Executive Summary

This executive summary is organized based on the organization of the *2004 City of Newberg Distribution System Plan*.

ES.1 Section 1—Introduction

Founded in 1869, the City of Newberg (City) was formally incorporated in 1893. The town soon became the active service center for surrounding agricultural areas. The community also had an early Quaker influence with the founding of the Friends Church in 1884 and the establishment of the Pacific Academy, now George Fox University, 1 year later.

The City owns and operates the public drinking water system, which serves City residents and a small number of customers located outside the City limits. The first components of the system were constructed in 1894, and the system has been owned and operated by the City since then.

The system identification number provided by the Oregon Department of Human Services Drinking Water Program (DHS DWP) is Public Water Supply No. 41-00557. It is listed as the Newberg Water District.

ES.1.1 Purpose

The purpose of this Water Distribution System Plan (WDSP, the plan) is to provide the City with a guide for operating, maintaining, and constructing its water distribution system into the future. The WDSP was developed based on information currently available and will be updated by the City as necessary.

This plan includes an evaluation of the Newberg water distribution system only. The City's groundwater supply, treatment, and spring supply systems are addressed in separate documents. These documents are:

- *Water Conservation and Management Plan*, CH2M HILL, February 2002
- *Water Treatment Facilities Plan*, MWH Americas, June 2002
- *Riparian Water System Study*, HDR, December 2002

The City's Water Master Plan Update consists of these documents and this WDSP. The last Master Plan Update was completed in 1992 by CH2M HILL.

ES.1.2 Service Population

The official 2002 City of Newberg population provided by City planning staff was 18,750. The City also serves a small number of nonresidents and water districts. These are discussed in detail in Section 1 of the plan. In summary, it is assumed that there are a total of 671 nonresident consumers (143 springs customers, 351 water districts customers, and 177 special cases) using City water. Therefore, the total service population for the end of 2002 was approximately 19,421.

ES.1.3 Study Period

The study period for this plan is through the year 2025. Recommended annual improvements are provided for the individual years ranging from 2004 to 2009 and in 5-year intervals thereafter, to 2025. It is recommended that this plan be updated in approximately 5 years (2010).

ES.1.4 Study Area

The Newberg water distribution system is located in Yamhill County. Figure ES-1 shows the City limits, urban growth boundary (UGB), and urban reserve area (URA). The study area is within the UGB and the URA, with the addition of the following five areas located outside the current URA, as shown in Figure ES-1:

- Chehalem Parks and Recreation District Golf Course
- Potential "East" Development
- Water Districts
- Springs Distribution System
- Aspen Estates

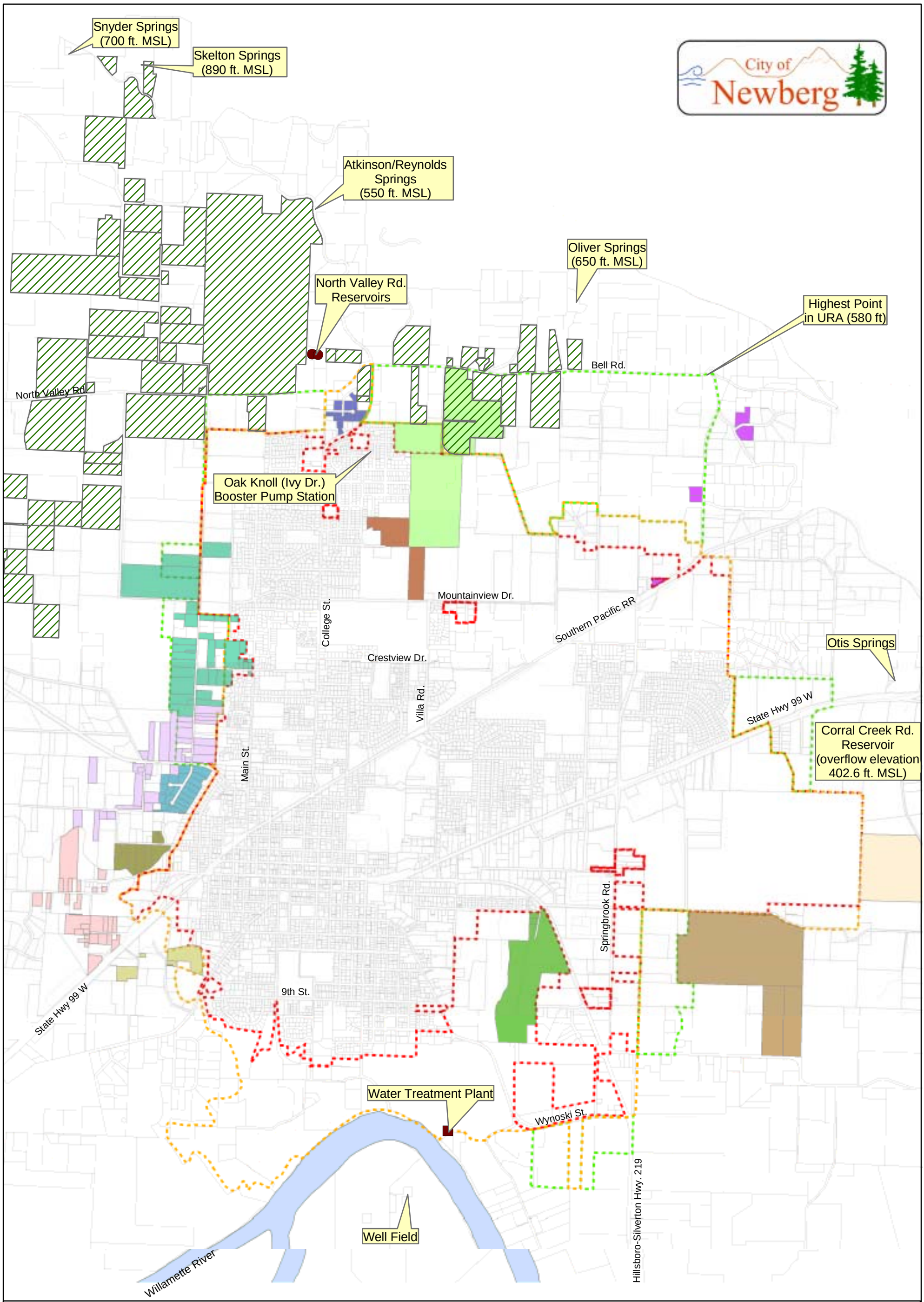
ES.1.5 Water Supply

The City water source consists of both springs and groundwater (wells). The City wellfield consists of six operational wells, all located in Marion County, Oregon, Section 29, Township 3S, Range 2W, on the south side of the Willamette River, across the river from the City's water treatment plant (WTP). Current production from the wells is limited to about 6 million gallons per day (mgd) during the summer months (because of lowered water levels in wells). The WTP, which removes iron from the wellfield water, has a current rated capacity of 5.6 mgd. All water from the wellfield is delivered directly to the WTP (2004).

Since 1991, the WTP has provided 88 percent of the total water supply production, with remaining supply provided by the springs. The WTP, as a source of water, has increased over time and in 2002 the WTP contributed about 93 percent of the total system production.

The spring sources are located to the north of the City in Yamhill County. Springs production has varied from approximately 0.5 to 0.2 mgd with an apparent gradual decrease to 0.17 mgd in 2002. The reason for this decline currently is unknown. Possible explanations include decreased rainfall, overpumping of the aquifer above the springs, or modifications to the distribution system resulting in increased headloss and, therefore, less flow. A detailed hydraulic and hydrogeologic investigation will be necessary to determine the long-term reliability of springs supply as a continued source of water.

The City has initiated water right applications and land use permits allowing expansion of the wellfield. Potentially, these could increase the summertime capacity by 10.3 mgd to a total of 22.6 mgd. See Table ES-1. The WTP will need a similar expansion, and the transmission capacity from the wellfield to the plant would need to be expanded. Currently, expansion of the WTP to 9.5 mgd is planned for 2006. A new wellfield-WTP transmission line is planned for 2006.



Legend

- Reservoirs
- Water Treatment Plant
- City Limits
- Urban Growth Boundary (UGB)
- Urban Reserve Area (URA)
- Spring Water Customers

Water Districts

- Chehalem Terrace
- Chehalem Valley
- Flatland
- Foothills
- NW Newberg
- Overlook
- Ramsey Terrace
- Sam Whitney
- Sunny Acres
- West Sheridan

Areas Outside the Current UGB/URA

- Aspen Estates
- Chehalem Parks & Recreation
- Potential "East" Development

N W E S

1 inch equals 2,000 feet

0 1,000 2,000 4,000 Feet

Figure ES-1
Newberg Study Area
Includes areas within the UGB/URA and shaded areas
2004 City of Newberg Water Distribution System Plan

CH2MHILL

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TABLE ES-1
Newberg Water Rights
2004 City of Newberg Water Distribution System Plan

