Water Management and Conservation Plan

November 2012

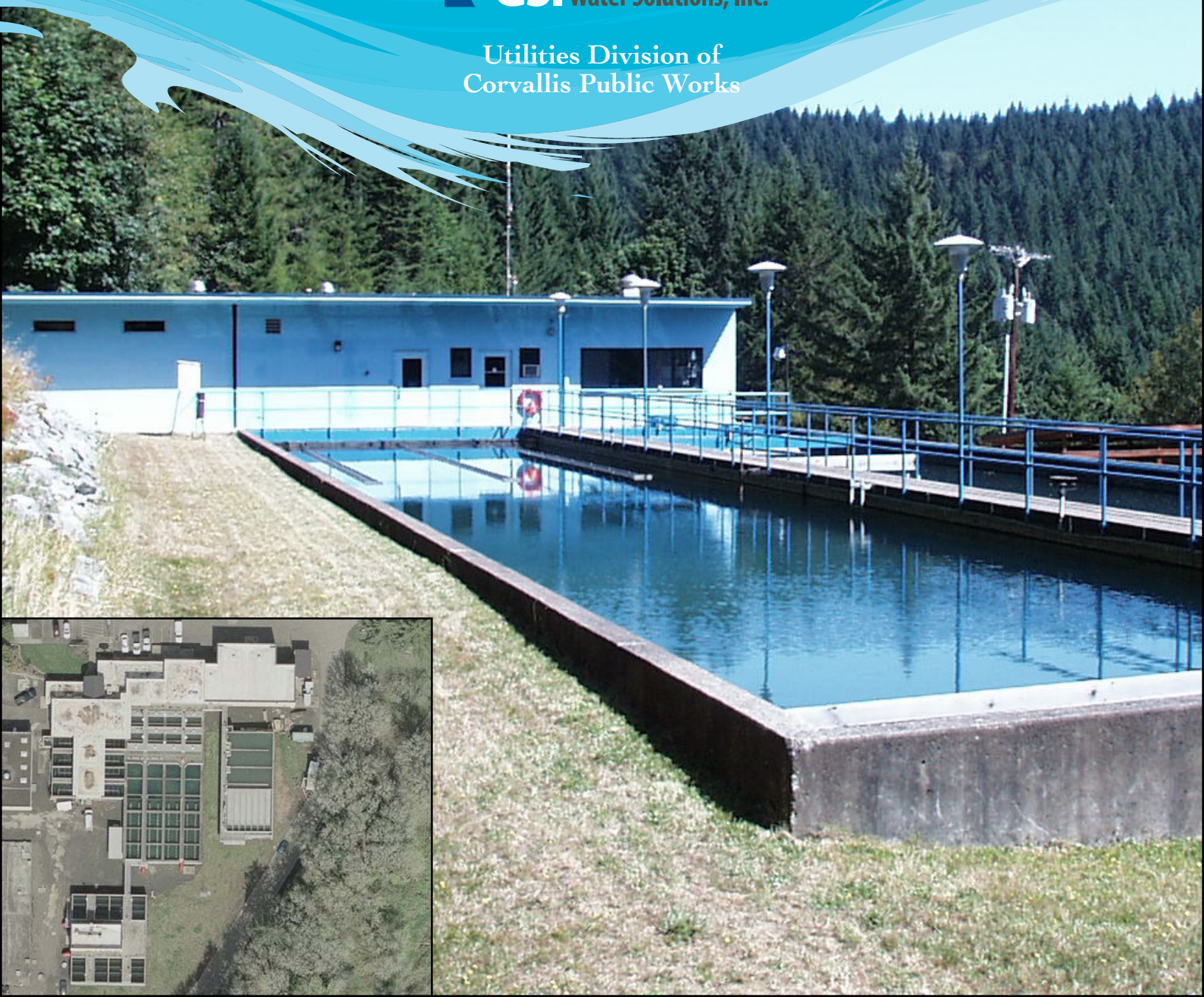
Prepared for

City of Corvallis, Oregon

Prepared by

GSI Water Solutions, Inc.

Utilities Division of
Corvallis Public Works



BEFORE THE WATER RESOURCES DEPARTMENT
OF THE
STATE OF OREGON

In the Matter of the Proposed Water Management and Conservation Plan for City of Corvallis, Benton County	)))	FINAL ORDER APPROVING A WATER MANAGEMENT AND CONSERVATION PLAN

Authority

OAR Chapter 690, Division 086, establishes the process and criteria for approving water management and conservation plans required under the conditions of permits, permit extensions and other orders of the Department. An approved water management plan may authorize the diversion and use of water under a permit extended pursuant to OAR Chapter 690, Division 315.

Findings of Fact

1. The City of Corvallis submitted a Water Management and Conservation Plan (plan) to the Water Resources Department (Department) on July 25, 2012. The plan was required by a condition set forth under the City's previously approved plan *(Sp. Or. Vol. 73, Pg. 378)* issued on September 27, 2007, and by a condition set forth in the final order approving an extension of time for the City's Permit S-35551.

2. The Department published notice of receipt of the plan on July 31, 2012, as required under OAR Chapter 690, Division 086. No comments were received.

3. The Department provided written comments on the plan to the City on October 2, 2012, and in response, the City submitted the final revised plan on November 30, 2012.

4. The Department reviewed the final revised plan and finds that it contains all of the elements required under OAR 690-086-0125.

5. The projections of future water needs in the plan demonstrate a need for up to an additional 6.6 cfs of water available under Permit S-35551 to help meet the City's anticipated 20-year water demands. These projections are reasonable and consistent with the City's land use plan.

6. The City's system is fully metered and the rate structure includes a base service charge with an inclining block rate structure *(i.e., volumetric charge)*. The City bills its customers on a monthly basis. Unaccounted-for water is estimated at 6 percent.

This is a final order in other than a contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review must be filed within the 60-day time period specified by ORS 183.484(2). Pursuant to ORS 536.075 and OAR 137-004-0080, you may petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the Director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied.

7. The plan includes 5-year conservation benchmarks to continue to: perform monthly and annual water system audits; maintain a fully metered water system; bill customers monthly and based, in part, on the quantity of water metered at the service connection, using an inclining block rate structure; include water conservation messages with water service bills; fund leak detection and pipeline repair or replacement; monitor customer consumption records for evidence of leaks and inform customers of possible leaks; perform current public education efforts and update the City's web site and outreach materials as needed; work with the City Parks and Recreation Department to improve its water efficiency through technical assistance; offer financial assistance for timely leak detection and repairs; offer toilet leak detection tablets at the water utility billing office, the Public Works Department office, and on door knobs of customers who are suspected of having a leak, along with a notice stating that a leak is suspected and the available resources to the customer; offer free low-flow showerheads, faucet aerators and high efficiency toilet rebates; use reclaimed water for operation of the wastewater reclamation facility and irrigation of the entire Public Works Department campus adjacent to the facility.

8. The plan includes 5-year conservation benchmarks to implement programs to: periodically review the City's water audits for accuracy and validity; test at least 80 percent of the approximately 450 large meters in the system each year; repair or replace large meters as they fail; replace small meters as they fail; replace older meters that fail with meters that have AMI technology; replace water pipelines as the budget allows; seek additional partnerships to promote water conservation through public education; audit a majority of the un-audited City-owned buildings within 5 years, with the remainder being audited within 10 years.

9. The plan includes 5-year conservation benchmarks for evaluation, development, and implementation of programs to: evaluate incorporation of meter testing and replacement activities and leak detection surveys into the annual water audit; develop graphical tools and information to improve the water audit; evaluate water rates on an annual basis; evaluate public education efforts and look for additional cost-effective opportunities; explore opportunities for water reuse and recycling, such as expanded reuse of wastewater from the wastewater reclamation facility; and explore implementing a "Dormant Lawn" program in the City to decrease peak season water use.

10. The plan identifies the Willamette River, the Rock Creek watershed *(being Rock Creek, North Fork Rock Creek, South Fork Rock Creek, Middle Fork Rock Creek, Griffith Creek and Stilson Creek)* and ground water as the sources of the City's water rights. The plan accurately and completely describes the listed fish species that occur in the Upper Willamette River ESU (Evolutionary Significant Unit), namely: Spring Chinook *(federally-listed as threatened and state-listed as sensitive-critical)*; Steelhead *(state-listed as sensitive-vulnerable)*; Oregon Chub *(federally-listed as threatened and state-listed as sensitive-critical)*; Pacific Lamprey *(state-listed as sensitive-vulnerable)*; and Western Brook Lamprey *(state-listed as sensitive-vulnerable)*.

    The plan also accurately and completely describes the water quality parameters for which the Willamette River has been 303(d) listed by the Oregon Department of Environmental Quality (ODEQ), and identifies that the City's ground water sources are located within the Southern Willamette Valley Ground Water Management Area, as designated by ODEQ.

11. The water curtailment element included in the plan satisfactorily promotes water curtailment practices and includes a list of four stages of alert with concurrent curtailment actions.

12. The City has beneficially used 18.3 cfs of the 65.0 cfs of water authorized under Permit S-35551 for municipal purposes; the City received confirmation of the incremental perfection for the 18.3 cfs with the issuance of Certificate 84008.

13. The diversion of water under Permit S-35551 will be expanded during the next 20 years and is consistent with OAR 690-086-0130(7), as follows:

    a. As evidenced by the 5-year benchmarks described in Findings of Fact #7 – #9, the plan includes a schedule for continuation, implementation and/or development of water conservation measures that would provide water at a cost that is equal to or lower than the cost of other identified sources;

    b. Considering that implementation of water conservation measures alone cannot meet the City's projected 20-year water demands; the water supply limitations with the City's Rock Creek watershed sources *(i.e., limited streamflow during peak demand periods)*, the water quality issues with the City's ground water sources; and the lack of feasible opportunities for purchasing water from other water suppliers through interconnection, increased use from the Willamette River is the most feasible and appropriate water supply alternative available to the supplier.

    c. The City is not currently required to take any mitigation actions under state or federal law; however, the City is subject to "fish persistence" conditions included in the final order *(issued on June 15, 2010)* approving an extension of time for Permit S-35551 that establish minimum fish flows to maintain the persistence of listed fish species in the portion of the Willamette River affected by water use under the permit.

Conclusion of Law

The Water Management and Conservation Plan submitted by the City of Corvallis is consistent with the criteria in OAR Chapter 690, Division 086.

Now, therefore, it is ORDERED:

1. The City of Corvallis Water Management and Conservation Plan is approved and shall remain in effect until December 3, 2022, unless this approval is rescinded pursuant to OAR 690-086-0920.

2. The limitation of the diversion of water under Permit S-35551 established by the extension of time approved on June 15, 2010, is removed. Subject to other limitations or conditions of Permit S-35551, in addition to the 18.3 cfs under Certificate 84008 (Permit S-35551), the City of Corvallis is authorized to divert up to 6.6 cfs under Permit S-35551.

3. The City of Corvallis shall submit an updated plan meeting the requirements of OAR Chapter 690, Division 086 within 10 years and no later than June 3, 2022.

4. The City of Corvallis shall submit a progress report containing the information required under OAR 690-086-0120(4) by December 3, 2017.

5. The deadline established herein for the submittal of an updated Water Management and Conservation Plan (consistent with OAR Chapter 690, Division 086) shall not relieve the City of Corvallis from any existing or future requirement(s) for submittal of a Water Management and Conservation Plan at an earlier date as established through other final orders of the Department.

Dated at Salem, Oregon this 4 day of December, 2012.

Dwight French, Water Right Services Administrator *for*
PHILLIP C. WARD, DIRECTOR

Mailing date: DEC 07 2012

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Executive Summary

The City of Corvallis (City) is recognized for its quality of life, environmental practices, and water quality. The City is located in the heart of Oregon's Willamette Valley. As of 2009, the City had a residential population of 55,125 and an average annual growth rate of 1.28% (2000 to 2009). The City recognizes that as the demand for water continues to grow, particularly on hot summer days, improving water management and conservation is increasingly important.

The purpose of this Water Management and Conservation Plan (WMCP) is to guide development, financing and implementation of water management and conservation programs that ensure sustainable water use and consider the City's future water needs. This WMCP is an update of the City's WMCP approved by the Oregon Water Resources Department (OWRD) in 2007. The OWRD requires cities to develop a WMCP either as part of a new water use permit or as part of an *extension of time* for an existing water use permit. The City's Public Works Department completed development of a WMCP in 2005 and submitted it to OWRD in 2006 as part of an extension of time application for one of its municipal water rights from the Willamette River. The OWRD approved the City's WMCP in September 2007 and required an updated WMCP within 5 years (by August 3, 2012).

Description of Municipal Water Supplier

As of 2009, the City's estimated water delivery area population was 55,125, including students attending Oregon State University (OSU). The City delivers water to this population through approximately 16,728 water connections to residential and commercial customers, OSU, City facilities, and public schools. The City's water system serves the area within the present City limits and several properties outside of the City limits: the municipal airport and associated properties to the south, Crescent Valley High School to the north, and some private properties along the Rock Creek water transmission line. In addition, the City is a wholesale water supplier to the City of Philomath.

The Willamette River is the City's primary source of water. The City holds three surface water rights for the use of up to 90 cubic feet per second (cfs) from the Willamette River. These three water rights have a point of diversion located at approximately River Mile 134.5, which is the location of the intake for the Taylor Water Treatment Plant. Once the water is treated, it immediately enters the City's water distribution system. The Rock Creek watershed provides about half of the water supply during the winter and significantly less in the summer when streamflow decreases and demand increases. The City holds five surface water rights in the Rock Creek Watershed for the use of up to 12.13 cfs. Water diverted under these water rights is conveyed to the Rock Creek Water Treatment Plant. After the water is treated, it travels approximately 9 miles by gravity through water transmission lines to the City's water distribution system at Baldy Reservoir. In addition, the City holds two groundwater right certificates, as well as claims for surface water and groundwater that predate the water code (1909 for surface water and 1955 for groundwater).

Water Conservation

OWRD's WMCP rules require municipal water providers to have 5-year benchmarks for initiating or expanding conservation measures related to required conservation programs. The following is a summary of the City's activities associated with the required conservation measures and the 5-year benchmarks for implementing those measures, which are described in Section 3 of this WMCP.

Five-Year Benchmarks for Required Existing or Expanded Conservation Measures

1. Annual Water Audits

The City conducts water audits of its systems on a monthly and annual basis. The City's audit analysis includes: water production at its water treatment plants, water demand, water sold, non-revenue water, and water loss. The City produces a report using the American Water Works Association (AWWA) software and a Water Accountability Report, which mimics the AWWA water audit report, but has a different format and includes additional data not required for the water audit. The City's water loss was 6% in 2009, which is excellent when compared to other similar sized water systems.

Five-year Benchmark:

- The City will continue to audit its water system monthly and annually.
- Every 5 years, the City will review its water audit reports for accuracy and validity of assumptions, and if necessary, will institute protocols for correcting inaccurate data. The next review is scheduled for 2015.
- The City will evaluate how to incorporate data from meter testing and replacement activities and leak detection surveys into its annual water audit to help validate estimates of losses resulting from meter errors and leakage. Although the City does not currently include this information, the City has taken it into consideration for determining apparent water losses.
- The City views developing graphical information as a logical next step in its progress towards understanding and improving its water audit. Consequently, the City will explore developing graphical tools to locate deficiencies and to validate or disprove water production and consumption data and assumptions made within the report.

2. System-wide Metering

The City's water system is fully metered.

Five-year Benchmark:

- The City will continue to require all new connections to be metered.

3. Meter Testing and Maintenance

The City has a meter testing and replacement program in place. Approximately 80% of the City's large meters are typically tested each year, such that most of the large meters

are tested annually and all are tested biennially at a minimum. The City recently suspended its routine replacement of small meters on a 20-year cycle after testing indicated that 25-year-old meters were running as well as new meters. Consequently, the City now only replaces small meters when they fail to operate accurately. In addition, the City is installing the FlexNet brand of Advanced Metering Infrastructure (AMI) technology in its system. AMI enables real-time online monitoring of water services for leaks and anomalies, like stopped meters, making it more useful than the City's remaining traditional radio-read metering (AMR) and manual-read metering.

Five-year Benchmark:

- Test at least 80% of approximately 450 large meters in the system each year.
- Repair or replace large meters as they fail.
- Replace small meters as they fail.
- Replace older meters that fail with meters that have AMI technology.

4. Unit-based Billing Program

The City conducts monthly water meter reading and billing. This provides relatively rapid feedback to customers on their water use. Utility rates include both a base service charge and a consumption-based charge. The consumption-based portion utilizes inverted-block conservation pricing in which the cost of water increases with each increasing tier of water consumption. The City's rate structure is tiered for all customers, although the consumption levels of each tier differ based on the type of customer (multi-family, commercial, single-family, etc.) and meter size.

Five-year Benchmark:

- The City will continue to bill customers based, in part, on the quantity of water metered at the service connection, using an inclining block rate structure.
- The City will continue to evaluate its rates on an annual basis.

5. Leak Detection and Pipeline Repair or Replacement

The OWRD requires municipalities to have a regularly scheduled and systematic program to detect leaks when system leakage is above 10%. The City's water loss was 6% in 2009, but it still has a leak detection program in place to minimize water loss in its distribution system. The City uses the dataloggers to essentially listen to the system for leaks and now surveys its entire water system each year. If a leak is detected by a datalogger, the City uses a correlator to locate the leak, and once located, the leak is repaired. The City also strives to listen to each valve in the system with a ground microphone annually. In addition, the City is investing in line and main replacements within the system. If meter readers notice an unexpected increase in consumption, they leave a door hanger informing the customer that they may have a leak, and providing information about what to do.

Five-year Benchmark:

- The City will continue to fund leak detection and repair or replacement and to carry out repairs or replacements in a timely manner.

- The City will continue to monitor the consumption records of its customers for evidence of leaks and inform customers when there is evidence that there could be a leak.
- The City will replace water pipelines as budget allows.

6. Public Education

The City concentrates its outreach efforts on community events, schools, and publications. The City provides water conservation lessons for all grade levels upon request, offers talks for local groups, sets up booths at community events, and conducts outreach at OSU, including presentations at fairs and in living centers. The City produces a variety of publications and also adapts some publications from other cities and entities. Publications include newsletters, brochures, newspaper & magazine articles, and web pages. In 2010, the City installed several irrigation technologies in the Starker Arts Garden for Education, a community garden to educate youths and adults how to grow food. In addition, the Parks and Recreation Department (PRD) uses several sites for demonstrating water-wise landscaping, including a portion of Riverfront Park in downtown Corvallis.

Five-year Benchmark:

- The City will continue its current public education efforts and will continually evaluate them and look for additional cost-effective opportunities during the next 5 years.
- The City will continue to update its Web site and outreach materials as needed.
- The City will seek additional partnerships to promote water conservation.

In addition to these required measures, Section 3 of the WMCP highlights additional conservation measures implemented by the City including: technical and financial assistance, retrofit/replacement of inefficient fixtures, water rate structure and billing schedule, and reuse, recycling, and non-potable water opportunities.

Water Curtailment

The City has developed a curtailment plan that describes how it will respond to specific water-shortage conditions. The curtailment stages and initiating conditions are summarized in **Exhibit ES-1**. Initiating conditions and response actions are detailed in Section 4 of this WMCP.

EXHIBIT ES-1
Curtailment Stages 1 through 4

Curtailment Stages	Initiating Conditions
Stage 1: **Early Warning for a Potential Water Supply Shortage**	• Maximum daily production does not exceed the daily demand • There is expectation of a potential supply deficiency
Stage 2: **Water Supply Shortage**	• Maximum production does not meet daily demand and reservoir storage falls to 90% capacity • Minor damage to the water system because of a natural disaster or vandalism • Failure of a minor part of the water system or a facility
Stage 3: **Severe Water Supply Shortage**	• Maximum production does not meet daily demand and reservoir storage falls to 80% capacity • Serious damage to the water system because of a natural disaster or vandalism • Failure of a significant part of the water system or a facility • Isolated contamination of the water supply
Stage 4: **Critical Water Shortage**	• Maximum production does not meet daily demand and reservoir storage falls to 60% capacity • Extensive damage to the water system because of a natural disaster or vandalism • Failure of a critical water system or a facility • Contamination of the entire water supply

Water Supply

The City's future water delivery area is delineated by the Urban Growth Boundary (UGB) and includes the City's current water delivery area. The City's projected population for its water delivery area in 10 years (2022) is 64,500 and in 20 years (2032) is 73,248. The population projections are based on an average annual growth rate of 1.28% from 2000 to 2009 using data from Portland State University's Population Research Center.

