EXECUTIVE SUMMARY

Authorization

On March 13, 2007, the consulting engineering firm of Murray, Smith & Associates, Inc. (MSA) was authorized by the City of West Linn (City) to prepare this Water System Master Plan (WSMP).

Purpose and Compliance

The purpose of this WSMP is to provide an assessment of the City's water distribution system, to identify current system deficiencies, determine future water supply requirements and recommend improvements that correct existing system deficiencies and provide for future system needs. This WSMP complies with water system master planning requirements established under Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 61. Included in the planning and analysis work presented in this plan is the impact of complying with recent fire flow requirement changes for residential construction.

Planning Period and Study Area

The planning period for this WSMP is approximately 20 years, through the year 2030. Certain planning and facility sizing efforts will use estimated water demands at saturation development. Saturation development, or build out, occurs when all land within the Urban Growth Boundary (UGB) which City staff has determined to be economically and physically developable, has been fully developed according to current land use and zoning designations. The planning period for transmission and distribution facilities is to saturation development of the City's water system planning area which is concurrent with the UGB.

The study area for this master plan includes the City's existing water service area and all areas within the current City limits. The City provides potable water to approximately 24,615 people through 8,600 residential, commercial and industrial service connections. The City's water service area includes all areas within the current City limits as well as a limited number of customers outside the UGB that receive extra-territorial water service from the City. For the purpose of this analysis, this small number of services is included as if they were actually within the UGB. Plate 1 of Appendix A illustrates the City's water service area limits, pressure zone boundaries and major water system facilities.

South Fork Water Board Supply and Emergency Supply Connection Facilities

Currently, the City's primary water supply is from the South Fork Water Board (SFWB) water treatment plant (WTP) located in Oregon City. The City also has an emergency supply connection to the City of Lake Oswego's WTP located at the north end of the City. The City's water distribution system consists of six service zones supplied by six storage

facilities and five pumping stations. Each of the service zones is supplied by gravity from a storage facility.

Pressure Zones

The City's existing distribution system is divided into the following six major service levels, or pressure zones:

- Bolton Pressure Zone
- Horton Pressure Zone
- Rosemont Pressure Zone
- Robinwood Pressure Zone
- Willamette Pressure Zone
- Bland Pressure Zone

Storage Reservoirs

The City's water system has a total storage capacity of 5.5 mg distributed across six storage reservoirs. Table ES-1 presents a summary of the City's existing storage reservoirs, including capacities, overflow elevations, and pressure zone served.

Table ES-1
Reservoir Summary

Reservoir Name	General Location	Usable Capacity (mg)	Overflow Elevation (ft)	Pressure Zone Served
Bolton	Skyline Drive	2.0	440	Bolton
Horton	Horton Road & Santa Anita Drive	1.5	731	Horton
Rosemont	Suncrest Drive	0.4	860	Rosemont
Bland Circle	Bland Circle	0.5	585	Bland
Willamette	Salamo Road	0.6	351	Willamette
View Drive	View Drive	0.5	328	Robinwood

Pumping Facilities

The City's water distribution system includes four booster pump stations. A fifth pump station is located at the City's emergency supply connection with Lake Oswego. Table ES-2 summarizes the pump configuration, total capacity and firm capacity of each station. The pump station capacities presented in Table ES-2 represent the nominal capacities of the pumps.

Table ES-2
Existing Pump Station Summary

Reservoir Name	General Location	Usable Capacity (mg)	Overflow Elevation (ft)	Pressure Zone Served
Bolton	Skyline Drive	2.0	440	Bolton
Horton	Horton Road & Santa Anita Drive	1.5	731	Horton
Rosemont	Suncrest Drive	0.4	860	Rosemont
Bland Circle	Bland Circle	0.5	585	Bland
Willamette	Salamo Road	0.6	351	Willamette
View Drive	View Drive	0.5	328	Robinwood

Distribution System Piping

The City's water service area distribution system is composed of various pipe types in sizes up to 24-inches in diameter. The total length of piping in the service area is approximately 117 miles. The pipe types include cast iron, ductile iron, polyvinyl chloride (PVC), steel, asbestos cement, copper and galvanized iron. Table ES-3 presents a summary of pipe lengths by diameter. Table ES-4 presents a summary of pipe length and percentage of system by material.

Table ES-3
Existing Pipe Inventory

Diameter (in.)	Linear Feet in System	Miles in System	Percent of Total Pipeline Length
Less than 6	69,036	13.1	11
6	271,437	51.4	44
8	142,059	26.9	23
10	41,364	7.8	7
12	22,243	4.2	4
14	15,557	2.9	2
16	10,544	2.0	2
18	18,790	3.6	3
20	9,161	1.7	1
24	20,070	3.8	3
Total	**620,261**	**117.4**	**100**

Table ES-4
Pipe Material Summary

Pipe Material	Length (feet)	Percent of Total Length
Ductile Iron	379,862	61.2
Cast Iron	127,063	20.5
Asbestos Cement	63,932	10.3
Polyvinyl Chloride	14,630	2.4
Galvanized Steel	9,752	1.6
Steel	10,363	1.7
Copper	3,633	0.6
Polybutylene	815	0.1
Unknown	10,211	1.6
	620,261	**100**

Water Demand Projections

Estimates of future water demands were developed from the existing water use data and City land use data and population projection estimates. Water demand estimates are summarized in Table ES-5.

Table ES-5
Estimated Water Demand Summary

Year	Water Demand (mgd)		
	Average Day Demand	Maximum Day Demand	Peak Hour Demand
2008	3.5	8.1	21.3
2010	3.6	8.3	21.8
2015	3.7	8.6	22.6
2020	3.9	8.9	23.4
2025	4.0	9.3	24.5
2030	4.2	9.7	25.5
Saturation Development	4.3	10.0	26.3

Water System Operation and Maintenance

The City's water system is operated and maintained by the Public Works Department which performs all system operation and maintenance for the distribution system from the City's 24-inch diameter supply main in Oregon City, downstream of the Division Street Pump

Station and the SFWB WTP. An evaluation of the City's water system operation and maintenance (O&M) practices was completed with the following items recommended for inclusion in the City's water system Capital Maintenance Plan (CMP) and Capital Improvements Plan (CIP):

1. *Reservoir Seismic Assessment and Improvements* – Assess the current seismic risk at four reservoir sites and determine if the current level of seismic restraint is adequate. Develop recommended improvements to meet current seismic code requirements. It is recommended that these assessments will be completed for the Willamette, View Drive, Bland and Horton Reservoirs.

2. *Bolton Reservoir Replacement and Old Bolton Pump Station Abandonment* - Based on the current and previous evaluations of the Bolton site, it is recommended that the Bolton Reservoir be abandoned and replaced, and that the old Bolton Pump Station be demolished and removed. The required capacity of the proposed Bolton Reservoir replacement will be further discussed in Section 6. Given the age and condition of the reservoir, it is anticipated that this improvement is included as a near-term (less than five years) improvement in the CIP.

3. *Ongoing Reservoir Lining and Coating Maintenance* – Three of the City's reservoirs (Bland, Rosemont and View Drive) will require re-coating within the next 10 to 20 years. A schedule for completing these re-coatings is included in the CMP. Most coatings have a service life of approximately 20 to 30 years so it is anticipated that all of the reservoirs, with the possible exception of the Willamette and Horton Reservoirs which were re-painted in the past five years, will need coating maintenance within the 20-year planning horizon of this WSMP.

4. *Willamette Pump Station MCC Assessment* – An assessment of the condition, performance and operation of the existing MCC's in the Willamette Pump Station should be completed to determine if corrective repairs or replacement will be required to address issues identified by City staff.