Name	Location			Application No.	Permit No.	Certificate No.	Priority Date	Certificate Date	Permitted Amount			Type	WRD Status	Comments
	T	R	S						cfs	mgd	gpm			
Springs														
Gardner Spring	3S	2W	15	S-1646	S-915	2389	08/23/1911	08/01/1919	4.0	2.6	1795	Primary	Non-cancelled	Alternate to Otis Spring; total use from both is limited to 4.0 cfs
Otis Spring	3S	2W	15	S-1646	S-915	2389	08/23/1911	08/01/1919	4.0	2.6	1795	Alternate	Non-cancelled	Alternate to Gardner Spring; total use from both is limited to 4.0 cfs
Skeleton Spring	3S	2W	20	S-6604	S-5977	5456	06/24/1919	09/01/1925	2.0	1.3	898	Primary	Non-cancelled	
Atkinson (Reynolds) Spring	3S	2W	20	S-9065	S-6530	5456	07/10/1923	09/01/1925	2.0	1.3	898	Primary	Non-cancelled	
Oliver Spring	3S	2W	19		D-6829	6829	12/31/1894	12/20/1926				Primary	Non-cancelled	Exclusive rights to the spring
Snider Spring	3S	2W	36	S-1345	SWR-641		11/30/1905		0.5	0.3	224	Primary		Information from OWRD Water Use Reporting Database. Water right is pending with OWRD
Total (not including alternate spring)									**8.5**	**5.5**	**3815**			
Wells														
Well No. 1	3S	2W	29	GR-63	GR-54		09/30/1951		2.2	1.4	1000	Primary	Non-cancelled	Groundwater Registration
Well No. 2	3S	2W	29	GR-63	GR-54		05/31/1948		2.2	1.4	1000	Primary	Non-cancelled	Groundwater Registration
Well No. 3	3S	2W	29	G-5277	G-5277	48101	08/06/1970	05/25/1979	3.0	1.9	1346	Primary	Cancelled	Transferred to Well No. 5
Well No. 4	3S	2W	29	G-5254	G-5276	48100	07/20/1970	05/25/1979	2.7	1.7	1203	Primary	Non-cancelled	
Well No. 5	3S	2W	29	G-9638	G-10067		03/28/1980		1.0	0.7	453	Primary	Non-cancelled	Original Permit
Well No. 5	3S	2W	29	T-4547	G-5277	68620	08/06/1970	05/25/1979	3.0	1.9	1346	Primary	Non-cancelled	Transferred from Well No. 3
Well No. 6	3S	2W	29	G-9805	G-10068		06/23/1980		4.0	2.6	1800	Primary	Non-cancelled	
Collector Well (and Well No. 7)	3S	2W	29	G-12515	G-13876		05/03/1991		20.0	12.9	8976	Primary	Non-cancelled	
Total									**35.1**	**22.6**	**15,750**			

The City holds 35.1 cubic feet per second (cfs) (22.6 mgd) of groundwater rights for the wellfield and 8.5 cfs (5.5 mgd) from the five springs. Further details of the City's water rights are provided in CH2M HILL (2002) and HDR (2002). The City's water rights are included in Appendix A of the WDSP.

ES.1.6 Previous Reports

The following reports are relevant to the development of this WDSP:

- *Water Master Plan* (KCM, 1985)
- *Wellfield Evaluation Study* (CH2M HILL, 1992)
- *Water Master Plan Update* (CH2M HILL, 1992)
- *Wellfield Evaluation Study and Model Update* (CH2M HILL, 1996)
- *Comprehensive Land Use Plan* (City of Newberg, 2000)
- *Water Treatment Facilities Plan* (MWH Americas, 2002)
- *Riparian Water System Study* (HDR, 2002)
- *Water Management and Conservation Plan* (CH2M HILL, 2002)
- *Well #7/Collector Well Study* (currently not complete)

Significant issues that affect the water master plan are summarized by report in the WDSP.

ES.2 Section 2—Water System Regulations

As required by the DHS DWP, the City samples water quality in the distribution system on a regular basis for the following contaminants:

- Total coliform bacteria and chlorine residual
- Lead and copper at the customers' taps (including pH)
- Disinfectants and Disinfection Byproducts (D/DBP)

Since 1998, Newberg has created and provided an annual consumer confidence report to all customer connections, water districts, and the DHS DWP. The purpose of this annual report is to explain the water quality monitoring results for the previous year in accordance with U.S. Environmental Protection Agency (EPA) and DHS DWP requirements. The 2002 and 2003 reports are provided in Appendix A of the WDSP.

ES.2.1 Coliform Bacteria and Chlorine Residual—City of Newberg Compliance

A review of the DHS DWP water quality database for the period January 1997 to July 2003, indicates that the City has had three routine total coliform positive results (all associated with the springs system) and no repeat total or fecal coliform positive results in the treated water system. Based on these data, the City has consistently complied with the provisions of the Total Coliform Rule (TCR). A summary of the TCR data reports for the years 1998-2002 is included in Appendix B of the WDSP. Newberg currently complies with Oregon Administrative Rules (OAR) 333-061-0042(2)(a)(A) for public notification.

Newberg also has maintained compliance with OAR 333-061-0036(5), addressing chlorine residual. The average chlorine concentration sampled in the distribution system (including the springs system) since 1991 ranged from 0.1 to 1.0 milligrams/liter (mg/L) and averaged

about 0.5 mg/L. The DHS DWP requires that the chlorine residual be maintained between 0.1 and 4.0 mg/L.

ES.2.2 Lead and Copper at the Customer's Tap—City of Newberg Compliance

Newberg has completed six rounds of Lead/Copper Rule (LCR) monitoring. The results are summarized in Table 2-1 of the WDSP. The initial monitoring in 1992 showed that the City exceeded the copper maximum contaminant level (MCL) level of 1.2, with a reported 90th percentile value of 3.12 mg/L. Based on this result, pH adjustment was initiated at the WTP and the City has complied with the LCR since 1998.

On September 23, 2003, the City submitted a technical memorandum to DHS DWP, recommending a minimum pH of 7.0. Based on the memorandum, DHS DWP has reduced the required frequency of monitoring lead and copper to once every 3 years, and reduced the required number of sample sites to 30.

ES.2.3 Disinfection/Disinfectants By-Products—City of Newberg Compliance

For groundwater systems such as Newberg's, the Stage 1 Disinfection/Disinfectant By-product (D/DBP) Rule regulations will be in effect January 1, 2004. The anticipated timeline for implementing the Stage 2 D/DBP Rule is promulgation in mid-2004 with the Stage 2A D/DBP Rule provisions in effect by mid-2007. The Stage 2B D/DBP Rule provisions are expected to be in effect by mid-2010. While not expected, should the City determine capital improvements are necessary for compliance with the Stage 2 D/DBP Rule, these milestones may be extended, although there is no reference in the rule to indicate for how long.

Total trihalomethane (TTHM) testing has been conducted by Newberg since 1989. The data indicate a very low TTHM formation potential, with the range of 6.1 to 15.5 micrograms per liter (µg/L), well below the current and forthcoming Stage 1 D/DBP MCLs. Currently, Newberg does not sample for HAA5, but will begin to sample quarterly for TTHMs and HAA5 in 2004, as required by the Stage 1 D/DBP Rule. Because of the low organic content of Newberg's source water (wells and springs), and based on preliminary TTHM samples, it is anticipated that Newberg will continue to comply with current and forthcoming D/DBP MCLs without any required modifications to the water system.

ES.2.4 Regulatory Compliance Summary

The City currently complies with all applicable regulations relating to the distribution system. A regulatory summary is presented in Table ES-2.

TABLE ES-2
Regulatory Summary
2004 City of Newberg Water Distribution System Plan

Ordinance	Description	Compliance	Recommendations
OAR 333-061-0042 OAR 333-061-0036	Coliform Bacteria and Chlorine Residual	The City consistently has complied with the provisions of the TCR. Newberg also has maintained compliance with OAR 333-061-0036(5), addressing chlorine residual.	None
333-061-0036	Lead and Copper at the Customer's Tap	The City has complied with the LCR since 1998.	Maintain a minimum pH of 7.0 at the WTP.
N/A (Not promulgated)	Disinfection/Disinfectants By-Products	N/A (Not promulgated)	Continue current sampling procedure in anticipation of rule promulgation.
OAR 333-061-0070 OAR 333-061-0071 OAR 333-061-0072 OAR 333-061-0073 OAR 333-061-0074	Cross Connection Control Program	The City abides by the DHS DWP, Cross Connection Program requirements.	The City should review the 20-year-old Cross Connection Control ordinance.
OAR 690-086	Unaccounted-For Water	The City complies with OAR 690-086 requirements.	Continue to maintain a current WMCP.
OAR 690-086	Leak Detection	The City complies with OAR 690-086 requirements.	Continue to maintain a current WMCP.

ES.3 Section 3—Distribution System Description

Newberg's distribution system consists of one wellfield transmission pipeline, three storage reservoirs, a supply pump station (located at the WTP), one residential booster pump station, approximately 96 miles of distribution pipeline serving approximately 5,200 service connections, a telemetry system, and a leak detection program. A summary description of each system component is provided below.

ES.3.1 WTP Supply Line—Transmission Pipeline

The transmission main runs from the wellfield to the WTP and passes over the Willamette River on a city-owned bridge. The capacity of this 24-inch-diameter, 1,900-foot-long line is approximately 9.5 mgd. The City plans to install a redundant 24-inch-diameter line under the river in 2006. Additional information can be found in the *Water Treatment Facilities Plan* (MWH Americas, 2002).

ES.3.2 Storage Reservoirs

The system has three existing system storage reservoirs with total system storage of 12 million gallons (MG). All three reservoirs have the same overflow elevation within ± 0.14 feet. The North Valley Road (NVR) reservoir site is located along NVR on the north

side of the City. This location has two 4-MG, circular, prestressed concrete reservoirs. One reservoir was completed in 1960 and the other in 1977. A tank evaluation was performed in February 2004 and concluded that the tanks are in good condition. However, a complete survey and structural evaluation were recommended to evaluate the remaining useful life and rehabilitation options. The Corral Creek Road (CCR) reservoir was completed in 2003 and is located at CCR in the southeast part of the City. It is a 4-MG, circular, prestressed concrete reservoir.

ES.3.3 Pump Stations

The supply pump station is located in the WTP. All water supplied by the WTP must be pumped into the City's distribution system. The pumping system has three vertical turbine pumps with a total rated capacity of about 7.5 mgd. These pumps currently are limited to 6.5 mgd because of electrical power limitations of the WTP system. The current WTP expansion plan will address this issue.

The largest pump is 350 horsepower (hp), with a capacity of approximately 2,600 gallons per minute (gpm). The other two pumps are 150 hp with a capacity of 1,300 gpm each. Pump operation is controlled and set by the WTP operations staff. Decisions to operate pumps are based on the data provided through the telemetry system indicating clearwell level and water levels in the reservoirs. These pumps are configured for lead, lag, and lag2 operation.