To meet peak needs, the City uses the Taylor WTP. Projected maximum day demand often is used as an estimate of how much water a municipality uses on a peak day. The City's projected maximum day instantaneous rate of diversion in 10 years (2022) is 44 cfs and in 20 years (2032) is 49.9 cfs. The City currently has access to 43.3 cfs of Willamette River water rights. Based on the demand projections, the City will need to obtain approval from Oregon Water Resources Department to gain access to and expand use of its water right permit S-35551 by 2021 when the maximum day instantaneous rate of diversion is projected to reach 43.4 cfs. The City is projected to reach a maximum day instantaneous rate of diversion of 49.9 cfs by 2032, which will require the use of approximately 6.6 cfs under Permit S-35551 to meet projected demand. The City's water conservation efforts may delay, but will not eliminate the need to expand use of Permit S-35551. Thus, the City will need access to an additional 6.6 cfs within the 20 year period of this WMCP.

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1. Municipal Water Supplier Plan Elements

This section satisfies the requirements of OAR 690-086-0125.

This rule requires a list of affected local government to whom the plan was made available, and a proposed date for submittal of an updated plan.

Introduction

The City of Corvallis (City), located within the heart of Oregon's Willamette Valley, is home to a residential population of 55,125 as of 2009 and to Oregon State University (OSU). The City has won many awards, including Best Tasting Water for the Cascade to Coast subsection of the American Water Works Association in 2008 and 2011, the Julian Award for Sustainability from the Oregon Chapter of the American Public Works Association in 2008, and the Clean Water Act Recognition Award from the Environmental Protection Agency in 2006. The City also has been recognized as one of the top college towns in the nation, top 100 places to live in United States, and top eco-friendly small towns.

For many years, the City has recognized that a water conservation program is an important component of sustainable water management, as demonstrated by a municipal ordinance prohibiting water waste that has been in place since 1958, a water conservation program established in 1997, and sustainability goals adopted in 2003.

The purpose of this Water Management and Conservation Plan (WMCP or Plan) is to guide development, financing, and implementation of water management and conservation programs that ensure sustainable water use and consider the City's future water needs. This WMCP is an update of the City's WMCP approved by the Oregon Water Resources Department (OWRD) in 2007. The OWRD requires cities to develop a WMCP either as part of a new water use permit or as part of an *extension of time* for an existing water use permit. The City's Public Works Department completed development of a WMCP in 2005 and submitted it to OWRD in 2006 as part of an extension of time application for its municipal water right from the Willamette River (Permit S-35551). The OWRD approved the City's WMCP in September 2007 and required an updated WMCP within 5 years (by August 3, 2012). The City's approved WMCP analyzed data through 2004. This updated WMCP analyzes data from 2006, or earlier, through 2009.

Plan Organization

This WMCP fulfills the requirements of the Oregon Administrative Rules (OAR) adopted by the Water Resources Commission in November 2002 (OAR Chapter 690, Division 86). It describes water management, water conservation, and water curtailment programs to guide the wise use and stewardship of the City's water supply. The City is submitting this updated WMCP to comply with OWRD requirements in the final order of the City's WMCP approved in 2007 and in the final order for the extension of time for Permit S-35551, as well as to request access to additional water under Permit S-35551 (i.e., "green light water").

The WMCP is organized into the following sections, each addressing specific sections of OAR Chapter 690, Division 86. Section 2 is a self-evaluation of the City's water supply, water use, water rights, and water system. The information developed for Section 2 is the foundation for the sections that follow. The later sections use this information to consider how the City can improve its water conservation and water supply planning efforts.

Section	***Requirement***
Section 1 – Water Supplier Plan	*OAR 690-086-0125*
Section 2 – Water Supplier Description	*OAR 690-086-0140*
Section 3 – Water Conservation Element	*OAR 690-086-0150*
Section 4 – Water Curtailment Element	*OAR 690-086-0160*
Section 5 – Water Supply Element	*OAR 690-086-0170*

Affected Local Governments
OAR 690-086-0125(5)

The following governmental agencies may be affected by this WMCP:

- City of Corvallis
- Benton County
- City of Philomath

Thirty days before submitting this WMCP to OWRD, the City made the draft WMCP available for review by each affected local government listed above along with a request for comments relating to consistency with the local government's comprehensive land use plan. The letters requesting comment and any comments received are in **Appendix A**.

Plan Update Schedule

OAR 690-086-0125(6)

The City anticipates submitting an update of this WMCP within 10 years of the final order approving this WMCP. As required by OAR Chapter 690, Division 86, a progress report will be submitted within 5 years of the final order.

Time Extension

OAR 690-086-0125(7)

This WMCP is an update to the City's WMCP approved in 2007. The City is not requesting additional time to implement metering or benchmarks from the previously approved WMCP.

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2. Municipal Water Supplier Description

This section satisfies the requirements of OAR 690-086-0140.

This rule requires descriptions of the City's water sources, water delivery area and population, water rights, and adequacy and reliability of the existing water supply. The rule also requires descriptions of the City's customers and their water use, the water system, interconnections with other water suppliers, and quantification of system leakage.

Water Sources
OAR 690-086-0140(1)

Before 1906, the City used the Willamette River as its sole source of municipal water. In 1906, the City began collecting water from three creeks in the Rock Creek Watershed on the east slopes of Marys Peak: North Fork Rock Creek, South Fork Rock Creek, and Griffith Creek. From the Rock Creek Watershed, untreated water flowed 16 miles to the City through a series of redwood pipes. Other users, including the City of Philomath, tapped into the transmission line to get water. In 1927, the City built a pressure filtration plant near the Marys River in Philomath. The City used this filtration plant until 1956 when it built the Rock Creek Water Treatment Plant (WTP) in the City's municipal watershed to treat water, which runs 24 hours per day. In 1959, the City built an earthen dam on the North Fork of Rock Creek that is capable of storing 100 million gallons (MG) of raw (i.e., untreated) water. In 1949, the City built the H. D. Taylor WTP, a peaking plant, on the west bank of the Willamette River.

When the Taylor WTP began operating, the Rock Creek Watershed was the City's primary water source, and the Willamette River served mainly as a supplemental water source. As the City grew, water demand increased significantly. The Willamette River is now the City's primary source of water, and the Rock Creek Watershed provides about half of the water supply during the winter and significantly less in the summer when streamflow decreases and demand increases.

The Taylor WTP draws water from a concrete intake structure on the west side of the Willamette River at approximately River Mile (RM) 134.5. After the water is treated, it immediately enters the City's water distribution system. The North Fork Rock Creek/North Fork Reservoir intake is approximately 3.2 miles from the Rock Creek WTP, and the South Fork Rock Creek and Griffith Creek intakes are approximately 2.8 miles and 1 mile from the Rock Creek WTP, respectively. After the water is treated at the Rock Creek WTP, it travels approximately 9 miles by gravity through a series of 16-inch-diameter and 20-inch-diameter water transmission lines before connecting to the City's water distribution system at Baldy Reservoir.

The City holds two groundwater right certificates (Certificate 24694 and Certificate 37061) and one groundwater claim (GR-289) for municipal purposes, but none is used currently because of water quality issues. The City also holds two claims for irrigation use: SW-622 and GR-1888. SW-622 is for use of water from the Willamette River and currently is used to irrigate agricultural land bisected by a City bypass. GR-1888 is used to irrigate the City's Crystal Lake sports fields.

Interconnections with Other Systems
OAR 690-086-0140(7)

The City has a water system intertie with the City of Philomath, which lies approximately 7 miles west of Corvallis. In the mid-2000s, the City of Philomath recognized the potential for water supply shortages as its community continued to grow. To meet potential emergency and non-emergency peak demands, the City of Philomath wanted to reconnect to the City of Corvallis' water system. In 2006, the Cities of Corvallis and Philomath entered into an intergovernmental agreement (IGA) stipulating that the City of Corvallis would sell water to the City of Philomath on an as-needed basis. The City of Philomath then added the necessary infrastructure to allow the City of Corvallis to supply it with water. Details on the IGA are in the next section. The City of Corvallis has no other interties.

Intergovernmental Agreements
OAR 690-086-0140(1)

In 2006, the City of Corvallis entered into an IGA with the City of Philomath for the purpose of selling water to the City of Philomath on an as-needed basis.

The agreement required the City of Philomath to pay for all water used and all costs related to establishing the connection between the two water systems. The City of Philomath completed the construction work in 2008 and then activated the connection to the City of Corvallis transmission line passing through the City of Philomath, which conveys water from the Rock Creek Watershed to the City of Corvallis.

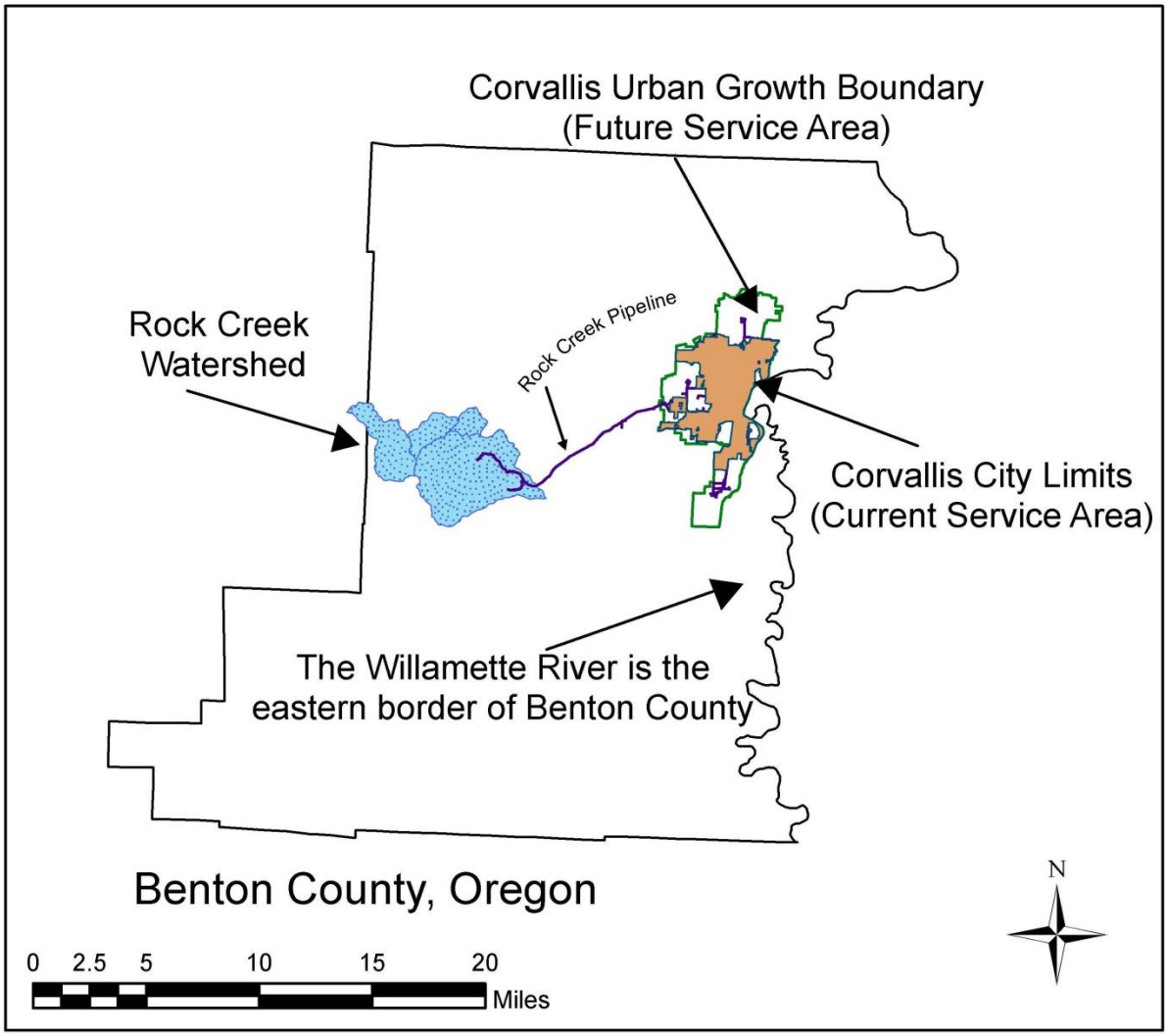
The IGA allows the City of Philomath to purchase up to 15 MG of water in the base year of 2008-2009 and allows an increase of up to 5 MG more per year through 2016-2017, for a 60-MG maximum.

Current Water Delivery Area Description
OAR 690-086-0140(2)

The City water system serves the area within the present City limits and several properties outside of the City limits: the municipal airport and associated properties to the south, Crescent Valley High School to the north, and some private properties along the Rock Creek water transmission line. In addition, the City is a wholesale water supplier to the City of Philomath.

According to the 2010 Corvallis Land Development Information Report (LDIR), the City represents a total land area of approximately 14.2 square miles (9,079.8 acres). Buildable land area within City limits is between 1,058.9 acres and 1,399.9 acres, depending on limits of development related to lands having natural features constraints (e.g., lands designated by the City as having natural hazards that present high risks to life and property or natural resources of importance). When the properties outside of the City limits also area considered, the City's service area encompasses a total of approximately 18.8 square miles (12,032 acres). Planning for the City's water distribution system is based on providing service to all areas within the City limits up to an elevation of 560 feet above mean sea level. **Exhibit 2-1** is a current water delivery area map for the City.

EXHIBIT 2-1
City of Corvallis Water Delivery Area



As of December 2009, the City had 16,728 total connections to the water system, both active and inactive. This total is composed of 1,117 irrigation-only service connections, 633 fire service connections, and 14,978 water connections. Of the 16,728 water connections, 131

connections (16 fire service connections and 115 water connections) are to the system outside the City limits. An irrigation service connection, which is primarily intended for commercial customers, is exclusively for irrigation use and has a distinct charge for service, as well as a separate meter. The City created these connections to avoid charging commercial customers a wastewater fee for water that does not go to the wastewater treatment plant (WWTP), given that the wastewater charge typically is based on water use from the water connection. A fire service connection is exclusively for automatic fire suppression service for sprinkler systems and has a distinct charge for service based on the size of meter and type of sprinkler system. The meter used on fire service connections is a type of compound meter. Large water demands open a check valve to allow water to flow through the large section of the compound meter connection for fire suppression. High fire suppression flows are unmetered and unrestricted. Lower flow rates do not open the check valve and, therefore, pass through the bypass portion. The bypass portion for lower flows has a "snooper" meter to determine if any water flowed through the service. The meter should show zero usage unless a fire occurs. Water use outside of fire suppression may be from a leak or from illegal use.

Population

Exhibit 2-2 presents the City's historical population estimates within City limits, the annual number of single family residential accounts, and single family population estimates. **Exhibit 2-3** graphically displays the City population. The City's average annual growth rate from 2000 to 2009 was 1.28%.

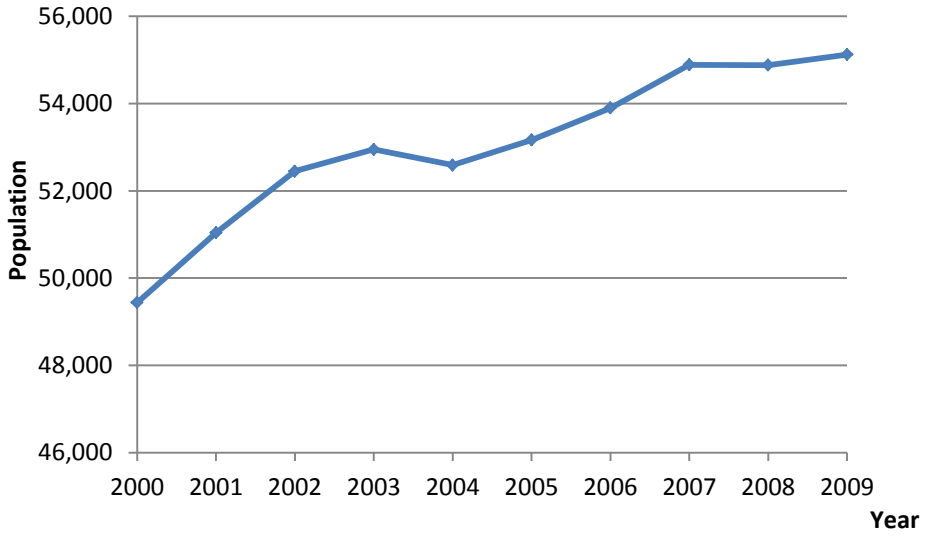
The City's historical population estimates come from Portland State University's Population Research Center (PRC). OSU students off campus and on campus are included in population estimates. Off campus students in private housing are counted as part of the general population. To determine the number of students on campus, the PRC sends a questionnaire to the City and Benton County annually to collect information on the number of occupants in school residences. The City also serves several customers located outside the City limits, along the transmission line from the Rock Creek WTP. Because this is a small fraction of the total population, for the purposes of this report, the service population is assumed to be equal to the population within City limits. The annual estimates of single family residential accounts are from utility billing data. The single family population was estimated by multiplying the number of accounts by the typical household size of 2.26 people per household from the 2000 U. S. Census. As shown, the estimated single family population has accounted for approximately 50% of the total city population in recent years.

EXHIBIT 2-2
Total and Single-Family Population Estimates

	In-City Total Population[1]	Number of Single Family Accounts[2]	Estimated Single-Family Population[3]	Single-Family Percentage of Total Population
2002	52,450	12,473	28,189	54%
2003	52,950	12,655	28,600	54%
2004	52,590	12,965	29,301	54%
2005	53,165			
2006	53,900	11,808	26,686	50%
2007	54,890	12,059	27,253	50%
2008	54,880	12,168	27,500	50%
2009	55,125	12,525	28,307	51%

[1]Portland State University Population Research Center
[2]City of Corvallis Utility Billing System data
[3]U.S. Census 2000: 2.26 people per household.

EXHIBIT 2-3
Population, 2000-2009



Records of Water Use

OAR 690-086-0140(4) and (9)

Methodology

The International Water Association and the American Water Works Association (AWWA) have published and promote a water audit method that is widely recognized and adopted throughout the water industry.[1] This method provides the definitions and classifications for annual water production and consumption shown in **Exhibit 2-4.** Determining the magnitude of each category can help a utility estimate the financial impact of production, billing, and leak detection practices. The City uses this method to determine a 12-month rolling water audit, meaning it can conduct a water audit of 12 consecutive months on an ongoing basis. The City's staff continues to review and refine data acquisition protocols and calculation of water losses. Several corrections to audit report procedures were instituted following review of previous annual audits conducted for the City's 2010 Water Use and Water Conservation Project report.

EXHIBIT 2-4

Components of the IWA/AWWA Water Balance, million gallons per year[2]

<table>
<tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th></tr>
<tr><td rowspan="3">Water from Own Sources (corrected for known errors)</td><td rowspan="5">System Input Volume = Demand</td><td>Water Exported</td><td rowspan="2">Authorized Consumption</td><td>Billed Authorized Consumption</td><td>Billed metered consumption (including water exported to another system).
Billed unmetered consumption.</td><td>Revenue Water</td></tr>
<tr><td rowspan="3">Water Supplied</td><td>Unbilled Authorized Consumption</td><td>Unbilled metered consumption.
Unbilled unmetered consumption.</td><td rowspan="4">Non-revenue Water</td></tr>
<tr><td rowspan="2">Water Losses</td><td>Apparent Losses</td><td>Unauthorized consumption.
Metering inaccuracies
Data handling error</td></tr>
<tr><td>Water Imported</td><td>Real Losses</td><td>Leakage on transmission and/or distribution Mains.
Leakage and overflows at storage tanks.
Leakage on service connections up to point of customer metering.</td></tr>
</table>

[1] AWWA. Manual of Water Supply Practices M36. *Water Audits and Loss Control Programs, Third Edition*, 2009. A free Excel - based model of this method is available from www.awwa.org.