5. *Demolition of Abandoned View Drive Site Facilities* – The abandoned reservoir and pump station on the View Drive site should be demolished and removed to improve site aesthetics and reduce the risk associated with failure of aging structures.

6. *SCADA System Upgrades* – The SCADA system should be upgraded to replace existing aging infrastructure, including the Master Telemetry Unit and components at remote pump station sites.

Water Supply Evaluation

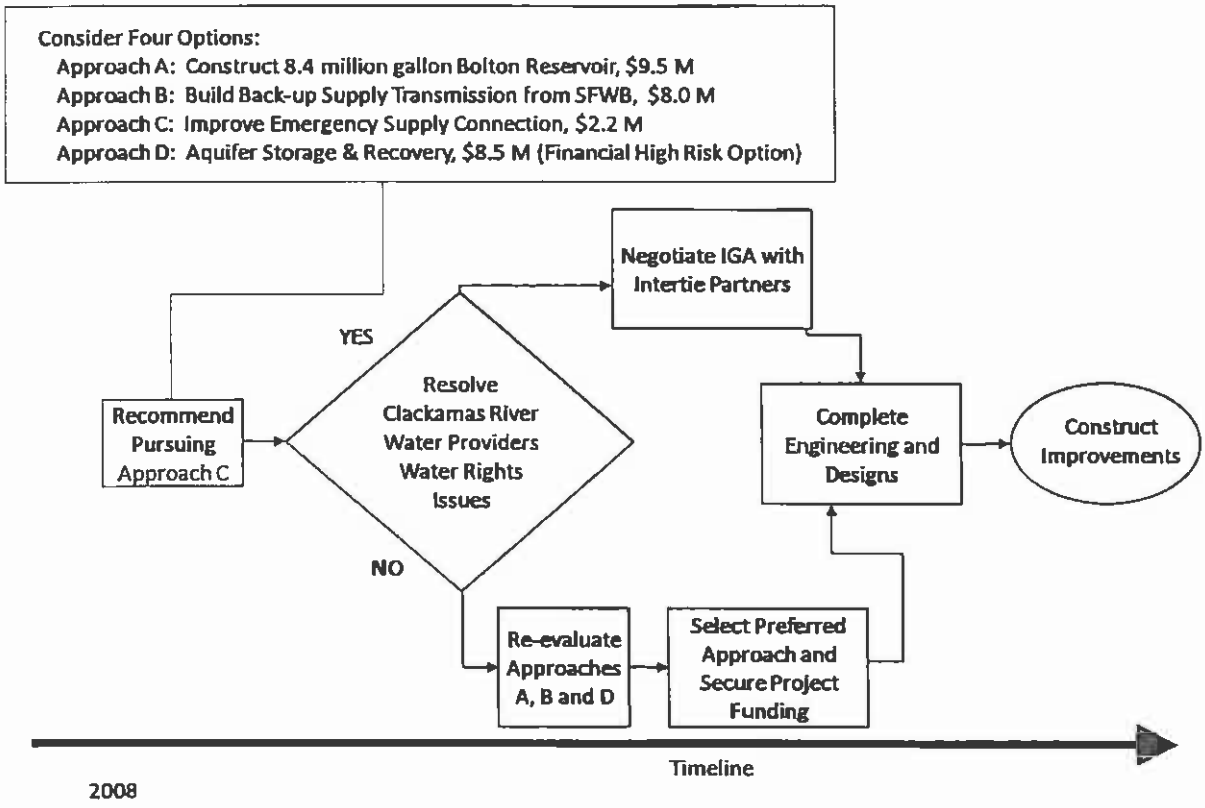
A comprehensive and system wide supply system evaluation of City supply facilities was completed that included consideration of a number of approaches, methodologies and solution option development. The supply analysis was completed based on capacity needs,

reliability, redundancy and included consideration of piping, pumping, aquifer storage and finished water storage options. The analysis considered the following four solution approaches:

- Solution Approach A: Construction of a new 8.4 million gallon Bolton Reservoir
- Solution Approach B: Build back-up supply transmission from SFWB
- Solution Approach C: Improve the emergency supply capacity and reliability of the Lake Oswego Emergency Supply Connection
- Solution Approach D: Aquifer Storage and Recovery (ASR)

The four solution approaches presented above provide varying degrees of certainty, risks and costs. Based on input from and discussions with City staff and policy makers it is recommended that Solution Approach C be pursued. Once fully developed and implemented this approach most economically meets the City's supply and reliability needs. The successful implementation of this approach requires the resolution of ongoing water rights discussions with a number of Clackamas River water users. Figure ES - 1 presents a decision tree diagram summarizing the recommended supply system strategy for the City.

Figure ES-1
Supply Approach Decision Tree



Distribution System Storage Evaluation

A distribution system storage evaluation was completed that established City-wide water storage requirements as well as storage requirements for the City's six pressure zones. Storage deficits were found in a number of the City's service zones under saturation development conditions. These deficits are summarized as follows:

- 0.4 mg in the Robinwood pressure zone
- 0.8 mg in the Willamette pressure zone
- 0.7 mg in the Horton pressure zone
- 0.3 mg in the Bland pressure zone
- 0.8 mg in the Rosemont pressure zone

Two approaches were considered to address the current and future supply and storage deficits presented above. Both approaches include system improvements that, if implemented, would result in adequate supply and storage through saturation development. Specifically, each approach addresses the following pressure zone supply and storage deficits at saturation development. Both approaches also consider the anticipated need to replace the Bolton Reservoir due to concerns over the age of the reservoir, usable capacity and maintenance of the floating cover.

Approach A – Storage Only

Approach A considers the construction of additional storage facilities to address the long-term supply and storage deficits discussed above. Where feasible, storage improvements are configured to address deficits in more than one pressure zone.

Approach B – Storage and Emergency Supply Improvement

Approach B considers the construction of additional storage facilities as well as the development of expanded, reliable emergency supply facilities to address the long-term supply and storage deficits discussed above. Where feasible, improvements are configured to address deficits in more than one pressure zone.

These two alternative approaches were presented to, and reviewed by City staff, the UAB and the City Council. The City Council directed that the development of recommended system improvements be based on Approach B. The resulting recommended improvements and associated project costs are incorporated in the recommended CIP and CMP.

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.

System performance and adequacy was evaluated to identify areas of deficiency and develop recommended system improvements for the CIP.

Recommended Improvements

The distribution system analyses formed the basis for the recommended water distribution system improvements. Recommended improvements include maintenance projects to improve the reliability or performance of existing facilities and proposed new or replacement facilities to address existing inadequacies or inadequacies found when future demand conditions were imposed on the system. System improvements include recommendations for improvements to reservoirs, pump stations, distribution system water lines and other facilities. The recommended improvements in this section are presented by project type and include projects related to the City's CMP and CIP. Project cost estimates are presented for all recommended improvements and annual budgets are presented which support on-going programs.

Capital Maintenance Program

A number of improvements were identified for inclusion in the City's water system CMP. The CMP is recommended for major maintenance and replacement needs of existing facilities. Table ES-6 lists the projects included in the CMP and itemizes the estimated project costs associated with these maintenance projects for the 20-year study period of the WSMP. All estimates are in 2008 dollars.

Table ES-6
Recommended CMP Project Cost and Budget Summary

CMP Project	Estimated Project Cost
Asbestos Cement Pipe Replacement	$ 6,900,000
Galvanized/Steel Pipe Replacement	750,000
Pressure Reducing Valve Vault Improvements	100,000
Reservoir Seismic Assessment and Improvements	390,000
Reservoir Coating Maintenance and Replacement	360,000
Willamette Pump Station Motor Control Center Assessment and Upgrades	120,000
Demolish Abandoned View Drive Site Facilities	75,000
SCADA System Upgrades	150,000
Total	**$ 8,845,000**

Capital Improvement Program

Based on the analysis of the water system's storage, pumping, transmission, and distribution facilities presented in previous sections, a list of recommended system improvements for

each category has been developed for inclusion in the CIP. CIP projects prioritized in the following order:

1. Correct existing deficiencies (health and safety risks)
2. Provide for existing maintenance needs
3. Providing for growth

A discussion of CIP elements is presented below.