A small portion of the system elevation is too high for adequate service. As a result, the Oak Knoll (Ivy Drive) booster pump station was constructed in 2000 at 3613 Ivy Drive. The purpose of this pump station is to augment low pressures to 40 homes in the area. Three pumps have a total capacity of 1,250 gpm, including one pump dedicated to providing the required fire flow. This pump station has a backup power generator.

ES.3.4 Distribution System Pipelines

Newberg has approximately 96 miles of pipelines in its water distribution system. The system is predominantly looped and located within public rights-of-way, providing the maintenance crews access for repairs and routine maintenance. The system consists primarily of ductile and cast iron pipe. The distribution pipeline ranges in size from 1-inch-diameter to 24-inch-diameter. Most of the pipeline is 6 or 8 inches in diameter. About 18 percent of the pipeline is smaller than 6 inches in diameter and about 22 percent is larger than 8 inches in diameter.

ES.3.5 Telemetry System

The Newberg distribution system is monitored by remote telemetry located throughout the system and at the WTP. The system uses dedicated telephone communications from the WTP to remote sites. Currently, the high-service pumps (final effluent output) at the WTP are automatically controlled through the wetwell level. The operators determine the clear-well operating level. The high-service pumps can also be operated manually, if necessary.

The City's three 4-MG reservoirs and one remote booster pump station also are monitored via telemetry. The six water supply wells in the wellfield are monitored and may also be controlled via the telemetry system.

All information from the remote locations within the telemetry system is available to staff at the WTP. WTP staff determine on a daily basis which wells to operate to meet system demand based on current reservoir levels and system demand.

City staff may also remotely connect to the WTP console system. This connection allows operators to monitor plant performance, make adjustments, and respond to alarm conditions while away from the WTP. Thus, all telemetry information available at the plant is also available from a remote site via computer.

ES.3.6 Unaccounted-for Water

The City's distribution system is in good condition with respect to water loss. Most of the installed pipe is cast iron or ductile iron, which contributes to the low leakage and failure rates.

ES.3.7 Leak Detection

Leak detection programs are required in OAR 690-086 if estimated leakage exceeds 10 percent. Leak repair programs are required if leakage exceeds 15 percent. Newberg's system complies with this standard, as noted in the WMCP. Unaccounted-for water averaged 8.5 percent from 1998 to 2001 (CH2M HILL, 2002).

ES.4 Section 4—Water Requirements

This section provides population and water demand projections for the years 2003 to 2025. Population projections for the defined planning period were obtained from the Newberg Planning Division, using the City's comprehensive plan.

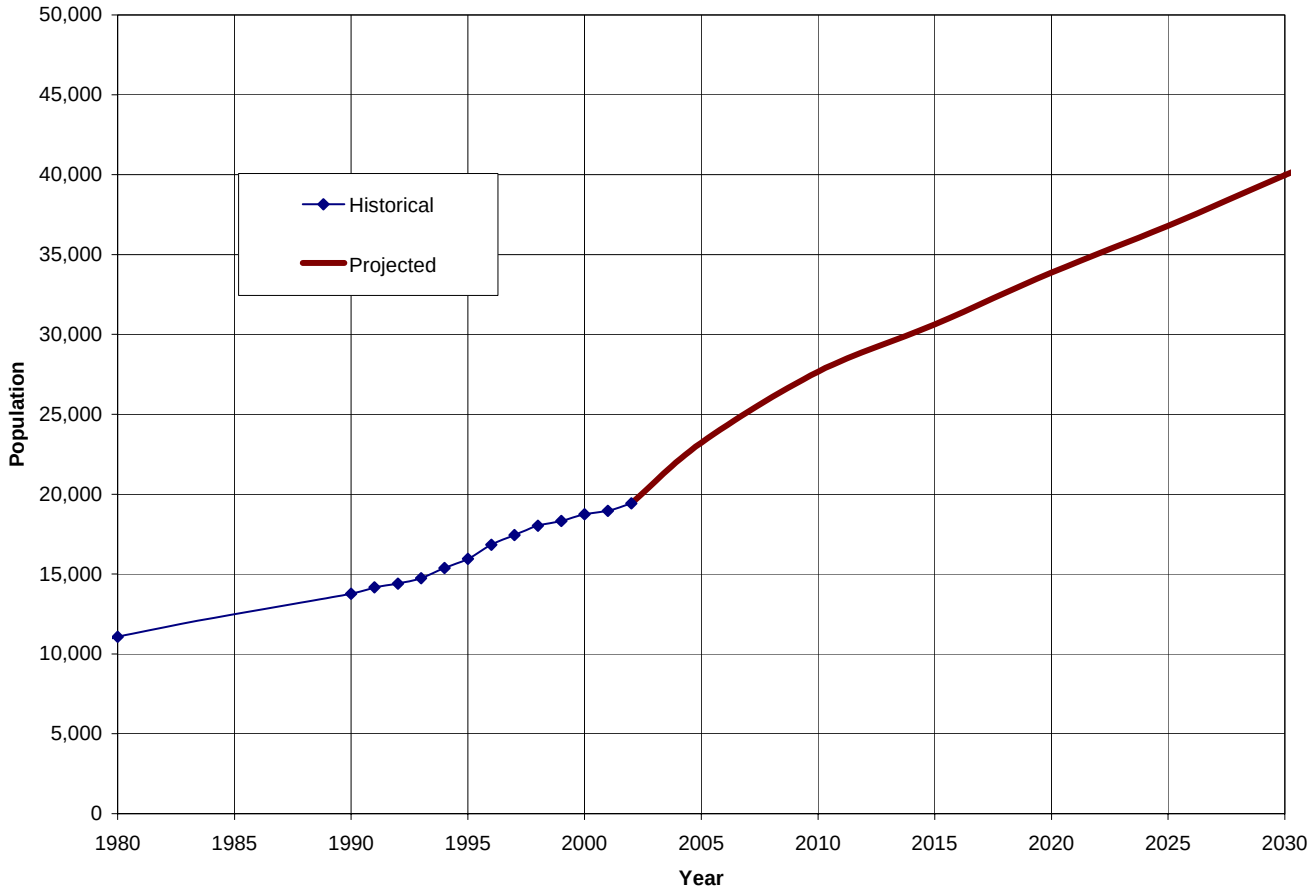
In addition to the service population within the City limits, the Newberg water system serves approximately 671 customers outside of the City. The 2002 Newberg total service area population is estimated to be 19,421. The projected 2010 and 2025 Newberg populations are 27,671 and 36,791, respectively. Figure ES-2 illustrates historical and projected populations for the Newberg water system, based on this forecast.

ES.4.1 Historical Water Use Information

Water use characteristics were obtained from the City's billing and WTP production data. For 2002, the total water production recorded was 2.57 mgd on average. For the 10-year period from 1991 to 2001, the average daily demand (ADD) including the 671 users outside of the City, was 142 gallons per capita day (gpcd). Since 1998, the ADD has declined to 136 gpcd. These numbers are within the normal range generally experienced by other municipalities similar to Newberg.

For planning purposes, increases in commercial and industrial demands were captured by applying the overall per capita usage rates to future population estimates. In addition, unaccounted-for water consumption also is derived in the same fashion, and the ratio of unaccounted-for water is assumed to remain constant through the planning period. Hence, the basis of future water use derives from current patterns, increased by the per capita usage for the anticipated growth.

FIGURE ES-2
Population Projections based on Newberg Urban Reserve Area Project
2004 City of Newberg Water Distribution System Plan



ES.4.1.1 Peaking Factors

The relationships between the ADD and other flow rate conditions in the system are referred to as peaking factors. Since 1989, the maximum day demand (MDD)/ADD peaking factor ranged from 1.70 to 2.37, with an average of 2.10. The maximum month demand (MMD)/ADD peaking factor ranged from 1.32 to 1.81, with an average of 1.57.

No hourly data were available for estimating the ratio of peak hour demand (PHD) to MDD. Empirical formulas were used to calculate PHD and result in a PHD/MDD factor of 1.58 for Newberg. A summary of the peaking factors used in this report is presented in Table ES-3.

TABLE ES-3
Newberg Average Peaking Factors
2004 City of Newberg Water Distribution System Plan

	Factor
MDD/ADD	2.10
PHD/MDD	1.58
MMD/ADD	1.57

In 2002, 77 accounts were classified as irrigation customers. Peak irrigation use occurs June through August. Average monthly use for these irrigation accounts for this period in 1999-2002 was 4.0 mgd.

ES.4.1.2 Unaccounted-for Water

Unaccounted-for (or nonrevenue) water is the difference between the total amount of water produced at the WTP and the total amount of water billed to customers. Unaccounted-for water is attributed to system leakage losses, meter discrepancies, hydrant and main flushing, street sweeping, operation and maintenance uses, fire flow uses, unauthorized connections, and unmetered miscellaneous uses. Although water used from hydrant connections for construction is recorded, it is not included in the billing records.

The *2002 Water Conservation and Management Plan (WMCP)* (CH2M HILL, 2002) reported that the average unaccounted-for water in the Newberg water system has averaged 8.5 percent between 1998 and 2001, ranging from 7.2 to 10.1 percent annually. Fluctuation in unaccounted-for water is affected by operations and maintenance (O&M) activities associated with hydrant and main flushing. This volume of unaccounted-for water is within the limits defined by DHW DWP of 10 percent.

ES.4.1.3 Equivalent Residential Units (ERU)

Based on single-family residential consumption meter readings for the period from 1998 through 2002, it was determined that the average single-family household uses 233 gallons per day (gpd). This is defined as an equivalent residential use (ERU). Based on an estimated density of 2.6 people per household, the average per capita consumption is 90 gpcd. This is comparable with other cities similar to Newberg. Note also that this consumption value excludes industrial and commercial usage. This value is useful for estimating future flow rates in residential areas where the number of houses is known, and there are no other significant uses in the area.