[2] *Ibid. Adapted from Figure 2-1 p. 9*

System input, shown in Column B of **Exhibit 2-4**, refers to the total quantity of water delivered to a distribution system from all sources (e.g., treated water from the Taylor and Rock Creek WTPs). The quantity of this water generally is measured using large master meters located at key entry points into the distribution system. System input also is known as "demand." By definition the system input volume must equal the sum of the authorized consumption and water losses that occur in the system after accounting for changes in system storage (Column D of **Exhibit 2-4**). For the City, system input is the sum of water produced at the City's two WTPs.

Authorized consumption is divided into billed and unbilled categories. Billed authorized consumption is equal to revenue water. Unbilled authorized consumption contributes to a system's non-revenue water. Authorized consumption may be either metered or unmetered. Unmetered volumes must be estimated on the basis of estimated flow rates and durations of flow. Examples of authorized, billed consumption include metered consumption for residential, commercial, industrial, irrigation, and wholesale water customers. Authorized unbilled consumption may include public uses for parks, public buildings and grounds, public works activities such as water line flushing and street cleaning, and for firefighting, or hydrant flushing.

Water losses include both apparent losses, and real losses. Apparent losses result from meter inaccuracies, error introduced by data entry or manipulation, and unauthorized consumption (illegal connection to the system or use of a fire hydrant). Real losses result when water is lost because of leakage, reservoir overflow, and evaporation. All water systems have some degree of real losses.

According to OWRD's administrative rules (OARs), if the annual water audit indicates that system leakage (water losses) exceeds 10%, a regularly scheduled and systematic program to detect leaks in the transmission and distribution system is required. In addition, if the municipal water supplier proposes to expand or initiate diversion of water under an *extended permit* for which resource issues have been identified, the water supplier must describe activities to reduce system leakage (water losses) to no more than 15%. Further, if the municipal water supplier serves a population greater than 7,500 and the water audit indicates that water losses are greater than 15%, the water supplier must implement and provide benchmarks for a system-wide leak repair or line replacement program to reduce water losses to 15% and, if feasible and appropriate, to 10%. Generally, demand and consumption in municipal systems are expressed in units of million gallons per day (mgd). They may also be expressed in cubic feet per second (cfs) or gallons per minute (gpm). One mgd is equivalent to 1.55 cfs or 694 gpm. For annual or monthly values, a quantity of water is typically reported in MG. Water use per person (per capita use) is expressed in gallons per person (per capita) per day (gpcd).

The following terms are used to describe specific values of system demands:

- Average day demand (ADD) equals the total annual system input (demand) divided by 365 days.
- Maximum day demand (MDD) equals the highest system demand that occurs on any single day during a calendar year. It is also called the 1-day MDD.

- Maximum monthly demand (MMD) in MG equals the highest total monthly demand of the 12 months of a calendar year. MMD in mgd equals the average day demand of the one month with the highest total demand of the 12 months of a calendar year.
- Peaking factors are the ratios of one demand value to another. The most common and important peaking factor is the ratio of the MDD to the ADD.

MDD is an important value for water system planning. The supply facilities (treatment plants, pipelines, reservoirs) and water rights must be capable of meeting the MDD. If the MDD exceeds the combined supply capacity on any given day, finished water storage levels will be reduced. Consecutive days at or near the MDD will result in a water shortage.

Historical Water Demands

Annual Demands

Exhibit 2-5 summarizes the City's demand data for its finished (treated) water for the period 2002 through 2009. Demands are presented as both overall demand and per capita demand. Because demand includes all use by commercial, industrial, and municipal customers, as well as residential customers, the calculated per capita demand values exceed the amounts of water actually used by a typical individual. Estimates of residential per capita demand are presented later in this report.

EXHIBIT 2-5
Annual Demand, Overall Demand, and Overall Per Capita Demand, 2002-2009

Year	Population	Annual Demand	Overall Demand (mgd)			Overall Per Capita Demand (gpcd)		
		MG	ADD	MDD	MMD	ADD	MDD	MMD
2002	52,450	2875.4	7.9	14.4	11.7	150	275	223
2003	52,950	2915.7	8	15.9	13.3	151	301	251
2004	52,590	2904.1	7.8	15.9	12.9	149	302	245
2005	53,165	2721.2	7.8	16.0	13.3	146	301	251
2006	53,900	2794.1	8	16.4	12.8	148	304	238
2007	54,890	2766.4	7.6	16.1	12.6	138	293	229
2008	54,880	2763.9	7.6	14.7	13.1	138	268	238
2009	55,125	2588.8	7.1	16.2	12.1	129	294	219
Average		2,791.2	7.7	15.7	12.7	144	292	237
Standard Deviation		108.6	0.3	0.7	0.6	8	13	12
Max		2,915.7	8.0	16.4	13.3	151	304	251
Min		2,588.8	7.1	14.4	11.7	129	268	219

Exhibit 2-6 graphically displays overall demand values, and **Exhibit 2-7** displays per capita demand values.

EXHIBIT 2-6
Demand, 2002–2009

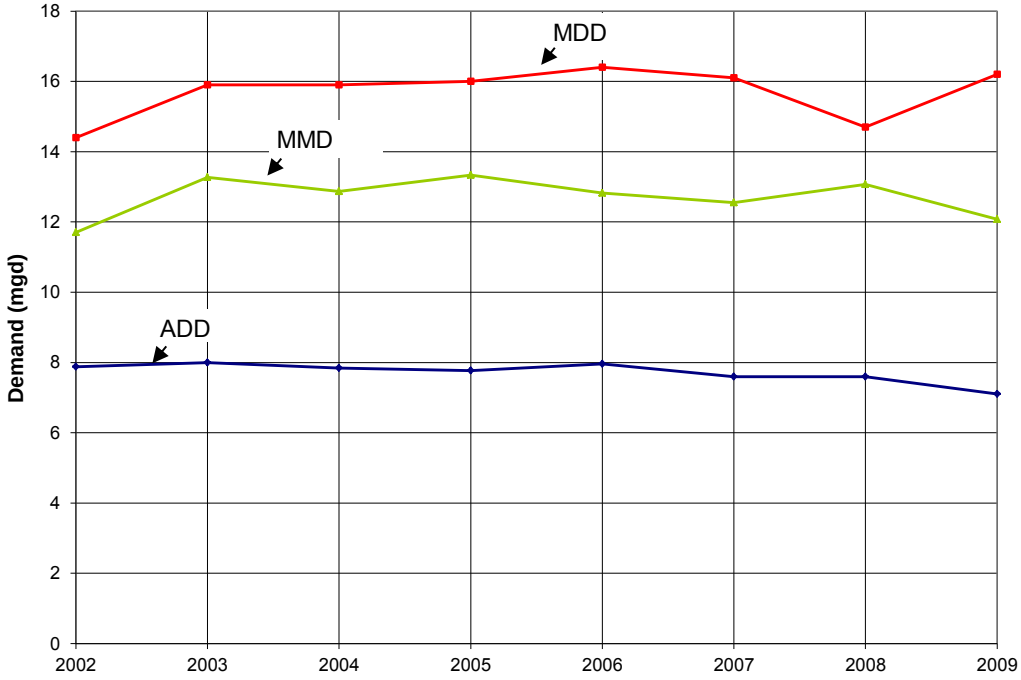
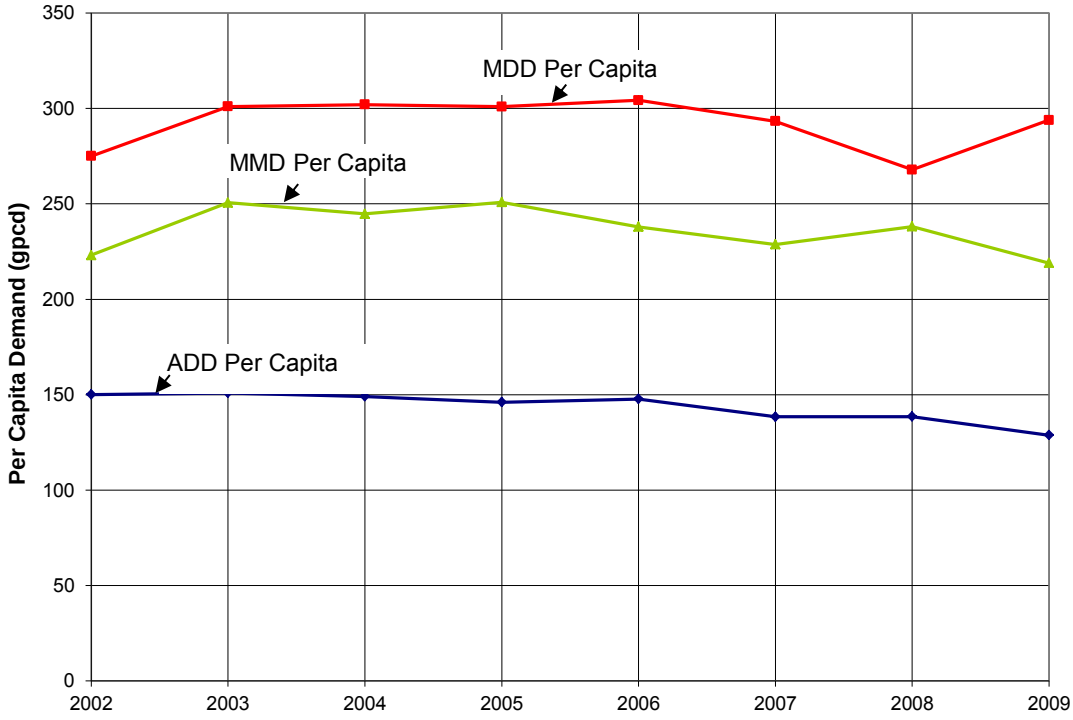


EXHIBIT 2-7
Per Capita Demands, 2002–2009



The City's ADD values were relatively constant from 2002 to 2006, with a decreasing trend between 2006 and 2009. Between 2002 and 2009, ADD ranged from 7.1 mgd to 8.0 mgd, and averaged 7.7 mgd. The average day per capita demand also showed a decreasing trend and averaged 144 gpcd.

MMD ranged from 11.7 mgd to 13.3 mgd, and averaged 12.7 mgd during the period of 2002 to 2009. MMD occurred in July during 6 years and in August during 2 years, making water conservation efforts during these 2 months the most critical. The overall MMD appears to have stayed relatively even from 2002 to 2009 while MMD per capita appears to have a decreasing trend.

For the period 2002 through 2009, MDD ranged from 14.4 mgd to 16.4 mgd, and averaged 15.7 mgd. MDD per capita averaged 292 gpcd. The highest MDD for the period occurred in 2006, followed by 2009. These increased MDDs are in contrast to the decreasing trend in ADD. This indicates that while ADD can decrease over time, MDD appears to remain high and more closely reflect population growth.

MDD often fluctuates from year to year because it is strongly influenced by weather patterns such as the following:

- Maximum temperatures
- The number of consecutive days at high temperatures
- When the high temperatures occur during the summer (e.g., If high temperatures occur early in the summer, the demand may be higher because residents are more consistent in their outdoor irrigation. Later in the summer, customers may not be as inclined to maintain green landscapes.)
- Overall rainfall levels during the summer
- Consecutive days without rainfall
- Number of new homes with new landscapes (owners generally will take extra care to keep newly installed landscapes thoroughly watered)

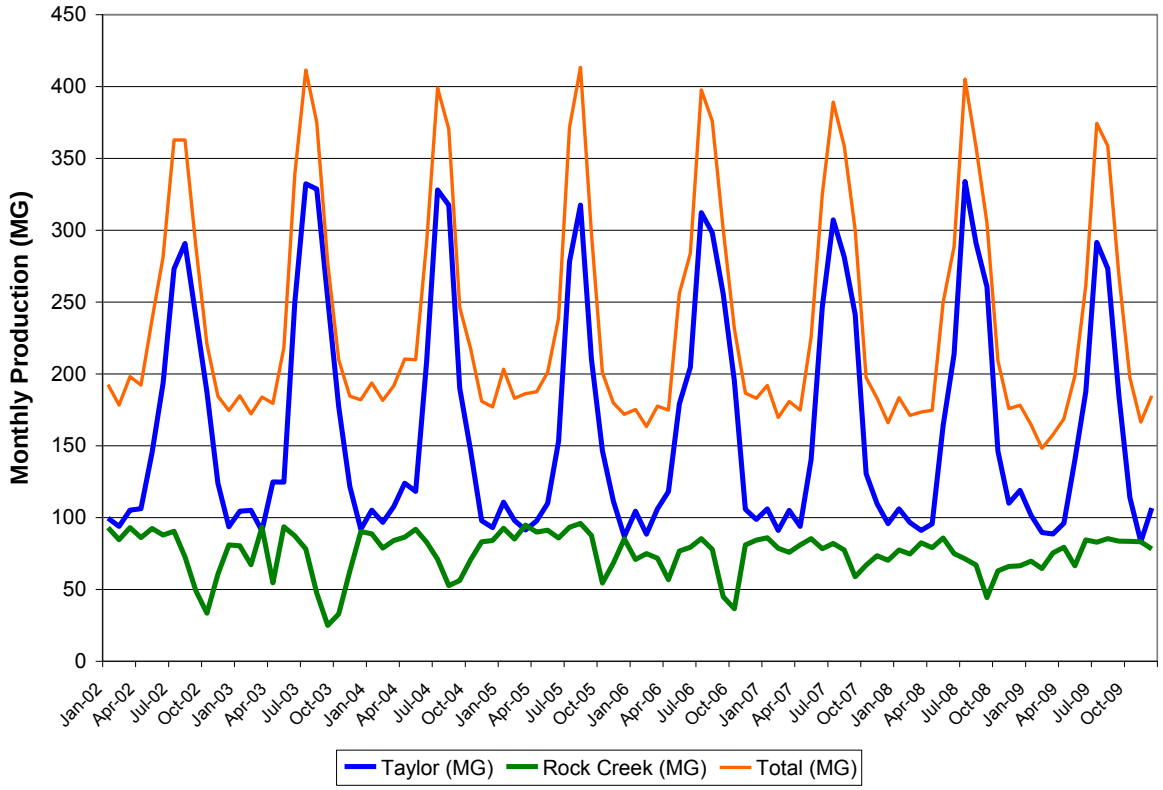
An allowance of plus or minus 1 mgd from average MDD values provides a reasonable indication of the MDD range, based approximately on the standard deviation.

Monthly and Seasonal Demand

Because of increased water demand for landscape irrigation, the City requires higher water production rates in the summer months. **Exhibit 2-8** shows the monthly production from the Taylor WTP, Rock Creek WTP, and total production from both plants from January 2002 to December 2009. As shown, several times during periods of maximum overall production in the summer months of June through September, the monthly production from the Rock Creek WTP was limited to a minimal volume because of low yield from the watershed. During these periods, the Taylor WTP was required to produce a larger portion of the water sent to the distribution system.

For the period 2002 through 2009, the peak summer production period of June through September accounted for an average of 47% of total annual production, with 53% distributed across the remaining two-thirds (8 months) of each year.

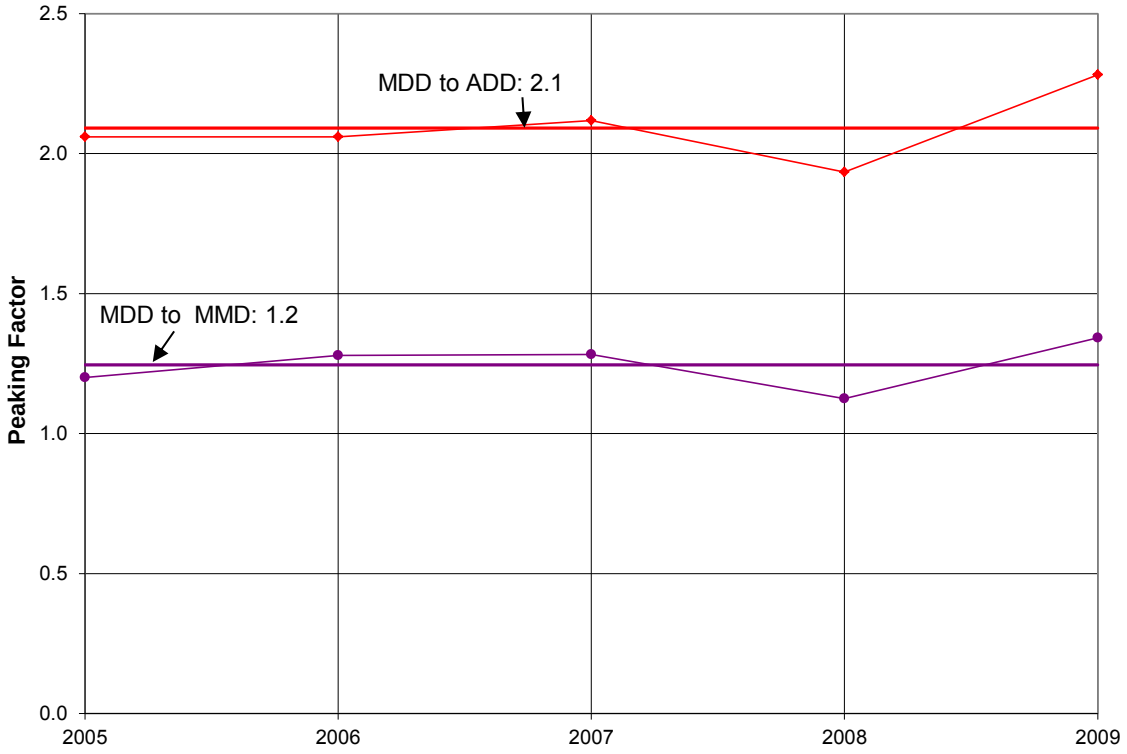
EXHIBIT 2-8
Monthly Demands, 2002–2009



Peaking Factors

The MDD to ADD peaking factor helps describe peak summer demand within the system, as well as the MDD to MMD. **Exhibit 2-9** shows these two peaking factors. The system MDD to ADD peaking factor ranged from 1.9 to 2.2 and averaged 2.1 during the period 2005 through 2009. The greatest factor was in 2009, reflecting the increase in MDD and decrease in ADD that year. The system-wide MDD to MMD peaking factor averaged 1.2 during the same period and its greatest factor was in 2009, indicating that the maximum day increased in the maximum month. These findings suggest that the City needs to plan for increased peak summer day demands despite a trend of decreasing ADDs and relatively constant MMDs.

EXHIBIT 2-9
Peaking Factors, 2005-2009



Authorized Consumption

Authorized consumption is equal to the metered and certain unmetered water uses within the system. Consumption data from billing records were analyzed to describe the ways in which metered water is used within the City's service area. Estimates of unmetered water use for firefighting and water and sewer system maintenance were obtained from the Public Works Department. Although water use by City facilities is not billed, the City began metering this category of water use in 1986. All other water customers served by the City are fully metered, including the City of Philomath, a wholesale customer.

Customer Characteristics and Water Use Patterns

OAR 690-086-0140(6)

The categories of metered water customers and the types of unmetered water use within the City are presented in **Exhibit 2-10.** The City provides metered irrigation and fire accounts, as well as standard water accounts (i.e., commercial and residential).

EXHIBIT 2-10
Description of the City of Corvallis Metered Customer Categories and Unmetered Water Use

Category	Description
Metered Use	
Commercial	Accounts for businesses, industries, Oregon State University, and hospital.
Residential	
Multi-family	Accounts serving several housing units: duplexes, triplexes, apartments and mobile home parks with a single meter.
Fraternity-Sorority	Accounts serving fraternities and sororities.
Single-Family	Accounts serving a single housing unit
City of Corvallis	Domestic and irrigation accounts for City facilities and irrigation of landscapes and parks, and water for street cleaning
Schools	Domestic and irrigation accounts for 509J public schools
Unmetered Use	Fire Department: firefighting and firefighter training. Water system maintenance: line flushing, hydrant flushing, reservoir draining

Exhibit 2-11 shows the number of accounts in each customer category for the years 2006 to 2009.