Reservoirs

It is recommended that two new reservoirs be constructed in the water service area within the planning horizon. Table ES-7 presents a summary listing of these recommendations and includes project cost estimates for each reservoir as well as timing for a recommended project start.

Table ES-7
Recommended Reservoir Improvement Summary

Project Start (Fiscal Year)	Project Description	Estimated Project Cost
2010	Bolton Reservoir Replacement – 4.0 MG	$8,000,000
2014	Bland Reservoir No. 2 – 0.3 MG	$525,000
	Total	**$8,525,000**

Pump Stations

It is recommended that two pump stations be modified or upgraded. Booster pump station recommendations are based on analysis presented in prior sections. Table ES-8 presents a summary of recommended pump station improvements including project priority and an estimated project start and cost for each recommendation.

Distribution System Improvements

The distribution system analysis found that water line improvements are needed to provide improved hydraulic transmission capacity, increased fire flow capacities and provide for system expansion. The recommended distribution system improvements are grouped in the categories based on the City's current SDC allocation methodology. A tabulated summary of recommended distribution system water line improvements for each pressure zone is presented in Table 8-5 in Section 8. Each improvement is identified by category and includes existing diameter and pipe material, proposed replacement or new diameter, linear feet of main and SDC allocation.

Table ES-8
Recommended Pump Station Improvement Summary

Project Start (Fiscal Year)	Project Description	Estimated Project Cost
2011	Emergency Intertie Pump Station Expansion	$ 75,000
2016	Bland Intertie Supply to Rosemont	$ 1,250,000
	Total	**$1,325,000**

CMP and CIP Summary

A summary of the recommended improvements is tabulated and presented in Section 8 as Table 8-6 that provides prioritized project sequencing by illustrating annual project needs for each facility or improvement category in the next eight years. Those improvements recommended for construction beyond fiscal year (FY) 2017 and within the 20-year horizon are identified as medium term projects and those beyond the 20-year planning horizon are identified as long-term improvements. It is recommended that the City's CMP be funded at approximately $550,000 per year for the first five years and then approximately $410,000 per year for the next fifteen years. It is recommended that the City's total 20-year CIP and CMP funding need be established at approximately $1,570,000 annually for storage, pumping and distribution system piping improvements over the 20-year planning horizon.

Plate 1 in Appendix A illustrates the City's water system and identifies proposed CIP and CMP projects discussed herein. Individual project data sheets, contained in Appendix E, include further detail about each CIP project.

Funding Sources and Water System CIP and CMP Funding

The City may fund the water 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.

It is recommended that the City complete a detailed water rate and SDC analysis with the completion of this WSMP to determine specific funding needs and potential funding sources associated with the adopted CIP and CMP. It is anticipated that changes in rates and SDC's will be required to keep pace with inflation and fund the proposed improvements through build-out of the system. It is recommended that these studies also provide guidance to the City on the best use of the funding options described above.

Study Recommendations

It is recommended that the City of West Linn take the following actions:

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

2. Adopt the prioritized recommended system improvements described in Section 8 and specifically listed in Tables 8-5 and 8-6 as the CMP and the CIP for the City's water service area.

3. Immediately proceed with supply system reliability improvements referred to as Approach C, which improves the emergency supply capacity and reliability of the Lake Oswego Emergency Supply Connection

4. Proceed with the detailed water rate and SDC analysis recommended above and follow the recommendations generated through these processes.

5. Review and update this plan within 7 to 10 years, or sooner, to accommodate changes or new conditions.

Summary

The water system master planning work completed as part of this study provided an inventory of the City's existing water supply and distribution system, developed and presented criteria for the system analysis and developed recommendations from these findings to correct existing deficiencies and to provide for system expansion needs. A summary of all recommended improvements is presented in Table 8-6. The table provides prioritized project sequencing by illustrating FY project needs for each facility or improvement category. It is recommended that the City's CIP and CMP be funded at approximately $1,570,000 annually over the 20 year planning horizon for recommended storage, pumping and distribution system piping improvements.

SECTION 2
EXISTING WATER SYSTEM

General

The purpose of this section is to document the facilities inventory and describe the City of West Linn's (City) existing water system. Included are brief discussions of supply facilities, storage reservoirs, pumping facilities and distribution system piping.

Background and Study Area

The City's existing water service area includes all areas within the current City limits. The City provides potable water to approximately 24,615 people through 8,600 residential, commercial and industrial service connections. The study area of this planning effort is the entire area within the City's urban growth boundary (UGB) as illustrated in Figure 2-1.

Currently, the City's primary water supply is from the South Fork Water Board (SFWB) water treatment plant (WTP) located in Oregon City. The City also has an emergency supply connection to the City of Lake Oswego's WTP located at the north end of the City. The City's water distribution system consists of six service zones supplied by six storage facilities and five pumping stations. Each of the service zones is supplied by gravity from a storage facility.

Plate 1 of Appendix A illustrates the City's water service area limits, pressure zone boundaries and major water system facilities.

Supply Facilities

South Fork Water Board Supply

The SFWB was established under Oregon Revised Statutes (ORS) 190 by agreement between the cities of West Linn and Oregon City for the purposes of supplying water to the two cities. The SFWB owns and operates water supply facilities consisting of a river intake on the Clackamas River, which includes a raw water pumping station, a water treatment plant located in the Park Place area of Oregon City, finished water pumping station, and raw and finished water transmission pipelines.

Water Rights Summary

The SFWB holds four water rights in the Clackamas River basin. These rights are the most senior municipal rights on the river and its tributaries except for a small intervening right on the Clackamas River held by the City of Gladstone, and all pre-date the major instream right held by the Oregon Water Resources Department (OWRD). The total permitted withdrawal

Figure 2-1

rate for all of the permits is 116.0 cubic feet per second (cfs) or 74.98 million gallons per day (mgd). During the summertime when low natural stream flows occur, the permitted withdrawal rates cannot be achieved as there are insufficient streamflows to support the authorized withdrawal amounts. Previous studies have estimated that the actual maximum withdrawal rate for all four rights during periods of low streamflow is 80.0 cfs (51.71 mgd). As of 2004, the SFWB has the right to withdraw at the new intake up to 66.0 cfs or 42.6 mgd. The four water rights held by the SFWB are summarized in Table 2-1.

Table 2-1
Water Rights Summary

Permit No.	Priority Date	Permitted Production Rate		
		Cubic feet per Second (cfs)	Gallons per Minute (gpm)	Million Gallons per Day (mgd)
S2257	7/17/1914	6	2,693	3.88
S3778	1/16/1918	20	8,977	12.93
S9982	8/11/1926	30	13,465	19.39
S22581	8/3/1953	60	26,930	38.78
Total		**116**	**52,064**	**74.98**

River Intakes

The SFWB has two raw water intakes located on the Clackamas River. The new intake, constructed in 1996, is located at Clackamas River Mile 1.7. This new intake is designed and constructed to pass a maximum flow of approximately 82 cfs (53 mgd) and is equipped with fish screens to meet current federal and state regulations.

The old intake, which is inoperable, is located approximately 500 feet upstream of the new intake and is no longer maintained or in service. As a condition of approval of the construction of the new intake, the City of Oregon City, Oregon Division of State Lands (DSL) and the United States Army Corps of Engineers (USACE) require the SFWB to remove the old river intake and raw water pump station. The 2004 South Fork Water Board Water System Master Plan includes a capital project to complete the removal.

