100 | Medium Term | $100,000 |
| West Military | V | Replace | 2,100 | Medium Term | $750,000 |
| Vermillion Ct.[2] | V | Replace | 2,100 | Medium Term | $750,000 |
| Ventura | R | Upgrade | 100 | Long Term | $100,000 |
| Frontier Lane | V | Replace | 2,000 | Long Term | $750,000 |
| Garden Valley | R | Upgrade | 891 | Long Term | $500,000 |
| Newton Creek | R | New | 900 | Long Term | $500,000 |
| Mt. Rose | R | New | 400 | Long Term | $100,000 |
| Fairhill | V | Upgrade | 1,500 | Growth Driven | $750,000 |
| Hooker | V | New | 2,200 | Growth Driven | $750,000 |
| SE Hills | V | New | 2,100 | Growth Driven | $750,000 |
| West | V | New | 2,100 | Growth Driven | $750,000 |
| Charter Oaks Hill | V | New | 2,100 | Growth Driven | $750,000 |
| North | V | New | 3,100 | Future Service | $750,000 |
| **TOTAL (20-year planning horizon – excluding Growth Driven)** | | | | | **$4,250,000** |

Notes: 1. R-type Pump Station: A pump station that operates to fill a higher level reservoir.
V-type Pump Station: A pump station that operates continuously to maintain constant pressure without the benefit of gravity storage.
2. The proposed Vermillion Ct. Pump Station will replace the existing Dogwood Pump Station.
3. This area within the UGB may be served by an IGA with UBWA.

Six pump station improvement projects are identified as Growth Driven and are all associated with development of service area around the edge of the UGB above the 610 foot elevation serviceable from the Main pressure zone that is not contiguous with other existing or proposed higher elevation pressure zones. One of these proposed pump station improvements is an upgrade of the Fairhill Pump Station to serve an expanded and higher elevation service area. The other five pump station improvements are new facilities serving proposed pressure zones spread throughout the UGB. The timing of these improvements is entirely dependent upon the development of these currently undeveloped areas and the required improvements should be coordinated with any proposed development plans that will require service above an elevation of 610 feet. The total project cost of these growth driven improvements is 4.5 million dollars.

***Pressure Reducing Facilities***

A number of new pressure reducing valve (PRV) stations are recommended throughout the water system service area to serve pressure zones above the Main pressure zone and below the level that can be served directly from higher elevation gravity storage facilities or pump stations serving higher elevation pressure zones. Additionally, one proposed PRV stations is also recommended to improve fire flow availability in an area of the Main pressure zone near to 610 feet in elevation where supply is from one direction due to an adjacent pressure zone boundary. As discussed in Section 4, it is recommended that these pressure zones be supplied from more than one PRV station to provide for redundant, reliable service. All pressure reducing facilities should consist of at least two valves, a main valve capable of transmitting fire flow at the desired downstream hydraulic grade and a smaller by-pass valve sized to transmit average daily demand at the desired hydraulic grade. The selection of supply piping diameter and valve sizing should be determined during design of proposed PRV stations. For the purposes of this plan, the planning level project cost estimate for each new PRV station is 90 thousand dollars. A total of 35 new PRV stations are recommended for service to existing and proposed pressure zones, with a total estimated project cost for 23 new stations through the 20-year planning horizon of $2,070,000.

***Transmission and Distribution System Piping Improvements***

As presented in Section 5, improvements are needed to address existing deficiencies and to continue to provide adequate service under future conditions in the transmission and distribution system. A discussion of the general types of improvements, overall length of new piping and summarized project costs for the 20-year planning horizon are presented below. Detailed itemized information related to each individual piping improvement project is presented in Tables H-1 through H-3 in Appendix H.

*Major Transmission Piping – Winchester WTP to Main Reservoir Complex*

To meet future transmission needs between the Winchester Water Treatment Plant (WTP) and Reservoir Nos. 5, 6 and 7 in the Main pressure zone, additional transmission capacity is needed. In addition, the existing 20-inch diameter Transmission Main 1 is reaching the end of its service life and is experiencing an increasing number of leaks, especially in the northern third of the transmission main closest to the WTP. As such, it is recommended that the City initiate a phased program for replacement of the transmission main with a new 24-inch diameter transmission main in segments through the 20-year planning horizon. Table 6-3 summarizes the phased replacement program, pipe segments and estimated project costs.

**Table 6-3**
**Major Transmission Piping Improvement Summary**

| Transmission Main Segment | Proposed Diameter (inches) | Recommended Timeline | Estimated Project Cost |
|---|---|---|---|
| HWY 99 -WTP to Hooker Rd | 24 | Short Term | $4,488,000 |
| HWY 99 - Hooker Rd to Garden Valley Blvd | 24 | Long Term | $3,896,400 |
| | | **TOTAL (20-years)** | **$8,384,400** |

*Transmission and Distribution System*

The analysis found that distribution system water line improvements are needed to provide improved hydraulic transmission capacity within the distribution system, provide for improved fire flow capacities and provide for system expansion needs.

For the purpose of this section recommended distribution system improvements are grouped in the following general categories:

1. Water line improvements needed to improve distribution system transmission capacity including improvements related to specific proposed reservoir and pump station improvements.
2. Improvements related to improving fire flow capacities.

The recommended short term CIP, for years 2010 through 2015, includes approximately 13,850 linear feet of transmission capacity improvements, including piping improvements at the Main Reservoir Complex. In addition, approximately 24,600 feet of piping improvements to address fire flow capacity needs are recommended in the medium term. The total estimated project cost of short term piping improvements is $5,917,250. This total does not include the major transmission improvements described above that are also in the short term CIP.

The recommended medium term CIP, for years 2016-2020, includes approximately 17,900 linear feet of transmission capacity improvements, generally related to proposed pump station and reservoir improvement projects. In addition, approximately 36,450 feet of piping improvements to address fire flow capacity needs are recommended in the medium term. The total estimated project cost of medium term piping improvements is $10,192,000.

The recommended medium term CIP, for years 2016-2020, includes approximately 17,900 linear feet of transmission capacity improvements, generally related to proposed pump station and reservoir improvement projects. In addition, approximately 36,450 feet of piping improvements to address fire flow capacity needs are recommended in the medium term. The total estimated project cost of medium term piping improvements is $10,192,000.

The recommended long term CIP, for years 2020-2030, includes approximately 37,750 linear feet of transmission capacity improvements. In addition, approximately 43,900 feet of piping improvements to address fire flow capacity needs are recommended in the long term. The total estimated project cost of long term piping improvements is $15,193,100. This total does not include the major transmission improvements described above that are also in the long term CIP.

The recommended CIP projects planned for beyond the 20-year planning horizon are identified as "Growth Driven" and the ultimate timing of these improvements are directly connected to development of currently undeveloped areas within the UGB. These improvements are identified in the CIP summary tables presented in this section by pressure zone and are illustrated on Plate 2 separately from the other CIP projects presented herein. The total estimated cost of these "Growth Driven" projects is approximately 58 million dollars.

*Routine Pipe Replacement*

It is recommended that the City's current water main replacement program continue. This program provides for the routine replacement of leaking, damaged and older water mains throughout the water system. In most cases the existing mains have adequate capacity and will be replaced with the same diameter water mains. It is recommended that 100 thousand dollars be budgeted annually for this program.

The City currently funds this program at a higher level, approximately 600 thousand dollars annually. The reduced funding through the 20-year planning horizon reflects a shift towards more specific water main replacement projects that involve upsizing to meet current fire flow deficiencies. The annual investment in replacement of older mains in the system will still be approximately 600 thousand dollars in the proposed CIP, but will reflect an emphasis on mains that are also undersized. A watermain replacement budget of approximately 600 thousand dollars provides funding for systematic renewal of the system over roughly 100 years. This schedule for renewal of the system is consistent with the service life of piping materials and systems currently in use by the water industry.

***Telemetry and Control Systems***

Based on the analysis and findings presented in Section 5, it is recommended that the City of Roseburg plan for upgrade and replacement of key hardware and software components of the water system SCADA and telemetry system. Major elements of the system are approaching twenty years old and it is assumed that they are nearing the end of their service life. It is recommended that the City budget 150 thousand dollars in the short-term for renewal and replacement of system components and an additional 50 thousand dollars every five years for ongoing maintenance and replacement.

### *Transmission Main Cathodic Protection*

As discussed in Section 5, the cathodic protection systems on the City's 20-inch diameter and 30-inch diameter transmission mains between the Winchester WTP and the Reservoir Nos. 5, 6 and 7. Given the age and condition of the 20-inch diameter transmission main, as well as the need for additional hydraulic transmission capacity, CIP planning includes the phased replacement of this transmission main with new 24-inch diameter piping.

It is recommended that a new CP system be installed to protect both transmission mains. Based on the analysis presented in Section 5, an impressed current type system is recommended as the most effective and economical system for the City of Roseburg. It is recommended that the City proceed immediately with preliminary engineering to develop a detailed scheduling and sequencing plan for upgrade and installation of this system to protect the existing transmission mains and ultimately provide protection for the upgraded segments of new 24-inch diameter transmission main.

For the purposes of this CIP, a budget of 25 thousand dollars is included in the short-term for the completion of the preliminary engineering study described above. Additional, a $130,500 budget is included for design and installation of the new CP system. Ongoing CP system inspection and maintenance must also be planned for and is included in the CIP as a budget of 25 thousand dollars every five years.

## Additional Recommendations

It is recommended that additional engineering studies be conducted to advance the planning work completed in this Master Plan to the preliminary engineering level. Periodic updating of the cost-of-service (water rate) and System Development Charge (SDC) analysis should be budgeted and conducted. Updates to the Water Management and Conservation Plan, as well as this Master Plan, will also be required within the 20-year planning horizon. A budget level cost of 100 thousand dollars every 10 years should be anticipated for Master Plan updates.

### *Water Management and Conservation Plan*

The Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 690, Division 86 requires water systems with water rights to submit a Water Management and Conservation Plan (WM&CP) that documents current water conservation measures, provides a water curtailment plan, evaluates long-term water supply planning and provides a water rights implementation schedule. It is recommended that the City complete a Water Management and Conservation Plan in the next 10 years to comply with Oregon Water Resources Department (OWRD) requirements (see OAR 690-086-0125). The estimated project cost for this plan is approximately 50 thousand dollars with updates every 10 years.

### *Water Rates and SDC Analysis*

Charges and rates for utility services are typically structured to direct the costs of providing service to those benefitting by the service. Developers building subdivisions and commercial complexes are required to construct the initial capital improvements (water mains, pump stations, storage reservoirs, fire hydrants, etc.) required to supply the water. Costs for maintenance and operation of the facilities are paid for by the City from ongoing monthly charges for service, as well as allowances for replacement of depreciated facilities. Where a major facility is constructed to supply a large number of non-associated developers, the initial cost is often fronted by the utility and collected as a reimbursement in the form of a SDC, as was done for the water treatment plant and 30-inch diameter transmission main. Local Improvement Districts (LID) are occasionally formed to distribute costs of new or improved service to property owners benefitted by the improvements. Projects benefitting both existing and future customers are commonly constructed with applicable combinations of funding to distribute costs to those benefitting by the improvements.

It is anticipated that changes in rates and SDCs will be required to keep pace with inflation and to fund the proposed improvements through build-out of the system. It is recommended that the City complete a detailed water rate and SDC analysis with the completion of this Master Plan to determine specific funding needs and potential funding sources associated with the adopted CIP. It is recommended that these studies also provide guidance to the City on the best use of the funding options described below. A budget level cost for a rate and SDC update is 20 thousand dollars every five years after a full study recommended immediately at a budget level cost of 50 thousand dollars.

## Water System Capital Improvement Program

A summary of all the recommended improvements identified in this plan is presented in Tables 6-4 through 6-7 for each of the time periods described above with estimated project costs, estimated developer funded portions and estimated costs to existing City customers.

### *Capital Improvement Program Funding*

It is recommended that the City's water system capital improvement program be funded at approximately 1.0 million dollars to 2.0 million dollars annually. While the funding for certain water system improvements may exceed this amount, the proposed improvements listed in Table 6-4 through 6-7 are phased and sequenced so that the average annual capital requirement for water system improvements is approximately 1.5 million dollars over the 20-year planning horizon.