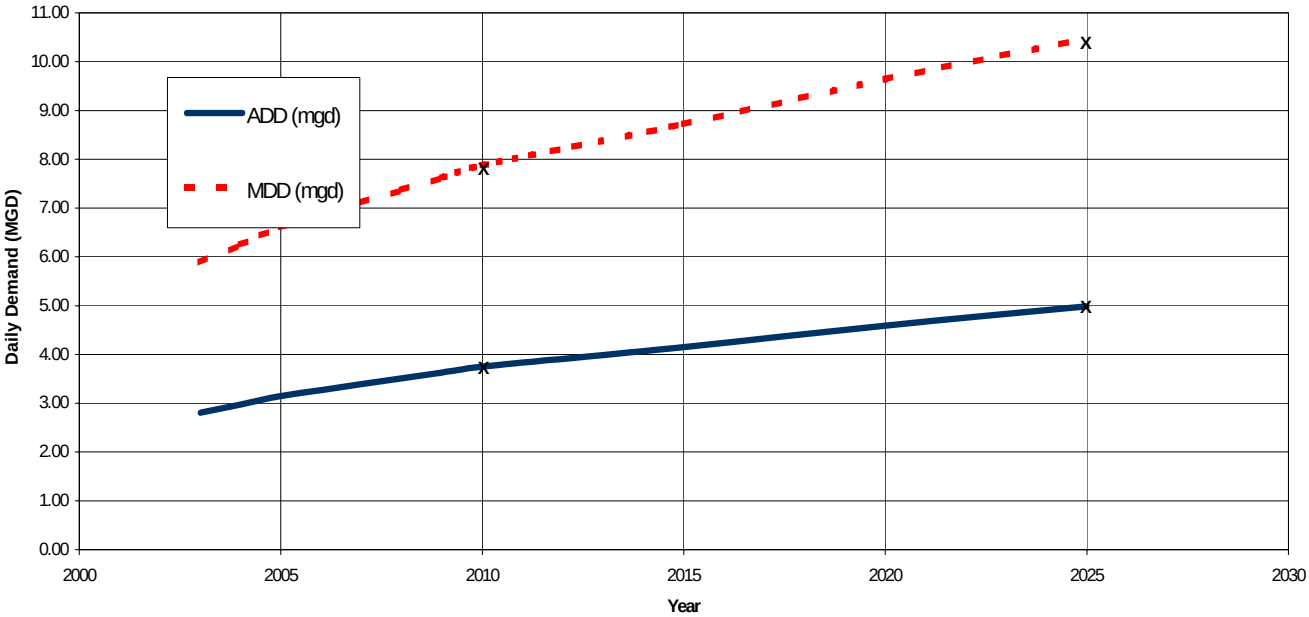
ES.4.2 Water Demand Projections

The historical water use information, current populations, and future population projections form the basis for projecting future water demands. Historical use and current population data are used to estimate per capita usage rates and peaking factors related to system demand. These values are then used with population projections to estimate future water demands.

Future water demand was projected on the basis of estimated per capita use and future population projections. It is assumed that the rate of increase in water use for industrial and other commercial users will follow a growth pattern similar to the residential population. This assumption provides a reasonable projection of future water needs in Newberg based on the best information currently available and without knowledge of the elimination or addition of specific large industrial/commercial users.

The demand projections are based on the average per capita system demand, peaking factors, and the population projections. The 2010 ADD and MDD projections are 3.75 and 7.88 mgd, respectively. The projected 2025 ADD and MDD are 4.99 and 10.48 mgd, respectively. Figure ES-3 presents the ADD and MDD projections graphically.

FIGURE ES-3
Average Daily Production Demand Projections
2004 City of Newberg Water Distribution System Plan



ES.4.3 Fire Flow

Fire flow is the amount of water required to combat a fire for a specific period. The Insurance Services Office (ISO) classifies a city for commercial insurance ratings purposes based on the ability to provide a maximum fire flow requirement of 3,500 gpm for 4 hours. Larger fire flow requirements are evaluated on an individual basis and are based on the building classification given in the *1997 Uniform Fire Code*. The fire flow criterion in commercial areas used in this plan is 3,500 gpm for 4 hours, consistent with ISO standards.

ES.4.4 Water Conservation

For planning purposes, water demands without conservation will be used in this analysis. Any conservation programs implemented will provide an additional factor of safety with regard to supply and capacity. The City will continue to update its WMCP and realized benefits will be considered in future planning efforts.

ES.5 Section 5—Operations and Maintenance

This section presents an evaluation of Newberg's current water distribution system O&M procedures. Existing programs are documented and evaluated, and additional programs are recommended. Finally, an assessment of staffing needs for existing and recommended O&M programs is presented.

ES.5.1 Overview

The Newberg water system is operated and maintained by the Public Works Division and the Operations Division. Public Works performs all distribution line work "outside the fence" of the WTP, booster station, storage reservoirs, and springs.

Work conducted by the Public Works Division includes water line repairs and maintenance, distribution system flushing, hydrant service, meter reading, meter program, and some construction projects such as line replacements and upgrades.

The Operations Division performs O&M on the WTP pumps, reservoirs, springs, and booster pump station. It also performs the distribution system water quality sampling and the corrosion control program.

ES.5.2 O&M Responsibilities

O&M is an essential component of every water distribution system. Water system facilities represent a significant investment and should be operated and maintained in a way that ensures a long and cost-efficient life cycle. The desired result of providing adequate financial and personnel resources for O&M is clean, safe, and reliable drinking water at an acceptable cost.

Operation of a distribution system includes the day-to-day tasks required to ensure that a continuous supply of water is delivered to the user. Operation activities consist of controlling the supply and booster pumps, reservoirs, pipes, and valves. Even automated control systems require significant operator input and monitoring.

Evaluation of O&M procedures requires good documentation of distribution system inventory and O&M tasks. It is important to emphasize that maintenance, documentation, and program evaluation ultimately result in lower cost to the user by extending the life of the distribution system components and reducing costs associated with unscheduled or emergency repairs.

ES.5.3 O&M Program Evaluation

The Operations and Public Works staffs currently are doing a good job of maintaining and replacing system components. Staff members are knowledgeable, dedicated, and capable of performing all the necessary tasks.

One element currently lacking, however, is documentation of the system facilities and current O&M programs. Typical of systems the size of Newberg, much of the system information is held by individual staff members and often is not documented in reproducible format. Although this "mental recordkeeping" has worked for many years, as the system continues to grow, and staff members retire or leave the City, the information held by those people may be lost.

During the last few years, individual Public Works staff members have taken the initiative to document some procedures and record tasks performed. However, this information has not been thoroughly organized and maintained in such a way that it is useful for evaluation.

The program evaluation presented in the WDSP is intended to serve as the basis for the development of the recommended programs. The City should continue to develop, document, and refine these programs as the system grows.

Table ES-4 summarizes the program recommendations given in this section.

TABLE ES-4
Recommendation Summary
2004 City of Newberg Water System Distribution Plan

Description	Recommendation
O&M Software Program	Initiate implementation of this software as the first step in recording the information needed to develop O&M programs further.
Program Development	Establish written procedures and goals for all programs discussed in Section 5.
Pipe Maintenance and Replacement	Enter undersized lines into the O&M database and schedule for future replacement. Inspect approximately 5 miles per year. Enter findings into the O&M database and schedule the next inspection or replacement date. Plan to replace about 1 mile of pipe per year. Provide adequate resources to achieve the goal of flushing the system at least once per year.
Dead-End Line Maintenance Program	The current program is consistent with standard industry practice and recommendations. Provide the Public Works crew ample resources to execute this program as outlined.
Water Meter Maintenance and Replacement	Test meters for accuracy on a regular basis. Record meter location, make, type, size, and age in the O&M database along with service dates, next scheduled appointment, and repair notes.
Hydrant Maintenance Program	The City should continue to flush each hydrant at least annually.
Valve Maintenance and Exercising Program	Exercise and inspect each valve annually.
Leak Detection Program	Prepare annual water audits as part of the water management and conservation plan. Estimate unmetered use and install metering devices wherever possible.
Reservoir Maintenance Program	Clean the inside of the tanks every 3 years using divers. Once every 10 years, drain each tank for a thorough inspection and cleaning.
WTP Effluent Pump Maintenance Program	Continue the current pump maintenance program. Record voltage and amperage along with speed and output, and compile into monthly and annual summaries for future reference.
Effluent Meter Maintenance Program	Test and calibrate this meter on an annual basis.
Booster Pump Maintenance Program	Continue the current pump maintenance program. Record voltage and amperage along with speed and output, and compile into monthly and annual summaries for future reference.

TABLE ES-4
Recommendation Summary
2004 City of Newberg Water System Distribution Plan

Description	Recommendation
Springs Maintenance Program	Check the chlorine residual twice a week.
	Create a procedure to divert springs water from the system if necessary.
	The City should develop a plan to relocate lines on private property and negotiate easements.
	Install air relief valves and additional isolation valves on the City's springs water lines.
Cross Connection Control and Back Flow Protection Program	Perform reinspections every 5 years in addition to the annual inspections performed by the owners.
Emergency Response Program	Require all new employees to become familiar with the Emergency Response Plan and brief them as to their specific role in the event of an emergency.
	Review emergency procedures on an annual basis. All staff should be familiar with emergency response equipment.
	Check the equipment regularly to ensure proper operation.
Valve Box Replacement	Replace structurally damaged valve boxes regularly.
Meter Vault Replacement	Replace structurally damaged meter vaults regularly.
Polypropylene Service Line Replacement	Identify these lines and develop a plan to replace them.
Commercial Customer Class Irrigation Meter Retrofit and Replacement	If the City decides to continue or expand this program, thoroughly evaluate costs associated with reading and maintaining additional meters.

ES.5.4 Recommended System Improvements

The following recommended improvements result from the O&M analysis.

ES.5.4.1 North Valley Road Reservoir Upgrades

Operational upgrades required at the North Valley Road Reservoirs were provided by City staff. The projects will increase safety and reliability and reduce maintenance costs.