Raw Water Pump Station

The raw water pump station is located in the same structure as the river intake. The pump station contains five vertical turbine pumps. The current firm capacity, or capacity with the largest pump out of service, is approximately 30 mgd. The planned ultimate capacity of the raw water pump station is approximately 53 mgd.

Raw Water Transmission Main

An existing 42-inch diameter steel raw water transmission main extends approximately 600 feet from the raw water pump station and connects to a 27-inch diameter concrete cylinder pipe main, originally constructed in 1954, that extends to the WTP. The capacity of the existing raw water transmission main is approximately 22 mgd.

Water Treatment Plant

The SFWB WTP is located in the Park Place area of Oregon City on Hunter Avenue south of the river intake and raw water pump station. The WTP, constructed in 1958 and upgraded in 1975, 1986 and more recently, has a rated production capacity of approximately 22 mgd.

Finished Water Supply to West Linn

A 30-inch diameter concrete cylinder pipe transmission main transmits water by gravity from the SFWB WTP clearwell to the Division Street Pump Station. The Division Street Pump Station, located near the intersection of Division Street and Penn Lane in Oregon City, pumps water to the City of Oregon City Mountainview Reservoir. The pump station has a firm pumping capacity of approximately 17.6 mgd. Supply to West Linn is from a connection to the 24-inch diameter pump station discharge main near the station. The connection includes a pressure control station and 16-inch diameter master meter. The City's 24-inch diameter transmission main extends west and crosses the Willamette River on the Interstate 205 (I-205) bridge where it connects to the City's distribution system.

City of Lake Oswego Emergency Supply Connection

In 1984, the City entered into an intergovernmental agreement with the City of Lake Oswego and the SFWB to construct, operate and maintain an intertie between the Lake Oswego water supply system and the West Linn and SFWB system. An 18-inch diameter intertie between the Lake Oswego system and the 24-inch diameter transmission line in the City was constructed. Activation of the intertie may be accomplished only by the mutual consent of Lake Oswego and SFWB.

In 2001, the intertie was improved with the construction of an intertie pump station with a current nominal capacity of approximately 6 mgd. The below-grade pump station is located near the intersection of Old River Road and Willamette Drive. The pump station contains two 2,200 gpm frame mounted end suction centrifugal pumps with space for a future third pump. The pump station can be used to pump emergency supply from the Lake Oswego distribution system into the Bolton and Robinwood pressure zones via altitude and pressure reducing valves located at the station. The pump station provided water to the City from November 2001 to April 2002 during the upgrade of the City's I-205 transmission main from the SFWB and has subsequently provided supply for short durations.

Pressure Zones

General

The City's existing distribution system is divided into six major 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 of pressure reducing facilities serving the zone. A description of each of the City's major pressure zones is presented below and includes a description of the service area, storage facilities and pumping facilities serving the zone.

Bolton Pressure Zone

The Bolton pressure zone serves lower elevation areas of the City on either side of Willamette Drive (Highway 43) south from Cedaroak Drive to the mouth of Tanner Creek, and encompasses approximately 1,250 acres. The Bolton pressure zone and subzones serve customers below an approximate ground elevation of 340 feet above mean sea level (msl). This pressure zone is directly connected to the SFWB transmission main and operates at an approximate hydraulic grade line (HGL) of 490 feet based on the overflow elevation of Oregon City's Mountainview Reservoir which is served by the same transmission main from the Division Street Pump Station. The City's Bolton Reservoir also provides gravity service to this zone although the overflow elevation of the reservoir, at 440 feet, is typically below the hydraulic grade of the SFWB supply.

Horton Pressure Zone

The Horton pressure zone serves higher elevation areas of the City on the uphill side of I-205 and Willamette Drive, and encompasses approximately 1,000 acres. The Horton pressure zone and subzones serve customers at ground elevations between 340 and 620 feet above msl. This pressure zone is served from the Horton Reservoir and operates at a hydraulic grade of approximately 731 feet.

Rosemont Pressure Zone

The Rosemont pressure zone serves the highest elevation areas in the City west of the Horton pressure zone, encompassing approximately 950 acres. The Rosemont pressure zone and subzones serve customers at ground elevations between 220 feet and 750 feet above msl. This pressure zone is served by the Rosemont Reservoir and operates at a hydraulic grade of approximately 860 feet.

Robinwood Pressure Zone

The Robinwood pressure zone is located at the northerly end of the City, encompassing approximately 560 acres. The Robinwood pressure zone serves customers at ground elevations below 220 feet above msl. This pressure zone is served by the View Drive Reservoir and operates at a hydraulic grade of approximately 328 feet.

Willamette Pressure Zone

The Willamette pressure zone is located at the southerly end of the City between I-205 and the Tualatin River, encompassing approximately 1,140 acres. The Willamette pressure zone serves customers at ground elevations between 100 feet and 280 feet above msl. This pressure zone is served by the Willamette Reservoir and operates at a hydraulic grade of approximately 351 feet.

Bland Pressure Zone

The Bland pressure zone is located on the northerly side of I-205 between the Horton and Willamette pressure zones, and encompasses approximately 350 acres. The Bland pressure zone and its subzone serve customers at ground elevations between 280 feet and 475 feet above msl. This pressure zone is served by the Bland Reservoir and operates at a hydraulic grade of approximately 585 feet. In 2003, the Bland pressure zone was connected to the Horton pressure zone with a manually operated intertie to provide supplemental supply to the Bland pressure zone during peak demand periods. The intertie can supply approximately 100,000 gallons per day to the Bland pressure zone.

Storage Reservoirs

General

The City's water system has a total storage capacity of 5.5 mg distributed across six storage reservoirs. Table 2-2 presents a summary of the City's existing storage reservoirs, including capacities, overflow elevations, and pressure zone served. Also presented below is a brief discussion of the features of each reservoir.

Bolton Reservoir

The Bolton Reservoir, located on Skyline Drive, was constructed in 1913 as part of the original supply from the SFWB. It is a concrete slab-on-grade reservoir with 2:1 (horizontal: vertical) side slopes. An interior liner was installed in 1989. A Hypalon cover was placed over the reservoir in 1995. The floating cover is equipped with an access hatch. Piping serving the reservoir consists of an 18-inch diameter steel inlet/outlet pipe. As discussed above, the Bolton Reservoir provides 2.0 mg of gravity storage for the Bolton pressure zone, but the reservoir water surface is normally below the hydraulic grade line of the transmission line from the SFWB. The reservoir also provides suction supply to the Bolton Pump Station.

Table 2-2
Reservoir Summary

Reservoir Name	General Location	Usable Capacity (mg)	Overflow Elevation (ft)	Pressure Zone Served
Bolton	Skyline Drive	2.0	440	Bolton
Horton	Horton Road & Santa Anita Drive	1.5	731	Horton
Rosemont	Suncrest Drive	0.4	860	Rosemont
Bland Circle	Bland Circle	0.5	585	Bland
Willamette	Salamo Road	0.6	351	Willamette
View Drive	View Drive	0.5	328	Robinwood

Horton Reservoir

The Horton Reservoir is located at the intersection of Horton Road and Santa Anita Drive. It is a 1.5 mg ground level welded steel reservoir. The reservoir is filled by the Bolton Pump Station and supplies suction supply to the Horton Pump Station in addition to providing gravity supply to the Horton pressure zone. The inlet pipe is 14-inch diameter and extends from the distribution system to the reservoir. A 14-inch diameter outlet/suction pipe extends from the wall of the reservoir to the adjacent Horton Pump Station.