EXHIBIT 2-11
Number of Accounts by Customer Category (MG), 2006-2009

Year	Schools	City	Residential		Commercial	Total
			Multi-Family[1]	Single-Family		
2006	16	67	1,268	11,808	1,130	14,289
2007	21	68	1,276	12,059	1,126	14,550
2008	22	69	1,273	12,168	1,140	14,672
2009	22	69	1,268	12,525	1,134	15,018
Average	20	68	1,271	12,140	1,133	14,632

[1]Category includes fraternities and sororities.

Annual consumption by customer category and unmetered consumption for the period 2006 through 2009 is summarized in **Exhibit 2-12**, and presented graphically in **Exhibit 2-13**.

EXHIBIT 2-12
Annual Metered and Unmetered Consumption by Customer Category (MG), 2006-2009

Year	Un-metered	Schools	City	Residential		Commercial	Total
				Multi-Family[1]	Single-Family		
2006	38	31	99	534	1,015	990	2,707
2007	18	31	105	466	963	980	2,564
2008	32	30	182	460	941	960	2,604
2009	15	29	113	466	936	883	2,443
Average	26	30	125	482	964	953	2,580
Standard Deviation	11	1	39	35	36	49	109

[1] Category includes Fraternities and Sororities

EXHIBIT 2-13
Annual Unmetered Consumption and Metered Consumption by Customer Category (MG), 2006-2009

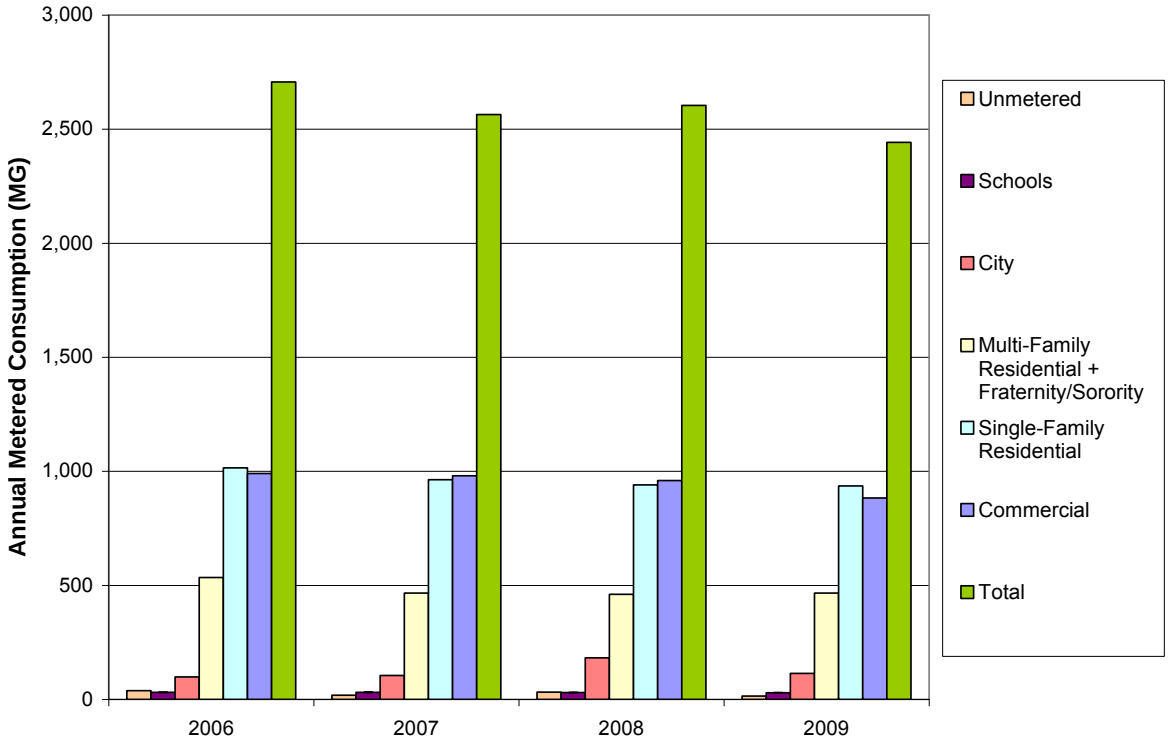
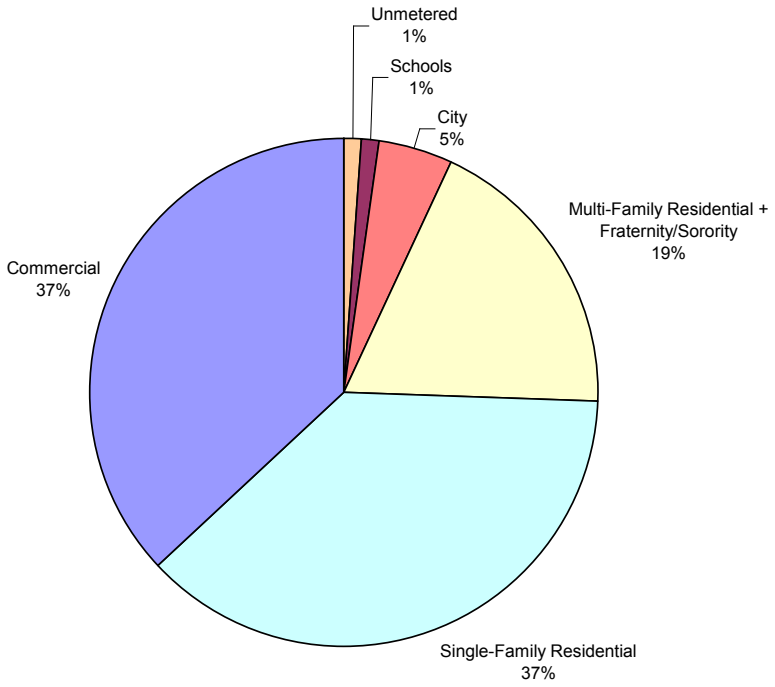


Exhibit 2-14 presents a pie chart that indicates the average percentage of unmetered consumption and metered water consumption by each customer category for the period. Water use for irrigation and fire has been incorporated into each customer category.

EXHIBIT 2-14
Percentage of Annual Water Use by Customer Category, Average (2006-2009)



Water use has been relatively stable across categories. Water use by the two largest customer categories, commercial and single-family, has declined moderately during the 4-year period of 2006 through 2009, as shown in **Exhibits 2-13 and 2-14**. Future data will help determine whether these trends persist, or represent normal fluctuation in water use resulting from transient seasonal or economic conditions.

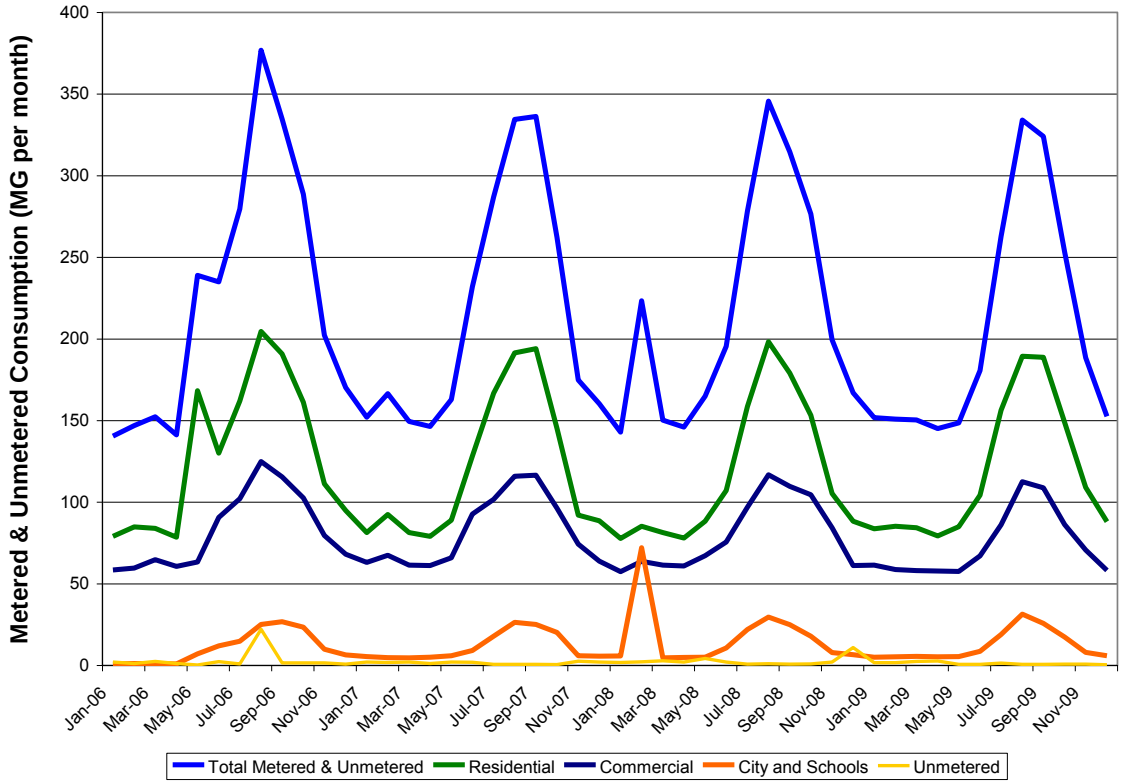
As shown in **Exhibit 2-14**, residential use dominated annual metered and unmetered water use, averaging 56% (19% multi-family and 37% single-family). Commercial use accounted for 37%, and City use for public facilities and irrigation of parks accounted for 5% of metered and unmetered consumption. Schools and unmetered uses each accounted for approximately 1% of authorized consumption. This indicates that water conservation efforts should focus largely on residential and commercial customers.

Monthly Water Use

Exhibit 2-15 shows the monthly metered consumption by customer category and authorized unmetered consumption from 2006 through 2009. Metered consumption by customer category was calculated as the sum of water use recorded by all water meters, including those dedicated to irrigation and firefighting. Because rainfall is minimal during the summer months, the seasonal increase in water consumption is directly related to water used for irrigation of landscapes and parks. Irrigation at school district properties and parks contributes to the seasonal increase in the City and schools category. Because of the City's meter reading schedule, the period of peak consumption is offset by periods of up to 1 month from the period of peak production. As a result, the 4 months with the highest metered consumption are July through October rather than June through September.

The large spike in consumption in the City and schools category in February 2008 was attributed to a single irrigation account and was either caused by a leak or a meter reading error. This data point was omitted from seasonal water use calculations.

EXHIBIT 2-15
Monthly Unmetered and Metered Consumption by Category, 2006-2009



Largest Water Users

Exhibit 2-16 presents the 23 individual water accounts with annual consumption averaging 4 MG or greater during the period 2007 through 2009. The single largest water customer accounted for 11%, and the top 23 customers accounted for approximately 19% of the total average authorized consumption for the same period. The City may obtain cost-effective conservation results by focusing on one or more of these high use water customers. Five of the top 23 accounts are for un-billed City activities. Optimizing water use for City parks and facilities would provide both financial and water saving benefits. Non-City accounts are billed, so reducing water use by these customers through conservation will reduce revenue for the City in the short term. However, the long-term financial benefit of conservation may include deferral of growth-driven capital improvement projects.

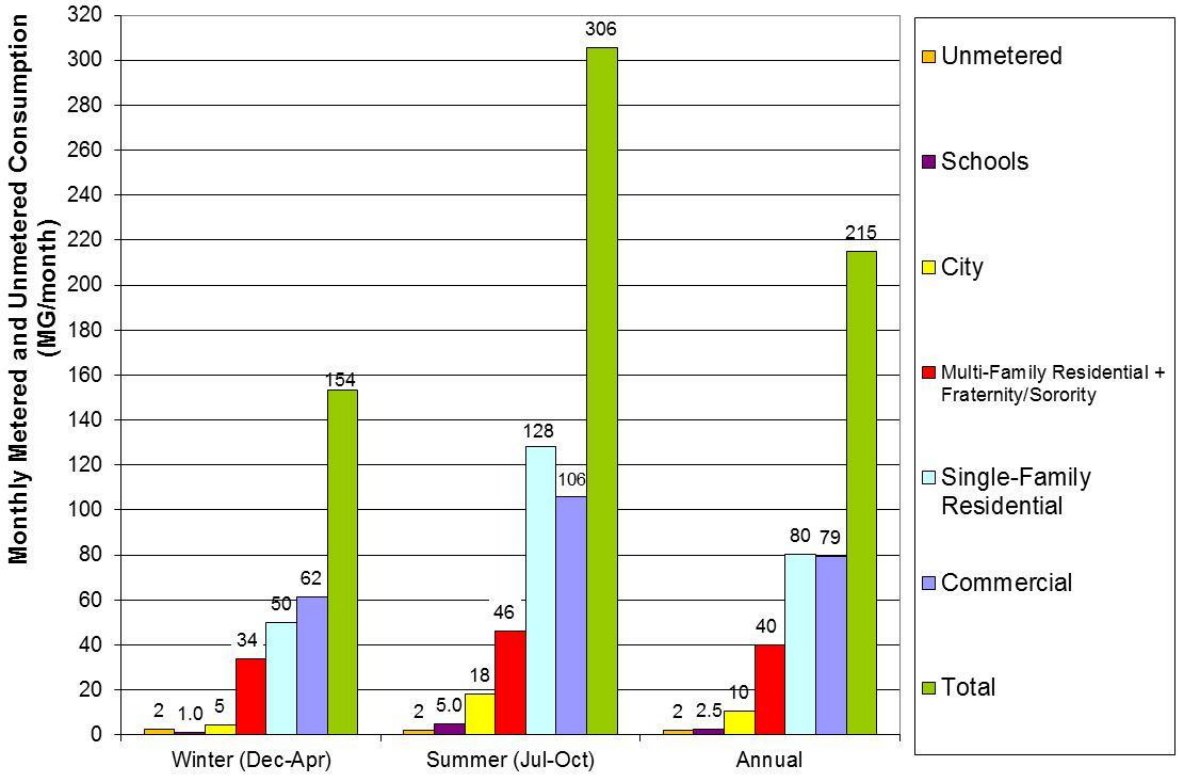
EXHIBIT 2-16
Top Water Users, 2007-2009

	Customer Class	Annual Consumption (MG)	
		Average (2007-2009)	Standard Deviation (2007-2009)
1	Commercial	276	30
2	Commercial	23	1
3	Commercial	18	3
4	City of Corvallis	18	1
5	Commercial	13	2
6	Multi-family	11	0
7	Commercial	10	1
8	Commercial	10	2
9	Commercial	10	1
10	Multi-family	9	0
11	Commercial	8	5
12	City of Corvallis	8	0
13	Commercial	8	1
14	Commercial	7	2
15	Schools	7	1
16	Commercial	6	0
17	Multi-family	6	0
18	City of Corvallis	5	3
19	Commercial	5	1
20	Commercial	5	4
21	City of Corvallis	4	3
22	City of Corvallis	4	4
23	Commercial	4	2
	Total	475	

Seasonal Water Use

Seasonal trends are further illustrated in **Exhibit 2-17**, which shows the average monthly consumption by season and by category for the period of 2006 through 2009.

EXHIBIT 2-17
Average Monthly Consumption by Season and Customer Category, 2006-2009



The total average monthly consumption for the summer months was 306 MG per month (10 mgd) compared to an annual average of 215 MG per month (7 mgd) and a winter season average of 154 MG per month (5 mgd). A summer season to winter season ratio of approximately 2.0 (306/154 = 2.0) is typical of utilities in the Willamette Valley.

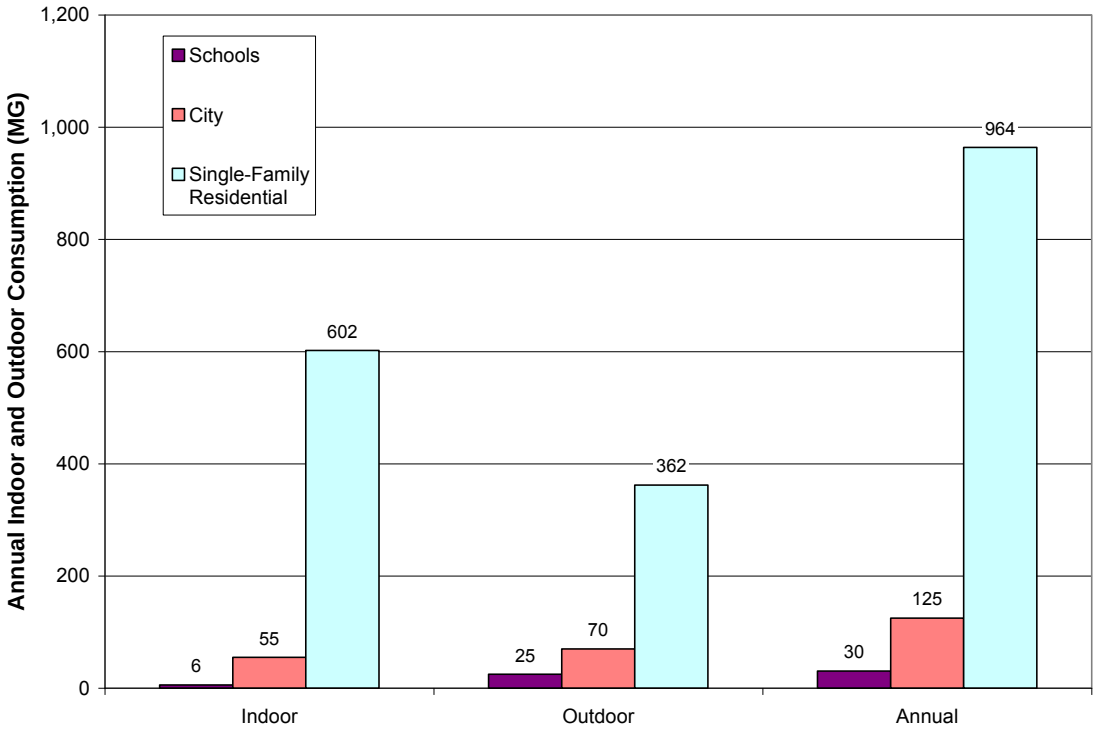
The ratio of summer use to winter use for single-family residential customers was 2.6. This ratio is greater than the total average monthly consumption ratio, demonstrating that single-family residential customers increase water use in the summer more than other customers. Both ratios correspond with the annual two- to three-fold increase in demand during the summer shown in **Exhibit 2-8**. The ratio of summer to winter use for multi-family residential customers was 1.4. University students make up a large fraction of the multi-family residential population. Therefore, increased water use for irrigation during the summer may be partially offset by a decrease in indoor water consumption associated with a decrease in student population. In addition, the irrigated lawn area for multi-family residences typically is smaller than for single-family residences.

Indoor and Outdoor Water Use

For analyzing seasonal and indoor versus outdoor water use, the summer months were defined as July through October, and the winter months were defined as the period of lowest metered consumption between December and April. This winter period was assumed to have minimal outdoor water use and to be representative of annual indoor water use for schools, City facilities and single-family residential accounts. Indoor water use at schools was adjusted for a 170-day school year. Use by commercial customers and multi-family residential customers was not included in this analysis. The commercial category includes a wide variety of customer types, which may have seasonal fluctuations irrespective of indoor and outdoor water use. Further, seasonal fluctuation in the multi-family (student) population precludes this type of analysis. Water use in the transition months of November, May, and June may reflect some irrigation.

Exhibit 2-18 presents the estimated average annual indoor and outdoor use by category for schools, City facilities, and single-family residential accounts. Assuming a 170-day indoor season, outdoor use by schools was 4.2 times greater than indoor use. Annual outdoor use by City facilities was 1.3 times greater than indoor use. Conversely, annual indoor water use throughout the year by single-family residences was 1.7 times greater than outdoor use during the summer months.

EXHIBIT 2-18
Average Annual Indoor and Outdoor Metered Consumption; Select Customer Categories, 2006-2009



Conservation efforts targeting outdoor water uses reduce peak season demands. School and City outdoor water consumption are logical targets for initial conservation efforts because these customer classes have relatively few accounts associated with relatively large water

volumes. However, because total school and City water use accounts for only 6% of overall consumption, optimizing these uses will have a relatively modest impact on overall consumption.