ES.5.4.2 Water Line Valve Insertion Projects

The two water mains in College Street, between Vermillion Street and the North Valley Road Reservoirs, have a limited number of isolation valves. In the event of a line break, this could present a catastrophic event if City staff cannot isolate the break. It is assumed that two additional valves will be inserted along the 18-inch-diameter pipe at Edgewood Street and Pinehurst Street and four additional valves will be inserted along the 10-inch-diameter pipe at Foothills Drive, Edgewood Street, Arlington Street, and Pinehurst Street. In addition, City staff have identified the need to insert an 18-inch valve at the main trunk line tee from WTP to allow for isolating the west branch of the main line.

ES.5.4.3 Looping Water Lines

No specific projects were identified by the City. However, looping is important to increase reliability and water quality. It is recommended that the City budget an annual allotment for looping projects as they are identified. In addition, automatic line flushing devices may be installed in cul-de-sac and other dead-end lines where looping is not practical. The Public Works Division has identified approximately 100 locations where looping projects are necessary.

ES.5.4.4 Springs Upgrades

An investigation is currently being performed to determine the best course of action addressing DHW DWP requirements. This includes the option of eliminating the springs and serving the springs customers with water from the City's wellfield. Assuming that the City decides to continue use of the springs, the following projects related to the springs have been identified by the Operations Division:

- Address recommendations identified in the *Riparian Water System Study* (HDR, 2002)
- Springs overflow—need better valving system, dechlorination issues
- Springs distribution line altitude valve upgrades
- Spring boxes anchored into ground to help winter turbidity problems
- Oliver springs system disconnection
- Capacity issues at springs SCADA connection to read springs flow to reservoir
- Move spring lines to property lines and purchase easements
- North Valley Road tie-in for springs lines emergency disconnect

ES.5.4.5 Aging Line and Valve Replacements

As existing lines and valves reach the end of their useful life, they should be replaced before failure occurs. It is recommended that the City budget annually for aged line and valve projects as they are identified. Specific projects have been identified by City staff at four locations and a total of 6,000 feet of pipe replacement lines.

ES.5.5 Additional Activities and Labor Requirements

ES.5.5.1 Meter Shutoff, Turn-On, and Door Hangers

The Public Works Division is responsible for delivering late payment notices and performing meter shutoff and turn-on tasks, as required, on a monthly basis. Door hangers are delivered around the 10th of each month to customers with past due accounts. The entire crew usually delivers these notices in about 2 hours. There is a $15 charge when these late payment notices are issued. After late payment notices are issued, the Public Works crew performs shutoffs and restores service once payment has been received. The Public Works Division billed approximately 150 hours per year during 2000-2002 for this task.

ES.5.5.2 Meetings and Miscellaneous

In addition to the tasks discussed in Section 5.5.2 of the WDSP, the City staff is expected to attend regular meetings and conduct miscellaneous organizational tasks. It is estimated that these tasks account for about 20 percent of the total daily activities and will be accounted for

in the following analyses. Note that this is only an estimate and should be confirmed through documentation of these additional tasks.

ES.5.5.3 Training and Education Opportunities

A well-trained and educated crew is an integral part of the water system. Because regulations and technology are constantly changing, it is important to provide education and training for the staff. As a rule, 16 to 24 hours per year per employee for training are recommended.

Other educational resources include American Water Works Association (AWWA) newsletters (for example, Opflow), manuals of practice, and videos. The availability of these educational materials allows the staff to stay current with O&M equipment and research and industry standards.

ES.5.6 Staffing Evaluation

The Public Works Division consists of a Public Works superintendent, three crew chiefs, and 12 laborers. Of these numbers, about 4.25 full-time equivalents (FTE) are dedicated to the water system. The Operations Division staff has 1.0 FTE for reservoir, springs, pump station, cross connection program, and water quality testing, for a total of about 5.25 FTE currently budgeted to O&M of the water distribution system. It is important to note that these are budgetary or official assignments only.

Timesheets indicate that the Public Works and Operations divisions are only providing 3.88 FTE and 0.59 FTE, respectively, for a total of 4.47 FTE of actual work on the Water Distribution system. Tasks outside of the water distribution system that staff is required to perform include the City mail distribution, public and council requests, computer maintenance, and assisting with other divisions. The time allotted to the water distribution system is not being used fully because staff members are working outside their budgetary assignments.

ES.5.7 Program Staffing Requirements

The comparisons and recommended staffing levels discussed here are related to the operation of the distribution water system only. If the staff is expected to perform tasks outside of those discussed in the section, additional staff will be required accordingly.

A comparison of Newberg's staffing levels with more than 80 other utilities was conducted. The results presented are general comparisons only. The resulting trend indicates that Newberg's O&M divisions currently are understaffed.

Based on the program evaluation presented in Section 5.1.1.2 of the WDSP, an outline for workforce requirements was prepared. It is estimated that approximately 6 FTE are required to operate and maintain the distribution system, as compared to the 4.47 FTE of documented work performed in 2002. Therefore, it is the conclusion of this investigation that additional staff members are required. An increase in the staff should occur gradually and in parallel with the documentation and development of the programs discussed previously. As the system grows, the guidelines given can be used to estimate necessary staff requirements.

ES.6 Section 6—Existing Distribution System Analysis

This section contains an analysis of the City's water distribution system with regard to existing demands. Evaluations of the pumping, storage, and transmission components of the water system are performed.

ES.6.1 Hydraulic Distribution System Model

The hydraulic model consists of a "data" model representing the distribution system (data model) and the computer software capable of performing a hydraulic analysis. The computer software interprets the data model using mathematical equations.

This project used customized geographic information system (GIS) applications for water distribution system analysis that share information with various databases, spreadsheets, and pipe network analysis software. GIS software is used to manage, display, report, and analyze hydraulic data.

The pipe network analysis software performs the computations of flow rates in pipes and pressures at junctions. The modeling engine used in this project is EPANET, a public-domain program developed by EPA. This software determines the distribution of flow in a pipe network and calculates the resulting pressures. The model calculates head losses in pipes with the Hazen-Williams energy loss equation. H20Net/Map Modeling software produced by MWHSoft was used.

The basic elements of the data model were taken from the City's GIS database. The model was calibrated to field-collected data. The calibration consisted of comparing pressures measured in the field to those predicted by the computer model. Computer model analyses were performed to simulate the system conditions that occurred during the field collection of data. Computed pressures, flow rates, and hydraulic grade lines (HGLs) then were compared to the field measurements. The model was adjusted to match the field-measured conditions within a reasonable range of tolerance. The model was calibrated within 3 percent of the pressures observed in the field.

ES.6.2 Existing System Analysis

The calibrated hydraulic model was used to simulate system performance under existing demands to determine its adequacy to meet design criteria. Annual consumption data provided by the City were used to distribute demands throughout the system, and then were increased to the predicted 2003 system demand.

Another important planning criterion is the system's ability to fill the reservoirs during MHD (that is, at night). In all of the model analyses, MHD was assumed to be 70 percent of ADD. This is a conservative, assumed, value based on experience with other systems similar to Newberg.

The current capacity of the WTP was used for all ADD, MDD, and MHD analyses. Firm capacity was used for fire flow analyses. Firm capacity is the capacity of the WTP to pump to the system with the largest pump out of service. This is a standard industry practice which ensures a reasonable level of redundancy to provide adequate operation of the water system at all times.

Currently, the maximum pumping capacity for the existing plant exceeds the rate that the WTP can produce water. As a result, during PHD, the pumps will be drawing from the clearwell to make up the difference.

ES.6.2.1 Existing System Scenarios

Computer simulations were made for various flow conditions, included PHD, MHD, and fire flows plus MDD. Six locations were chosen by the City to conduct fire flow analyses. For residential areas and industrial and commercial areas, fire flows were set to 1,500 and 3,500 gpm, respectively. The fire flow duration was 4 hours and the minimum pressure allowed throughout the system during a fire flow was 20 pounds per square inch (psi).

The analysis indicates the current system is operating within the established criteria.

ES.6.2.2 Peak Hour Analysis

Under the 2003 PHD conditions, the system meets the pressure criteria of 30 pounds per square inch gauge (psig) at all locations, including the springs system. The reservoirs supply the system at a rate of approximately 2.59 mgd during peak hour periods, with the remainder being supplied by the WTP and springs supply sources. The distribution of PHD being met by the reservoirs is more or less equal among the three reservoirs.

ES.6.2.3 Minimum Hour Analysis

The MHD analysis indicates that the reservoirs are able to refill during the night at a rate of about 3.88 mgd. The CCR reservoir appears to fill slightly faster than the NVR reservoirs given similar water surface elevations. This was expected because it is closer to the WTP.

ES.6.2.4 Fire Flow Analyses

For these analyses, MDD demands were applied in conjunction with the specified fire flow demand at six locations as directed by the City. A separate simulation was performed for each of the six locations and flows shown. Finally, a “worst-case” fire flow scenario analysis was conducted in which the WTP was turned off. This analysis will indicate how low the City may draw down its reservoirs in the event of a regional power failure or other event that prohibits pumping from the WTP, while still maintaining enough pressure in the system to fight a fire.

The results of a second series of fire flow analyses were performed in which the WTP pumps are operational. The reservoirs were assumed to be empty. To provide the fire flow volume, the minimum water surface level at the start of a fire flow event should be no lower than 372 feet elevation mean sea level (msl) to allow sufficient volume of water to fight the fire and supply MDD demands. The fire flow volume represents approximately 3,500 gpm for 4 hours, or 0.84 MG. MDD during a 4-hour period is about 0.94 MG. For all fire flow runs, the WTP firm capacity of 4.2 mgd was used. All locations meet the fire flow plus MDD and pressure criteria for the scenario in which the reservoirs are empty and the WTP pumps are operational at firm capacity of 4.2 mgd (2,900 gpm).

In the worst-case scenario, MDD plus fire flow analysis was performed when the WTP pumps were turned off. In this case, it was determined that the minimum reservoir level to provide 20 psi is 370 feet msl. Adding the volume of water required to fight the fire and to

meet MDD demands, the reservoir level at the beginning of this event should be no lower than about 377 feet msl, which provides 0.84 MG for fire flow volume only.