## Table 6-4
## Short Term (2010-2015) Capital Improvement Summary

| Category | Project Type or Pressure Zone Served | Project Descritpion | Estimated Total Project Cost | Developer Funded % | Developer Funded $ | Estimated Project Cost to City |
|---|---|---|---|---|---|---|
| **Storage Facilities** | | On-going reservoir coating maintenance- $100,000 per year | $ 500,000 | 0% | $ - | $ 500,000 |
| | | *Sub-Total* | *$ 500,000* | | *$ -* | *$ 500,000* |
| **Distribution System Piping** | Transmission Improvements | Replace 20-inch transmission main on Hwy 99 between the treatment plant and Hooker Road with 24-inch line | $ 4,488,000 | 49% | $ 2,199,120 | $ 2,288,880 |
| | | Relocate and replace 24-inch mains between NE Walnut Street at NE West Avenue and the Main Reservoir Complex with 30-inch lines | $ 1,153,000 | 85% | $ 983,000 | $ 170,000 |
| | | Phase I Main Reservoir Complex yard piping including impressed current corrosion protection system | $ 575,750 | 0% | $ - | $ 575,750 |
| | | Phase II Main Reservoir Complex yard piping | $ 236,000 | 0% | $ - | $ 236,000 |
| | | Construct 16-inch main on SE Starmer Street between SE Booth Avenue and the proposed Starmer Reservoir site at SE Dillard Avenue | $ 312,800 | 100% | $ 312,800 | $ - |
| | Fire Flow Improvements | Piping Improvements for Fire Flow | $ 3,585,300 | 0% | $ - | $ 3,585,300 |
| | Routine Pipe Replacement | Replace aging and undersized pipe - $100,000 per year | $ 500,000 | 0% | $ - | $ 500,000 |
| | Corrosion Protection System Upgrades | Preliminary engineering study - upgrade and sequencing of corrosion protection | $ 25,000 | 0% | $ - | $ 25,000 |
| | | Install impressed current corrosion protection system on transmission mains between the water treatment plant and the Main Reservoir Complex | $ 130,500 | 49% | $ 63,945 | $ 66,555 |
| | | *Sub-Total* | *$ 11,006,350* | | *$ 3,558,865* | *$ 7,447,485* |
| **Telemetry** | | Upgrade and replacement of water system SCADA and telemetry system components | $ 150,000 | 0% | $ - | $ 150,000 |
| | | *Sub-Total* | *$ 150,000* | | *$ -* | *$ 150,000* |
| **Other** | Planning Studies | Water Rate and SDC Study | $ 50,000 | 0% | $ - | $ 50,000 |
| | | *Sub-Total* | *$ 50,000* | | *$ -* | *$ 50,000* |
| | | ***Capital Improvement Plan (CIP) Total*** | *$ 11,706,350* | | *$ 3,558,865* | *$ 8,147,485* |
| | | | | | | **$1,629,497 Short Term Annual Average** |

## Table 6-5
## Medium Term (2016-2020) Capital Improvement Summary

| Category | Project Type or Pressure Zone Served | Project Descritpion | Estimated Total Project Cost | Developer Funded % | Developer Funded $ | Estimated Project Cost to City |
|---|---|---|---|---|---|---|
| Pumping Facilities | *Summit* | 250 gpm Terrace Replacement PS | $ 100,000 | 100% | $ 100,000 | $ - |
| | *Terrace and Summit* | 700 gpm Upgrade at Hawthorne PS | $ 500,000 | 100% | $ 500,000 | $ - |
| | *West Ridge* | 100 gpm New West Ridge PS | $ 100,000 | 100% | $ 100,000 | $ - |
| | Stacie Ct and *West Ridge* | 200 gpm Upgrade at Kline Street PS | $ 500,000 | 94% | $ 467,500 | $ 32,500 |
| | West Military | 2,100 gpm West Military Replacement PS | $ 750,000 | 6% | $ 47,143 | $ 702,857 |
| | Dogwood | 2,100 gpm Vermillion Court PS | $ 100,000 | 5% | $ 4,619 | $ 95,381 |
| | Ventura, Crystal Vista and Gibby | 100 gpm Upgrade Ventura PS | $ 100,000 | 100% | $ 100,000 | $ - |
| | | *Sub-Total* | *$ 2,150,000* | | *$ 1,319,262* | *$ 830,738* |
| Storage Facilities | *Summit Zone* | 0.6 MG Powerline Reservoir | $ 1,200,000 | 73% | $ 880,000 | $ 320,000 |
| | *West Ridge Zone* | 0.4 MG West Ridge Reservoir | $ 800,000 | 100% | $ 800,000 | $ - |
| | System-wide | Reservoir coatings - $100k per year | $ 500,000 | 0% | $ - | $ 500,000 |
| | | *Sub-Total* | *$ 2,500,000* | | *$ 1,680,000* | *$ 820,000* |
| Distribution System Piping | Transmission Improvements | Construct 12-inch mains adjacent to SE Summit Drive connecting the Terrace Pump Station with the Proposed Powerline Reservoir | $ 918,000 | 73% | $ 673,200 | $ 244,800 |
| | | Construct 8-inch mains on Ridgecrest Drive from the Proposed West Ridge Pump Station to Moorea Drive | $ 312,800 | 100% | $ 312,800 | $ - |
| | | Construct 12-inch mains on Moorea Drive from Ridgecrest Drive to the Proposed West Ridge Reservoir | $ 520,200 | 100% | $ 520,200 | $ - |
| | | Replace 12-inch mains on NW Kline Street between the Kline Reservoir and NW Calkins Avenue | $ 1,550,400 | 49% | $ 759,696 | $ 790,704 |
| | | Construct 12-inch mains from NW Edenbower Boulevard to the Proposed Vermillion Court Pump Station | $ 112,200 | 5% | $ 5,183 | $ 107,017 |
| | | Construct 10-inch mains from the Proposed Vermillion Ct Pump Station to the NW Goetz Street alignment | $ 391,000 | 5% | $ 18,060 | $ 372,940 |
| | Fire Flow Improvements | Piping Improvements for Fire Flow | $ 6,387,400 | 0% | $ - | $ 6,387,400 |
| | Routine Pipe Replacement | Aging and undersized pipe - $100k annual | $ 500,000 | 0% | $ - | $ 500,000 |
| | Pressure Reducing Facilities | PRV Stations for Proposed Pressure Zones | $ 810,000 | 49% | $ 396,900 | $ 413,100 |
| | Corrosion Protection | CP system inspection and maintenance | $ 25,000 | 0% | $ - | $ 25,000 |
| | | *Sub-Total* | *$ 11,527,000* | | *$ 2,686,039* | *$ 8,840,961* |
| Telemetry | | SCADA and telemetry system | $ 50,000 | 0% | $ - | $ 50,000 |
| | | *Sub-Total* | *$ 50,000* | | *$ -* | *$ 50,000* |
| Other | Planning Studies | Water Rate and SDC Update | $ 20,000 | 0% | $ - | $ 20,000 |
| | | Water System Master Plan Update | $ 100,000 | 0% | $ - | $ 100,000 |
| | | Water Mngmt and Conservation Plan | $ 50,000 | 0% | $ - | $ 50,000 |
| | | *Sub-Total* | *$ 170,000* | | *$ -* | *$ 170,000* |
| | | ***Capital Improvement Plan (CIP) Total*** | ***$ 16,397,000*** | | ***$ 5,685,301*** | ***$ 10,711,699*** |
| | | | | | | **$2,142,340 Medium Term Annual Average** |

## Table 6-6
## Long Term (2020-2030) Capital Improvement Summary

| Category | Project Type or Pressure Zone Served | Project Descritpion | Estimated Total Project Cost | Developer Funded % | Developer Funded $ | Estimated Project Cost to City |
|---|---|---|---|---|---|---|
| Pumping Facilities | Crystal Vista and Gibby Zones | 2,100 gpm Frontier Lane Replacement PS | $ 750,000 | 8% | $ 63,214 | $ 686,786 |
| | *East Hills* | 900 gpm Upgrade Garden Valley PS | $ 500,000 | 100% | $ 500,000 | $ - |
| | *East Hills* | 900 gpm New Newton Creek PS | $ 500,000 | 100% | $ 500,000 | $ - |
| | *Mt. Rose* | 400 gpm New Mt. Rose PS | $ 100,000 | 100% | $ 100,000 | $ - |
| | | *Sub-Total* | *$ 1,850,000* | | *$ 1,163,214* | *$ 686,786* |
| Storage Facilities | Main Zone | 1.0 MG Starmer Reservoir | $ 2,000,000 | 100% | $ 2,000,000 | $ - |
| | Ventura Zone | 0.4 MG Frontier Lane 2 Reservoir | $ 800,000 | 100% | $ 800,000 | $ - |
| | *East Hills Zone* | 0.5 MG East Hills Reservoir | $ 1,000,000 | 100% | $ 1,000,000 | $ - |
| | *East Hills Zone* | 0.75 MG Newton Creek Reservoir | $ 1,500,000 | 100% | $ 1,500,000 | $ - |
| | System wide | On-going reservoir coating maintenance- $100,000 per year | $ 1,000,000 | 0% | $ - | $ 1,000,000 |
| | | *Sub-Total* | *$ 6,300,000* | | *$ 5,300,000* | *$ 1,000,000* |
| Distribution System Piping | Transmission Improvements | Construct 12-inch mains on the water system's eastern border between Davis Creek Way and the Proposed East Hills Reservoir | $ 530,400 | 100% | $ 530,400 | $ - |
| | Transmission Improvements | Construct 12-inch mains on the water system's eastern border between the Proposed East Hills and Newton Creek Reservoirs | $ 2,611,200 | 100% | $ 2,611,200 | $ - |
| | Transmission Improvements | Construct 18-inch mains in the East Hills Pressure Zone between the Proposed Newton Creek Pump Station and Reservoir | $ 1,422,900 | 100% | $ 1,422,900 | $ - |
| | Transmission Improvements | Construct 12-inch mains on SE Mill Street from SE Burke Avenue across the river to SW Portland Avenue | $ 948,800 | 49% | $ 464,912 | $ 483,888 |
| | Transmission Improvements | Replace 20-inch transmission main on Hwy 99 between Hooker Road and NE Garden Valley Boulevard with 24-inch line | $ 3,896,400 | 49% | $ 1,909,236 | $ 1,987,164 |
| | Fire Flow Improvements | Piping Improvements for Fire Flow | $ 6,517,800 | 0% | $ - | $ 6,517,800 |
| | Routine Pipe Replacement | Replace aging and undersized pipe - $100,000 per year | $ 500,000 | 0% | $ - | $ 500,000 |
| | Pressure Reducing Facilities | PRV Stations for Proposed Pressure Zones | $ 450,000 | 49% | $ 220,500 | $ 229,500 |
| | Corrosion Protection | On-going CP system inspection and maintenance | $ 50,000 | 0% | $ - | $ 50,000 |
| | | *Sub-Total* | *$ 16,927,500* | | *$ 7,159,148* | *$ 9,768,352* |
| Telemetry | | SCADA and telemetry system component upgrades | $ 100,000 | 0% | $ - | $ 100,000 |
| | | *Sub-Total* | *$ 100,000* | | *$ -* | *$ 100,000* |
| Other | Planning Studies | Water Rate and SDC Updates | $ 40,000 | 0% | $ - | $ 40,000 |
| | Planning Studies | Water System Master Plan Update | $ 100,000 | 0% | $ - | $ 100,000 |
| | Planning Studies | WMCP Update | $ 50,000 | 0% | $ - | $ 50,000 |
| | | *Sub-Total* | *$ 190,000* | | *$ -* | *$ 190,000* |
| | | ***Capital Improvement Plan (CIP) Total*** | *$ 25,367,500* | | *$ 13,622,362* | *$ 11,745,138* |
| | | | | | | **$1,174,514 Long Term Annual Average** |

## Table 6-7
## Growth Driven (2030+) Capital Improvement Summary

| Category | Project Type or Pressure Zone Served | Project Descritpion | Estimated Total Project Cost | Developer Funded | | Estimated Project Cost to City |
|---|---|---|---|---|---|---|
| | | | | % | $ | |
| **Pumping Facilities** | Fairhill | 1,500 gpm Upgrade to Fairhill PS | $ 750,000 | 100% | $ 750,000 | $ - |
| | *Hooker* | 2,200 gpm New Hooker PS | $ 750,000 | 100% | $ 750,000 | $ - |
| | *SE Hills* | 2,100 gpm New SE Hills PS | $ 750,000 | 100% | $ 750,000 | $ - |
| | *West* | 2,100 gpm New West PS | $ 750,000 | 100% | $ 750,000 | $ - |
| | *Charter Oaks Hill* | 2,100 gpm New Charter Oaks Hill PS | $ 750,000 | 100% | $ 750,000 | $ - |
| | | *Sub-Total* | *$ 3,750,000* | | *$ 3,750,000* | *$ -* |
| **Storage Facilities** | *East Hills Zone* | 0.75 MG Newton Creek Reservoir | $ 1,500,000 | 100% | $ 1,500,000 | $ - |
| | *Mt. Rose Zone* | 0.7 MG Mt. Rose Reservoir | $ 1,400,000 | 100% | $ 1,400,000 | $ - |
| | System wide | On-going reservoir coating maintenance-$100,000 per year | on-going budget req'd | 0% | $ - | $ - |
| | | *Sub-Total* | *$ 2,900,000* | | *$ 2,900,000* | *$ -* |
| | Improvements for Growth | Main Pressure Zone - Dixonville Area | $ 3,760,400 | 100% | $ 3,760,400 | $ - |
| | | Main Pressure Zone - Charter Oaks Area | $ 17,090,188 | 100% | $ 17,090,188 | $ - |
| | | Main Pressure Zone | $ 7,524,200 | 100% | $ 7,524,200 | $ - |
| | | Proposed East Hills Pressure Zone | $ 9,377,200 | 100% | $ 9,377,200 | $ - |
| | | Terrace Pressure Zone | $ 9,016,800 | 100% | $ 9,016,800 | $ - |
| | | Summit Pressure Zone | $ 1,659,200 | 100% | $ 1,659,200 | $ - |
| | | Ventura, Crystal Vista and Gibby Pressure Zones | $ 3,194,300 | 100% | $ 3,194,300 | $ - |
| | | Stacie Court Pressure Zone | $ 2,961,400 | 100% | $ 2,961,400 | $ - |
| | | West Ridge Pressure Zone | $ 843,200 | 100% | $ 843,200 | $ - |
| | | Hooker Pressure Zone | $ 1,254,600 | 100% | $ 1,254,600 | $ - |
| | Routine Pipe Replacement | Replace aging and undersized pipe - $100,000 per year | $ - | 0% | $ - | $ - |
| | Pressure Reducing Facilities | PRV Stations for Proposed Pressure Zones | $ 1,080,000 | 100% | $ 1,080,000 | $ - |
| | Corrosion Protection | On-going CP system inspection and maintenance | on-going budget req'd | 0% | $ - | $ - |
| | | *Sub-Total* | *$ 57,761,488* | | *$ 57,761,488* | *$ -* |
| **Telemetry** | | SCADA and telemetry system components upgrades | on-going budget req'd | 0% | $ - | $ - |
| | | *Sub-Total* | *$ -* | | *$ -* | *$ -* |
| ***Capital Improvement Plan (CIP) Total*** | | | *$ 64,411,488* | | *$ 64,411,488* | *$ -* |

### *Financial Evaluation and Plan*

The City of Roseburg may fund the water system capital maintenance and improvement programs from a variety of sources. In general, these sources can be summarized as: 1) governmental grant and loan programs, 2) publicly issued debt, and 3) cash resources and revenues. These sources are described below.