Effective conservation initiatives targeting indoor and outdoor water use by single-family residential customers could have a larger impact on annual and peak season water consumption, respectively. However, because of the large number of relatively small water users (12,525 single family accounts in 2009), implementing these initiatives will be proportionately more challenging.

Nevertheless, conservation efforts may not reduce demand enough to prevent the MDD from increasing, which was the case in 2009. Population growth may override savings from water conservation efforts on a peak day in certain years.

Single-Family Residential Per Capita Demand

Single-family residential per capita demands were estimated on the basis of overall annual per capita demand, the proportion of single family residential consumption, and the percentage of single-family residents out of the total population.

The overall average daily production per capita for the City for the period 2002 through 2009 was estimated at 144 gpcd. From billing data, single-family residential use represented approximately 37% of the total authorized consumption. Based on the number of single-family accounts and occupancy of 2.26 people per residence,[3] the single-family resident population was approximately 50% of the total population during the 8-year period of 2002 through 2009. The single-family residential per capita demands were estimated as follows:

- Single-family average daily per capita demand = 0.37 (144 gpcd)/0.50 = 107 gpcd

The City does not specifically track water demand by single-family residents for outdoor uses, but estimating this demand provides a general idea of water use for irrigation by these customers. Consequently, the following outdoor demand values should be considered rough estimates.

As previously described, outdoor use represented 38% of single-family residential use, and indoor use thereby represented 62% of single-family residential use.

- Single-family daily outdoor per capita demand = 107 gpcd (0.38) = 41 gpcd
- Single-family daily indoor per capita demand = 107 gpcd (0.62) = 66 gpcd

The City's residential per capita demand estimates fall within typical per capita demand ranges of 60 to 80 gallons per person per day indoors and 10 to 80 gpcd outdoors for single-family residences.[4]

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[3] *2000 U.S. Census.*

[4] AWWA. Manual of Water Supply Practices M52. *Water Conservation Programs—A Planning Manual, First Edition*, 2006.

Water Loss and Non-Revenue Water

Exhibit 2-19 presents the annual water loss from 2006 through 2009. The City currently does not estimate apparent losses, which are losses from meter inaccuracies, errors during data entry or manipulation, and unauthorized consumption. The City is not aware of any specific locations that account for the annual water losses. Assuming that apparent losses equaled zero, the average percentage of real losses for the 4-year period was 7%. This value meets OWRD's goal for municipalities serving a population greater than 7,500 of having losses resulting from system leakage to be equal to or less than 15% of production, and, if feasible, less than 10% of production.

EXHIBIT 2-19
Calculation of Annual Water Loss, 2006-2009

Year	System Input (MG)	Metered and Unmetered Consumption (MG)	Apparent Losses[1] (MG)	Real Losses (MG)	Loss Percent of Production
2006	2,906	2,707	0	199	7%
2007	2,801	2,564	0	237	8%
2008	2,769	2,604	0	164	6%
2009	2,590	2,442	0	147	6%
Average	**2,766**	**2,579**	**0**	**187**	**7%**

[1] Assumed value.

Exhibit 2-20 presents the annual non-revenue water for the period from 2006 through 2009. Non-revenue water is the sum of unmetered and metered, unbilled authorized consumption and real losses. Unbilled authorized consumption includes water used in City facilities, and for activities such as street cleaning, hydrant flushing, and sewer maintenance. The City's non-revenue water during the 4-year period averaged 12% of its total production.

EXHIBIT 2-20
Non-Revenue Water

Year	Unbilled(MG)		Losses (MG)	Non-Revenue Water (MG)	Non-Revenue Percent of Total
	Unmetered	Metered			
2006	38	99	199	335	12%
2007	18	105	237	360	13%
2008	32	182	164	378	14%
2009	15	113	147	275	11%
Average	**26**	**125**	**187**	**337**	**12%**

All water utilities experience some degree of unavoidable real water loss. The AWWA developed an empirical model to estimate unavoidable annual real losses (UARL) for systems with more than 3,000 service connections and a service connection density greater than 16 connections per mile of distribution pipeline[5]:

UARL (gal) = (5.4Lm + 0.15 Nc +7.5Lc) x P

Where

Lm = Total length of distribution mains including hydrant lead length, miles
Nc = Number of service connections
Lp = Average length of private pipeline per connection, mile/connection
Lc = Nc x Lp = Total estimated length of private pipe, miles
P = Average operating pressure in the system, psi

This calculation is included in the AWWA Water Audit model.

With approximately 251 miles of transmission mains, and nearly 16,000 connections (active and inactive) the City's UARL is approximately 113 MG per year.

The City's 12-month rolling water audit routinely calculates the ratio of estimated real water loss to UARL in a benchmark called the Infrastructure Leakage Index (ILI):

ILI = real loss/UARL

Annual ILI for 2006 through 2009 is presented in **Exhibit 2-21.** The ILI is a useful parameter for comparing system performance with time, and for comparing the performance of water systems of similar size. An ILI equal to 1 indicates that a water provider is achieving the best possible water loss control. AWWA guidelines caution that if the calculated ILI is less than or equal to 1, the accuracy of the data used to determine the real loss may be questionable. The City's ILI ranged from 1.8 to 2.1 and averaged 1.7 during the period. This is a typical ILI for a well run water system with exceptional loss control.

EXHIBIT 2-21
Infrastructure Leakage Index

Year	Estimated Annual Real Losses[1] (MG)	Estimated Unavoidable Annual Real Loss (MG)	Infrastructure Leakage Index
2006	199	113	1.8
2007	237	113	2.1
2008	164	113	1.5
2009	147	113	1.3
Average	**187**	**113**	**1.7**

[1] Apparent losses are assumed to equal zero.

[5] AWWA. Manual of Water Supply Practices M36. *Water Audits and Loss Control Programs, Third Edition*, 2009. p.61

According to AWWA water audit guidance, all water systems also have some degree of apparent water loss related to unauthorized consumption, customer meter inaccuracies, and systematic data handling errors. The City has not attempted to quantify these losses, and currently assumes that apparent losses are equal to zero. With this assumption, all water loss is attributed to real losses. If actual apparent losses are a positive value, this overestimates system leakage, and if apparent losses are a negative value this underestimates system leakage.

City of Corvallis Water Rights

OAR 690-086-0140(5)

Exhibit 2-22 shows the City's water rights. The City holds three surface water rights for the use of up to 90 cfs from the Willamette River for municipal purposes. Certificate 59051 allows use of up to 25 cfs and has a priority date of November 12, 1948. Certificate 84008 and Permit S-35551 allow use of up to 18.3 cfs and 46.7 cfs, respectively, and both have a priority date of August 21, 1970. These three water rights have a point of diversion located at approximately RM 134.5.

The City also holds a surface water registration (SW-622). A surface water registration is a claim for the use of surface water before enactment of Oregon's water code in 1909. SW-622 claims a right for the use of up to 2.67 cfs from the Willamette River for irrigation. The claimed priority date is September 1902.

The City holds five surface water rights in the Rock Creek Watershed for the use of up to 12.13 cfs of water for municipal purposes. Certificate 50182 allows use of up to 1.93 cfs from North Fork Rock Creek and South Fork Rock Creek and has a priority date of September 30, 1907. Certificate 2356 authorizes use of Stilson Branch of Rock Creek (1 cfs), Griffith Creek (1.5 cfs), and Middle Fork Rock Creek (1.5 cfs), and has priority dates of November 26, 1911; December 10, 1912; and December 8, 1915, respectively. Certificate 3245 authorizes use of up to 1.5 cfs from Rock Creek and has a priority date of January 7, 1919. The City also holds Certificate 33340 to store 257 acre-feet (AF) of water from North Fork Rock Creek and Certificate 33339 for use of that stored water at a rate of up to 4.7 cfs. Both water rights have a priority date of August 27, 1959.

In addition, City holds two groundwater rights (Certificate 24694 and Certificate 37061) and two groundwater registrations (GR-272 and GR-1888). A groundwater registration is a claim for a right to use groundwater initiated before enactment of Oregon's groundwater code in 1955. Certificate 24694 and Certificate 37061 allow the use of up to 0.25 cfs and 0.13 cfs of groundwater, respectively, at the Corvallis Airport. Certificate 24694 has a priority date of July 19, 1956, and Certificate 37061 has a priority date of November 3, 1965. GR-272 claims a groundwater right for municipal use from three wells: Well 1 (Dry Creek Watershed) for 0.18 cfs, Well 3 (Marys River Watershed) for 0.18 cfs, and Well 4 (West Fork Booneville Channel) for 0.27 cfs. The place of use of these wells includes the Corvallis Airport. The claimed priority dates are August 1942; August 1943; and August 28, 1952, respectively. GR-1888 is a claim for up to 550 gpm (1.23 cfs) of groundwater for irrigation

and has a claimed priority date of 1912. GR-1888 is currently under the name Oscar Kendall; however, the owner of the land and groundwater registration agreed to sell 107 acres of the property and associated water rights, except for 10 acres of water rights, to the City on February 24, 1995. The City is in the process of having GR-1888 assigned. The City currently uses this water to irrigate Crystal Lake sports fields.

EXHIBIT 2-22. City of Corvallis Municipal Water Rights.

Application	Permit	Certificate	Claims	Decree	Source	Priority Date	Type of Beneficial Use	Authorized Date for Completion	Maximum Authorized Rate (cfs)	Maximum Authorized Rate (mgd)	Maximum Authorized Volume(AF)	Maximum Withdrawal To Date		2009 Average Withdrawal		Five-Year (2005-2009) Average Withdrawal
												Instantaneous cfs	Annually (MG)	Monthly (MG)	Daily (MG)	Monthly (MG)
SURFACE WATER RIGHTS																
Willamette River Water Rights																
S-23522	S-18539	59051			Willamette River, tributary to the Columbia River	11/12/1948	Municipal	N/A	25	16.2	N/A	25.00	1,949.90	140.76	4.63	152.07
S-47453	S-35551	84008			Willamette River, tributary to the Columbia River	8/21/1970	Municipal	N/A	18.3	11.8	N/A	18.3				
S-47453	S-35551				Willamette River, tributary to the Columbia River	8/21/1970	Municipal	10/1/2061	46.7	30.2	N/A	0.0				
			SW-622		Willamette River, tributary to the Columbia River	September 1902	Irrigation	N/A	2.67	1.73	N/A	2.67	-	-	-	-
Rock Creek Watershed Water Rights																
		50182		Marys River	North and South Fork Rock Creek, tributaries of Greasy Creek	9/30/1907	Municipal	N/A	1.93	1.25	N/A	1.93	1029.13	35.37	1.16	30.60
S-1892	S-1085	2356			Stilson Branch of Rock Creek, a tributary of Rock Creek	11/26/1911	Domestic and Municipal Supplies	N/A	1	0.65	N/A	1		14.62	0.48	16.77
Unknown	S-1425	2356			Griffith Creek, a tributary of Rock Creek	12/10/1912	Domestic and Municipal Supplies	N/A	1.5	0.97	N/A	1.5				
Unknown	S-2761	2356			Middle Fork Rock Creek, a tributary of Rock Creek	12/8/1915	Domestic and Municipal Supplies	N/A	1.5	0.97	N/A	1.5				
S-6371	S-3979	3245			Rock Creek, a tributary of Mary's River	1/7/1919	Municipal	N/A	1.5	0.97	N/A	1.5		0	0	0
S-33327	S-26408	33339			North Fork Reservoir, a tributary of Marys River	8/27/1959	Municipal	N/A	4.7	3.04	N/A	4.7		31.20	1.03	31.13
R-33326	R-2287	33340			North Fork of Rock Creek, a tributary of Marys River	8/27/1959	Municipal	N/A	N/A	N/A	257 AF	257 AF	257 AF	N/A	N/A	N/A
GROUNDWATER RIGHTS																
G-422	G-305	24694			Corvallis Municipal Airport Well 5, a tributary of the Willamette River	7/19/1956	Municipal Use at the Corvallis Airport	N/A	0.25	0.16	N/A	0.25	N/A	N/A	N/A	N/A
G-3277	G-3068	37061			A well, a tributary of the Willamette River	11/3/1965	Municipal Use at the Corvallis Airport	N/A	0.13	0.08	N/A	0.13	N/A	N/A	N/A	N/A
			GR-272		Well 1 (Dry Creek Watershed); Well 3 (Marys River Watershed); Well 4 (West Fork Booneville Ch)	August 1942; August 1943; 8-28-1952	Municipal (at the Corvallis Airport)	N/A	0.18 cfs; 0.18 cfs; 0.27 cfs	0.12 mgd; 0.12 mgd; 0.17 mgd	N/A	0.18 cfs; 0.18 cfs; 0.27 cfs	N/A	N/A	N/A	N/A
			GR-1888		Well 2 (East Channel), a tributary of the Willamette	1912	Irrigation	N/A	1.23 cfs (550 gpm)	0.79	N/A	1.23 cfs (550 gpm)	-	-	-	-

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Aquatic Resource Concerns

The City's Willamette River water rights authorize diversion at approximately RM 134.5. At the authorized diversion, the Willamette River is on the Oregon Department of Environmental Quality's (DEQ) 303(d) list of water quality limited streams for the following parameters: chlorophyll a, chromium (hex), copper, dibutylphthalate, dioxin (2,3,7,8-TCDD), dioxins/furans, dissolved oxygen, fecal coliform (Summer), flow modification, iron, malathion, manganese, nickel, nutrients, pesticides, pH, polynuclear aromatic hydrocarbons, sedimentation, arsenic (tri), lead, selenium, zinc, alkalinity, ammonia, antimony, barium, beryllium, cadmium, chloride, *E. coli* (Summer), phosphate, phosphorus, silver, and thallium. The Upper Willamette River at the authorized diversion was de-listed for temperature, mercury, fecal coliform (Fall/Winter/Spring), and *E. coli* (Fall/Winter/Spring) as of 2010, because a Total Maximum Daily Load (TMDL) was approved.

The City also has water rights authorizing the use of water from North Fork Rock Creek, South Fork Rock Creek, Middle Fork Rock Creek, Rock Creek, Stilson Branch of Rock Creek, and Griffith Creek, none of which are on DEQ's 303(d) list.

The list of water quality impairments in the Upper Willamette River can be found on DEQ's Web page for "Oregon's 2010 draft Integrated Report Database" for water bodies on the 2010 303(d) list and removed from the 303(d) list in 2010: http://www.deq.state.or.us/wq/assessment/rpt2010/search.asp.

The Upper Willamette River supports fish species that are listed as threatened, sensitive-critical, or sensitive-vulnerable under state and federal laws, which are shown in **Exhibit 2-23**. According to the Marys River Watershed Assessment (1999), spring Chinook have not been observed above the lower mainstem of Greasy Creek, into which Rock Creek drains, and the last steelhead documented in the Marys River was in 1992. The Marys River Watershed Council Action Plan (2003) states that cutthroat trout are the only native salmonid that spawns and rears in the Marys River. Both documents indicate that Pacific lamprey and western brook lamprey have been reported, but that the extent of their presence in the Marys River Watershed is unclear.

EXHIBIT 2-23
Native Fish Species that Occur within the Willamette River (approx. RM 134.5) that are Listed as under the Oregon Sensitive Species List or Federal Endangered Species Act

Species	Evolutionarily Significant Unit (ESU) (if applicable)	Federal Listing	State Listing
Spring Chinook	Upper Willamette River	Threatened	Sensitive-Critical
Steelhead	-	-	Sensitive-Vulnerable
Oregon Chub	-	Threatened	Sensitive-Critical
Pacific Lamprey	-	-	Sensitive-Vulnerable
Western Brook Lamprey	-	-	Sensitive-Vulnerable

Sources:
Federal ESA listed species (T&E), from NOAA Fisheries Office of Protected Resources: http://www.nmfs.noaa.gov/pr/species/esa/fish.htm
Federal Sensitive species, from the Interagency Special Status/Sensitive Species Program for Oregon and Washington State: http://www.fs.fed.us/r6/sfpnw/issssp/agency-policy/
Oregon State ESA listed species, from the Oregon Department of Fish & Wildlife: http://www.dfw.state.or.us/wildlife/diversity/species/threatened_endangered_candidate_list.asp
Oregon State Sensitive Species, from the Oregon Department of Fish & Wildlife: http://www.dfw.state.or.us/wildlife/diversity/species/sensitive_species.asp
Federal Species of Concern, from the U.S. Fish & Wildlife Service, Oregon Fish & Wildlife Office: http://www.fws.gov/oregonfwo/Species/Data/PacificLamprey/default.asp

Evaluation of Water Rights/Supply
OAR 690-086-0140(3)

The City holds municipal surface water rights authorizing use of up to 12.13 cfs from the Rock Creek Watershed and up to 90 cfs from the Willamette River. The City's current water supply capacity from these sources is limited by the production capacity of its WTPs, conveyance system capacity, and source capacity in the Rock Creek Watershed. The City's future supply capacity potentially may be limited by its ability to access additional water supply from the Willamette River.

Surface Water

The City's current water system supply capacity from the Rock Creek Watershed is limited by the production capacity of its Rock Creek WTP (9.3 cfs) and the capacity of the transmission pipeline from the WTP to Baldy Reservoir. In the summer, streamflow in the Rock Creek Watershed is limited, resulting in as little as 3.1 cfs (2 mgd) available to satisfy the City's water demands. This production limitation from the City's Rock Creek Watershed sources does not impact the adequacy and reliability of the City's overall water supply because the City can meet its current water demands using its Willamette River water rights. Furthermore, having dual water sources increases the overall reliability of the City's water supply. If one WTP has mechanical problems or one source becomes contaminated, the other source can provide back-up supply.

The City's municipal water rights for the use of the Willamette River are evidenced by two certificates and an undeveloped permit. The amount of water available to satisfy the City's Willamette River water rights is a function of water right priority date (seniority) and streamflow ultimately available for use under the City's water rights.

The City currently appropriates water from the Willamette River under its two water right certificates: Certificate 59051, which has a November 12, 1948, priority date and authorizes the use of up to 25 cfs; and Certificate 84008, which has a priority date of August 21, 1970, and authorizes the use of up to 18.3 cfs. The City also holds an undeveloped permit (Permit S-35551), which has a priority date of August 21, 1970, and authorizes the use of up to 46.7 cfs. OWRD recently approved an extension of time for Permit S-35551, which gives the City until October 1, 2061, to divert the 46.7 cfs for beneficial municipal use.

To date, the City has been able to withdraw the quantity of water it has needed from the Willamette River under these water rights. OWRD has never regulated the City's use of water under these rights. According to OWRD's Water Availability Analysis for the Willamette River at U.S. Geological Survey (USGS) Gage 14191000 in Salem, water currently is available to meet existing demands year round at 80% exceedance. While the adequacy and reliability of the City's Willamette River municipal water rights have been good to date, their future adequacy and reliability will depend on the amount of water in the Willamette River available for the City's use, which could be affected by the factors described below.

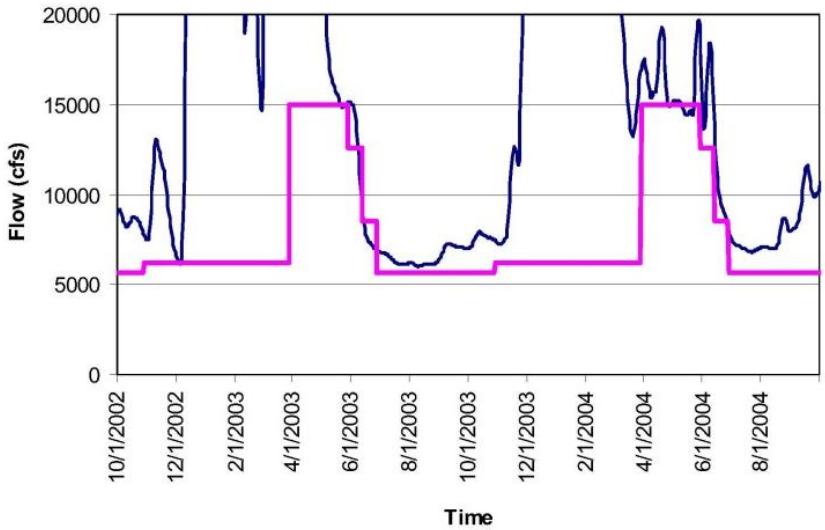
- The final order for the extension for Permit S-35551 included fish persistence conditions, which identified minimum flows (fish flow targets) that must be met in the Willamette River at Salem (USGS Gage 14191000) throughout the year, as shown in **Exhibit 2-24**. If the minimum flows are not met, the City's use of water under Permit S-35551 must be reduced in proportion to the amount by which the minimum flow is not met (based on a 7-day rolling average of mean daily flows). The overall reduction, however, will not exceed 20% of the undeveloped portion of the permit that legally can be diverted (the amount to which the City has received access).