Therefore, the minimum reservoir elevation recommendation is 377 feet msl. If all three reservoirs are operational, the volume is 0.84 MG.

ES.6.2.5 Storage Analysis

The existing total system storage is 12 MG. The current storage of 12 MG is sufficient. As a result of the fire flow analyses, no dead storage currently exists in the system. Dead storage is the amount of water in the reservoirs that cannot be used because minimum pressure requirements cannot be maintained if the water surface drops below a certain level. The lack of dead storage in the City's system is evident because minimum pressures can be provided throughout the system, with the largest pump out of service and the reservoirs empty.

ES.6.2.6 Curtailment Analysis

The existing total system storage is 12 MG. Based on the fire flow analysis shown in Table 6-5 of the WDSP, the City currently can meet MDD and provide adequate fire flow, if the WTP is producing 4.2 mgd (2,900 gpm). However, the City must have a minimum stored water volume of 0.94, which correlates to 377 feet msl, minimum water surface level. Therefore, the City's curtailment plan should be based more on the amount of risk that the City is willing to incur before curtailment measures are implemented. The 2003 emergency, fire flow, and peaking storage requirement is approximately 6.6 MG. This volume is available when the reservoirs are at an elevation of about 386 feet elevation msl. It is recommended that the City attempt to maintain this minimum level at all times during the summer season, and adjust the curtailment plan accordingly. The storage required will increase over time and, therefore, the curtailment plan should be reviewed and revised on an annual basis.

ES.6.3 Recommended System Improvements

Based on the analysis presented in this section, there are no recommended improvements for immediate construction.

ES.7 Section 7—Future Distribution System Analysis

This section presents an evaluation of the City of Newberg's water distribution system and required improvements to serve future demands. The analysis consists of an evaluation of the pumping, storage, and transmission components of the water system and recommended phasing of the necessary improvements.

ES.7.1 Analysis and Design Criteria

As demands in the system increase in the future, additional pumping and pipeline capacity will be required to move water through the system. A primary criterion in the analysis was

to limit the pressure at the WTP to the current maximum of about 410 feet above msl[1] or about 110 psi.

Another important planning criteria is the system's ability to fill the reservoirs during MHD (that is, at night). In all of the model analyses, MHD was assumed to be 70 percent of ADD, as discussed in Section 6.4. This is the controlling scenario for the Newberg water system, as discussed below.

Additional criteria included maintaining minimum system pressure of 30 psi during PHD and 20 psi during fire flow events.

ES.7.2 Demand Distribution

Transportation Analysis Zone (TAZ) data developed by the ODOT Transition Planning Analysis Unit (TPAU) in 2003 were used to distribute the future demands throughout the study area. The housing and employment data were prepared by the City of Newberg Planning Division, Community Development Department, in 2003. These data provide new areas of both residential and I/C development for the 5- and 20-year planning intervals. The new water demand was based on population growth and was distributed proportionally to these projected developments as defined by the TAZ data.

ES.7.3 Additional Demands

Review of the TAZ distribution data by City staff members determined additional planned developments that were not accounted for in the TAZ growth projections. These areas were relatively minor developments and were added into the demand distribution separately to ensure that required localized capacity upgrades, if any, were planned accordingly. These developments represent an additional 6 percent of flow over the TAZ demand projections.

ES.7.3.1 Planned Developments within the UGB/URA

All currently known developments were identified by the City and compared to the new growth identified in the TAZ projections. As a result of this process, it was determined that several known developments, such as Springbrook Oaks, the new hospital, and the Crater Lane LID, were adequately accounted for in the TAZ projections. Four additional developments were included in the analysis that are inside the current UGB/URA, but were not accounted for in the TAZ projections:

- New High School Softball Field
- New Elementary School
- Friends View Manor
- Riverfront Development

ES.7.3.2 Planned Developments Outside URA

The three developments discussed below are outside the current UGB/URA. They were identified by the City as developments that are anticipated to occur within the next 6 years:

[1] All references to hydraulic grade line (HGL) in this section are relative to mean sea level (msl). Reference water surface level at the WTP is about 155 feet msl, the pressure is related to the HGL by the following equation:
Pressure in psi = (HGL in feet—155)/2.31.

- Chehalem Parks and Recreation (Golf Course)
- East Development
- Aspen Estates

Demands developed in conjunction with these additional demands result in the flow projections presented in Table ES-5. These are the flow projections that were used in the analyses. Peaking factors developed in Section 4 were applied to obtain estimates of MDD, PHD, and MHD.

TABLE ES-5
Summary of Modeled Flows
2004 City of Newberg Water Distribution System Plan

	2003 (mgd)	2010 (mgd) (projected)	2025 (mgd) (projected)
ADD	2.80	3.97	5.27
MDD	5.89	8.33	11.07
PHD	9.42	13.33	17.72
MHD	1.96	2.78	3.69

ES.7.4 Future System Analysis

Future improvements will include WTP pumping capacity upgrades, additional storage, booster pumps, and transmission and distribution piping within the existing service zone (Zone 1) to meet future demands. New facilities also will be required to serve the areas in the study area, but outside the current service area.

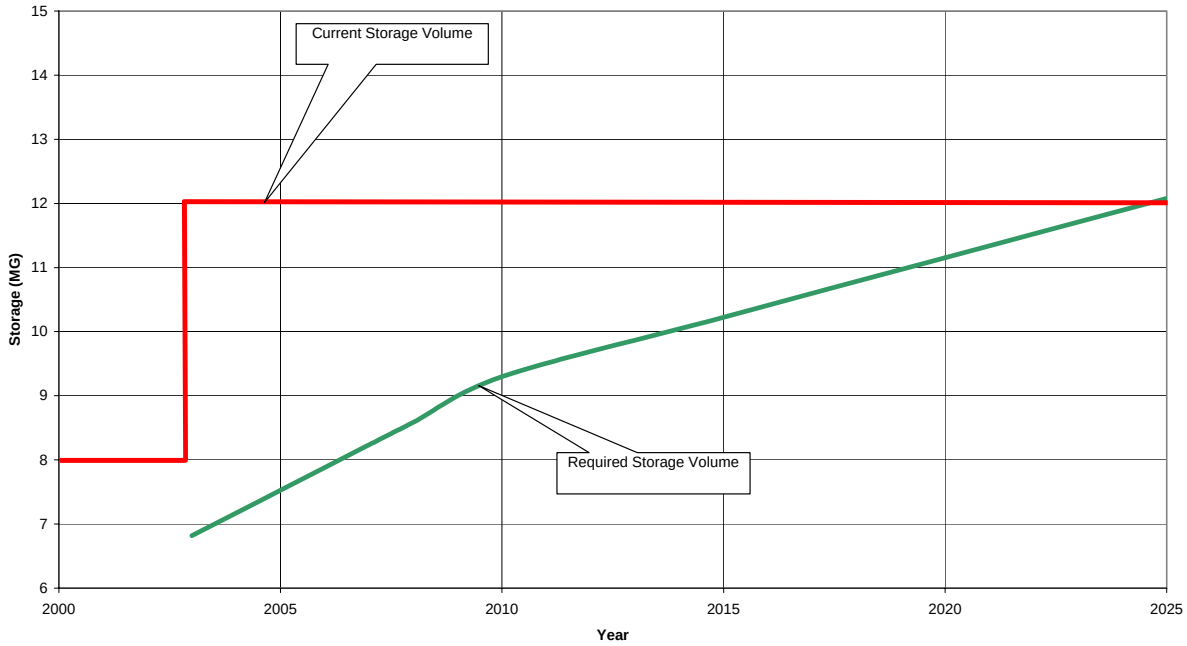
ES.7.4.1 WTP Improvements

WTP capacity improvements are presented in the *2002 Water Treatment Facilities Plan* (MWH Americas, 2002). The planned upgrades to the WTP will allow the City to meet MDD demands in the future.

ES.7.4.2 New Zone 1 Storage

As demand increases in the future, new storage will be required to serve demand in the current service level (Zone 1). The estimate of required future storage is shown in Figure ES-4. A new 4-MG reservoir in Zone 1 will most likely be required in the current planning period. Site selection, predesign, design, and construction activities are recommended several years before the reservoir is operational.

FIGURE ES-4
Estimated Future Zone 1 Storage Requirements (based on Method 3 discussed in text)
2004 City of Newberg Water Distribution System Plan



ES.7.4.3 New Zones 2 and 3 Facilities

The higher elevations of the northeast portion of the UGB/URA cannot be served by the existing (Zone 1) service zone. Although the timing of development in this upper area is undetermined, it was assumed to occur sometime after 2010.

Transmission supply pipelines will be required to move water from Zone 1 to the upper zones and the new 1.5-MG Zone 2-3 reservoir. These transmission pipelines are included in the CIP, but internal distribution lines will not be included, as they will be constructed by developers.

As shown in Table ES-6, the average daily demand at buildout of Zones 2-4 is about 0.48 mgd. This number is greater than that estimated by the TAZ distribution data in the same area for 2025. Assuming that growth will occur in an outward fashion, growth in the area for the current planning period can be accommodated in Zones 2 and 3. The facilities discussed below assume that the City will serve Zones 2 and 3 within the next 20 years and Zone 4 sometime thereafter. The facilities to serve Zones 2 and 3 should be sufficiently sized to carry the additional flow, when Zone 4 is finally constructed.

TABLE ES-6
2025 Future Zones Demand Summary
2004 City of Newberg Water Distribution System Plan

	Buildout Flow[1] (mgd)		
Zone	**ADD**	**MDD**	**PHD**
2	0.25	0.53	0.85
3	0.17	0.35	0.56
4	0.06	0.12	0.20
	0.48	**1.01**	**1.61**

[1] Buildout flow used for ultimate design capacity.

ADD = Average day demand.
Mgd = Million gallons per day.
MDD = Maximum day demand.
PHD = Peak hour demand.