*Government Loan and Grant Programs*

*Oregon State Safe Drinking Water Financing Program*

Annual grants from the U.S. Environmental Protection Agency (EPA) and matching state resources support the Safe Drinking Water Fund. The program is managed jointly by the Department of Human Services (DHS) - Drinking Water Program and the Oregon Business Development Department (OBDD). The Safe Drinking Water Fund program provides low-cost financing for construction and/or improvements of public and private water systems. This is accomplished through two (2) separate programs: the Safe Drinking Water Revolving Loan Fund (SDWRLF) for collection, treatment, distribution and related infrastructure, and the Drinking Water Protection Loan Fund (DWPLF) for sources of drinking water improvements prior to the water system intake.

SDWRLF lends up to 8 million dollars per project, with a possibility of subsidized interest rate and principal forgiveness for a Disadvantaged Community. The standard loan term is 20 years or the useful life of project assets, whichever is less, with interest rates at 80 percent of the current state/local bond rate. The maximum award for the DWPLF is 100 thousand dollars per project.

*Special Public Works Fund*

The Special Public Works Fund program provides funding for the infrastructure that supports job creation in Oregon. Loans and grants are made to eligible public entities for the purpose of studying, designing and building public infrastructure that leads to job creation or retention. There are four major project categories eligible for funding under this program:

- Public infrastructure needed to support job creation
- Community facilities that support the local economy
- Essential Community Facilities Emergency Projects
- Railroads

Water systems are listed among the eligible infrastructure projects to receive funding. The Special Public Works Fund is comprehensive in terms of the types of project costs that can be financed. As well as actual construction, eligible project costs can include costs incurred in conducting feasibility and other preliminary studies and for the design and construction engineering.

The Fund is primarily a loan program. Grants can be awarded, up to the program limits, based on job creation or on a financial analysis of the applicant's capacity for carrying debt financing. The total loan amount per project cannot exceed 15 million dollars. The OBDD is able to offer discounted interest rates that typically reflect low market rates. In addition, the Department absorbs the associated costs of debt issuance thereby saving applicants even more on the overall cost of borrowing. Loans are generally made for 20-year terms, but can be stretched to 25 years under special circumstances.

*Water/Wastewater Fund*

The Water/Wastewater Fund was created by the Oregon State Legislature in 1993. It was initially capitalized with lottery funds appropriated each biennium and with the sale of state revenue bonds since 1999. The purpose of the program is to provide financing for the design and construction of public infrastructure needed to ensure compliance with the Safe Drinking Water Act or the Clean Water Act.

Eligible activities include costs for construction improvement or expansion of drinking water, wastewater or storm water systems. To be eligible, a system must have received, or is likely to soon receive, a Notice of Non-Compliance by the appropriate regulatory agency, associated with the Safe Drinking Water Act or the Clean Water Act. Projects also must meet other state or federal water quality statutes and standards. Funding criteria include projects that are necessary to ensure that municipal water and wastewater systems comply with the Safe Drinking Water Act or the Clean Water Act.

In addition, other limitations apply including:

- The project must be consistent with the acknowledged local comprehensive plan.
- The municipality will require the installation of meters on all new service connections to any distribution lines that may be included in the project.
- The funding recipient shall certify that a registered professional engineer will be responsible for the design and construction of the project.

The Water/Wastewater Fund provides both loans and grants, but it is primarily a loan program. The loan/grant amounts are determined by a financial analysis of the applicant's ability to afford a loan including the following criteria: debt capacity, repayment sources and other factors.

The Water/Wastewater Fund financing program's guidelines, project administration, loan terms and interest rates are similar to the Special Public Works Fund program. The maximum loan term is 25 years or the useful life of the infrastructure financed, whichever is less. The maximum loan amount is 15 million dollars per project through a combination of direct and/or bond funded loans. Loans are generally repaid with utility revenues or voter-approved bond issuance. A limited tax general obligation pledge may also be required. Certain entities may seek project funding within this program through the sale of state revenue bonds.

*Public Debt*

<u>*Revenue Bonds*</u>

Revenue bonds are commonly used to fund utility capital improvements. The bond debt is secured by the revenues of the issuing utility and the debt obligation does not extend to other City resources. With this limited commitment, revenue bonds typically require security conditions related to the maintenance of dedicated reserves referenced as bond reserves and financial performance measures which are added to the bond debt as service coverage. In order to qualify to sell revenue bonds, The City must show that the net revenue defined as total revenue less operating and maintenance expense, for the water fund is equal to or greater than a standard factor, typically 1.2 to 1.4 times the annual revenue bond debt service. This factor is commonly referred to as the coverage factor, and is applicable to revenue bonds sold on the commercial market. There is no bonding limit, except the practical limit of the utility's ability to generate sufficient revenue to repay the debt and meet other security conditions. In some cases, poor credit may impair a community's ability to acquire and use revenue bonds.

Revenue bonds incur relatively higher interest rates than government programs, but due to the highly competitive nature of the low-interest government loans, revenue bonds are assumed to be a more reliable source of funding as they typically can be obtained by most communities.

*Water Fund Cash Resources and Revenues*

The City's financial resources available for capital funding include rate funding, cash reserves, and SDCs.

SDCs are sources of funding generated through development and system growth and are typically used by utilities to support capital funding needs. The charge is intended to recover a fair share of the costs of existing and planned facilities that provide capacity to serve new growth.

Oregon Revised Statute (ORS) 223.297 – 223.314 defines SDCs and specifies how they shall be calculated, applied, and accounted for. By statute, an SDC amount can be structured to include one or both of the following two components:

- *Reimbursement Fee* – Intended to recover an equitable share of the cost of facilities already constructed or under construction.

- *Improvement Fee* – Intended to recover a fair share of future, planned, capital improvements needed to increase the capacity of the system.

The reimbursement fee methodology must consider such things as the cost of existing facilities and the value of unused capacity in those facilities. The calculation must also ensure that future system users contribute no more than their fair share of existing facilities costs. Reimbursement fee proceeds may be spent on any capital improvements or debt service repayment related to the system for which the SDC is applied. For example, water reimbursement SDCs must be spent on water improvements or water debt service.

The improvement fee methodology must include only the cost of projected capital improvements needed to increase system capacity. In other words, the cost of planned projects that correct existing deficiencies, or do not otherwise increase capacity, may not be included in the improvement fee calculation. Improvement fee proceeds may be spent only on capital improvements (or related debt service), or portions thereof, that increase the capacity of the system for which they were applied.

**Summary**

This section presents recommendations for improvements to the City of Roseburg's storage reservoirs, pump stations and distribution system. The total estimated project cost of these improvements is approximately 54 million dollars for the 20-year planning horizon, with approximately 31 million dollars to be funded by the City. Of the improvements required in the 20-year planning horizon, the total project cost of the improvements required in the next ten years is approximately 28.1 million dollars. Approximately 1.9 million dollars per year should be budgeted over the next 10 years for funding of the City's share of these projects which is approximately 19 million dollars. Financial planning and analysis is recommended to evaluate overall water system financial needs and to identify funding options and alternatives.

# APPENDIX A

## Plate 1 – Existing System Map

## Plate 2 – Improvements Map

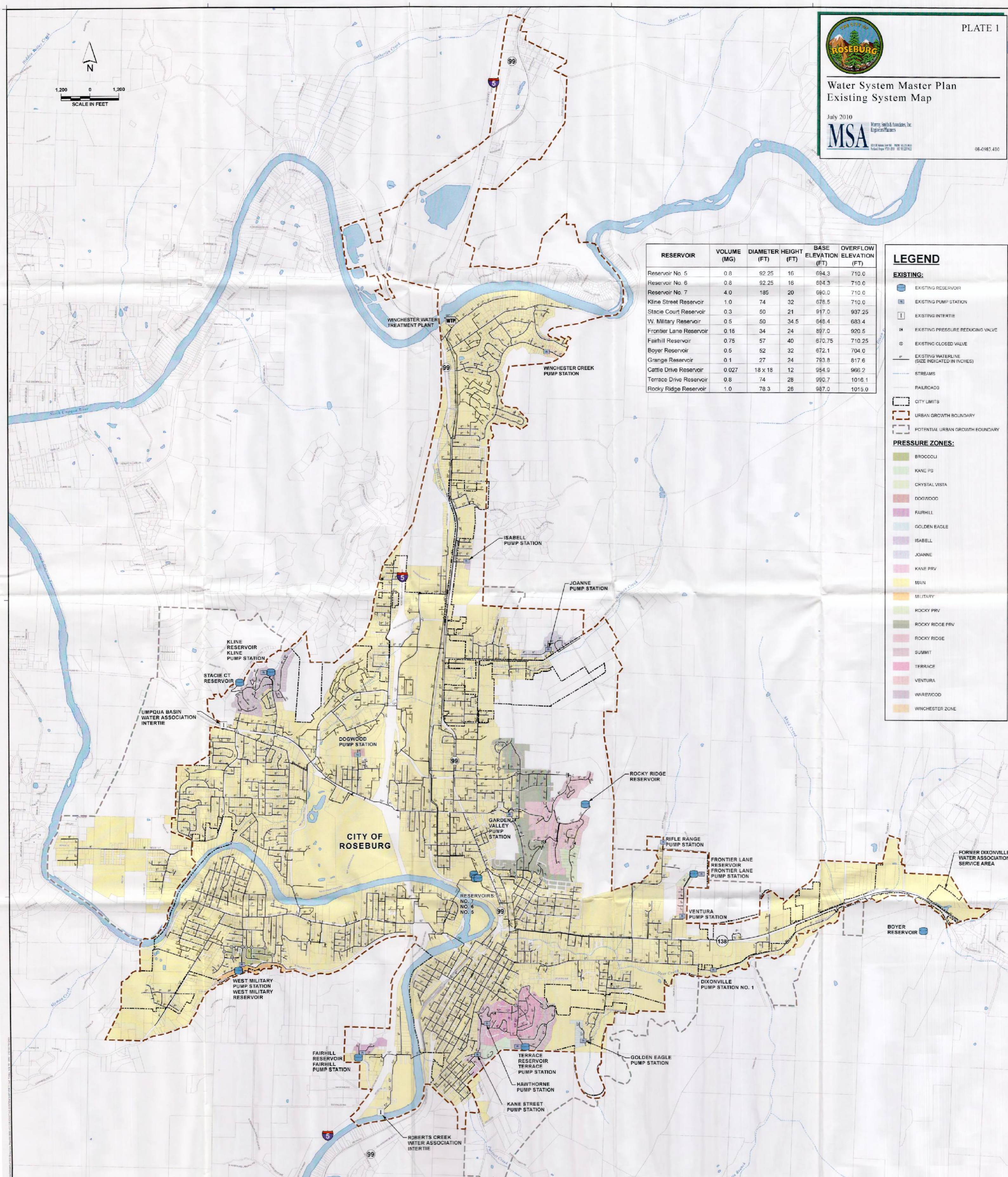
PLATE 1

# Water System Master Plan
## Existing System Map

July 2010

MSA Murray, Smith & Associates, Inc. Engineers/Planners

08-0983.410




| RESERVOIR | VOLUME (MG) | DIAMETER (FT) | HEIGHT (FT) | BASE ELEVATION (FT) | OVERFLOW ELEVATION (FT) |
|---|---|---|---|---|---|
| Reservoir No. 5 | 0.8 | 92.25 | 16 | 694.3 | 710.0 |
| Reservoir No. 6 | 0.8 | 92.25 | 16 | 694.3 | 710.0 |
| Reservoir No. 7 | 4.0 | 185 | 20 | 690.0 | 710.0 |
| Kline Street Reservoir | 1.0 | 74 | 32 | 678.5 | 710.0 |
| Stacie Court Reservoir | 0.3 | 50 | 21 | 917.0 | 937.25 |
| W. Military Reservoir | 0.5 | 50 | 34.5 | 648.4 | 683.4 |
| Frontier Lane Reservoir | 0.15 | 34 | 24 | 897.0 | 920.5 |
| Fairhill Reservoir | 0.75 | 57 | 40 | 670.75 | 710.25 |
| Boyer Reservoir | 0.5 | 52 | 32 | 672.1 | 704.0 |
| Grange Reservoir | 0.1 | 27 | 24 | 793.8 | 817.6 |
| Cattle Drive Reservoir | 0.027 | 18 x 18 | 12 | 954.9 | 966.2 |
| Terrace Drive Reservoir | 0.8 | 74 | 28 | 990.7 | 1016.1 |
| Rocky Ridge Reservoir | 1.0 | 78.3 | 28 | 987.0 | 1015.0 |