EXHIBIT 2-24
ODFW Recommended Fish Flow Targets in the Willamette River, Measured at Salem, Oregon (USGS Gage 14191000)

Month	Recommended Minimum Fish Flow Needs (cfs)
July 1 – October 31	5,630
November 1 – March 31	6,000
April 1 – April 15	15,000
April 16 – April 30	17,000
May 1 – May 31	15,000
June 1 – 15	12,600
June 16 – 30	8,500

Since the early 2000s, the U.S. Army Corps of Engineers (USACE) has managed its reservoirs to meet the fish flow targets at Salem, and has been largely successful, as shown in **Exhibit 2-25**. The exhibit shows target flows in pink and streamflow in blue. Based on analysis of streamflow records from the USGS Gage 14191000 in Salem, fish flow targets on the Willamette River were met from 2006 to 2010, with the exception of approximately 23 days in May and June of 2007, or 99% of the time. Before the USACE's reservoir management for fish flow targets, records from 1970 to 2005 show that fish flow targets for May 15 to May 31 were missed at least once during 60% of those years and flow targets for June 1 to June 15 were missed at least once during 69% of those years.

EXHIBIT 2-25
Target Fish Flows in the Willamette River and Actual Streamflow, as Managed by the U.S. Army Corps of Engineers



- The section of the Willamette River at the City's intake has an unconverted minimum perennial streamflow (MF 184) for 1,750 cfs year-round at the Albany USGS Gage 14174000 for supporting aquatic life. The priority date for MF 184 is June 22, 1964, which is senior to Permit S-35551 and Certificate 84008. If the minimum perennial streamflow is converted to an instream water right, the City would have access only to water under Permit S-35551 and Certificate 84008 when Willamette River streamflow is in excess of the instream water right.

- In addition, the Willamette Basin Program[6] also includes unconverted minimum perennial streamflows for water stored in the USACE reservoirs upstream from the City. The minimum perennial streamflow for stored water in this reach of the Willamette River would protect up to 3,140 cfs of released stored water at the Albany USGS Gage 14174000. Significant uncertainty is associated with the ultimate "conversion" of the stored water component of the minimum perennial streamflows to instream water rights.

[6] Oregon Water Resources Commission's administrative rules specific to the Willamette Basin.

- Currently, most of the water released from storage is considered natural flow (i.e., unallocated streamflow available to water right holders). Consequently, the City can appropriate this water under its Willamette River municipal water rights. If the stored water component of the minimum perennial streamflow (3,140 cfs) is converted to an instream water right, the City no longer could appropriate the released stored water, regardless of priority date, under its natural flow water rights. OWRD would consider the stored water released to meet the instream water right to be a different water source than that identified on the City's water rights (natural flow rather than stored water).

- If unconverted minimum perennial streamflows held by OWRD (1,750 cfs) and by the USACE in storage reservoirs (3,140 cfs) are both converted to an instream water right, then a total streamflow of 4,890 cfs would need to be met before the City could appropriate water under some of its Willamette River municipal water rights. Historically, there have been times when there is less than 4,890 cfs at Albany.

- The National Oceanic and Atmospheric Administration (NOAA) Fisheries Service released the final Biological Opinion (BiOp) for the Willamette River Project in 2008, which recommends identifying additional stored water in reservoirs that could be allocated to instream flow for fish listed under the Endangered Species Act. As described above, unallocated stored water is considered Willamette River natural flow. If additional unallocated stored water is converted to instream water rights, the City's access to water under Permit S-35551 could be impaired.

In summary, the City's Willamette River water rights currently provide a reliable water supply. However, there are a number of complex activities under consideration on the Willamette River and the outcome of those activities is difficult to predict. Some of these activities could result in future constraints on the City's Willamette River water supply, and may require the City to evaluate other supply alternatives. The City will diligently follow Willamette River management discussions and will adjust its evaluation of the reliability of its water rights if necessary.

Groundwater

Finally, the City holds groundwater rights for municipal purposes from five wells. These wells are located south of the City at the Corvallis Municipal Airport. Historically, these wells provided water for the airport, but water quality was always a concern because of high levels of iron and manganese, which are very common for wells in the Corvallis area. Furthermore, the area falls within the recently designated Southern Willamette Basin Groundwater Protection Area, a designation primarily resulting from the high levels of nitrate in groundwater in the area primarily because of agricultural activity. As a result of these water quality concerns, the City extended the water distribution system to the Corvallis Municipal Airport in the 1986. Since then, the City has held these groundwater rights in reserve.

System Description
OAR 690-086-0140(8)

The City operates a public drinking water system (Public Water System Identification Number OR4100225).

The City's water production facilities consist of two conventional WTPs: Taylor WTP, which treats Willamette River water; and Rock Creek WTP, which treats water from the Rock Creek Watershed. The Taylor WTP is a peaking plant in southeast Corvallis. The Rock Creek WTP draws water from the Rock Creek Watershed using three intakes: on North Fork Rock Creek; on South Fork Rock Creek; and on Griffith Creek. North Fork Rock Creek also contains a 100 MG raw water reservoir created with an earthen dam. The water travels between 1 mile and 3.2 miles from the intakes to the Rock Creek WTP, which runs 24 hours per day and has a capacity of between 5 and 6 mgd. Treated water from the Rock Creek WTP travels approximately 9 miles by gravity to Baldy Reservoir where the water enters the City's water distribution system. The current maximum sustained production capacity for the City's water system is 24.5 mgd, consisting of approximately 3.5 mgd from the Rock Creek WTP and 21 mgd from the Taylor WTP. Future infrastructure improvements will provide the opportunity to divert and treat water at sustained higher rates.

The distribution system currently consists of nine covered finished water reservoirs that can store up to 21.02 MG of treated water, 10 booster pumping stations utilizing 22 pumps, 1 pressure reducing valve, and approximately 255.4 miles of distribution piping. The pipelines are steel, cast iron, or ductile iron and range in size from 1 inch to 42 inches in diameter. The system also has three service pressure levels. The first level serves the lower pressure zone between 210 and 290 feet above mean sea level (fmsl). The second level serves the middle pressure zone between 290 and 410 fmsl and the third level serves the highest pressure zone between 410 and 560 fmsl. **Exhibits 2-26, 2-27, and 2-28,** summarize the City's pipelines, reservoirs, and booster pump stations.

EXHIBIT 2-26
Summary of Pipeline Sizes (as of February 2012)

Pipe Diameter (in)	Estimated Length (mi)	Estimated Length (ft)	Percent of Total Pipeline (%)
1	0.89	4,675	0.3
2	2.34	12,353	0.9
3	0.27	1,445	0.1
4	11.02	58,206	4.3
6	52.97	279,665	20.7
8	92.85	490,254	36.4
10	2.69	14,198	1.1
12	41.51	219,173	16.3
14	0.22	1,152	0.1
16	23.14	122,198	9.1
20	14.93	78,831	5.8
24	5.59	29,497	2.2
30	4.98	26,320	2.0
36	1.89	9,954	0.7
42	0.09	455	0
Total Length	**255.37**	**1,349,374**	**100.0**

EXHIBIT 2-27
Summary of System Reservoirs

Reservoir Name/Location	Service Level	Capacity (MG)	Overflow Elevation (ft)	Depth (ft)	Year of Completion
Baldy	1st	6.8	401.78	17.75	1936
North Hill #1[1]	1st	4.42	397.0	26	1959
North Hill #2[1]	1st	4.42	397.0	26	1969
South Hills	2nd	0.5	481.0	23.5	1973
Sylvan Acres[2]	2nd	0	495.57	60	1952
Woodland Park	2nd	1.25	495.81	23.51	1969
North Hills	2nd	2.5	496.0	25	1974
Woodland Park	3rd	0.125	621.94	223	1969
Timberhill	3rd	1.0	660.0	19	1982
	Total	**21.02 MG**			

[1] The North Hills reservoirs are nominally 5.0 MG, but seismic concerns limit capacity to 88.46%, reducing effective capacity of 4.42 MG each.
[2] Sylvan reservoir is currently not in service.

EXHIBIT 2-28
Summary of Existing Pump Stations

Pump Station Location	Service Level	Pumps (#)	Horsepower of each pump (Hp)	Nominal Capacity of each pump (gpm)	Serves Areas with Reservoirs
South Hills	2nd	2	15	225	Yes
36th and Grant	2nd	2	25	300	Yes
Hoover	2nd	2	40	750	Yes
North Hills	2nd	1	25	900	Yes
		1	20	500	
		1	100	4,000	
Baldy	2nd	3	75	1500	Yes
		1	50	1000	
		1	50	1200	
		1	20	500	
South Hills	3rd	1	5	150	No
		2	15	500	
Sylvan	3rd	1	2	50	No
		1	3	110	
Woodland Park	3rd	2	40	750	Yes
Queens View	3rd	2	50	790	Yes
North Hills	3rd	2	25	350	No
		1	7.5	110	

Exhibits 2-29 and 2-30 show a schematic of the City's water supply and distribution system, as well as the current City limit and urban growth boundary (UGB). With the exception of a few customers outside the City, the City limit defines the current service area. The UGB defines the potential future service area. **Exhibit 2-29** also shows the City's water system intertie with the City of Philomath.

EXHIBIT 2-29
City of Corvallis Water System Schematic, Part 1

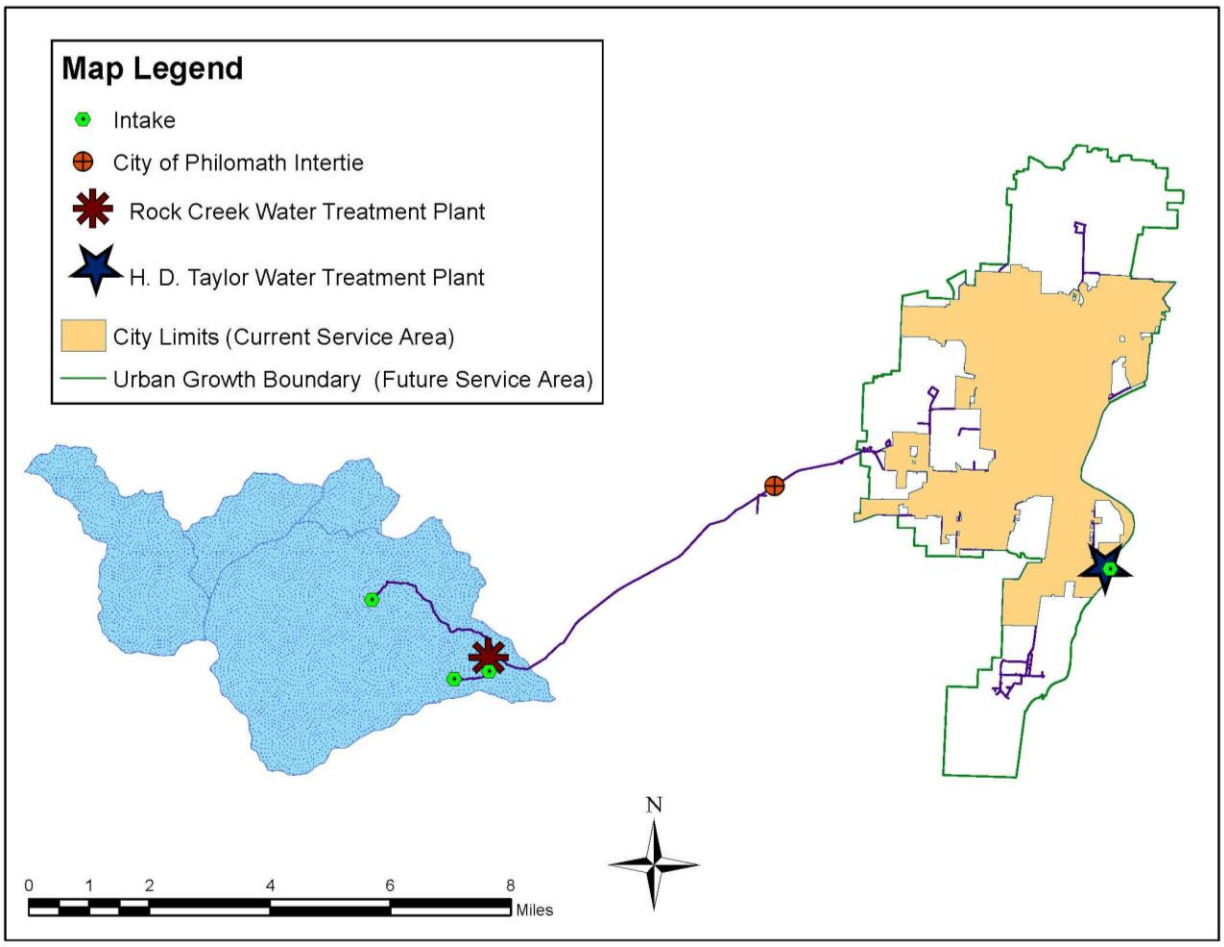
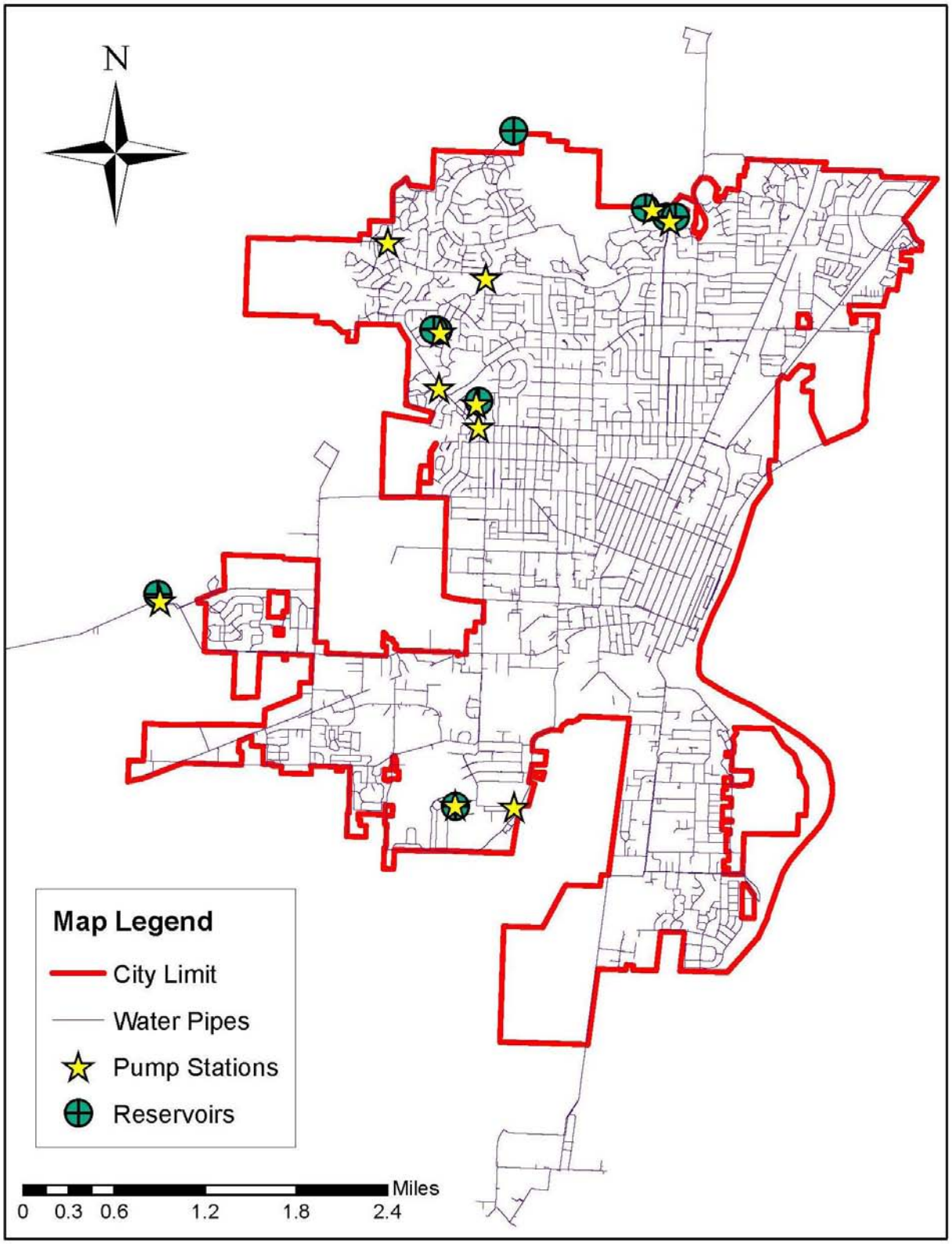


EXHIBIT 2-30
City of Corvallis Water System Schematic, Part 2



3. Municipal Water Conservation Element

This section addresses the requirements of OAR 690-086-0150(1) – (6).

This rule requires a progress report on conservation measures in an existing Plan, if any, and a description of any additional conservation measures. The rule also requires descriptions of specific required conservation measures and benchmarks.

Background and Current Conservation Measures
OAR 690-086-0150(1) and (3)

Background

This is an update of the City's 2005 WMCP, which OWRD approved in 2007. As part of its final order of approval, OWRD required submission of an updated WMCP within 5 years.

The City has recognized for many years that a water conservation program is an important component of sustainable water management and has made water conservation a priority. The City has maintained a municipal ordinance that prohibits water waste since 1958 and initiated its water conservation program in 1997.

The Corvallis City Council adopted an overarching goal of sustainability in 2003. The following year the City adopted a policy that provided more guidance and created six general topic areas for staff to focus on when reviewing City operations and maintenance activities. The topic areas are: Sustainable Purchasing Practices, Green Building Practices, Solid Waste Management, Land Use Planning, Greenhouse Gas Emissions, and Toxics and Persistent Biotoxins. Water conservation is a part of the Green Building Practices focus area.

In 2009, the City worked with a consultant to analyze historical water use, current conservation measures, and water savings and costs associated with implementing different types of conservation measures in the future. The City's 2010 Water Use and Water Conservation Project report presents the result of this effort (see **Appendix B** for an excerpt). The examination of opportunities to enhance the City's existing water conservation program, involved a water conservation analysis focused on demand-side conservation measures, which directly save water, rather than incentives, which motivate customers to save water. In addition, the analysis focused on measures related to hardware rather than behavior. Hardware measures tend to be more expensive, but have longer-lasting water savings and a higher certainty of savings compared to behavioral measures.

Water savings and associated costs were analyzed during a 20-year planning period under the following four scenarios:

1. **Maximum Water Savings.** This scenario considered water savings available using all 86 water conservation measures analyzed for this project. Estimated average annual cost of $267,000, an average annual savings of 4.2%, and a cost per hundred cubic feet (ccf) saved over the measure life of $1.58[7].

2. **Current Annual Conservation Budget.** This scenario included measures intended to reflect the most cost-effective use of the City's current $30,000 annual conservation budget. Estimated average annual cost of $19,000 during the 20-year planning period (annual costs vary over the planning period and will be higher in the beginning), an average annual savings of 2.1%, and a cost per ccf saved during the measure life of $0.22.

3. **Doubled Annual Conservation Budget.** This scenario included measures that reflect the most cost-effective use of a doubled City conservation budget ($60,000). Estimated average annual cost of $32,000 during the 20-year planning period (annual costs vary over the planning period and will be higher in the beginning), an average annual savings of 2.3%, and a cost per ccf saved during the measure life of $0.34.