Rosemont Reservoir

The Rosemont Reservoir is a 0.4 mg elevated welded steel, spheroid tower located on Suncrest Drive. The reservoir is filled from the Horton and View Drive Pump Stations. It supplies water to the Rosemont pressure zone service area. Piping for the elevated reservoir includes a single 18-inch diameter ductile iron pipe from Suncrest Drive, a steel inlet/outlet, and an overflow pipe inside the reservoir.

Bland Reservoir

The Bland Reservoir is a 0.5 mg ground level welded steel reservoir located on Bland Circle and serves the Bland pressure zone. It is supplied by the Willamette Pump Station. A 10-inch diameter common inlet/outlet pipe serves the reservoir.

Willamette Reservoir

The Willamette Reservoir is a 0.6 mg ground level welded steel reservoir located on Salamo Road. Flow to the reservoir is through a transmission main along Willamette Falls Drive from the Bolton pressure zone. The reservoir provides gravity supply to the Willamette pressure zone and suction supply to the Willamette Pump Station. A 16-inch diameter pipe extending out of the south side of the reservoir serves as the main suction for the pump station. A 14-inch by 10-inch diameter cross has also been cut into the 10-inch diameter inlet/outlet pipe to provide suction for the pump station if the reservoir is taken out of service. A new control/altitude valve and meter vault were recently constructed on Willamette Falls Drive to control flow from the Bolton pressure zone into the Willamette pressure zone and Willamette Reservoir.

View Drive Reservoir

The View Drive Reservoir is a 0.5 mg ground level welded steel reservoir located on View Drive in the Robinwood neighborhood. The View Drive Reservoir provides gravity supply to the Robinwood pressure zone and suction supply to the View Drive Pump Station. A 10-inch diameter common inlet/outlet pipe extends to a valve vault near the reservoir where it tees into two 10-inch lines, one with an altitude valve that closes supply to the reservoir when it is full and the other with a check valve which allows flow from the reservoir when the system pressure drops. Flow to the reservoir is controlled by an adjacent pressure reducing valve (PRV) and altitude valve located near the Lake Oswego Intertie Pump Station.

Pumping Facilities

General

The City's water distribution system includes four booster pump stations. A fifth pump station is located at the City's emergency supply connection with Lake Oswego. Table 2-3 summarizes the pump configuration, total capacity and firm capacity of each station. The pump station capacities presented in Table 2-3 represent the nominal capacities of the pumps. Also presented below is a brief description of the existing features of each pump station.

Bolton Pump Station

The Bolton Pump Station is located adjacent to the Bolton Reservoir and was constructed in 1999 replacing the old Bolton Pump Station which was constructed in the early 1970's. The facility contains three 1,500 gpm can-type vertical turbine pumps with space for a fourth future pump. The station pumps water from the Bolton Reservoir to the Horton Reservoir through a 14-inch diameter transmission main. The pumps are controlled by the Supervisory Control and Data Acquisition (SCADA) system with control setpoints based on the water

level in the Horton Reservoir. The pump station also includes an emergency, standby diesel generator in case of a power failure.

Table 2-3
Existing Pump Station Summary

Pump Station	Pump Configuration (gpm)	Total Installed Capacity (gpm)	Nominal Firm Capacity (gpm)
Bolton	3 @ 1,500	4,500	3,000
Horton	2 @ 1,300; 2 @ 900	4,400	3,100
Willamette	3 @ 500	1,500	1,000
View Drive	3 @ 600	1,800	1,200
Lake Oswego Emergency Intertie	2 @ 2,200	4,400	2,200

Horton Pump Station

The Horton Pump Station is a concrete and wood frame structure located adjacent to the Horton Reservoir. The Horton Pump Station contains four frame mounted end suction centrifugal pumps. The station pumps water from the Horton Reservoir to the Rosemont Reservoir through Rosemont pressure zone distribution piping. The pumps are controlled by the SCADA system with control setpoints based on the water level in the Rosemont Reservoir. The pump station also includes an emergency, standby diesel generator in case of a power failure.

Willamette Pump Station

The Willamette Pump Station is a concrete structure constructed in 1994 and located adjacent to the Willamette Reservoir. The station contains three 500 gpm can-type vertical turbine pumps. The station pumps water from the Willamette Reservoir to the Bland Reservoir. The pumps are controlled by the SCADA system with control setpoints based on the water level in the Bland Reservoir. The Willamette Reservoir provides suction supply to the pump station through a 16-inch diameter pipe. The pump station also includes an emergency, standby diesel generator in case of a power failure.

View Drive Pump Station

The View Drive Pump Station is a concrete structure located at the View Drive Reservoir site. The station contains three 600 gpm can-type vertical turbine pumps. The station pumps water from the View Drive Reservoir to the Rosemont Reservoir and supplies two subzones through PRV's connected to the pump station discharge. The pumps are controlled by the SCADA system with setpoints based on the water level in the Rosemont Reservoir. The pump station also includes a manual transfer switch and plug for a portable emergency generator.

Distribution System Piping

The City's water service area distribution system is composed of various pipe types in sizes up to 24-inches in diameter. The total length of piping in the service area is approximately 117 miles. The pipe types include cast iron, ductile iron, polyvinyl chloride (PVC), steel, asbestos cement, copper and galvanized iron. The oldest piping in the system likely dates back to 1915 when the SFWB was first established. Table 2-4 presents a summary of pipe lengths by diameter.

Table 2-4
Existing Pipe Inventory

Diameter (in.)	Linear Feet in System	Miles in System	Percent of Total Pipeline Length
Less than 6	69,036	13.1	11
6	271,437	51.4	44
8	142,059	26.9	23
10	41,364	7.8	7
12	22,243	4.2	4
14	15,557	2.9	2
16	10,544	2.0	2
18	18,790	3.6	3
20	9,161	1.7	1
24	20,070	3.8	3
Total	**620,261**	**117.4**	**100**

The distribution system includes 17 pressure reducing valve (PRV) stations, creating 13 subzones. These stations reduce the pressure from the main pressure zones within the system

to acceptable service levels in areas of lower elevation. These areas would have unacceptable high pressures if operated directly off the pressures of the main zones.

There are approximately 8,600 water meters throughout the water system. Over 96 percent of these meters are residential, 5/8 x 3/4-inch meters. Most of the remaining meters are 1-inch, 1½-inch, and 2-inch meters that serve multifamily housing, commercial, and public facilities. There are less than 20 meters system-wide that are 3-inches or greater in size.

Based on data from the City's GIS pipeline data base more than 80 percent of the pipe in the City is Ductile or Cast Iron. Approximately 10.3 percent is AC and the remaining 10 percent is polyvinyl chloride (PVC), galvanized steel, steel, copper, polybutylene and unknown material. Table 2-5 presents a summary of pipe material, length and percentage within the distribution system.

Table 2-5
Pipe Material Summary

Pipe Material	Length (feet)	Percent of Total Length
Ductile Iron	379,862	61.2
Cast Iron	127,063	20.5
Asbestos Cement	63,932	10.3
Polyvinyl Chloride	14,630	2.4
Galvanized Steel	9,752	1.6
Steel	10,363	1.7
Copper	3,633	0.6
Polybutylene	815	0.1
Unknown	10,211	1.6
	620,261	**100**

Summary

Section 2 presents a summary of the City's existing water system, including the transmission and supply system, storage and pumping facilities, pressure zones and distribution system piping.

The City provides potable water to approximately 24,615 people through over 8,600 residential, commercial and industrial service connections. The City's primary water supply is from the SFWB WTP located in Oregon City. The SFWB was created by the cities of West Linn and Oregon City for the purposes of supplying water to the two cities. The City also has an emergency supply connection to the City of Lake Oswego's WTP located at the north end of the City.