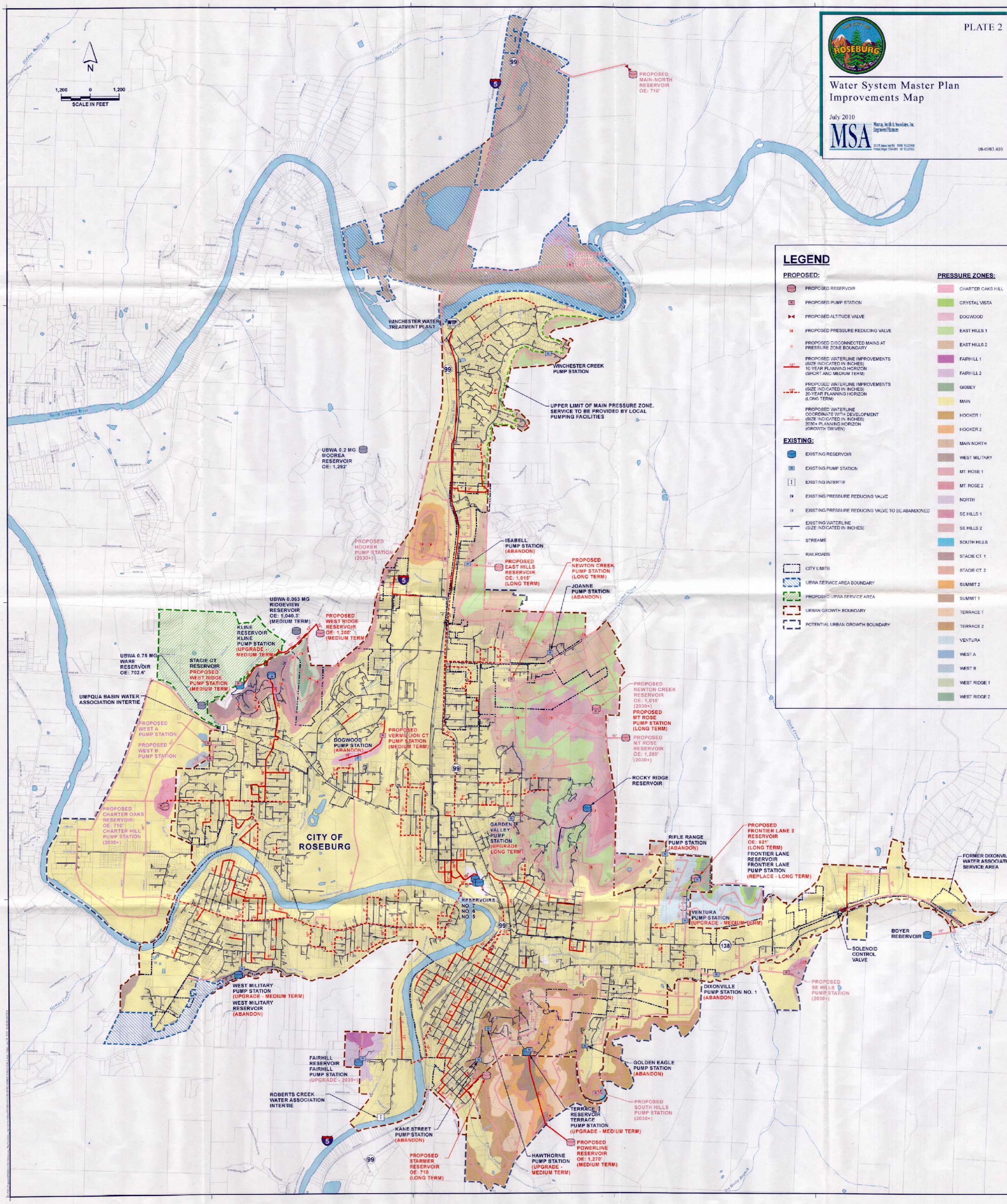


PLATE 2
ROSEBURG
Water System Master Plan
Improvements Map
July 2010
MSA
Murray, Smith & Associates, Inc.
Engineers/Planners
08-0983.410
SCALE IN FEET
1,200 0 1,200
N
LEGEND
PROPOSED:
PROPOSED RESERVOIR
PROPOSED PUMP STATION
PROPOSED ALTITUDE VALVE
PROPOSED PRESSURE REDUCING VALVE
PROPOSED DISCONNECTED MAINS AT PRESSURE ZONE BOUNDARY
PROPOSED WATERLINE IMPROVEMENTS (SIZE INDICATED IN INCHES) 10 YEAR PLANNING HORIZON (SHORT AND MEDIUM TERM)
PROPOSED WATERLINE IMPROVEMENTS (SIZE INDICATED IN INCHES) 20 YEAR PLANNING HORIZON (LONG TERM)
PROPOSED WATERLINE COORDINATE WITH DEVELOPMENT (SIZE INDICATED IN INCHES) 2030+ PLANNING HORIZON (GROWTH DRIVEN)
EXISTING:
EXISTING RESERVOIR
EXISTING PUMP STATION
EXISTING INTERTIE
EXISTING PRESSURE REDUCING VALVE
EXISTING PRESSURE REDUCING VALVE TO BE ABANDONED
EXISTING WATERLINE (SIZE INDICATED IN INCHES)
STREAMS
RAILROADS
CITY LIMITS
UBWA SERVICE AREA BOUNDARY
PROPOSED UBWA SERVICE AREA
URBAN GROWTH BOUNDARY
POTENTIAL URBAN GROWTH BOUNDARY
PRESSURE ZONES:
CHARTER OAKS HILL
CRYSTAL VISTA
DOGWOOD
EAST HILLS 1
EAST HILLS 2
FAIRHILL 1
FAIRHILL 2
GIBBEY
MAIN
HOOKER 1
HOOKER 2
MAIN NORTH
WEST MILITARY
MT. ROSE 1
MT. ROSE 2
NORTH
SE HILLS 1
SE HILLS 2
SOUTH HILLS
STAGIE CT. 1
STAGIE CT. 2
SUMMIT 2
SUMMIT 1
TERRACE 1
TERRACE 2
VENTURA
WEST A
WEST B
WEST RIDGE 1
WEST RIDGE 2
PROPOSED MAIN-NORTH RESERVOIR OE: 710'
WINCHESTER WATER TREATMENT PLANT
WTP
WINCHESTER CREEK PUMP STATION
UPPER LIMIT OF MAIN PRESSURE ZONE. SERVICE TO BE PROVIDED BY LOCAL PUMPING FACILITIES
UBWA 0.2 MG MOOREA RESERVOIR OE: 1,292'
PROPOSED HOOKER PUMP STATION (2030+)
ISABELL PUMP STATION (ABANDON)
PROPOSED EAST HILLS RESERVOIR OE: 1,015' (LONG TERM)
PROPOSED NEWTON CREEK PUMP STATION (LONG TERM)
JOANNE PUMP STATION (ABANDON)
UBWA 0.063 MG RIDGEVIEW RESERVOIR OE: 1,040.3' (MEDIUM TERM)
PROPOSED WEST RIDGE RESERVOIR OE: 1,200' (MEDIUM TERM)
KLINE RESERVOIR KLINE PUMP STATION (UPGRADE - MEDIUM TERM)
UBWA 0.75 MG WARE RESERVOIR OE: 702.6'
STAGIE CT RESERVOIR PROPOSED WEST RIDGE PUMP STATION (MEDIUM TERM)
UMPQUA BASIN WATER ASSOCIATION INTERTIE
PROPOSED WEST A PUMP STATION
PROPOSED WEST B PUMP STATION
DOGWOOD PUMP STATION (ABANDON)
PROPOSED VERMILLION CT PUMP STATION (MEDIUM TERM)
PROPOSED NEWTON CREEK RESERVOIR OE: 1,015' (2030+)
PROPOSED MT ROSE PUMP STATION (LONG TERM)
PROPOSED MT ROSE RESERVOIR OE: 1,280' (2030+)
ROCKY RIDGE RESERVOIR
PROPOSED CHARTER OAKS RESERVOIR OE: 710' CHARTER HILL PUMP STATION (2030+)
CITY OF ROSEBURG
GARDEN VALLEY PUMP STATION (UPGRADE - LONG TERM)
RIFLE RANGE PUMP STATION (ABANDON)
PROPOSED FRONTIER LANE 2 RESERVOIR OE: 921' (LONG TERM)
FRONTIER LANE RESERVOIR FRONTIER LANE PUMP STATION (REPLACE - LONG TERM)
FORMER DIXONVILLE WATER ASSOCIATION SERVICE AREA
RESERVOIRS: NO. 7 NO. 6 NO. 5
VENTURA PUMP STATION (UPGRADE - MEDIUM TERM)
BOYER RESERVOIR
SOLENOID CONTROL VALVE
WEST MILITARY PUMP STATION (UPGRADE - MEDIUM TERM)
WEST MILITARY RESERVOIR (ABANDON)
DIXONVILLE PUMP STATION NO. 1 (ABANDON)
PROPOSED SE HILLS PUMP STATION (2030+)
FAIRHILL RESERVOIR FAIRHILL PUMP STATION (UPGRADE - 2030+)
GOLDEN EAGLE PUMP STATION (ABANDON)
ROBERTS CREEK WATER ASSOCIATION INTERTIE
PROPOSED SOUTH HILLS PUMP STATION (2030+)
TERRACE RESERVOIR TERRACE PUMP STATION (UPGRADE - MEDIUM TERM)
KANE STREET PUMP STATION (ABANDON)
PROPOSED POWERLINE RESERVOIR OE: 1,270' (MEDIUM TERM)
PROPOSED STARMER RESERVOIR OE: 710 (LONG TERM)
HAWTHORNE PUMP STATION (UPGRADE - MEDIUM TERM)
North Umpqua River
5
99
138

# APPENDIX B
# Reservoir Data Summary

**TABLE B-1**
**APPENDIX B**
**RESERVOIR DATA SUMMARY**

| Reservoir | Other Names | Address | Vol. (MG) | Type | Dia. (ft) | Hgt. (ft) | Base (ft – msl) | Overflow (ft –msl) | Year Built | Last Coating | Coating Type | Cathodic Protection | Telemetry |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. 5 | | 707 NE Bellview Ct. | 0.8 | Welded | 92.25 | 16 | 794.8 | 710.0 | 1949 | R94-14 | Epoxy | Yes (1994) | No |
| No. 6 | | 707 NE Bellview Ct. | 0.8 | Welded | 92.25 | 16 | 794.8 | 710.0 | 1949 | R95-21 | Epoxy | Yes (1995) | No |
| No. 7 | | 707 NE Bellview Ct. | 4.0 | Welded | 185 | 20.5 | 690.0 | 710.0 | 1980 | 09WA13 | Epoxy | Yes (2010) | Yes |
| Kline St. | Garden Valley | 2843 NW Kline St. | 1.0 | Welded | 74 | 32 | 678.5 | 710.0 | 1976 | 97WA05 | Epoxy | Yes (1997) | Yes |
| Stacie Ct. | | 2990 NW Stacie Ct. | 0.3 | Welded | 50 | 21 | 917.0 | 937.25 | 1992 | 91-04 | Epoxy | No | Yes |
| W. Military | West Side | 2625 W. Military Ave. | 0.5 | Welded | 50 | 34.5 | 648.4 | 683.4 | 1956 | 98WA03 | Epoxy | Yes (1998) | Yes |
| Frontier Ln. | Denn-Nora | 1551 NE Frontier Ln. | 0.15 | Welded | 34 | 24 | 897.0 | 920.5 | 1983 | R95-21 | Epoxy | Yes (1995) | Yes |
| Fairhill | Fairgrounds | 1870 Fairhill Dr. | 0.75 | Welded | 57 | 40 | 670.75 | 710.25 | 1969 | 99WA03 | Epoxy | Yes (1999) | Yes |
| Boyer | | 207 Buckhorn Rd. | 0.5 | Welded | 52 | 32 | 672.1 | 704.0 | 1966 | 00WA23 | Epoxy | No | No |
| Grange | | 267 S. Deer Creek Rd. | 0.1 | Welded | 27 | 24 | 793.8 | 817.6 | 1966 | 1966 | Vinyl | No | No |
| Cattle Dr. | | 995 Cattle Dr. | 0.027 | Concrete | 18x18 | 12 | 954.9 | 966.2 | 1977 | (conc.) | N/A | N/A | No |
| Terrace Dr. | | 1500 SE Terrace Dr. | 0.8 | Welded | 74 | 28 | 990.7 | 1,016.1 | 1998 | 98WA04 | Epoxy | Yes (1998) | Yes |
| Rocky Ridge | | 5000 NE Rocky Ridge Dr. | 1.0 | Bolted | 78.3 | 28 | 987.0 | 1,015.0 | 2002 | 02WA08 | Glass | No | No |