4. **Measures that Cost Less Than the Variable Cost of Production.** This scenario included only measures that cost less than the variable cost of production (i.e., costs that change based on the volume of water produced). Estimated average annual cost of $750, an average annual savings of 0.2%, and a cost per ccf saved during the measure life of $0.08.

The analysis revealed that Scenario 2 had reasonable cost-effectiveness, the Scenarios 1 and 3 did not deliver a proportional increase in water savings for the cost, and the Scenario 4 had much lower water savings. The City presented the results of the water conservation analysis to the Urban Services Committee of the City Council in 2010. The City Council directed City staff to pursue Scenario 2 (current annual conservation budget approach), but with a somewhat different focus of providing customers with 1.0 gpm bathroom aerators, 1.5 gpm showerheads, and toilet leak detection tablets, and encouraging customers to let their lawns go dormant in the summer.

The City has been fortunate to have many residents who are responsive to its conservation efforts and willing to help do their part with respect to water conservation. The City's recent water conservation accomplishments are shown in **Exhibit 3-1**. The exhibit also presents a progress report on the City's 2005 WMCP 5-year benchmarks, which are related to the required and additional conservation measures required by OAR 690-086-0150(4)-(6).

[7] These budget numbers are for expendable items and do not include water conservation or management staff hours.

EXHIBIT 3-1. Progress Report on 2005 WMCP Conservation Benchmarks, 2010 Update, and Accomplishments pre-2010 and from 2005-2010.

Conservation Measures	2005 Benchmarks, per Approved WMCP	Status 2005	Status 2010	Pre-2005 Accomplishments	2005-2010 Accomplishments
Required Existing or Expanded Conservation Measures					
Annual water audit	Conduct annual system-wide water audit.	Audits occur on a monthly and annual basis. The City's audit analysis includes: water production at its treatment plants, water demand, water sold, non-revenue water, and water loss.	Audits continue to occur on a monthly and annual basis. The City has used the AWWA water audit software to conduct its water audits since 2006.		
System-wide metering	Meter all existing service connections and require meters on all new service connections.	System is fully metered.	No change		
Meter testing and maintenance	Test large (2-inch and larger) compound meters.	The city is divided into 20 routes and one route is replaced each year (5 percent of all small meters), such that small meters are replaced on a 20-year cycle. Large meters are tested annually and replaced when necessary. A meter testing and replacement program is in place.	The City recently suspended its routine replacement of small meters on a 20-year cycle after testing indicated that 25 year old meters were running as well as new meters. Small meters are now only replaced when they fail to operate accurately.		
	Replace aging small meters.				
Rate structure and unit-based billing program	Develop and implement consumption-based billing.	Billing is monthly.			
	Develop and implement conservation pricing (inverted block structure).	The City uses inverted-block conservation pricing that is three-tiered for residential (single-family, multi-family, sorority, and fraternity) and irrigation customers and two tiered for commercial and school customers. The consumption levels where rates change for multi-family, commercial, and school customers depend on the size of their service meter.	No change		
Leak detection and repair program	Conduct leak detection program.	The City surveys one-third to one-half of the system each year.	The City has purchased equipment to do its own survey and no longer contracts this service. In the past three years (2007-2009), the entire system was monitored. The equipment consists of data loggers deployed in the system.	2002: Surveyed 85 mi and identified 54 leaks, saving 20.5 MGY of water and $29,000 2003/4: Surveyed 80 mi and found 53 leaks, saving 30.5 MGY and $43,000	The City monitored the entire system from 2007-2009. In 2009, the City surveyed 129 mi of water pipelines (79 mi with ground microphones and 50 mi with data loggers) and discovered 44 leaks. Forty of these leaks were at fire hydrants and required only routine maintenance.
Public education	Develop conservation mass-media messages for movie theaters.	Outreach included slides for water conservation and pollution prevention on movie screens for 5 years (not consecutively), but the City suspended this program due to lack of market infiltration, contractor issues, and expense. The City had a local ad on Comcast cable for short time. As of 2005, the City had ads on a local access channel.	This outreach method is no longer used.		
	Develop conservation mass-media messages for television.				
	Direct outreach to customers at community festivals and events.	Outreach includes: classroom visits, talks for local groups, and outreach at community and Oregon State University events.	The City continues to promote water conservation in the community at schools, fairs, and festivals.		Outreach efforts include: Earth Faire, da Vinci Days, OSU's annual "Where It's At" Fair, and Kids Day for Conservation.
	Develop publications to educate customers about water conservation.	Publications include: fact sheets, brochures, newsletters, newspaper and magazine articles, and posters. In some cases, the City adapts publications made by other cities/entities for Corvallis. The City also has an internet webpage.	No change		
Additional Conservation Measures					
Leak detection and pipeline repair and replacement	Provide financial assistance to customers that fix underground leaks.	If an owner finds a leak and reports it quickly, the City may cover 50 percent of the cost of lost water from the line leak (limited to 2 months that the meter was in service and proof of the fixed leak is required). The City has a rebate programs (washing machines), as well as water audit and irrigation audit programs. The City is also exploring the development of a low-income assistance program.	No change		
Technical and financial assistance	Develop residential water audit program.	Home water audits are free and scheduled at a customer's request or offeredif billing staff observe high use. The audit includes examination of water-using fixtures and appliances, analysis of water use patterns/practices, and creation of a report specifying the payback time for replacing inefficient fixtures.	The program is targeted at users who have had a major change in consumption as identified by meter readers, but is also available upon request. The program is not advertised heavily due to staffing limitations.	2002, 2003, 2004: 29 audits (average)	2005: 17 audits 2006: 21 audits 2007: 15 audits 2008: 10 audits 2009: 5 audits 2010, First Quarter: 2 audits, included a commercial facility with the potential to save 439,000 gallons per year from indoor measures, which represents a 38 percent water savings, and an audit of the commercial facility's irrigation system will be performed when the system is energized.
	Develop landscape irrigation audit program.	The City started the program in 2002. The free audit uses a slightly modified form of the Irrigation Auditing Protocol. The City plans to expand the program to include city parks.	The program is available upon request, but is not heavily advertised due to limitations on staff time to conduct audits. Additionally, staff recognized that those individuals who responded to advertising could not benefit from an audit and high water users that could benefit from an audit were not interested in one. However, the city-wide sustainability goal for 2010 is for all city irrigation systems to operate at a minimum of 80 percent efficiency, which will require more audits by Public Works staff or others. Interns from the Lane Community College Water Conservation Program collected data from city-operated irrigation systems during the summer of 2010.		2005: 42 (Last year an intern ran the program) 2006: 2 2007: Possibly zero (No data) 2008: 4 (Including the library) 2009: 1 (Re-audit of library post retrofit; audit and head retrofit at the library increased efficiency from 51percent to 73-84 percent) Water savings from most audits is unknown.
	Assist Parks and Recreation Department to improve irrigation efficiency in parks.	The Parks and Recreation Department (PRD) doesn't pay for its water, but the finance department still meters and documents use. The Public Works Department gave PRD $60,000 over the course of three years to make irrigation technology upgrades. Many city parks now irrigate using MaxiComm, an automated evapotranspiration-based irrigation control system. The City purchased a weather station and communication software so the weather station could control irrigation systems. The system includes an integral flow sensor that detects water line breaks and closes the valve to a pipe where a leak is detected. Some parks also use cell phone connections to a central computer to control irrigation where cellular phone service exists. Additional parks should be connected to a MaxiComm system in the next few years.	The City is optimistic that the 2010 sustainability goal for all city irrigation systems to operate at 80 percent efficiency or better will encourage PRD to request financial assistance for projects. Interns collected efficiency data during the summer of 2010.		
		A Cost analysis of selected water conservation measures occurred for the following measures: 1. Distribution of efficient pre-rinse spray nozzles for non-residential customers using pre-rinse spray in operations ($7,142 per MG saved at 44.4 times the cost of additional water supply) 2. Rebate for installation of evapotranspiration-based irrigation controllers ($667 per MG saved at 4.1 times the cost of additional water supply) 3. Landscape irrigation audits for non-residential customers ($4,106 per MG saved at 25.5 times the cost of additional water supply)	The City briefly had pilot programs for pre-rinse spray nozzles and evapotranspiration-based irrigation controllers, but decided to discontinue them due to lack of cost effectiveness.		

EXHIBIT 3-1 continued. Progress Report on 2005 WMCP Conservation Benchmarks, 2010 Update, and Accomplishments pre-2010 and from 2005-2010.

Conservation Measures	2005 Benchmarks, per Approved WMCP	Status 2005	Status 2010	Pre-2005 Accomplishments	2005-2010 Accomplishments
Additional Conservation Measures					
Retrofit/replacement of inefficient fixtures	Provide water-saving devices to customers.	The City offers free devices: showerheads (2.2 gpm), shower timers, faucet aerators (no more than 2.2 to 1.5 gpm), toilet tank displacement bags (save 0.8 gallons/flush) and adjustable early-close flappers.	The program to provide water saving devices continues and the City now offers showerheads (1.5 gpm) and faucet aerators (1.0 gpm) with greater water savings. The City also distributes 1.5 and 2.2 gpm aerators for use in kitchens since many customers have found that 1.0 gpm is not sufficient for their kitchen needs, but the City still encourages customers to use the lowest flow aerator possible. The City discontinued offering shower timers in 2007.		
	Develop rebate program for replacing older toilets with water efficient models. Develop rebate program to encourage purchase of water-efficient laundry machines	The City provides financial incentives to replace inefficient fixtures and may provide additional rebates for other technologies, such as efficient irrigation application hardware or controllers.	The City continued to provide incentives for replacing washing machines and toilets through 2010.		
		The City offers a $50 rebate for "EnergyStar" machines, which focus on energy, not water efficiency.	The City changed its guidelines. It requires machines to have a water factor of 6.0 or less by approximately 2007, which is the new Energy Star standard in 2011. The rebate amount is unchanged.	Number of Rebates (Water Savings) 2002: 260 2003-4: 261 (~1.7 mgy)	Number of Rebates (Water Savings) 2004-5: 280 (1.8 to 2.7 mgy) 2005-6: 369 (2.4 to 3.5 mgy) 2006-7: 241 (1.6 to 2.3 mgy) 2007-8: 221 (1.5 to 2.1 mgy) 2008-9: 263 (1.7 to 2.5 mgy) 2009-10: 258 (1.7 to 2.5 mgy)
		The City offers a $75 rebate for approved models of toilets, using the Los Angeles Department of Water and Power Supplemental Purchasing Specification List to determine eligibility of toilets. The City may use the City of Seattle's "Flush Star" list in the future and may phase out the program by 2012.	The City changed its guidelines from 2005 through 2010. Toilets had to be 1.28 gallons/flush (gpf) High Efficiency Toilet (HET) models that were WaterSense labeled. The rebate amount did not changed from its 2005 level. This toilet rebate program will end in 2011 to focus resources on other water conservation measures.	Number of Rebates 2000-01: 80 2002-03: 100 2003-04: 92	Number of Rebates (Water Savings) 2004-5: 94 (1.5 to 1.9 mgy) 2005-6: 141 (2.2 to 2.8 mgy) 2006-7: 101 (1.6 to 2.0 mgy) 2007-8: 19 (0.19 to 0.36 mgy) 2008-9: 36 (0.27 to 0.67 mgy) 2009-10: 69 (0.53 to 1.29 mgy)
	Replace fixtures in City-owned buildings with more efficient models.	The City will assess water use in City-owned buildings, analyze the data, and develop a plan to replace fixtures and appliances with water conserving alternatives.	Some buildings have had water audits and most of those had fairly good water efficiency. Audited buildings (8): City Hall, Library (indoor and irrigation system), Senior Center, Public Works, Taylor Water Treatment Plant, Finance (Madison Avenue Building), and two residences owned by Parks (Avery Park house and Corl House). Buildings not yet audited (5+): Majestic Theatre, Parks offices, Police station (shared with Benton County Sheriff), and Fire stations (Fire Station 1 was recently upgraded and Fire Station 5 is very new with efficient fixtures, so they don't need auditing). The City installed new water-saving shower controls and a liquid floating cover for an outdoor pool at the Osborn Aquatic Center, which reduces evaporation and maintains pool heat, as well as the reduces the use of chlorine and the frequency of dumping and refilling pool water.		
Water rate structure and billing schedule	See "Rate structure and unit-based billing program."	See "Rate structure and unit-based billing program."	See "Rate structure and unit-based billing program."		
Reuse, recycling, and non-potable water opportunities	Reuse treated wastewater for irrigation and process water for wastewater reclamation facility.	Reclaimed water is used primarily for operation of the wastewater reclamation facility and irrigation near the facility. The City reused 6.4 percent of all treated wastewater in 2004 (232 MG used for irrigation and other facility tasks). The City wants to expand reuse from the wastewater reclamation plant.	This project continues, but slowly. The City is engaging the community to determine how to reuse some treated wastewater effluent. From April 1, 2009 to March 31, 2010, the wastewater reclamation facility reused 8.1 percent of effluent (295 mgd). The City began working with a consultant in 2007 to conduct a TMDL Alternatives Evaluation for the discharge from the City's WWTP.		
Other conservation measures	Maintain local ordinance against wasting water.	The City may discontinue service if wasteful or negligent water use is not corrected within five calendar days.	No change		
	Develop water conservation demonstration garden.	The City is considering developing a demonstration garden, but the City needs to find a visible place, current budget constraints raise concerns about appropriateness of the project, and concerns exist that the public may perceive the project as wasteful.	The City is installing several irrigation technologies in the SAGE youth garden, a community garden effort where youths and adults grow food for the food bank. The SAGE garden is in a highly visible location in Bruce Starker Arts Park. In addition, the Parks and Recreation Department utilizes three sites for demonstrating water-wise landscaping:a portion of Riverfront Park in downtown Corvallis, a landscape bed on the south side of Osborn Aquatic Center, and a circular landscape bed at 18th Street and Van Buren Avenue.		
	Maintain internal city sustainability policy.	The City adopted an overall goal of sustainability in 2003 and the following year adopted a policy that provided more guidance and created six general topic areas for staff to focus their attention on when reviewing City operations and maintenance activities. The topic areas are: Sustainable Purchasing Practices, Green Building Practices, Solid Waste Management, Land Use Planning, Greenhouse Gas Emissions, and Toxics and Persistent Biotoxins. Water conservation is a part of the Green Building Practices focus area.	No change		
	Encourage water-conserving landscapes	The City is considering a rebate or incentive program to convert landscapes from high water use to water efficient designs and an incentive program for installation of evapotranspiration based irrigation controllers in customer landscapes.	These programs have not been instituted yet.		

Use and Reporting Program
OAR 690-086-0150(2)

The City has a water use measurement and reporting program that complies with the measurement standards in OAR Chapter 690, Division 85. The City's water use records can be found on the OWRD Web page (http://apps.wrd.state.or.us/apps/wr/wateruse_report/default.aspx).

The City's largest surface water diversion is on the Willamette River at the Taylor Water WTP. The City also operates three diversions within the Rock Creek Watershed for the Rock Creek WTP. These diversions are located on North Fork Rock Creek, South Fork Rock Creek, and Griffith Creek. Griffith Creek is a tributary to the main stem of Rock Creek. Rock Creek is a tributary to Greasy Creek, which is a tributary into the Marys River. The Marys River flows into the Willamette River adjacent to the City's downtown.

Willamette River. The diversion at the Taylor WTP has a 36-inch electronic mag-meter on the influent line to the WTP and the effluent line from the WTP's clearwells has a 36-inch insertion turbine meter. Data from the meter are reported to OWRD annually.

North Fork Rock Creek. The intake on North Fork Rock Creek is at the base of an intake tower in North Fork Reservoir, which is impounded by North Fork Dam. The screened intake is also the intake for water released from storage and it feeds a 24-inch-diameter pipeline that conveys water approximately 3.2 miles to the Rock Creek WTP. Flows from the creek and storage reservoir are calculated by subtracting the South Fork Rock Creek and Griffith Creek intake flows from the Rock Creek WTP inflow.

South Fork Rock Creek and Griffith Creek. Adjustable weirs regulate streamflow and water level at the intakes of South Fork Rock Creek and Griffith Creek, which allow the water to remain at a constant flow to and over the intakes. A stationary staff gage is read to determine water level and streamflow. Water levels are maintained year round except in the summer when weir levels are slightly lowered in response to decreased streamflows. The South Fork Rock Creek and Griffith Creek intakes are approximately 2.8 miles and 1 mile from the Rock Creek WTP, respectively. The South Rock Creek intake feeds a 24-inch-diameter pipe that connects with the 24-inch-diameter pipe conveying water from the North Fork Rock Creek and North Fork Reservoir intake. This later 24-inch-diameter pipe then feeds a 16-inch-diameter pipe that conveys water to the Rock Creek WTP. The Griffith Creek intake feeds a 14-inch-diameter pipeline that connects to the 16-inch-diameter pipe that also conveys water from the Rock Creek Watershed. This line passes through a vault at the WTP where a 16-inch magnetic meter measures the raw water flows. Data from the meter are reported to OWRD annually.

Required Conservation Programs
OAR 690-086-0150(4)

OAR 690-086-0150(4) requires that all water suppliers establish 5-year benchmarks for implementing the following required conservation measures:

- Annual water audit
- System-wide metering
- Meter testing and maintenance
- Unit-based billing program
- Leak detection and repair (if system leakage exceeds 10%)
- Public education

Five-Year Benchmarks for Required Existing or Expanded Conservation Measures

The City currently addresses all of the required conservation measures. A summary of the 5-year benchmarks for required and additional conservation measures is provided below and in **Exhibit 3-2** at the end of this section. During the next 5 years, the City plans to continue or expand the following existing conservation measures that are required of all municipal water providers:

1. **Annual Water Audits.** The City conducts water audits of its systems on a monthly and annual basis. A water audit is an examination of records to determine the consumption by customers and the losses that exist in a water supply system, as well as check the accuracy of the analyzed records. The water audit helps identify water system improvements and minimize unbilled water use and water loss. The City's audit analysis includes: water production at the WTPs, water demand, water sold, non-revenue water, and water loss.

   The City has used the AWWA water audit software to conduct its water audits since 2006, when AWWA released the software. In addition to the typical water audit reporting capabilities, this software allows the City to indicate data sources, describe changes in data collection or calculation, explain unusual events (i.e., reservoir draining), and describe any other assumptions associated with the annual water audit report spreadsheet. The City produces this report in tandem with a Water Accountability Report, which mimics the AWWA water audit report, but retains the format and much of the terminology of reports produced before 2006. The Water Accountability Report also includes additional data not required for the water audit.

   As part of the City's 2010 Water Use and Water Conservation Project, the City learned that a new version of AWWA's water audit software was available. The City subsequently updated its AWWA water audit software and corrected water audit reports back to 2006, when the AWWA software first became available for use.

   The City's water loss was 6% in 2009 and its average ILA number is 1.0 to 2.0 (described in Section 2), both of which are excellent when compared to other similar-sized water systems.

Five-year Benchmark:

- The City will continue to audit its water system monthly and annually.
- Every 5 years, the City will review its water audit reports for accuracy and validity of assumptions, and, if necessary, will institute protocols for correcting inaccurate data. The next review is scheduled for 2015.
- The City will evaluate how to incorporate data from meter testing and replacement activities and leak detection surveys into its annual water audit to help validate estimates of losses resulting from meter errors and leakage. Although the City does not currently include this information, the City has taken it into consideration for determining apparent water losses.
- The City views developing graphical information as a logical next step in its progress toward understanding and improving its water audit. Consequently, the City will explore developing graphical tools to locate deficiencies and to validate or disprove water production and consumption data and assumptions made within the report.

2. **System-wide Metering.** The City's water system is fully metered.

   ***Five-year Benchmark*:** The City will continue to require all new connections to be metered.

3. **Meter Testing and Maintenance.** The City has a meter testing and replacement program in place. Approximately 80% of the City's large meters are tested each year. As a result, most large meters are tested annually and all are tested biennially, at a minimum. Large meters are defined as compound meters that are 1.5 inches or larger. The City has approximately 450 of these large meters in its distribution system. Meters are tested on a constant-head flow regulating test bench. Three flow levels are tested. Percent errors for the three tests are averaged, and meters that fail are repaired to AWWA's accuracy standards or replaced.