The City's water distribution system consists of six service or pressure zones supplied by six storage facilities and five pumping stations. These pressure zones are: Bland, Bolton, Horton, Robinwood, Rosemont, Willamette and View Drive. Each of the service zones is supplied by gravity from a storage facility.

SECTION 4
EXISTING SYSTEM EVALUATION

General

The City of West Linn's (City) water system is operated and maintained by the Public Works Department. Public Works performs all system operation and maintenance for the distribution system from the City's 24-inch diameter supply main in Oregon City, downstream of the Division Street Pump Station and the South Fork Water Board (SFWB) Water Treatment Plant (WTP). This section focuses on the City's major distribution system facilities, including pump stations and reservoirs and includes a general assessment of the performance of the distribution system piping.

Water system operation and maintenance (O&M) work conducted by the Public Works Department includes line repairs and maintenance; hydrant service and maintenance; meter reading, maintenance and replacement; distribution system flushing; valve maintenance and exercising, as well as some line replacements and upgrades. The Public Works Department also performs O&M for reservoirs, booster pump stations and the Lake Oswego emergency intertie, performs distribution system water quality sampling, and oversees the City's cross-connection control and backflow prevention programs. The Public Works Department also provides emergency response for all components of the water system.

Current O&M Program Evaluation

The Public Works Department is currently working to prepare a "Water Systems Operations and Maintenance Guide" to document system facilities and current O&M programs. As is typical of water systems the size of the City, much of this information is not currently documented in an accessible manner but is instead held by individual staff members. It is anticipated that completion of the O&M Guide for the water system will ensure that operations and maintenance procedures are thoroughly documented and understood by all staff and will allow for ongoing efficient operation of the system as the City experiences future work-force transitions. A copy of the preliminary outline for the "Water Systems Operations and Maintenance Guide" is included in Appendix C.

The City also maintains checklists for each type of critical water system facility and for the telemetry system. These checklists act as a guide for routine inspections and preventative maintenance at reservoirs and booster pump stations.

Currently, reactive water system O&M tasks such as leak repairs and mechanical/electrical equipment repair and replacement are documented and logged. This is an important first step in collecting the necessary data to develop a more thorough accounting of work orders, labor expenditures and to track areas where major system deficiencies exist. A software database should be considered for logging and tracking this information for further development of more systematic O&M programs. The City has developed a comprehensive geographic information system (GIS) distribution system inventory. Once a database of O&M activity is

developed, linking this database to the GIS inventory would provide the City with a valuable tool for analyzing, planning and prioritizing O&M decisions.

O&M Program Development and Documentation

A summary of proposed steps in development of a comprehensive O&M program are listed below and can serve as the basis for development of a more comprehensive system that can guide staffing, labor allocation and budgeting decisions as well as provide valuable input into the City's water system Capital Maintenance Plan (CMP). A check mark is located next to the tasks which the City has already completed.

	Tasks	Completed
1.	Establish an inventory of system components including: piping, valves, hydrants, pumps, reservoirs and other facilities.	☑
2.	Determine the time required to perform the various maintenance and repair tasks required based on staff input and industry standards.	☐
3.	Identify equipment needed by staff to complete work and estimate the cost per hour for each piece of equipment. A replacement schedule for the equipment should also be developed for budgeting purposes.	☐
4.	Develop a target maintenance schedule for each system component/program.	☐
5.	Determine the total amount of time/budget required to complete O&M tasks/programs based on this information.	☐
6.	Assess overall Public Works Department staffing and budgeting needs to meet water system O&M goals. Prioritize programs and goals within current and future budget constraints.	☐

Recommended O&M Program Element Summary

Based on typical industry standards and a review of local, regional and national practices for similar sized water systems, a summary of specific preventative/proactive O&M program elements has been developed for consideration by the City. Some of these programs have already been implemented by the City in some form and this is identified in the list below, recognizing that the City invests significant staff time and financial resources to ongoing O&M of the water system.

O&M Program		Current Status and Recommendations	Completed
1.	Pipe Maintenance and Replacement	• City is currently replacing aging and undersized piping on an emergency basis due to funding. • Develop a systematic program, a CMP, coordinated with the CIP to identify and prioritize main replacements as funds allow.	☑ ☑
2.	Water Meter Maintenance and Replacement	• Establish a schedule for testing large meters based on water loss and consider the cost/benefit ratio of such a program. • Document meter location, type, size and age in support of developing a schedule and budget for a meter replacement. • Develop a fire line detector monitoring program.	☐ ☑ ☐
3.	Hydrant Maintenance Program	• The City currently exercises all hydrants on a five year cycle.	☑
4.	Valve Maintenance and Exercising Program	• Develop a schedule for isolation valve exercising. Exercise every valve at least once every five years. Maintenance to be completed as needed based on valve exercising.	☐
5.	Leak Detection Program	• City currently addresses leak detection and repair needs reactively as evidence of leaks is manifested. • Prepare annual water audits to track water loss and determine the cost/benefit ratio of pursuing a systematic leak detection and repair program.	☑ ☐
6.	Reservoir Maintenance Program	• Continue current program of routinely cleaning and inspecting tanks (divers); should be completed every five years, and maintaining coating and cathodic protection systems as needed. Typical cycle for coating maintenance is 20 to 30 years, depending on exposure.	☑
7.	Booster Pump Maintenance Program	• Continue current pump preventative maintenance program. • Record voltage/amperage data as well as pump speed, output and run time data. Compile into monthly reports for identifying performance changes that could indicate a need for maintenance or replacement.	☑ ☐

The Public Works Department staff is charged with maintaining and replacing system components to allow for continuous and reliable operation of the water system. Staff members are dedicated and capable with the appropriate skills and knowledge required to perform all necessary O&M tasks. Based on the analysis of the current operations, it appears that the Public Works Department has made efficient use of limited resources to adequately maintain the system in a manner that ensures satisfactory delivery of water to all customers.

Evaluation of Existing Facilities

General

The City's water distribution system includes six primary pressure zones and an additional fourteen subzones, four booster pump stations, six distribution storage reservoirs, 32 pressure reducing valve stations and over 117 miles of distribution system piping. Figure 4-1 presents a hydraulic profile of the water system illustrating all of the major system components. An analysis of the condition of the City's existing SFWB supply transmission main from the Division Street Pump Station across the Willamette River on the I-205 Bridge will be included in Section 5 which documents the evaluation of the City's supply system.

An evaluation of the condition of each of the major components of the distribution system is presented below.

Distribution System

As summarized in Section 2 the City's existing distribution system contains approximately 12.1 miles of asbestos cement (AC) water mains, comprising approximately 10.3 percent of the City's distribution system piping. Most of this piping was installed in the 1950s and 1960s. AC pipe can generally be expected to have a design, or service life, of approximately 50 years. A number of communities have under taken replacement programs targeting AC pipe which was installed in the 1950's and 1960's. Approximately two-thirds, or 330 miles of the City of Regina, Saskatchewan, Canada's water distribution is older AC piping. Regina completed a study of the Failure Conditions of Asbestos Cement Water Mains in 2003 which evaluated water main break history of the City's AC pipe. The analysis found that from 1994 to 2003 the incidents of AC water line breaks increased exponentially, which correlated with pipe age as a majority of the City's AC pipe, which was installed 40 to 50 years ago. The American Water Works Association Research Foundation is currently funding a comprehensive research project to evaluate the long-term performance of AC water pipe. The objective of this 4 year project, expected for completion in 2011, is to provide water utilities with a comprehensive guidance document for the management of AC pipe in water distribution systems.