**TOTAL STORAGE VOLUME: 10.7 MG**

## CITY OF ROSEBURG WATER SYSTEM

8/20/2009

## PRESSURE REDUCING VALVE SETUP DATA SHEET

| Designation: | Hawthorne Dr PRV | Reservoir Av PRV | Lincoln St PRV | Alameda Av PRV | Beulah Dr PRV | Rocky Dr PRV |
|---|---|---|---|---|---|---|
| Near Location: | 1317 Hawthorne Dr | 1615 Reservoir Av | 1491 Lincoln St | Alameda Av | 1741 Beulah Dr | 1690 Rocky Dr |
| Elev. - VAULT LID: | 680.06' (floor) | 702.79' | 619.68' | 750.01' | 769.29' | 749.97' |
| Elev. - GAUGE: | 683.1' | 697.2' | 616.5' | 744.7' | 762.9' | 744.6' |
| Supply: | Terrace Dr Res | Terrace Dr Res | Rky Rdg Reservoir | Rky Rdg Reservoir | Rky Rdg Reservoir | Rky Rdg Reservoir |
| -Inlet HGL (ft.) | OF 1016.1' | OF 1016.1' | O.F. 1015' | O.F. 1015' | O.F. 1015' | OF 1015' |
| -Inlet Pres. (psi) | 144 psi | 138 psi | 173 psi | 117 psi | 109 psi | 117 psi |
| Line Status | Lead | Lag | Lead | 1st Lag | 2nd Lag | Lead |
| Normal Pressure | 74 psi | 68 psi | 103 psi | 47 psi | 39 psi | 44 psi |
| Domestic Model: | ClaVal: 90-DIBCX | ClaVal: 90-01YBC | ClaVal: 90-DIBCS | ClaVal: 90G-01BSY | ClaVal: 90G-01BCS | ClaVal: 90G-01YBCS |
| -Size (in.) | 2" | 2" | 2" | 3" | 2" | 2" |
| -Outlet Setting (psi) | 74 psi | 65 psi | 103 psi | 44 psi | 33 psi | 44 psi |
| -Outlet HGL (ft.) | 854' | 847' | 854' | 847' | 840' | 847' |
| Fire Model: | ClaVal: 90G-01BCS | ClaVal: 90-01YB | ClaVal: 90G-DIBCS | ClaVal: 90G-01BY | ClaVal: 90G-01BCS | ClaVal: 90G-01YBC |
| -Size (in.) | 6" | 6" | 6" | 8" | 6" | 6" |
| -Outlet Setting (psi) | 68 psi | 59 psi | 97 psi | 38 psi | 27 psi | 38 psi |
| -Outlet HGL (ft.) | 840' | 833' | 840' | 833' | 826' | 833' |
| Pres. Relief Mod: | ClaVal: 650-01 | ClaVal: 50-01B | ClaVal: 50-01YB | ClaVal: 50A-01B | ClaVal: 50-01YB | ClaVal: 50A-01YB |
| -Size (in.) | 4" | 3" | 3" | 3" | 3" | 3" |
| -Outlet Setting (psi) | 84 psi | 78 psi | 113 psi | 57 psi | 49 psi | 54 psi |
| -Outlet HGL (ft.) | 877' | 877' | 877' | 877' | 877' | 870' |
| Project No. | 02WA17 | 05WA02 | 01WA03 | 06WA26 | 01WA06 | 05WA25 |
| Service Elevation (ft) | 750' | | 750' | | | 750' |
| Highest Service: | 730' | | 800' | | | 740' |
| Basis of Design: | Hydraulic grade line used in design was 850'. Actual split between 710' main level reservoir overflow and 1,016' Terrace reservoir overflow is 863'. Highest existing fixture served is about 730'. Use values of 850' +4'/-3' for 3 psi lead/lag separation. | | Hydraulic grade used in design was 850'. Actual split between 710' main level reservoir overflow and 1,015' Rocky Ridge reservoir is 863'. Highest existing fixture served is about 740' (excepting service from Kane Street pump station). Use values of 850' +4'/-3' for 3 psi lead/lag separation between primary and secondary. | | | No design basis was submitted by civil engineer. Actual split between 710' main level reservoir overflow and 1,015' Rocky Ridge reservoir is 863'. |

1. Lag pressures should be set 3 psi (7' HGL) lower than lead station pressures.
2. Fire valves should be set 6 psi (14' HGL) lower than domestic valves.
3. Pressure relief valves should be set 10 psi (23' HGL) above highest setpoint of pressure of zone.
4. Elevations verified with GPS 8/20/09 by Neil Hibbs, surveyor (Elevations shot NE corner of vault, Hawthorne floor).

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# APPENDIX C
## Pump Station Design Guidelines

# APPENDIX C
# PUMP STATION DESIGN GUIDELINES

This appendix presents pump station design guidelines intended to establish minimum design and performance standards for City pump stations. In order to aid designers determine pump station design flow rates, Figure C-1, illustrates a preliminary estimate of anticipated peak flow for a residential service area based on the number of dwelling units served. This chart, developed from several references, is presented to illustrate the high and low range of expected peak demands shown as a function of number of residences served. Final pump unit selection and pumping system design should be based on more detailed engineering analysis of the specific conditions including development of a detailed system-head curve and assessment of actual flow and head requirements.

The following guidelines for pumping station configuration and appurtenant design is provided as a guide for development of new pumping station facilities within the City's water system. These guidelines are excerpted and paraphrased from the Washington State Department of Health's Water System Design Manual (August 2001) and are meant to serve as minimum requirements for all pumping station facilities.

***Pump Station Appurtenant Design***

The housing for the booster pump station should be designed and installed so that it:

1. Complies with applicable building and electrical codes;
2. Is secure from vandalism, trespass and severe weather conditions;
3. Is adequately insulated;
4. Provides for heating to prevent freezing during winter;
5. Provides for adequate ventilation to control humidity and to prevent overheating in the summer;
6. Provides for adequate drainage; and
7. Provides for easy access to allow for replacement or repair of equipment.

Other recommended appurtenances include:

1. A sampling tap (installed on the common discharge line) to aid in water quality monitoring and investigation; and
2. An injection tap on the common discharge line to aid in emergency treatment.
3. Concrete floor, CMU or concrete walls, and wood or steel framed roof.

*Meters and Gauges*

Each pump, at a minimum, should have a standard pressure gauge on its discharge line, between the pump and the discharge check valve, a compound gauge on its suction side, and a means for metering the discharge. Larger VFD type stations should have recording gauges.

Each station should also have a meter capable of measuring the total water pumped and a rate of flow indicator (flow meter) should also be provided in order to monitor the performance of the pumps.

*Valving*

Pumps should be adequately valved to permit satisfactory operation, maintenance and repair of the equipment. Isolation valves should be provided on the suction and discharge side of the booster pump. Other appurtenances include:

1. Check valves on the discharge side of each pump;
2. Flexible flanged coupling adapters for the larger units and threaded unions for the smaller units provided at the end connections for booster pumps, pressure vessels, and large equipment in order to simplify maintenance and provide flexibility in installation; and
3. Pump control valves, surge anticipation valves, etc., as needed, to prevent the development of destructive surge pressures during normal and emergency pump start/stop.

*Controls*

A visible external alarm light (powered by a battery back-up) designed to indicate pump failure or low pressure conditions in the pumping station service area should be provided. Control system should be connected to the City's SCADA system for monitoring, control and anunciation of alarms. A system to monitor suction pressure should also be provided to assure that pumps are not permitted to operate with insufficient net positive suction head (NPSH), or at the expense of operating pressures in the distribution system from which they are drawing water.

*Pump Protection*

In addition to check valves listed above, protection for each pump motor from disruption in the power supply should be provided. Such disruptions include, but are not limited to, lightning, loss of voltage, or loss of phase. Pumps shall also be protected from suction air locks or low suction pressure. See Section 4 for backup power/pumping requirements.

*Piping Material*

Interior pumping station piping design should use appropriate materials such as ductile iron, AWWA C205 steel piping or copper piping. PVC piping should not be used. Special anchoring or support requirements for equipment and piping should also be addressed. Three-inch diameter and larger pipe shall be joined using threaded or integral flanges (AWWA C115). Pipes smaller than 3-inch diameter shall use threaded flange or grooved end joints.

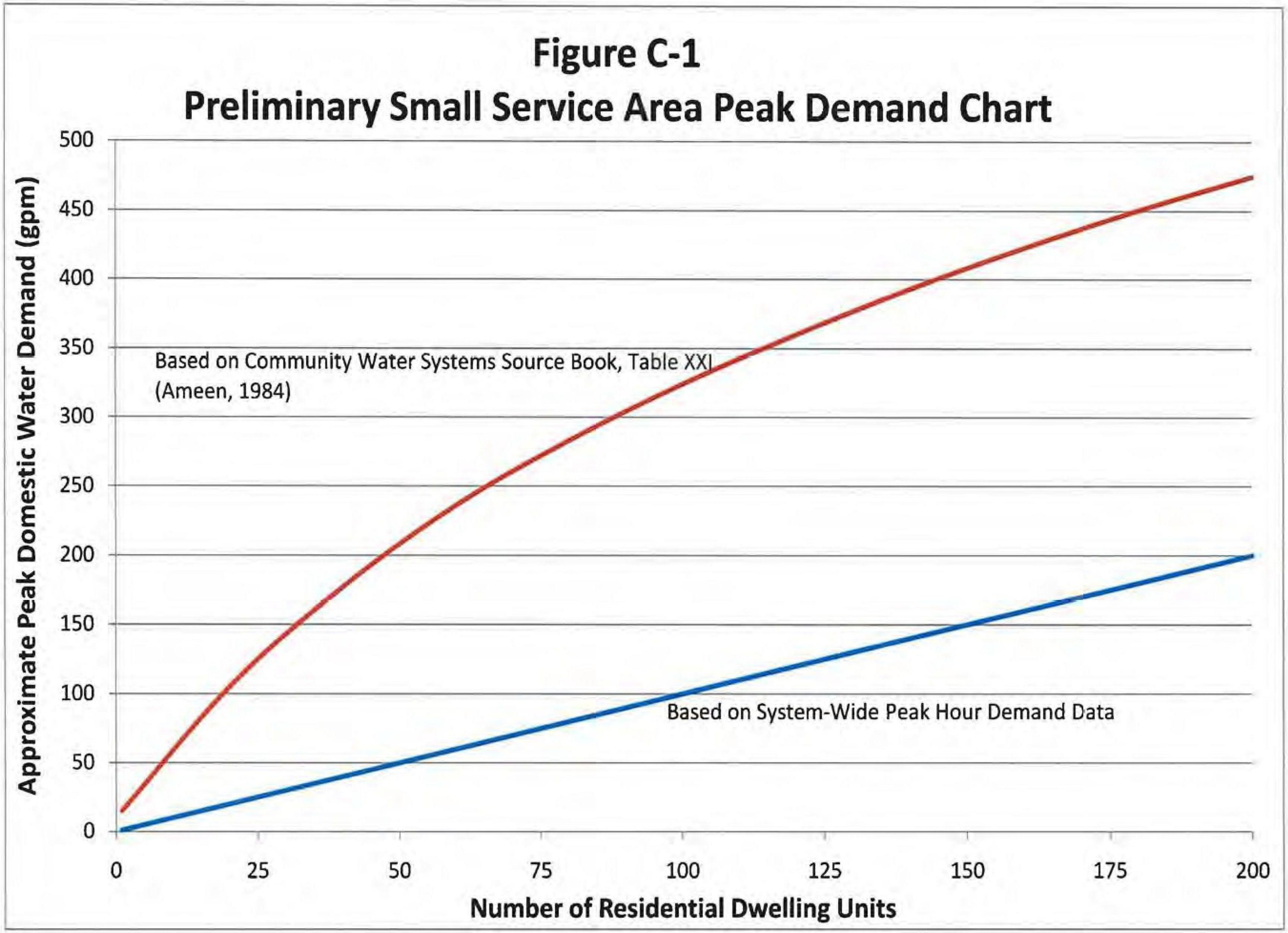
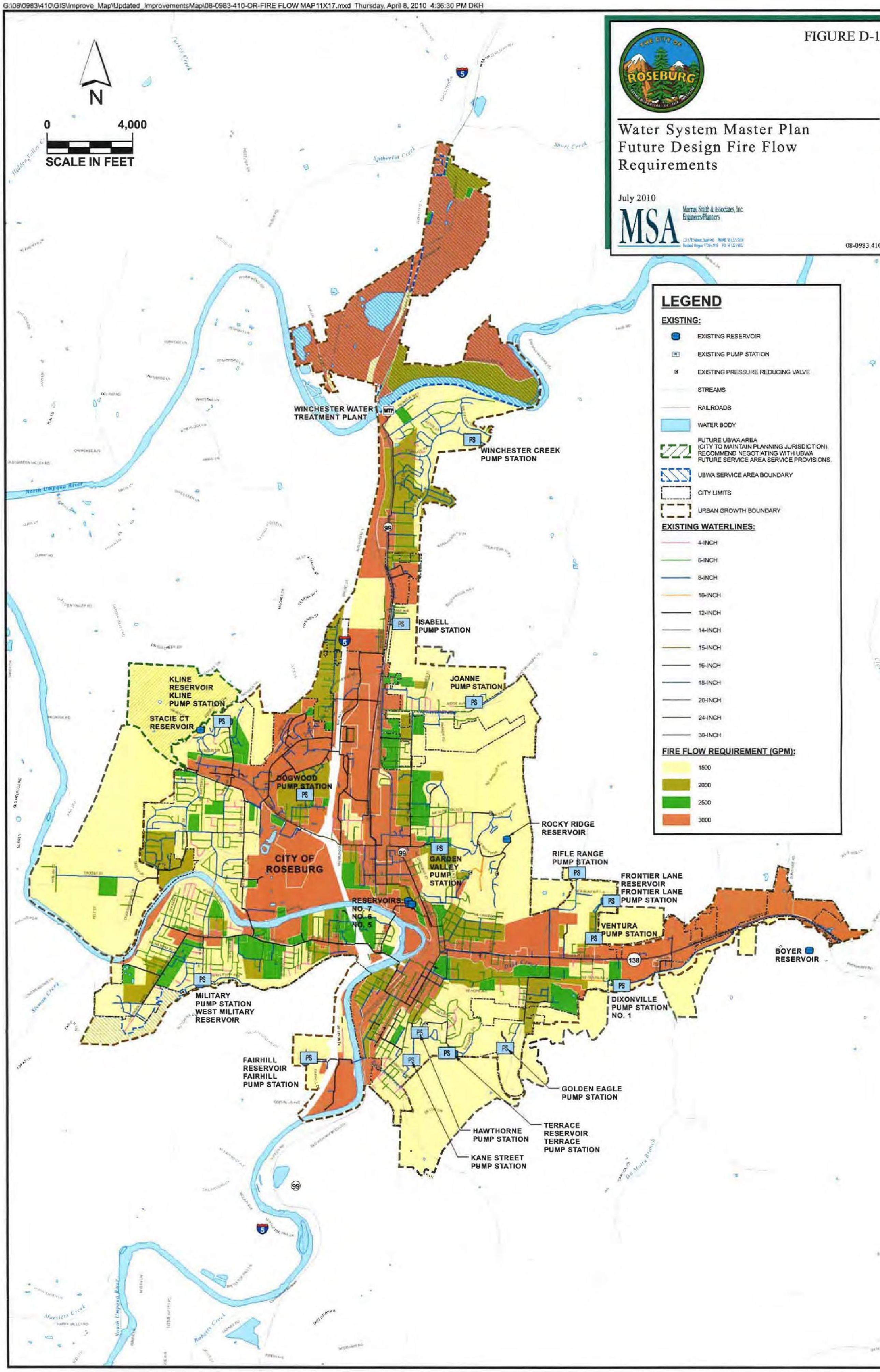