New Zone 2-3 Pump Stations. As shown in Table ES-5, the build-out MDD for Zones 2 through 4 is about 1 mgd. Cost estimates for the pump stations to serve this area assume an initial capacity of 0.88 mgd (Zones 2 and 3) expandable to 1 mgd (Zones 2-4). It is recommended that the City ultimately construct two pump stations, each with the capability to serve these zones independently. These pump stations will be identified as the (1) North Valley Road (NVR) and (2) Central Zone 2-3 pump stations.

New Zone 2-3 Storage. Based on the sizing requirements presented in Section 6, the storage required to serve Zones 2 and 3 is about 1. 25 MG (3 x ADD). If the City decides to serve zones 2- 4 with one new reservoir, a reservoir capacity of 1.5 MG would be needed. Siting will be evaluated at a later date.

ES.7.5 Initial Model Results

Future demands were first applied to the existing system. New facilities were added to serve new areas only. The WTP was set to provide MDD for both PHD and MHD. As shown in Table ES-7, without distribution system improvements, the HGL at the WTP would exceed the maximum criteria of 110 psi. The MHD demand scenario controls both 2010 and 2025, indicating that the pipes connecting the WTP to the reservoirs are undersized. As a result, without additional pipe capacity, the reservoirs will not be refilled quickly enough. System upgrades designed to address this issue are discussed below. Because upgrades for the 2010 analyses will be recommended on the basis of the size required for the 2025 demand, the 2025 analyses were performed first.

TABLE ES-7
Summary of Initial Model Analyses (No Improvements)
2004 City of Newberg Water Distribution System Plan

	HGL Discharge Pressure @ WTP (psi)	
	PHD	**MHD**
2003	109	112
2010	115	118
2025	120	128

Planning criteria are not to exceed 110 psi at the WTP.

ES.7.5.1 2025 System Analysis

Several model analyses were performed to reduce the HGL at the WTP below 410 feet (110 psi). Pressures at the WTP were highest under the MHD. Therefore, this flow condition was used to size new piping improvements. A second analysis then was performed to ensure that the PHD criteria were also satisfied.

2025 Minimum Hour Analysis. Based on the MHD analyses, the existing system does not have sufficient capacity to deliver MDD flow to the reservoirs during low-flow periods within the HGL criteria. To provide this capacity, a new, 24-inch-diameter water line is required, extending from the WTP to the NVR reservoirs. To provide redundancy in the pipe mainline network, the preferred route of this pipe is along Springbrook Road and through the currently undeveloped Austin property to the NVR reservoirs. This improvement will be identified as the Springbrook Road water mainline. The total length of this line is about 29,000 feet.

2025 Peak Hour Analysis. PHD analyses were conducted for each of the Zone 2-3 pump stations. All minimum pressure (30 psi at demand nodes) and maximum HGL at the WTP (410 feet msl) requirements were satisfied for each of these scenarios.

To investigate the most beneficial location of future Zone 1 storage (4 MG), MHD scenarios were performed with storage at two different locations. The location of the new Zone 1 reservoir is not system-dependent and the final location will need to be determined by the City at a later date. The location will be based on site availability and security issues rather than hydraulic concerns. In summary, the need for additional storage in Zone 1 in the current planning period has been confirmed, but the location is currently undetermined. The CIP includes a predesign study and property purchase several years before the need is anticipated so that the reservoir can be built and brought on-line in time to meet growing demands.

2025 Fire Flow Analysis. Fire flow analyses were conducted for 2025 assuming the new 24-inch-diameter Springbrook Road line is constructed. All flow and pressure criteria are satisfied.

A similar analysis was conducted in which the WTP pumps are operating at firm capacity of 12 mgd, however, all the reservoirs are assumed to be empty. In this case as well, all pressure and flow criteria are satisfied. As a result, the model analyses indicate that there is

no dead storage in the system, even in 2025. The ability of the City to use all of the storage in the existing reservoirs greatly delays when the new Zone 1 storage will be required.

ES.7.5.2 2010 System Analysis

To maintain the HGL at the WTP below the criterion of 110 psi, portions of the new 24-inch-diameter Springbrook Road water line will need to be constructed before 2010. The purpose of this 2010 analysis is to determine which portions should be constructed in the next 6 years.

2010 Minimum Hour Analysis. For the 2010 analyses, approximately 13,200 feet of pipe improvements are required to meet the HGL criteria at the WTP of 110 psi. The analysis indicates construction of the pipeline in the southern portion of the system is most beneficial. One concern is that the reservoir fills faster than NVR reservoirs. However, in the long term, the new 24-inch-diameter water line will allow the reservoirs to fill more equally. This benefit will not be realized until the line is fully constructed.

2010 Peak Hour Analysis. All PHD minimum pressure and maximum HGL criteria for the analyses are satisfied.

ES.7.5.3 Fire Flow Analysis

Fire flow analyses for 2010 demands were conducted assuming the improvements for the Springbrook Road water main line were complete. As in 2025, all flow and pressure requirements for the 2010 demands are satisfied under normal operating conditions with the WTP pumping at a firm capacity of 9.5 mgd (6,600 gpm) and the empty reservoirs.

ES.7.6 Recommended System Improvements

The following improvements are the result of the capacity analysis conducted in Section 7. The costs associated with these projects should be recuperated through system development charges assessed on new developments.

ES.7.6.1 2010 Improvements—Springbrook Trunk Phases 1 to 5

This new 24-inch-diameter water line is proposed to extend from the WTP to the North Valley Road reservoirs site via Springbrook Road. To the extent possible, the construction of this line should be coordinated with the development activities occurring along Springbrook Road and within the Austin property. The total length of this line is about 29,000 feet. The route of this line may change as development occurs. This water line is required to control maximum WTP HGL requirements while the reservoirs are filling during MHD, as well as provided redundant transmission and distribution capacity to the east side of the city.

The portions of the Springbrook Road water line that are required to serve 2010 demands are divided into three phases. Actual sequencing may change and will depend on scheduled road improvements and development in the area. Planning level cost estimates are presented in Section 8.

Springbrook Trunk Phase 1. This 4,000-foot portion of the new 24-inch-diameter water line on Mountainview Drive from Springbrook Road to Villa Road is required to provide additional looping and reduce the HGL at the WTP. This project may be constructed in

conjunction with the S-curve road project on the Mountainview Drive Extension. This project will require pipe construction under the railroad right-of-way. When this water line is available, the adjacent water district customers could be placed on City service. The existing 10-inch line in Mountainview Drive will be abandoned after this line is placed in service.

Springbrook Trunk Phase 2. This 5,000-foot portion of the water line is located near the WTP on Wynooski Road up to the intersection of Highway 219 and Wilsonville Road. This pipe is to be constructed in an unimproved portion of existing roadway.

Springbrook Trunk Phase 3. This 4,200-foot portion of the water line is from Highway 219 and Wilsonville Road along Springbrook Road to Highway 99. This pipe is to be constructed in an unimproved portion of existing roadway, and under Highway 99W.

ES.7.7 2025 Improvements

The following improvements are based on the analyses performed for 2025 demands. Planning level cost estimates are presented in Section 8. Actual sequencing may change and will depend on road improvements and development in the area. The costs associated with these projects should be recuperated through system development charges assessed on developments in the areas served by these facilities.

ES.7.7.1 New 24-Inch-Diameter Springbrook Trunk Phases 4 to 6

The remaining portions of the Springbrook Trunk are divided into three additional phases. The completion of this pipeline is required to serve 2025 flows. Phase 4 is the 6,000-foot section from Highway 99 to the railroad crossing. Phase 5 is the 4,800-foot section along Villa Road extending North from Mountainview Drive. Phase 6 is the 5,000-foot section from the end of Phase 5 to the NVR reservoirs. Actual sequencing may change and will depend on road improvements and development activity in the area.

ES.7.7.2 New Zone 1 Storage

A new 4-MG reservoir will be required in the lower Zone 1 to serve peak flows around the year 2025. This new facility may be constructed at the existing Corral Creek Road Reservoir site or a new site in the central part of the City, most likely near Springbrook Road at a base elevation of approximately 380 feet. A site selection and predesign study will be required. The City may need to purchase additional property.

ES.7.7.3 Zone 2 and 3 Facilities

New Zone 2 and 3 facilities will be required within the current planning period, but after 2010. The costs associated with these projects should be recuperated through system development charges assessed on developments in the areas served by these facilities. Developers may construct these facilities with “oversizing” credits provided by the City. Main supply lines, pump stations, and storage projects included in the CIP and construction of the 8-inch distribution lines will be constructed and paid for by developers. A predesign study will be required. Also, the City may need to acquire additional property for the pump station and storage facilities.

North Valley Road Zone 2-3 Pump Station. This booster pump station is required to serve the areas above the 300-foot elevation. Initially, only one pump station may be required, depending on the extent of development in these areas. However, the City should plan to construct a redundant pump station to service these upper zones.

Zone 2-3 North Valley Road Supply Lines. This line will be required to pump water to the new Zone 2-3 reservoir and to supply demand in this area. Based on estimated build-out flows, these water lines should be 12 inches in diameter to provide fire flow and MDD at acceptable velocities. Pressure-reducing valves will be required to serve Zone 2 from Zone 3. It is assumed for the purposes of redundancy that two connections and PRVs will be required. An 8-inch-diameter distribution network is sufficient and developers therefore will construct these lines.

Zone 2-3 Central Pump Station. This pump station is required to serve the areas above the 300-foot elevation. Initially, only one pump station may be required, depending on the extent of development in these areas. However, the City should plan to construct a redundant pump station.

Zone 2-3 Central Supply Lines. These lines will be required to pump water to the new Zone 2-3 reservoir and to supply demand in this area. Based on estimated build-out flows, these water lines should be 12 inches in diameter to provide fire flow and MDD at acceptable velocities. Pressure reducing valves will be required to serve Zone 2 from Zone 3. It is assumed for the purposes of redundancy that two connections and PRVs will be required. An 8-inch-diameter distribution network is sufficient and developers therefore will construct these lines.