The City of West Linn's water department has documented increased break repair incidents of AC pipe. The majority of the existing AC pipe is in the Robinwood, Horton and Rosemont service zones. Based on the current understanding of AC pipe service life and performance, as well as the age of the existing pipe in the City's distribution system, the City

can anticipate increasing incidents of AC pipe failures within its distribution system. Recommendations for the systematic replacement of the City's AC piping are presented in Section 8.

Section 8 also contains recommendations for the systematic replacement of the remaining steel and galvanized steel piping, which makes up approximately 3.3 percent of the pipe in the distribution system. PVC and polybutylene piping, which makes up less than 1 percent of the pipe in the distribution system should be replaced as needed or as the opportunity arises. A majority of the distribution system piping is ductile iron, cast iron and PVC and most of this piping is still within its service life. Current water industry literature indicates that the service life of ductile and cast iron may range from 50 years to over 100 years depending on a number of variables. As most of the piping material in the City's distribution system, other than AC and galvanized steel, appears to be within this general design life limit for the 20-year planning horizon of this master plan, it is recommended that the City evaluate the condition of these pipes as part of subsequent master planning work and take action as needed to replace this piping as it approaches the end of its design life. Should certain piping develop elevated breakage and repair incidents, it is recommended that a systematic and targeted replacement program be evaluated and implemented.

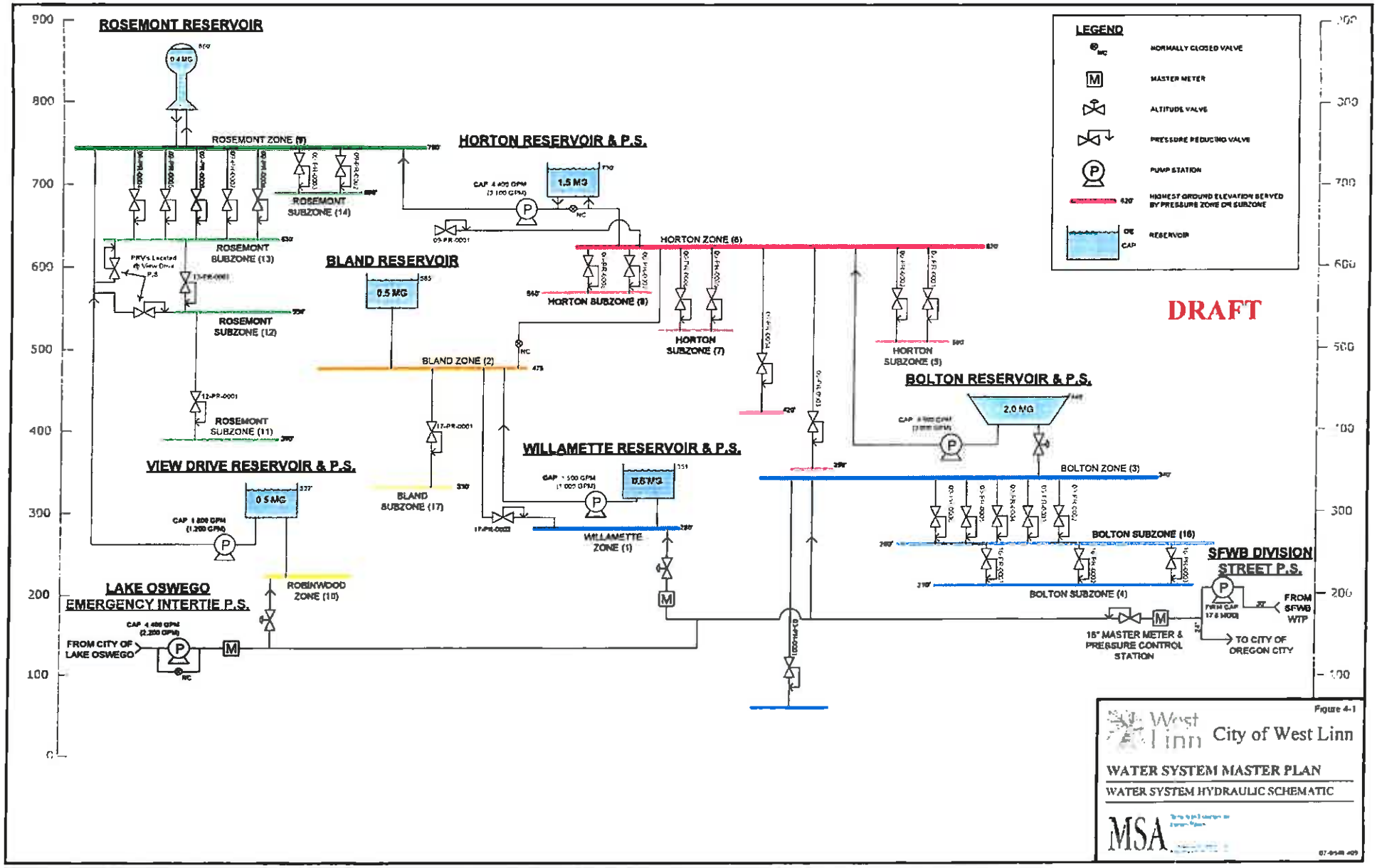
Storage Reservoirs

General Reservoir Seismic Assessment

The existence and condition of seismic anchorage and restraints varies widely from reservoir to reservoir in the City's system. Through previous evaluation of the water system it was determined that a site-specific evaluation should be completed for each reservoir using the most recent seismic zone criteria. It appears that this analysis and the addition of seismic restraints have not been completed. Budgeting for this assessment and the proposed improvements should be planned. Section 8 will include a recommended budget for completing these assessments.

Bolton Reservoir

The Bolton Reservoir, a concrete slab-on-grade reservoir with 2:1 (horizontal: vertical) side slopes, was constructed in 1913. An interior liner was installed in 1989 and a Hypalon cover was placed over the reservoir in 1995. Previous inspections of the reservoir identified some concrete spalling and some localized cracking that may warrant surface patching. The floating cover for the reservoir appears to be reaching the end of its service life. Based on inspection and recent repairs of one large (18-inches) and four smaller holes/tears in the


ROSEMONT RESERVOIR
0.4 MG
ROSEMONT ZONE (9)
ROSEMONT SUBZONE (14)
ROSEMONT SUBZONE (13)
ROSEMONT SUBZONE (12)
ROSEMONT SUBZONE (11)
HORTON RESERVOIR & P.S.
1.5 MG
HORTON ZONE (6)
HORTON SUBZONE (8)
HORTON SUBZONE (7)
HORTON SUBZONE (5)
BLAND RESERVOIR
0.5 MG
BLAND ZONE (2)
BLAND SUBZONE (17)
WILLAMETTE RESERVOIR & P.S.
0.5 MG
WILLAMETTE ZONE (1)
BOLTON RESERVOIR & P.S.
2.0 MG
BOLTON ZONE (3)
BOLTON SUBZONE (16)
BOLTON SUBZONE (4)
VIEW DRIVE RESERVOIR & P.S.
0.5 MG
ROBINWOOD ZONE (10)
LAKE OSWEGO EMERGENCY INTERTIE P.S.
FROM CITY OF LAKE OSWEGO
SFWB DIVISION STREET P.S.
FROM SFWB WTP
TO CITY OF OREGON CITY
18" MASTER METER & PRESSURE CONTROL STATION
LEGEND
NORMALLY CLOSED VALVE
MASTER METER
ALTITUDE VALVE
PRESSURE REDUCING VALVE
PUMP STATION
HIGHEST GROUND ELEVATION SERVED BY PRESSURE ZONE OR SUBZONE
RESERVOIR
DRAFT
Figure 4-1
City of West Linn
WATER SYSTEM MASTER PLAN
WATER SYSTEM HYDRAULIC SCHEMATIC
MSA

cover in January 2008 it is beginning to show significant signs of wear, especially at locations where movement occurs, such as around the rain troughs (gutters). Given the findings of this inspection and previous assessments, it is likely that the cover will require more frequent repairs within the next five years.