Figure C-1
Preliminary Small Service Area Peak Demand Chart
Approximate Peak Domestic Water Demand (gpm)
500
450
400
350
300
250
200
150
100
50
0
Based on Community Water Systems Source Book, Table XXI (Ameen, 1984)
Based on System-Wide Peak Hour Demand Data
0
25
50
75
100
125
150
175
200
Number of Residential Dwelling Units

# APPENDIX D

## Water System Master Plan
## Future Design Fire Flow Requirements

G:\08\0983\410\GIS\Improve_Map\Updated_ImprovementsMap\08-0983-410-OR-FIRE FLOW MAP11X17.mxd Thursday, April 8, 2010 4:36:30 PM DKH



# APPENDIX E
## Model Calibration Overview

## APPENDIX E
## MODEL CALIBRATION OVERVIEW

### General

Calibration of the hydraulic network model consists of identifying the value of model parameters required to match modeled results with measured field data. The level of detail used in model calibration depends on the size and type of system being modeled and the scope, scale and purpose of the analysis or planning exercise. The minimum calibration exercise for any system is to match field-measured pressures and fire flows with model simulated system pressures and fire flows by adjusting pipeline friction factors as necessary and reasonable for the age and type of pipe. The calibration process can clarify system operations and validates existing distribution system connections, or disconnections such as unintentional valve closures, that may need to be corrected in the model or in the system.

### *Boundary Conditions*

Boundary condition data, such as reservoir levels and major pump on/off status or flow rate must be collected for the time of field pressure and flow data collection so that the same conditions can be represented in the model. Comparison of field collected and modeled data may indicate the need for adjustments to the spatial distribution of model demands, valve settings or elevations, pipeline friction factors and other variables. Because the network model provides a "snap-shot" of the system, data assembled must be concurrent, that is, occurring at the same time.

City staff collected calibration and boundary condition data during hydrant flow testing. Pressure and flow tests were carried out at pre-selected fire hydrant locations around the City. Ideally at least two fire hydrant flow tests would be completed in each zone; however, in small zones, one or no fire hydrants may exist on water lines serving the zone.

### *Fire Flow Tests*

Fire flow tests involve the use of two adjacent hydrants simultaneously. One hydrant is used to measure pressure and another hydrant is opened to create a pressure drop in the system. The locations of hydrant test pairs were pre-selected and evaluated by the City to attempt to minimize property disturbance from flowing hydrants and to ensure that that hydrants were in close proximity to each other and hydraulically connected. Pressure and flow gauge equipment was pre-calibrated before arrival at the site. The readings from separate gauges were compared on site at the beginning of the testing to verify calibration. The hydrant testing process for model calibration was as follows:

- Collection of boundary condition operating data via phone call to the Winchester Water Treatment Plant.
- The static system pressure at the pressure hydrant was measured.

- Static pressure was measured at a second hydrant, referred to as the flow hydrant. After static measurements were recorded, the smallest flow orifice or port of the flow hydrant was and flowed until a targeted pressure drop of at least 10 psi is observed at the pressure hydrant.
- A pitot gage, with a diffuser was used at the flow hydrant to measure the discharge pressure at the flowing hydrant once the 10 psi drop is observed at the pressure hydrant.

Occasionally more than one flow hydrant was operated in order to achieve the 10 psi pressure drop. Flow measurements were recorded at all flow hydrants. A drop of less than 10 psi was accepted if opening additional hydrants would cause erosion or water damage to adjacent property.

Depending on the accuracy and completeness of the available information describing the distribution system, some pressure zones might achieve a higher degree of calibration than others. The accuracy descriptions in Table E-1 are used to identify the level of calibration accuracy throughout the system.

**Table E-1**
**Model Accuracy Level Summary**

| Calibration Level | Static Pressure Results | Residual Fire Flow Pressure Results |
|---|---|---|
| High | {Field Pressure – Model Pressure}<br>Nearly all results ±5 psi | {Field Pressure Drop – Model Pressure Drop}<br>Nearly all results < =10 psi |
| Medium | {Field Pressure – Model Pressure}<br>A few results >5 psi error | {Field Pressure Drop – Model Pressure Drop}<br>A few results >10 psi |
| Low | {Field Pressure – Model Pressure}<br>Several results >5 psi | {Field Pressure Drop – Model Pressure Drop}<br>Several Results >10 psi |

***Calibration Results***

Table E-2 summarizes the results of the hydraulic model calibration. Generally model calibration showed a high level of confidence and excellent agreement with field measured pressure and flow data. Medium to low calibration confidence levels were found in two smaller pressure zones. These results most likely resulted in variable elevation data. Overall agreement of model results and field measurements was very good. The model's performance reflects a reasonable approximation of the actual performance of the City's water distribution system.

**Table E-2**
**Model Calibration Confidence Level Summary**

| Zone | Number of High Confidence Tests | Number of Medium Confidence Tests | Number of Low Confidence Tests | Overall Calibration Level |
|---|---|---|---|---|
| Broccoli | 1 | 0 | 0 | High |
| Gibby | 1 | 0 | 0 | High |
| Kane PRV Zone | 0 | 1 | 1 | Medium-Low |
| Main | 16 | 0 | 3 | High |
| Military | 1 | 0 | 0 | High |
| Rocky Drive PRV | 0 | 0 | 1 | Low |
| Rocky Ridge PRV | 0 | 2 | 0 | Medium |
| Rocky Ridge | 2 | 0 | 0 | High |
| Summit | 2 | 0 | 0 | High |
| Terrace | 2 | 0 | 0 | High |
| Warewood | 2 | 0 | 0 | High |

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# APPENDIX F
## Storage Analysis Summary

**Table F-1**
**Storage Analysis Summary - Future Conditions (2058)**

| Proposed Pressure Zone (Existing Storage) | Storage Component (gallons) | | | Storage Required (mg) | Existing Storage (mg) | Zone Surplus / (Deficit) (mg) | System Surplus / (Deficit) (mg) | Recommended 2058 Storage Facilities and Capacity (mg) |
|---|---|---|---|---|---|---|---|---|
| | Operational | Fire | Emergency | | | | | |
| East Hills 1 and 2 (Rocky Ridge) | 923,200 | 240,000 | 923,200 | 2.09 | 1.00 | (1.09) | (1.09) | East Hills: 0.50 Newton Creek: 0.75[3] |
| Main (Nos. 5, 6, 7, Fairhill, Kline)<br>Dogwood[1,2]<br>West Military[1,2,5]<br>Fairhill 1 and 2[1,2]<br>Hooker 1 and 2<br>West A and B<br>SE Hills 1 and 2<br>Charter Oaks/Charter Oaks Hill | 6,531,900 | 540,000 | 6,531,900 | 13.60 | 7.35 | (6.25) | (6.25) | Starmer: 1.0<br>Charter Oaks: TBD[4] |
| Stacie Ct. 1 and 2 (Stacie Ct.)<br>West Ridge 1 and 2 | 197,700 | 240,000 | 197,700 | 0.64 | 0.30 | (0.34) | (0.34) | West Ridge: 0.40[3] |
| Terrace 1 and 2 (Terrace)<br>South Hills | 479,200 | 240,000 | 479,200 | 1.20 | 0.80 | (0.40) | (0.40) | -- |
| Summit 1 and 2 | 146,200 | 240,000 | 146,200 | 0.53 | - | (0.53) | (0.53) | Powerline: 0.6[3] |
| Ventura (Frontier Lane)<br>Crystal Vista/Gibby[1,2] | 152,900 | 240,000 | 152,900 | 0.55 | 0.15 | (0.40) | (0.40) | Frontier Lane 2: 0.4[3] |
| Mt Rose 1 and 2 | 249,000 | 180,000 | 249,000 | 0.68 | - | (0.68) | (0.68) | Mt Rose: 0.70[3] |
| | | | **Total (mg)[6]** | **19.28** | **9.60** | | **(9.68)** | **2028 Horizon: 4.35** |
| Main North<br>North 1 | 899,100 | 540,000 | 899,100 | 0.90 | - | (0.90) | (0.90) | Main North: 1.0[3,6] |

Notes:
1. Pressure zone is recommended to continue to be served by pump stations without the benefit of gravity storage. See Note 2.
2. Storage need for smaller, isolated pressure zones referenced under Note 1 is included in the system-wide surplus/(deficit) column.
3. Storage volume needs based on ultimate demands (2058 projections) for zones where a single reservoir will best meet the gravity storage needs of the zone and construction of additional future reservoirs is unlikely.
4. Projected maximum day demands in 2058 indicate an additional large storage facility will be needed in the Main pressure zone. The Charter Oaks proposed reservoir is included here to aid the City in their long-term planning efforts.
5. Abandon existing West Military Reservoir serving the existing Brocolli pressure zone when reconfigured.
6. Main North and North 1 Pressure Zones and Main North Reservoir are not included in system-wide totals because it is anticipated that this area will be served by the Umpqua Basin Water Association.