New Zone 2/3 Reservoir. This reservoir will be required to serve peak flow in the areas above the 300-foot elevation and should be 1.5 MG in size. Site selection and pre-design studies will be required before design. Also, the City may need to acquire additional property for the reservoir.

ES.8 Section 8—Capital Improvement Plan

This section contains a summary of the Newberg water system CIP. The CIP was developed from the results of the master plan analyses to address distribution system needs, such as pump station, pipeline, pressure reducing valve (PRV) station, and storage improvements to serve the 20-year planning horizon to 2025.

With the adoption of this updated water master plan, it is recommended that the City initiate the process to review the water systems development charge (SDC). The goal of the review would be to determine if revisions are needed to support future system improvements requirements and accommodate future growth.

ES.8.1 Capital Improvement Plan Recommendations

The CIP recommendations are based on the latest available growth projections and planning assumption information. These projections and planning assumptions should be monitored regularly for accuracy as the CIP is implemented. Newberg should create a rolling 5-year capital project summary each year, including all miscellaneous projects needing capital

funding, for annual budgeting purposes. The CIP presented in this section should be used to supplement the annual comprehensive project summary updates.

The CIP improvements are prioritized according to the immediacy of the system needs. Improvements needed to meet future growth should be implemented only when growth projections and demands are confirmed.

The CIP projects are presented in the following four time categories:

- Annual improvements through the year 2009
- Improvements anticipated for the years 2010-2014
- Improvements anticipated for the years 2015-2019
- Improvements anticipated for the years 2020-2024

The recommended improvements were prioritized with guidance and input from City staff. A summary of the projected annual costs of recommended CIP projects is presented in Table ES-8. Detailed project worksheets are presented in Appendix M of the WDSP. Annual expenditures shown in Table ES-8 are further divided as to whether the projects are required to serve existing customers or new growth. The development of the division of costs attributed to existing and new customers is based on whether the system deficiency is a result of growth impacts or current demand conditions.

TABLE ES-8
Newberg Annual CIP Cost Estimate Summary for Water Distribution System
2004 City of Newberg Water Distribution System Plan

		Cost Distribution	
Year	**Total Cost**	**Existing Customers**	**New Customers**
2004	$1,130,000	$1,130,000	$0
2005	$2,270,000	$2,090,000	$180,000
2006	$2,740,000	$1,300,000	$1,440,000
2007	$3,070,000	$1,370,000	$1,700,000
2008	$2,840,000	$1,440,000	$1,400,000
2009	$1,850,000	$1,470,000	$380,000
2010-2014	$14,700,000	$7,840,000	$6,860,000
2015-2019	$17,130,000	$9,030,000	$8,110,000
2020-2024	$18,830,000	$13,620,000	$5,210,000
Total	**$64,600,000**	**$39,300,000**	**$25,300,000**

ES.8.2 Pump Station Improvements

The pump station analyses indicate all the planned WTP pump station upgrades are sufficient to serve 2010 and 2025 demand conditions.

Two new booster pump stations will be required to serve new development in the areas above the 300-foot elevation (Zone 2-3). Phasing of these pump stations will depend on

development in these areas. For planning purposes, it is assumed that one pump station will be required in the period from 2010-2014, and the second in the period from 2015-2019. Each of these pump stations should be designed to serve the Zone 2-3 areas independently, so one pump station may be adequate initially. As the population in this area grows, the City should reduce the risk of interruption of service in this area and construct the second pump station for redundancy as soon as possible. Each pump station should be designed to pump 0.88 mgd (620 gpm) for the 2025 MDD demands and sized to be upgraded to 1 mgd (700 gpm) to serve build-out demands.

ES.8.3 Pipeline Improvements

Annual projects are required to install lines to loop the existing system and to replace aging pipe. All looping can be completed in the near future. Therefore, annual looping projects are assumed to be necessary for the next 6 years only. Pipe replacement projects occur annually and the cost allocated for each year increases to account for growth in the City.

The pipeline analyses in Sections 6 and 7 concluded that the Newberg distribution system is adequate to serve the existing, 2010, and 2025 PHD and fire flow conditions. However, a new, 29,000-foot-long, 24-inch-diameter water line will be required to allow the reservoirs to fill at an acceptable rate during low flow periods. This project is divided into six phases for the purposes of this CIP. Phases 1 through 3 are required to meet 2010 demands. Construction of this pipeline might be phased differently as it is coordinated with road construction projects to minimize restoration costs.

In addition, Zone 2-3 transmission lines will be required to convey water to the proposed Zone 2-3 Reservoir and distribute water to the users. Zone 2 will be served through a PRV, while Zone 3 would be served directly from the new Zone 2-3 reservoir.

ES.8.4 Storage Improvements

A new, 1.5-MG reservoir will be required to serve the Zone 2-3 developments as they occur. The City may choose to operate the system within these zones without storage for a period of time, however, as growth occurs, a storage reservoir will be required.

The total 2025 Newberg storage needs are approximately 12.08 MG. Currently, Newberg has 12 MG of existing storage. A new, 4-MG storage reservoir is predicted for 2025. This project should be addressed in the 2020-2024 CIP interval to allow sufficient time for siting, design, and construction.

ES.8.5 Cost Summary

The cost estimates developed for the recommended improvements are budget planning-level estimates and should be updated for specific project conditions when implementation is imminent. The estimates should be considered accurate within plus 50 percent to minus 30 percent of final project costs. Final costs will vary depending on actual labor and material costs, market conditions, final project scope, and other variables at the time the project is constructed.

Total project costs presented comprise the following four specific components:

- Capital facilities construction costs

- Engineering and construction management
- Legal and administration costs
- Contingency allowance

ES.8.6 Schedule

An estimated CIP schedule is presented at the end of Section 8. The actual timing of the projects will depend in actual budget availability and decision of the Newberg staff. The values shown in Table ES-9 are year 2003 dollars, and have not been adjusted for inflation. Project priorities were developed with input and guidance from the Newberg staff. The financial planning and budgeting aspects of the CIP will be administered through Newberg's Finance Department.

TABLE ES-9
Newberg Annual CIP Schedule for Water Distribution System
2004 City of Newberg Water Distribution System Plan

Description	Category	Year	CIP ID	Estimated Project Cost
Looping Water Lines	Pipe	2004	PI-LP	$100,000
Pipe and Valve Replacement 2004	Pipe	2004	PI-RP	$1,026,000
Looping Water Lines	Pipe	2005	PI-LP	$100,000
Pipe and Valve Replacement 2005	Pipe	2005	PI-RP	$70,000
Identified Pipe Replacement Projects	Pipe	2005	PI-RP 2005	$700,000
Valve Inserts	Pipe	2005	PI-VI	$500,000
Springs Upgrades	Springs	2009	SY-SP	$500,000
North Valley Road Reservoir Evaluation and Upgrades	Storage	2005	ST-05-03	$400,000
Looping Water Lines	Pipe	2006	PI-LP	$100,000
Pipe and Valve Replacement 2006	Pipe	2006	PI-RP	$1,197,000
24-inch Springbrook Road Water Main Line (Phase 1)	Pipe	2006	PI-SB (1)	$1,440,000
Looping Water Lines	Pipe	2007	PI-LP	$100,000
Pipe and Valve Replacement 2007	Pipe	2007	PI-RP	$1,267,000
24-inch Springbrook Road Water Main Line (Phase 2)	Pipe	2007	PI-SB (2)	$1,700,000
Looping Water Lines	Pipe	2008	PI-LP	$100,000
Pipe and Valve Replacement 2008	Pipe	2008	PI-RP	$1,336,000
24-inch Springbrook Road Water Main Line (Phase 3)	Pipe	2008	PI-SB (3)	$1,400,000
Looping Water Lines	Pipe	2009	PI-LP	$100,000
Pipe and Valve Replacement 2009	Pipe	2009	PI-RP	$1,374,000
New Zone 2-3 Facilities Pre-design Study	Study	2009	Zone 2-3	$380,000
Pipe and Valve Replacement 2010-2014	Pipe	2010-2014	PI-RP	$7,629,000
24-inch Springbrook (Phase 4)	Pipe	2010-2014	PI-SB (4-6)	$2,052,000
New Zone 2-3 Facilities Property Purchase	Property	2010-2014	Zone 2-3	$1,520,000
New NVR Zone 2-3 Pump Station	Pump Station	2010-2014	Zone 2-3	$1,900,000

TABLE ES-9
Newberg Annual CIP Schedule for Water Distribution System
2004 City of Newberg Water Distribution System Plan

Description	Category	Year	CIP ID	Estimated Project Cost
New NVR Zone 2-3 Supply Line (2 PRVs)	Pipe	2010-2014	Zone 2-3	$1,216,000
Water Distribution System Plan Update 2010	Study	2010-2014	SY-PL	$380,000
Pipe and Valve Replacement 2015-2019	Pipe	2015-2019	PI-RP	$8,385,000
24-inch Springbrook (Phase 5)	Pipe	2015-2019	PI-SB (4-6)	$1,642,000
New Central Zone 2-3 Pump Station	Pump Station	2015-2019	Zone 2-3	$1,900,000
New Central Zone 2-3 Supply Line (2 PRVs)	Pipe	2015-2019	Zone 2-3	$1,216,000
New 1.5-MG Zone 2-3 Reservoir	Storage	2015-2019	Zone 2-3	$2,850,000
New 4-MG Zone 1 Reservoir Pre-design Study	Study	2015-2019	ST-Zone 1	$190,000
New 4-MG Zone 1 Reservoir Property Purchase	Property	2015-2019	ST-Zone 1	$570,000
Water Distribution System Plan Update 2016	Study	2015-2019	SY-PL	$380,000
Pipe and Valve Replacement 2020-2024	Pipe	2020-2024	PI-RP	$9,143,000
24-inch Springbrook (Phase 6)	Pipe	2020-2024	PI-SB (4-6)	$1,710,000
New 4-MG Zone 1 Reservoir	Storage	2020-2024	ST-Zone 1	$7,600,000
Water Distribution System Plan Update 2022	Study	2020-2024	SY-PL	$380,000
	Total			**$64,600,000**