The actual usable capacity of the Bolton Reservoir is also limited to approximately 2 mg due to the reservoir's configuration. Approximately 1 mg is available for suction supply to the Bolton Pump Station and 1 mg is available for supply to the Bolton pressure zone. Approximately 0.5 mg of the total volume of the Bolton Reservoir, which is approximately 2.5 mg, is unusable. Given the functional limitations, condition and age of the reservoir, replacement of the Bolton Reservoir should be considered a high-priority improvement. Further discussion of the storage needs of the water system related to replacement of the Bolton Reservoir is presented in Section 6.

Horton Reservoir

The 1.5 mg ground level welded steel Horton Reservoir, constructed in 1974, is generally in good condition. The exterior of the reservoir was repainted and a new cathodic protection system was installed in 2006. The interior coating of the reservoir is coal tar enamel and should ultimately be considered for replacement when the condition of the coating shows signs of wear.

Rosemont Reservoir

The 0.4 mg Rosemont Reservoir, an elevated welded steel spheroid, constructed in 1991, is the newest reservoir in the City's water system and does not currently have any observed deficiencies. Re-painting of the tank exterior should be planned for sometime in the next 10 years as the original coating system is now approximately 15 years old. This site needs security improvements due to its use by multiple agencies. The City is currently assessing security improvement opportunities at the site.

Bland Reservoir

The 0.5 mg ground level welded steel Bland Reservoir, constructed in 1980, appears to be generally in good condition. The reservoir is in need of interior and exterior repainting and the cathodic protection system is aging and in need of refurbishing. These improvements are included in the City's current CMP and should be completed within the next five years. Interior coating is coal tar enamel and should be considered for replacement.

Willamette Reservoir

The 0.6 mg ground level welded steel Willamette Reservoir constructed in 1970, appears to be in good condition. The reservoir interior and exterior were re-painted and a new cathodic protection system for the steel structure was installed within the past five years.

View Drive Reservoir

The 0.5 mg ground level welded steel View Drive Reservoir, constructed in 1970, appears to be in good condition. The exterior coating, applied in 1991, is showing signs of wear due to age and adjacent overhanging tree limbs. Re-painting of the reservoir exterior should be planned for the next 10 years.

Distribution Booster Pump Stations

Bolton Pump Station

The new Bolton Pump Station is a concrete structure with standby power generator completed in 1999 to replace the aging and undersized Bolton Pump Station. There are no apparent deficiencies or issues with the condition of the new Bolton Pump Station. Abandonment and removal of the old Bolton Pump station should be coordinated with the ultimate replacement of the Bolton Reservoir. The old pump station is still in use to provide for flushing of the old pump station discharge main which serves a small number of customers downstream of the pump station prior to the first interconnection with the Horton pressure zone distribution mains.

Horton Pump Station

The Horton Pump Station is a concrete structure located adjacent to the Horton Reservoir. Mechanical and electrical upgrades were completed at the station in 2000, including the installation of two new pumps, telemetry system upgrades and an outdoor standby power generator. The station appears to be in good condition.

Willamette Pump Station

The Willamette Pump Station, constructed in 1994, is a concrete structure located adjacent to the Willamette Reservoir. The station was upgraded in 2001 with the addition of a standby generator City staff related that there have been issues with the performance and operation of the existing motor control center (MCC) and automatic transfer switch (ATS) in the station. Further investigation of the potential issues and the need for modification or replacement of this equipment should be completed and is included in Section 8.

View Drive Pump Station

The View Drive Pump Station is a concrete and concrete masonry unit (CMU) structure located adjacent to the View Drive Reservoir. The pump station, completed in 2006, is the newest pump station in the system, providing a second reliable supply to the Rosemont pressure zone. The station appears to be in good condition. An abandoned pump station structure and partially buried concrete reservoir located behind the existing View Drive Pump Station on the View Drive site should be demolished and removed.

Pressure Reducing Valve Stations

Previous evaluations of the water system identified flooding issues with PRV vaults located below a ground elevation of approximately 175 feet. These vaults should be sealed to reduce groundwater infiltration and surface water inflow, and sump pumps installed to effectively remove any water that enters the vault. Section 8 will include a recommended budget for completion of these improvements.

SCADA System

The City's existing Supervisory Control and Data Acquisition (SCADA) system consists of several aging components including the Master Telemetry Unit at the Public Works Shop which is approximately 18 years old. Typically, this type of technology based equipment is replaced on a fairly routine cycle and cannot be expected to provide reliable service beyond 10 years. In addition, as components reach the end of their service life, the availability of replacement parts decreases significantly which could potentially result in extended down time. The SCADA system is a critical piece of the City's water system infrastructure providing for automatic operation of pumping facilities to maintain adequate system pressure as well as providing alarm conditions to alert Public Works Department staff of problems in the water system and provide real-time feedback on the performance and operation of the system. Should the telemetry system fail for some reason, an emergency condition would exist requiring full-time observation and staffing of key water system facilities to maintain water service until the system can be brought back on-line.

The City's water system CMP will include recommendations for evaluation and upgrade of the SCADA system to ensure reliable service. A recommended budget level estimate for these upgrades is included in Section 8.

Existing Facility Evaluation Recommendations Summary

Based on the evaluations documented above, several recommended improvements to be included in the City's water system CMP and CIP are listed below:

1. *Reservoir Seismic Assessment and Improvements* – Assess the current seismic risk at four reservoir sites and determine if the current level of seismic restraint is adequate. Develop recommended improvements to meet current seismic code requirements. It

is recommended that these assessments will be completed for the Willamette, View Drive, Bland and Horton Reservoirs.

2. *Bolton Reservoir Replacement and old Bolton Pump Station Abandonment* – Based on the current and previous evaluations of the Bolton site, it is recommended that the Bolton Reservoir be abandoned and replaced, and that the old Bolton Pump Station be demolished and removed. The required capacity of the proposed Bolton Reservoir replacement will be further discussed in Section 6. Given the age and condition of the reservoir, it is anticipated that this improvement is included as a near-term (less than five years) improvement in the CIP.

3. *Ongoing Reservoir Lining and Coating Maintenance* – Three of the City's reservoirs (Bland, Rosemont and View Drive) will require re-coating within the next 10 to 20 years. A schedule for completing these re-coatings is included in the CMP. Most coatings have a service life of approximately 20 to 30 years so it is anticipated that all of the reservoirs, with the possible exception of the Willamette and Horton Reservoirs which were re-painted in the past five years, will need coating maintenance within the 20-year planning horizon of this Master Plan.

4. *Willamette Pump Station MCC Assessment* - An assessment of the condition, performance and operation of the existing MCC's in the Willamette Pump Station should be completed to determine if corrective repairs or replacement will be required to address issues identified by City staff.

5. *Demolition of Abandoned View Drive Site Facilities* – The abandoned reservoir and pump station on the View Drive site should be demolished and removed to improve site aesthetics and reduce the risk associated with failure of aging structures.

6. *SCADA System Upgrades* – The SCADA system should be upgraded to replace existing aging infrastructure, including the Master Telemetry Unit and components at remote pump station sites.

Summary

This Section presents an evaluation of the condition of the City's existing water system infrastructure including storage reservoirs, pumping facilities and telemetry components. This section also assesses the City's operations and maintenance program and provides recommendations for developing and documenting a more detailed program building on recent work done by the West Linn Public Works Department. The recommendations presented in this section are included in the recommended comprehensive capital improvement and capital maintenance programs presented in Section 8.