**Table F-2**
**Pumping Station Capacity Analysis Summary - Year 2058**

| Pump Station | Storage Facility Supplied | Pressure Zone Served | Firm Capacity Required (gpm) | Existing Firm Capacity (gpm) | Capacity Deficit (gpm) | Recommended 2058 Improvements - Capacity (gpm) |
|---|---|---|---|---|---|---|
| Fairhill | - | Fairhill 1 and 2 | 2,098 | 690 | (1,408) | Fairhill (Upgrade): 1,500 |
| Hawthorne | Terrace | Terrace 1 and 2, Summit 1 and 2 | 1,737 | 300 | (1,437) | Hawthorne (Upgrade): 700 |
| Terrace | *Powerline* | Summit 1 and 2 | 406 | 100 | (306) | Terrace (Replace): 150 |
| Ventura | Frontier Lane / *Frontier Lane 2* | Frontier, Crystal Vista, Gibby | 425 | 150 | (275) | Ventura (Upgrade): 100 |
| Frontier Lane | - | Crystal Vista, Gibby | 2,142 | 95 | (2,047) | Frontier Lane (Replace): 2,000 |
| Garden Valley[2] | Rocky Ridge | East Hills 1 and 2 | 1,710 | 50 | (1,360) | Garden Valley (Upgrade): 1,660 |
| Winchester Creek | - | Winchester Creek | 300 | 300 | | |
| *Newton Creek*[2,4] | *Newton Creek* | East Hills 1 and 2, Mt. Rose 1 and 2 | 1,546 | - | (1,546) | Newton Creek (New): 1,546 |
| *Mt. Rose* | *Mt. Rose* | Mt. Rose 1 and 2 | 692 | - | (692) | Mt. Rose (New): 400 |
| Kline Street | Stacie Court | Stacie Court 1 and 2 | 431 | 60 | (371) | Kline Street (Upgrade): 200 |
| *West Ridge* | *West Ridge* | West Ridge 1 and 2 | 118 | - | (118) | West Ridge (New): 100 |
| *Vermillion Ct.* | - | Dogwood | 2,069 | - | (2,069) | Dogwood (Replace): 2,100 |
| West Military | - | West Military | 2,114 | 45 | (2,069) | West Military (Replace): 2,100 |
| *Hooker 1* | - | Hooker 1 and 2 | 2,253 | - | (2,253) | Main (New): 2,200 |
| *SE Hills* | - | SE Hills 1 and 2 | 2,065 | - | (2,065) | SE Hills (New): 2,100 |
| *South Hills* | - | South Hills | 2,020 | - | (2,020) | South Hills (New): 2,100 |
| *West* | - | West A and B | 2,047 | - | (2,047) | West (New): 2,100 |
| *Charter Oaks Hill* | - | Charter Oaks Hill | 2,084 | - | (2,084) | Charter Oaks (New): 2,100 |
| *North* | - | North 1 | 3,086 | - | (3,086) | North (New): 3,100 |

Notes:
1. Where higher level pressure zones are served from the discharge of the pump station or from gravity storage supplied by the pump station, the higher level pressure zone demands are included in the required capacity of the pump station.
2. The East Hills 1 and 2 Pressure Zones are supplied from the Garden Valley and Newton Creek Pump Stations.
3. Facility names shown in italics are proposed facilities.
4. Suction supply for the proposed Mt. Rose Pump Station will be from the proposed Newton Creek Reservoir. Recommended capacity of the Newton Creek Pump Station reflects the demand of the Mt. Rose pressure zones

# APPENDIX G
## Cost Allocation for Facilities and Piping Improvements

## APPENDIX G
## COST ALLOCATION FOR FACILITIES AND PIPING IMPROVEMENTS

**Table G-1**
**Piping Unit Project Cost Summary**

| Pipe Diameter | Cost per Linear Foot |
|---|---|
| 8-inch | $136 |
| 10-inch | $170 |
| 12-inch | $204 |
| 16-inch | $272 |
| 18-inch | $306 |
| 24-inch | $408 |

Basic Assumptions:

The cost estimates presented are opinions of cost based on the assumptions stated and developed from information available at the time of the estimate. Final costs for all projects will depend on actual field conditions, on actual material and labor costs, final project scope, project implementation and other variables.

- No rock excavation
- No dewatering
- No property or easement acquisitions
- No specialty construction included
- A 45% contingency, administration and engineering allowance included
- Construction by private contractors
- An Engineering News Record (ENR) construction cost index CCI for Seattle, Washington of 8647 (March 2010).
- Add an additional 60% for construction with rock excavation the entire depth of trench

# APPENDIX H
## Recommended Piping Improvement Summary

MSA

**Table H-1**
**Recommended Piping Improvement Summary**
**Short Term**

| CIP No. | Location | From | To | Diameter (inches) | Length (lf) | Estimated Project Cost |
|---|---|---|---|---|---|---|
| **Short Term Piping Improvements (2010 - 2015)** | | | | | | |
| T-1 | Stephens Street/Hwy 99 Transmission | Water Treatment Plant | Hooker Road | 24 | 11,000 | $ 4,488,000 |
| T-2 | Transmission to Main Reservoir | Walnut Street & West | Reservoir Nos. 5, 6 & 7 | 30 | 1,500 | $ 1,153,000 |
| T-3 | Main Reservoir Complex | Phase I | - | - | - | $ 575,750 |
| T-4 | Main Reservoir Complex | Phase II | - | - | - | $ 236,000 |
| T-5 | SE Starmer Street | SE Booth Avenue | Proposed Starmer | 16 | 1,150 | $ 312,800 |
| F-1 | SE Starmer Street | SE Marsters Avenue | SE Booth Avenue | 8 | 450 | $ 61,200 |
| F-2 | SE Booth Avenue | SE Starmer Street | SE Ichabod Street | 8 | 400 | $ 54,400 |
| F-3 | SE Cobb Street | SE Roberts Avenue | SE Stone Avenue | 12 | 950 | $ 193,800 |
| F-4 | SE Stone Avenue | SE Cobb Street | SE Hamilton Street | 8 | 650 | $ 88,400 |
| F-5 | SE Hamilton Street | SE Stone Avenue | SE Main Street | 8 | 600 | $ 81,600 |
| F-6 | SE Stephens Street/Hwy 99 | SE Rice Avenue | | 12 | 150 | $ 30,600 |
| F-7 | SE Sanford Avenue | SE Kane Street | SE Giles Street | 8 | 250 | $ 34,000 |
| F-8 | SE Main Street | SE Marsters Avenue | SE Booth Avenue | 8 | 450 | $ 61,200 |
| F-9 | SE Marsters Street | SE Main Street | SE Eddy Street | 8 | 300 | $ 40,800 |
| F-10 | W Bradford Court | W Bradford Avenue | W Broccoli Street | 8 | 1,600 | $ 217,600 |
| F-11 | W Fair Street | W Harvard Avenue | W Alamosa Court | 8 | 800 | $ 108,800 |
| F-12 | W Alpha Street | W Fair Street | W Bradford Avenue | 8 | 850 | $ 115,600 |
| F-13 | Near W Alamosa Court | W Broccoli Street | W Shenandoah Street | 8 | 250 | $ 34,000 |
| F-14 | W Bradford Avenue | W Sharp Avenue | W Bradford Court | 8 | 550 | $ 74,800 |
| F-15 | W Sharp Avenue | W Cardinal Street | W Bradford Avenue | 8 | 300 | $ 40,800 |
| F-16 | W Cardinal Street | W Sharp Avenue | W Gilbert Avenue | 8 | 800 | $ 108,800 |
| F-17 | W Gilbert Avenue | W Berdine Street | W Cardinal Street | 8 | 500 | $ 68,000 |
| F-18 | W Berdine Street | W Sharp Avenue | W Gilbert Avenue | 8 | 650 | $ 88,400 |
| F-19 | W Oriole Drive | W Cardinal Street | | 8 | 100 | $ 13,600 |
| F-20 | W Oriole Drive | W Broccoli Street | east | 8 | 400 | $ 54,400 |
| F-21 | W Elm Street | W Bradford Court | | 8 | 150 | $ 20,400 |
| F-22 | W Hazel Street | W Sharp Avenue | north to dead end | 8 | 400 | $ 54,400 |
| F-23 | W Shenandoah Street | W Harvard Avenue | existing 12-inch on | 8 | 50 | $ 6,800 |
| F-24 | W Langenberg Avenue | W Broccoli Street | west | 8 | 600 | $ 81,600 |
| F-25 | W Foothill Drive & Myrtlewood Court | W Harvard Avenue | dead end | 10 | 1,050 | $ 178,500 |
| F-26 | SW Kendall Street | SW Portland Avenue | existing 12-inch | 12 | 1,750 | $ 357,000 |
| F-27 | W Luellen Drive | W Lorraine Avenue | W Military Avenue | 12 | 150 | $ 30,600 |
| F-28 | W Indianola Street | W Lorraine Avenue | W Luellen Drive | 8 | 500 | $ 68,000 |
| F-29 | W Kenwood Street | W Lorraine Avenue | W Crestview Avenue | 8 | 300 | $ 40,800 |
| F-30 | W Crestview Avenue | W Kenwood Street | W Pilger Street | 8 | 400 | $ 54,400 |
| F-31 | W Pilger Street | W Harvard Avenue | south | 8 | 750 | $ 102,000 |
| F-32 | W Rainbow Street | dead end | W Pilger Street | 8 | 250 | $ 34,000 |
| F-33 | NW Cherry Drive | NW Calkins Avenue | NW Jefferson Street | 8 | 2,150 | $ 292,400 |
| F-34 | NW Whipple Avenue | NW Riverview Drive | - | 8 | 1,900 | $ 258,400 |
| F-35 | NE Walker Court & Atkinson Court | NE Vine Street | - | 8 | 350 | $ 47,600 |
| F-36 | Winchester Elementary School | Pioneer Way | Page Road | 8 | 250 | $ 34,000 |
| F-37 | NE Mary Ann Lane | dead end | SE Stephens | 8 | 1,350 | $ 183,600 |
| F-38 | NE Ridenour Street | Pleasant Avenue | NE Mary Ann Lane | 8 | 1,250 | $ 170,000 |
| | | | | | **Short Term Improvements Total** | **$ 10,350,850** |

**Table H-2**
**Recommended Piping Improvement Summary**
**Medium Term**

| CIP No. | Location | From | To | Diameter (inches) | Length (lf) | Estimated Project Cost |
|---|---|---|---|---|---|---|
| **Medium-Term Improvements (2016 - 2020)** | | | | | | |
| T-6 | SE Summit Drive | Terrace Pump Station | Proposed Powerline | 12 | 4,500 | $ 918,000 |
| T-7 | Ridgecrest Drive | Proposed West Ridge Pump | Moorea Drive | 8 | 2,300 | $ 312,800 |
| T-8 | Moorea Drive | Ridgecrest Drive | Proposed West Ridge | 12 | 2,550 | $ 520,200 |
| T-9 | NW Kline Street | Kline Reservoir | NW Calkins Avenue | 16 | 5,700 | $ 1,550,400 |
| T-10 | Dogwood Pressure Zone | NW Edenbower Boulevard | Proposed Vermillion Ct | 12 | 550 | $ 112,200 |
| T-11 | Dogwood Pressure Zone | Proposed Vermillion Ct Pump | NW Goetz Street | 10 | 2,300 | $ 391,000 |
| F-39 | General Avenue | NW Broad Street | NW Aviation Drive | 12 | 1,200 | $ 644,800 |
| F-40 | NW Broad Street | W Angela Court | General Avenue | 10 | 800 | $ 136,000 |
| F-41 | Charles S Gardiner Park | NW Renann Avenue | northeast | 8 | 850 | $ 115,600 |
| F-42 | NW Grove Street | dead end | NW Cedar Ridge Court | 8 | 500 | $ 68,000 |
| F-43 | NE Winchester Street | SE Stephens Street/Hwy 99 | NE Wright Avenue | 10 | 1,850 | $ 314,500 |
| F-44 | NE Fulton Street | NE Diamond Lake Boulevard | NE Fleser Avenue | 12 | 500 | $ 102,000 |
| F-45 | NE Fleser Avenue | NE Fulton Street | NE Lake Street | 12 | 600 | $ 122,400 |
| F-46 | NE Lake Street | NE Diamond Lake Boulevard | NE Fleser Avenue | 12 | 500 | $ 102,000 |
| F-47 | SE Stephens Street/Hwy | SE Lane Avenue | SE Sykes Avenue | 10 | 1,900 | $ 323,000 |
| F-48 | SE Oak Avenue | SE Pine Street | SE Chadwick Street | 8 | 1,600 | $ 217,600 |
| F-49 | SE Cass Avenue | SE Stephens Street/Hwy 99 | SE Chadwick Street | 8 | 1,300 | $ 176,800 |
| F-50 | SE Lane Avenue | SE Sheridan Street | SE Rose Street | 10 | 800 | $ 136,000 |
| F-51 | SE Spruce Street | SE Douglas Avenue | SE Oak Avenue | 12 | 850 | $ 173,400 |
| F-52 | SE Oak Avenue | SE Parrott Street | SE Spruce Street | 12 | 300 | $ 61,200 |
| F-53 | SE Oak Avenue | SE Flint Street | SE Parrott Street | 8 | 300 | $ 40,800 |
| F-54 | SE Flint Street | SE Oak Avenue | SE Lane Avenue | 8 | 700 | $ 95,200 |
| F-55 | SE Mosher Avenue | SE Fullerton Street | SE Parrott Street | 12 | 600 | $ 122,400 |
| F-56 | SE Fullerton Street | SE Mosher Avenue | SE Micelli Avenue | 12 | 1,400 | $ 285,600 |
| F-57 | SE Douglas Avenue | SE Spruce Street | SE Rose Street | 10 | 550 | $ 93,500 |
| F-58 | SE Washington Avenue | SE Stephens Street/Hwy 99 | SE Rose Street | 18 | 300 | $ 91,800 |
| F-59 | SE Chadwick Street | SE Washington Avenue | SE Cass Avenue | 8 | 750 | $ 102,000 |
| F-60 | SE Woodward Avenue | SE Mill Street | SE Pine Street | 8 | 350 | $ 47,600 |
| F-61 | SE Cobb Street | SE Mosher Avenue | SE McClellan Avenue | 12 | 450 | $ 91,800 |
| F-62 | SE Floed Avenue | SE Pine Street | SE Stephens Street/Hwy 99 | 8 | 300 | $ 40,800 |
| F-63 | SE Spring Avenue | SE Pine Street | SE Stephens Street/Hwy 99 | 8 | 300 | $ 40,800 |
| F-64 | SE Sykes Avenue | SE Pine Street | SE Stephens Street/Hwy 99 | 12 | 300 | $ 61,200 |
| F-65 | SE Waite Avenue | SE Stephens Street/Hwy 99 | SE Jackson Street | 8 | 500 | $ 68,000 |
| F-66 | SE Pitzer Street | SE Court Avenue | SE Douglas Avenue | 8 | 500 | $ 68,000 |
| F-67 | SE Arizona Street | SE Mosher Avenue | SE Houck Avenue | 8 | 850 | $ 115,600 |
| F-68 | NE Malheur Avenue | NE Central Street | NE Jackson Street | 8 | 1,050 | $ 142,800 |
| F-69 | NE Jackson Street | NE Malheur Avenue | NE Klamath Avenue | 8 | 350 | $ 47,600 |
| F-70 | NE Casper Street | NE Malheur Avenue | NE Klamath Avenue | 8 | 400 | $ 54,400 |
| F-71 | NE Oswego Avenue | NE Casper Street | NE Denver Street | 8 | 250 | $ 34,000 |
| F-72 | NE Klamath Avenue | NE Denver Street | NE Fulton Street | 8 | 750 | $ 102,000 |
| F-73 | NE Atlanta Street | NE Commercial Avenue | NE Diamond Lake | 8 | 750 | $ 102,000 |
| F-74 | NE Odell Avenue | NE Boston Street | NE Casper Street | 8 | 400 | $ 54,400 |
| F-75 | North Umpqua Highway | NE Douglas Avenue | Kester Road | 12 | 450 | $ 91,800 |
| F-76 | Kester Road | North Umpqua Highway | north to dead end | 12 | 1,500 | $ 306,000 |
| F-77 | SE Eddy Street | SE Marsters Avenue | SE Strong Avenue | 8 | 450 | $ 61,200 |
| F-78 | NE Evans Avenue | NW Kline Street | NW Keasey Street | 8 | 1,000 | $ 136,000 |
| F-79 | NW Beaumont Avenue | NW Apache Drive | NW Kline Street | 8 | 600 | $ 81,600 |
| F-80 | NW Apache Drive | NW Beaumont Avenue | NW Wanell Street | 8 | 700 | $ 95,200 |
| F-81 | NW Wanell Street | NW Apache Drive | NW Calkins Avenue | 8 | 350 | $ 47,600 |
| F-82 | NW Dogwood Street | NW Black Avenue | NW Garden Valley | 8 | 650 | $ 88,400 |
| F-83 | NW Black Avenue | dead end | across Ross Dress for Less | 8 | 450 | $ 61,200 |
| F-84 | NW Garden Valley | NE Willow Street | NE Dee Street | 12 | 450 | $ 91,800 |
| F-85 | NE College Street | NE Cedar Street | NE Willow Street | 8 | 600 | $ 81,600 |
| F-86 | NE Willow Street | NE West Avenue | south to dead end at Gaddis | 12 | 900 | $ 183,600 |
| F-87 | NE Walnut Street | NE College Street | south to dead end at Gaddis | 12 | 500 | $ 102,000 |
| F-88 | NE Willow & Walnut | connect dead ends along Gaddis | | 12 | 250 | $ 51,000 |
| F-89 | NE West Avenue | NE Post Street | NE Alder Street | 10 | 300 | $ 51,000 |
| F-90 | NE Alder Street | NE Chestnut Street | NE West Avenue | 10 | 500 | $ 85,000 |
| F-91 | W Hazel Street | W Harvard Avenue | W Moose Drive | 10 | 600 | $ 102,000 |
| F-92 | W Hickory Street | W Riverridge Avenue | W Goedeck Avenue | 8 | 550 | $ 74,800 |
| | | | | | **Medium Term Improvements Total** | **$ 10,192,000** |

**Table H-3**
**Recommended Piping Improvement Summary**
**Long Term**

| CIP No. | Location | From | To | Diameter (inches) | Length (lf) | Estimated Project Cost |
|---|---|---|---|---|---|---|
| **Long-Term Improvements (2021 - 2030)** | | | | | | |
| T-12 | Eastern water systen boundary-Proposed East Hills Zone | Davis Creek Way | Proposed East Hills Reservoir | 12 | 2,600 | $ 530,400 |
| T-13 | Eastern water systen boundary-Proposed East Hills Zone | Proposed East Hills Reservoir | Proposed Newton Creek Reservoir | 12 | 12,800 | $ 2,611,200 |
| T-14 | East Hills Pressure Zone | Proposed Newton Creek Pump Station | Proposed Newton Creek Reservoir | 18 | 4,650 | $ 1,422,900 |
| T-15 | SE Mill Street | SE Burke Avenue | across river to SW Portland | 12 | 2,200 | $ 948,800 |
| T-16 | NE Stephens Street/Hwy 99 & NE Dee Street | Hooker Road | NE Garden Valley Boulevard | 24 | 9,550 | $ 3,896,400 |
| F-93 | W Stanton Street | W Harvard Avenue | W Bertha Avenue | 10 | 800 | $ 136,000 |
| F-94 | Freemont Middle School | W Stanton Street | W Keady Court | 10 | 850 | $ 144,500 |
| F-95 | W Anne Avenue | Freemont Middle School | W Nebo Street | 8 | 400 | $ 54,400 |
| F-96 | W Nebo Street | W Brown Avenue | W Myrtle Avenue | 8 | 750 | $ 102,000 |
| F-97 | W Brown Avenue | W Nebo Street | W Fairhaven Street | 8 | 450 | $ 61,200 |
| F-98 | NW Munson Court | NW Garden Valley Boulevard | northern border of Roseburg | 8 | 900 | $ 122,400 |
| F-99 | northern border of Roseburg | NW Munson Court | NW Highland Street | 8 | 900 | $ 122,400 |
| F-100 | NW Highland Street | NW Garden Valley Boulevard | south to dead end | 8 | 1,900 | $ 258,400 |
| F-101 | NE Alameda Avenue | NE Vine Street | NE Hollis Street | 8 | 1,500 | $ 204,000 |
| F-102 | NW Cecil Avenue | NW Rutter Lane | NW Mulholland Drive | 12 | 250 | $ 51,000 |
| F-103 | NW Rutter Lane | NW Cecil Avenue | NW Bethel Avenue | 12 | 550 | $ 112,200 |
| F-104 | NW Bethel Avenue | NW Rutter Lane | NW Mulholland Drive | 12 | 400 | $ 81,600 |
| F-105 | NW Eden Street | NW Bethel Avenue alignment | NW Garden Valley Boulevard | 12 | 500 | $ 102,000 |
| F-106 | across Safeway parking lot | NE Stephens Street/Hwy 99 | NE Thomas Street | 8 | 250 | $ 34,000 |
| F-107 | W Union Street | W Harvard Avenue | south | 8 | 200 | $ 27,200 |
| F-108 | W Harrison Street | W Harvard Avenue | W Brown Avenue | 10 | 550 | $ 93,500 |
| F-109 | W Umpqua Street | W Esperanza Court | W Princeton Avenue | 8 | 650 | $ 88,400 |
| F-110 | W Umpqua Street | Umpqua Valley Nursing Rehab | south to W Harvard Avenue | 8 | 650 | $ 88,400 |
| F-111 | W Umpqua Street | W Harvard Avenue | W Military Avenue | 10 | 400 | $ 68,000 |
| F-112 | NE Douglas Avenue | NE Rifle Range Road | east | 12 | 600 | $ 122,400 |
| F-113 | Pioneer Way | Gresham Lane | Page Road | 8 | 2,450 | $ 333,200 |
| F-114 | Camelia Street | Village Drive | Shell Lane | 8 | 600 | $ 81,600 |
| F-115 | Zachary Drive alignment | Olivia Lane | Northview Drive | 8 | 350 | $ 47,600 |
| F-116 | Cotton Lane | Oscar Drive | Northview Drive | 8 | 200 | $ 27,200 |
| F-117 | NW Cecil Avenue | NW Mulholland Drive | NW Fairmount Street | 8 | 1,000 | $ 136,000 |
| F-118 | NW Eden Street | NW Otie Street dead end | NW Bethel Avenue alignment | 8 | 1,750 | $ 238,000 |
| F-119 | NW Fairmount Street | NE Stewart Parkway | NW Cecil Avenue | 12 | 300 | $ 61,200 |
| F-120 | NW Fairmount Street | NW Cecil Avenue | NW Garden Valley Boulevard | 10 | 1,200 | $ 204,000 |
| F-121 | NE Oakland Avenue alignment | NE Vine Street | between NE Poplar and Morris | 8 | 1,050 | $ 142,800 |
| F-122 | NE Oakland Avenue alignment | NE Morris Street | NE Hollis Street | 8 | 450 | $ 61,200 |
| F-123 | NE Brooklyn Avenue | NE Todd Street | NE Winter Street | 8 | 1,200 | $ 163,200 |
| F-124 | W Myrtle Avenue | W Fairview Avenue | W Military Avenue | 8 | 800 | $ 108,800 |
| F-125 | W Military Avenue | W Myrtle Avenue | W Brown Avenue | 8 | 1,000 | $ 136,000 |
| F-126 | W Ballf Street | W Harvard Avenue | W Neil Avenue | 8 | 1,050 | $ 142,800 |
| F-127 | W Neil Avenue | W Ballf Street | W Maple Street | 8 | 550 | $ 74,800 |
| F-128 | W Maple Street | W Neil Avenue | W Yale Avenue | 8 | 350 | $ 47,600 |
| F-129 | W Yale Avenue | W Maple Street | W Harrison Street | 8 | 300 | $ 40,800 |
| F-130 | NE Gordon Avenue | NE Cummins Street | NE Miguel Street | 8 | 1,000 | $ 136,000 |
| F-131 | Taft Drive | NE Fairacres Lane | Pleasant Avenue | 8 | 800 | $ 108,800 |
| F-132 | NW Goetz Street | NW Black Avenue | dead end | 8 | 450 | $ 61,200 |
| F-133 | north of NW Hill Avenue | NW Goetz Street | NW Estelle Street | 8 | 750 | $ 102,000 |
| F-134 | NW Patricia Street | dead end | - | 8 | 250 | $ 34,000 |
| F-135 | NE Morris Street | NE Alameda Avenue | NE Brooklyn Avenue | 8 | 500 | $ 68,000 |
| F-136 | NE Brooklyn Avenue | NE Morris Street | NE Hollis Street | 8 | 400 | $ 54,400 |
| F-137 | NE Alameda Avenue | NE Jacobson Street | NE Taylor Street | 8 | 350 | $ 47,600 |
| F-138 | NW Grove Street | south of NW Loma Vista Drive | - | 8 | 350 | $ 47,600 |
| F-139 | Roseburg High School | W Chapman Avenue | W Laurelwood Court | 8 | 500 | $ 68,000 |
| F-140 | W Chapman Avenue | Roseburg High School | W Madrone Street | 8 | 550 | $ 74,800 |
| F-141 | W Laurelwood Court | Roseburg High School | W Madrone Street | 8 | 300 | $ 40,800 |
| F-142 | NE Flagg Street | NE Diamond Lake Boulevard | south | 10 | 400 | $ 68,000 |
| F-143 | NE Patterson Street | NE Hall Avenue | NE Douglas Avenue | 8 | 800 | $ 108,800 |
| F-144 | SE Stephens Street/Hwy 99 | NE Wright Avenue | SE Washington Avenue | 12 | 2,400 | $ 489,600 |
| F-145 | SE Pine Street | SE Stephens Street/Hwy 99 | SE Douglas Avenue | 10 | 900 | $ 153,000 |
| F-146 | NE Diamond Lake Boulevard | SE Stephens Street/Hwy 99 | NE Winchester Street | 12 | 500 | $ 102,000 |
| F-147 | NE Sterling Drive | NE Stephens Street/Hwy 99 | A Street | 8 | 800 | $ 108,800 |
| F-148 | A Street | NE Sterling Drive | NE Athena Lane | 8 | 850 | $ 115,600 |
| F-149 | NE Athena Lane | A Street | NE Kerr Street alignment | 8 | 250 | $ 34,000 |
| F-150 | NE Kerr Street alignment | NE Athena Lane | NE Zeus Lane | 8 | 500 | $ 68,000 |
| F-151 | NE Ethel Court | NW Harvey Avenue | north to end of street | 8 | 450 | $ 61,200 |
| F-152 | Moorea Drive | NE Kline Street | Woodrose Lane | 8 | 300 | $ 40,800 |
| F-153 | Woodrose Lane | dead end | NW Irsus Drive | 8 | 200 | $ 27,200 |
| F-154 | NW Irsus Drive | dead end | existing | 8 | 450 | $ 61,200 |
| F-155 | NE Lincoln Street | NE Central Street | NE Malheur Avenue | 8 | 850 | $ 115,600 |
| | | | | | **Long Term Improvements Total** | **$ 15,927,500** |