   In addition, the City utilizes compound meters for fire services. Fire flows are not actually metered because meters can create flow restrictions. High flows typical of fire suppression open a check valve that allows nearly all the flow to occur through the large portion of the compound meter. Lower flow rates do not open the check valve, and those smaller flows pass through the bypass portion of the meter. The bypass portion contains a "snooper" meter that will record when water use occurs. The meter should show zero use unless a fire has occurred. Water use in the absence of fire flows can come from leaks or theft.

   The City recently suspended its routine replacement of small meters on a 20-year cycle after testing indicated that 25-year-old meters were running as well as new meters. Consequently, the City now only replaces small meters when they fail to operate accurately. To assess accurate operation, an automated monitoring program compares current and historic use from monthly meter readings, and if use has changed significantly, the water distribution lead worker is notified. If the meter shows a drastic increase, the customer is contacted with an alert that they may have a leak. If the use has reached or approached zero, the meter is assumed to have failed and is replaced. The City uses the AWWA

standard to determine if a meter is recording within normal parameters, and the City's experience is that small meters either work or fail completely.

The City is installing Advanced Metering Infrastructure (AMI) technology in its system. AMI is a fixed-base automated meter reading system where an antenna is used to intercept radio wave signals from each water meter indicating time and quantity of water use. The new FlexNet (brand name) technology allows the City's staff to access actual use data at any time, making it more useful than the City's remaining traditional radio-read AMR metering and manual read metering. AMI allows real-time online monitoring of water services for leaks and anomalies, like stopped meters. A scheduled small meter replacement program will be revisited in 3 years, after the City completes its current phase of converting its meters to the FlexNet technology.

Five-year Benchmark:

- Test at least 80% of approximately 450 large meters in the system each year.
- Repair or replace large meters as they fail
- Replace small meters as they fail.
- Replace older meters that fail with meters that have AMI technology.

4. **Rate Structure and Unit-based Billing Program.** The City conducts monthly water meter reading and billing. This provides relatively rapid feedback to customers on their water use. Meters are read monthly and bills are sent to customers 1 to 2 weeks afterward, resulting in customer feedback within 6 weeks at the latest (the 4-week period of water use plus 2 weeks from meter reading to billing).

   Utility rates include both a base service charge and a consumption-based charge. The consumption-based portion uses inverted-block conservation pricing to discourage excessive water use. Inverted-block conservation pricing is a rate structure in which the cost of water increases with each increasing tier of water consumption. The City's rate structure is tiered for all customers, although the consumption levels of each tier differ based on the type of customer (multi-family, commercial, single-family, etc.) and meter size. For single-family residences, there are three tiers representing monthly use of: 7 units or less, 8 to 13 units, and 14 or more units. One unit equals 748 gallons. Irrigation customers are similarly three-tiered. Commercial and school customers have two tiers: 14 units or less and more than 15 units. The consumption levels where rates change for multi-family, commercial, and school customers depend on the size of their service meter. This rate structure charges the highest users extra for their greater water consumption while not punishing low to average water users. According to a League of Oregon Cities survey conducted in 2009, 45 entities used the inverted (inclining)-block rate structures in Oregon. **Appendix C** shows the City's rate structure by customer type as of February 1, 2012.

   Five-year Benchmark:

   - The City will continue to bill customers based, in part, on the quantity of water metered at the service connection, using an inclining block rate structure.
   - The City will continue to evaluate its rates on an annual basis.

5. **Leak Detection and Repair Program.** The OWRD requires municipalities to have a regularly scheduled and systematic program to detect leaks when system leakage is more than 10%. The City's water loss was 6% in 2009. Although the City's water loss is less than 10%, the City has a leak detection program in place to minimize water loss in its distribution system.

   The City started its leak detection program in 1998. For many years, the City hired contractors to survey approximately one-third to one-half of its system each year for leaks. The City ceased using contractors in 2008 after purchasing dataloggers and correlators that enable the City's staff to survey for leaks. The City uses the dataloggers to essentially listen to the system for leaks and now surveys its entire water system each year. The dataloggers are temporarily installed on valves throughout the system and they monitor between 2 a.m. and 3 a.m., the hours of least water use. If a leak is detected by a datalogger, the City uses a correlator to locate the leak, and after it is located, the leak is repaired. In addition to using data loggers and correlators, the City strives to listen to each valve in the system with a ground microphone annually. This work typically takes two staff members dedicated to the project for about 3 months. Most leaks are at fire hydrants that have not been closed completely.

   The City's leak detection surveys have resulted in considerable water and monetary savings. For example, the City's 2003-2004 survey of 80 miles of pipeline identified 53 leaks, and the City estimates that fixing the leaks saved 30.5 MG of water per year and $43,000. In 2009, the City surveyed 129 miles of water pipelines (79 miles with ground microphones and 50 miles with data loggers) and discovered 44 leaks. Forty of these leaks were at fire hydrants and required only routine maintenance.

   If meter readers notice an unexpected increase in consumption, they leave a door hanger informing the customer that they may have a leak, and providing information about what to do. The door hanger informs the customer that toilets commonly leak and that leakage can go unnoticed. Customers are made aware of the leak credit offered by the City, which is an opportunity to have the City cover 50% of the cost of lost water from the line leak (limited to 2 months) if the customer finds, reports, and fixes the leak quickly. Customers also are encouraged to find and repair leaks in a timely manner.

   If a customer contacts the City about a leak, the Utility Billing work group tells the customer about the leak credit. The work group also will refer a customer to the conservation staff if the customer needs assistance finding the leak or general conservation guidance.

   The City also is investing in line replacements to decrease system leakage. In even-numbered years, the City budgets $100,000 for line replacement design. In odd-numbered years, the City budgets $300,000 for in-ground work replacing pipes and mains within the system. Each year, this line replacement work continues until the allocated funds are spent. The City is proactively replacing all the polybutylene service lines that it can locate. These service lines were installed in the 1970s and they fail catastrophically because of a faulty chemical formulation that was used during manufacturing. All known polybutylene lines have been removed from the system (approximately 100,000 to120,000 feet) and replaced with copper line. Between 100 and 300 polybutylene service lines (approximately 2,000 to

3,000 feet) likely remain in the system, but their exact locations will not be known until they break, at which point the City will immediately replace them.

Five-year Benchmark:

- The City will continue to fund leak detection and repair or replacement and to carry out repairs or replacements in a timely manner.
- The City will continue to monitor the consumption records of its customers for evidence of leaks and inform customers when there is evidence that there could be a leak.
- The City will replace water pipelines as budget allows.

6. **Public Education.** The City concentrates its outreach efforts on community events, schools, and publications, as presented in **Exhibit 3-1**. The City provides water conservation lessons for all grade levels upon request. It offers talks for local groups, such as the Rotary, 4H Wildlife Stewards, and Neighborhood Sustainability Stewards. Outreach at OSU has included an audit of the Memorial Union, presence at OSU Earth Week and the annual "Where It's At" Fair, and presentations at living centers, along with providing the living centers with water-saving fixtures. The City also sets up a booth at community events, such as Earth Faire, daVinci Days, and Kids Day for Conservation.

   The City produces a variety of publications, as well as adapts some publications from other cities and entities. Publications include newsletters, brochures, newspaper and magazine articles, and Web pages. In the late 1990s and early 2000s, the City used TV and movie messages in its outreach efforts, but this outreach method is no longer used because of contractual issues, inconsistent showing of ads at the movies, and the inability to reach the target audience cost-effectively on cable TV. The City found that the cable TV ads reached far beyond its service area, choosing times to run the ads was difficult, and putting the ads on all the stations it wanted to include was too expensive.

   Since development of the 2005 WMCP, the City established a demonstration garden. In 2010, the City installed several irrigation technologies in the Starker Arts Garden for Education, a community garden to educate youths and adults about how to grow food. The food produced is donated to a food bank. The garden is located in the highly visible Bruce Starker Arts Park.

   In addition, the Parks and Recreation Department (PRD) uses several sites for demonstrating water-wise landscaping. One of the largest of these is a portion (about 3,880 square feet) of Riverfront Park in downtown Corvallis on the river side of a multi-modal path. Other locations include a long landscape bed south of the main entrance to the Osborn Aquatic Center and a 1,256-square-foot circular landscape bed at 18th Street and Van Buren Avenue. The water-wise landscapes at Riverfront Park and Osborn Aquatic Center have educational signs, and the City occasionally writes articles about these landscapes in the City's quarterly newsletter. In April 2011, the PRD installed a 6,800-square-foot water efficient landscape in Sunset Park. In total, there are about 30 landscaped areas maintained by PRD that are not irrigated. Furthermore, in 2009, the Public Works Department installed

and began managing a water-conserving landscape at City Hall, the primary place of contact for City business.

Five-year Benchmark:

- The City will continue its current public education efforts and will continually evaluate them and look for additional cost-effective opportunities during the next 5 years.
- The City will continue to update its Web site and outreach materials as needed.
- The City will seek additional partnerships to promote water conservation.

Expanded Use under Extended Permits
OAR 690-086-0150(5)

The City is proposing to expand diversion of water under its Permit S-35551, an *extended permit* for which resource issues have been identified under OAR 690-086-0140(5)(i). The request for "green light water" to expand diversion is in Section 5 under Schedule to Exercise Permits & Comparison of Projected Need to Available Sources. The City's water loss was 6% in 2009. As a result, the City's system leakage is less than the 15% target established by this rule. Nonetheless, the City has a system-wide leak repair and line replacement program, which is described above.

Additional Conservation Measures
OAR 690-086-0150(6)

OAR 690-086-0150(6) requires municipal water providers to implement an additional set of conservation measures or to provide documentation showing that implementation of the measures is neither feasible nor appropriate if they serve a population greater than 1,000 and propose to expand or initiate diversion of water under an *extended permit*, or serve a population greater than 7,500.

The City proposes to expand diversion of water under its *extended permit*, Permit S-35551, and currently serves a population of approximately 55,125; therefore, OAR 690-086-0150(6) applies.

Five-Year Benchmarks for Additional Conservation Measures

Benchmarks for the City's additional water conservation measures include:

1. **Leak Detection and Pipeline Repair and Replacement.** As described above, the City's water loss was 6% in 2009 and averaged 7% from 2005 to 2009. Although the system's water loss, and, therefore, system leakage, is less than 10%, the City diligently implements the following measures to keep system leakage as low as possible.

Five-year Benchmark:

- As described in Leak Detection and Repair under the section required by OAR 690-086-0150(4), the City will continue to fund leak detection and repair or replacement and to carry out repairs or replacements in a timely manner.
- The City will continue to monitor the consumption records of its customers for evidence of leaks.
- The City will design and replace water pipelines as described in Subsection 5 above and as budget allows ($100,000 in even-numbered years for design, $300,000 in odd-numbered years for replacement).

2. Technical and Financial Assistance.

Home and Landscaping Irrigation Water Use Audits. The City conducts home water audits and landscaping irrigation audits. No additional fees are charged for these services. Audit programs target customers with high water usage and are also available upon request. The home water audit involves examining water-using fixtures and appliances and analyzing water use practices. Results of audits are compiled in a report that includes information on payback time for replacing inefficient fixtures and suggested changes to water use practices. From 2002 to 2004, the City conducted an average of 29 home water audits per year, but from 2006 to 2009 the average number dropped to about 13 audits per year. The irrigation water audit program has also experienced a drop in the number of audits performed in recent years. In 2005, when an intern staffed the program, the City conducted 42 irrigation water audits. After that year, the City did not have interns and no more than four irrigation audits occurred in a given year until 2010, when interns again staffed the program.

Despite the lack of staffing, some important audits did occur, such as the library irrigation system audit that resulted in more than a 50% increase in water efficiency. Because of staffing limitations, the audit program relies on interns to complete the field work. During the summer of 2010, two interns from the Lane Community College Water Conservation Program conducted irrigation audits for a portion of City-operated irrigation systems (one-third of City parks) and a local business that is participating in a water conservation pilot project.

Future interns, if available, will continue this work in an attempt to identify which irrigation systems are operating efficiently and which need the most attention. These audits will provide City irrigation system managers with a tool to help achieve the internal sustainability goal for all irrigation systems under control of the City to operate at 80% efficiency or better. As time permits, interns may provide irrigation audits for residential and commercial customers, as well as the PRD.

In addition, the PRD received funding from the Public Works Department to upgrade its irrigation technology and now irrigates many parks using an automated evapotranspiration-based irrigation control system (brand name MaxiCom). The City purchased a weather station and software that allows the weather station to program irrigation controllers, as well. The City also has parks that have the capability to use

cellular phone connections to a central computer to control irrigation. The PRD water usage is metered by the City, but as with other City departments, the PRD does not pay for its water use.

Financial Assistance for Timely Leak Detection and Repairs. For customers who find a leak and report it quickly, the City may cover 50% of the cost of the water lost because of the line leak for a maximum of 2 months. Proof that the leak ultimately has been fixed is required to receive the financial assistance. Customers cover the full cost of water lost because of the leak beyond that 2-month period. This provides an incentive for customers to fix leaks in a timely manner.

Water Audits and Water Efficiency Upgrades in City-owned Buildings. The City has planned to audit City-owned buildings for their water efficiency and then develop a plan to replace fixtures and appliances with water conserving alternatives in those buildings. Since development of the 2005 WMCP, the City has been implementing this initiative. As of May 2010, eight buildings have been audited.

- Audited buildings (eight): City Hall, Library (indoor and irrigation system), Senior Center, Public Works, Taylor WTP, Finance (Madison Avenue Building), and two residences owned by Parks (Avery Park House and Corl House).
- Buildings to be audited in the near future (five+): Majestic Theatre, Parks offices, police station (shared with Benton County Sheriff), and fire stations (Fire Station 1 recently was upgraded and Fire Station 5 is new with efficient fixtures, so they do not require auditing).

The City has made water efficiency upgrades at Osborn Aquatic Center. It installed new shower controls that have push-button actuators with built-in timers, which have eliminated the common occurrence of children leaving showers on after they are finished. The City also installed a liquid floating cover on both indoor pools and the outdoor lap pool that reduces evaporation and maintains pool heat. The reduction in chlorine use has resulted in less dumping of water and pool refilling.

Toilet Leak Detection Tablets. The City encourages customers to test their toilets regularly for leaks and provides dye tablets to facilitate testing.

Five-year Benchmark:

- The Public Works Department or Water Utility will continue to work with the PRD to improve its water use efficiency through technical assistance.
- The City will continue to offer its financial assistance for timely leak detection and repairs.
- The City will audit a majority of the un-audited City-owned buildings within 5 years and the remainder within 10 years.
- The City will continue to offer toilet leak detection tablets at the Water Utility billing office, the Public Works Department office, and on the door knobs of customers whose residences are suspected of having a leak, along with a notice stating that a leak is suspected and the available resources to the customer.

3. **Retrofit/Replacement of Inefficient Fixtures.**

Residential Water Use Efficiency. The City offers free water-saving devices to customers and recently selected devices that offer even greater water savings. The City provides free showerheads that use 1.5 gpm (down from 2.2 gpm in 2005) and faucet aerators that use 1.0 gpm (from 2.2 to 1.5 gpm in 2005). The City also continues to distribute 1.5 and 2.2 gpm aerators for use in kitchens because many customers have found that 1.0 gpm is not sufficient for their kitchen needs. Toilet tank displacement bags and adjustable early-close flappers also are offered to customers.

The City offers up to three rebates to residential customers who install high-efficiency toilets ($75 per toilet). To qualify for a toilet rebate, toilets must be High Efficiency Toilets (HET) that use 1.28 gallons or less per flush and be certified by the U.S. Environmental Protection Agency's (EPA) WaterSense Program to ensure performance and continued efficiency. The number of HET rebates distributed has fluctuated. HET rebates dropped from 101 in 2006-2007 to 19 in 2007-2008 and then increased to 69 in 2009-2010. Ninety rebates were distributed in 2010-11. After increasing from $25 to $75 in 2003, the rebate limit has remained constant. Qualifications for the rebate have increased along with new technology and testing methods.

For more than a dozen years, the City offered $50 rebates to residential customers who installed high-efficiency clothes washers. Over the years, the washing machine rebate program evolved as water-efficiency guidelines for participation tightened. When the program ended, qualifying washers had to show water factors of 6.0 or less. Water factor is the number of gallons of water required per cubic foot of machine capacity. This requirement became part of the Energy Star standard in 2011. The washing machine program ended on June 30, 2011, and before its end, participation in the washing machine program remained fairly steady throughout the 8 years. The 258 rebates in 2009-2010 alone are estimated to produce water savings of 1.7 to 2.6 MG per year. The program ended as part of a response to an analysis of current and future conservation programming in the City's 2010 Water Use and Water Conservation Project report (described above under Background and Current Conservation Measures). The City Council directed the conservation program to eliminate this rebate and focus on new priorities identified in the report. The new program focus includes toilet leak detection, efficient showerheads and aerators, and encouragement for citizens to allow their lawns to become dormant for part of the summer.

Customer Landscaping for Water Efficiency. The City is continuing to consider a rebate or incentive program to further increase water efficiency in customer landscapes. This program may include promoting use of evapotranspiration-based irrigation controllers and converting high water use landscapes to landscapes designed with water efficiency in mind. However, the economy must improve and water revenues must increase for this program to become viable.

Five-year Benchmark:

- The City will continue to offer free showerheads (1.5 gpm) for single family and multi-family customers, and start to offer free showerheads to non-residential customers.
- The City will continue to provide 1.0 gpm faucet aerators to single and multi-family customers.
- The City will continue to offer HET rebates.
- The City will decide whether to implement a rebate or incentive program to increase water efficiency in customer landscapes within 1 year, and if the City moves forward with the program, then it will have a design in place by 2015. However, this program is highly dependent on the ability of the City to secure funding, which is currently scarce.

4. **Water rate Structure and Billing Schedule.** The City has a rate structure that supports and encourages water conservation. The unit-based billing discussion in the section responsive to OAR 690-086-0150(4) details the types of monthly charges and their rates for the City's customer classes, as well as the billing schedule.

   The City has traditional mail billing and electronic billing options for its customers. Mailed water bills are one piece of paper folded without an envelope, preventing inclusion of conservation inserts. However, the paper bill has a small space shared with other City departments where a conservation message is occasionally inserted. For example, the City tries to include a conservation message at the end of summer that reminds customers to shut off water supply to their irrigation systems. The electronic bills also have space for conservation messages.

   Customers receive water bills on a monthly basis and each water bill contains histograms that show monthly water use over time, both of which help customers track consumption and identify any major changes in their water use. Water bills are sent to customers 1 to 2 weeks after the meters are read, providing feedback on water use within 6 weeks of the initiation of a new month of water use.

   Five-year Benchmark:

   - As stated above, the City will continue to bill customers based, in part, on the quantity of water metered at the service connection.
   - The City will continue to evaluate its rates on an annual basis.
   - The City will continue to include water conservation messages with water service bills.
   - The City will maintain its monthly billing schedule.

5. **Reuse, Recycling, and Nonpotable Water Opportunities.** The City currently uses reclaimed water (treated wastewater effluent) for operation of the wastewater reclamation facility and irrigation of the entire Public Works Department campus adjacent to the facility. The City installed the irrigation system in 2007. The location of

the WWTP on the Public Works Department campus and behind the facility's gated fence created easy access to reclaimed water and made the project secure. Using reclaimed water for irrigation currently is not a feasible alternative for most other landscaped areas primarily because of to the cost of constructing the needed infrastructure. In 2004, the City reused 6.4% of its treated wastewater. From April 1, 2009, to March 31, 2010, the facility reused 8.1% of the treated wastewater, or 294.9 MG.

The City is considering additional utilization of reclaimed water as a water quality enhancement and conservation tool. The City's WWTP currently discharges into the Willamette River and is not designed to remove certain pollutants or to cool water temperature enough to meet DEQ's current TMDL standards on the portion of the Willamette River passing through the City, as well as meet future standards that likely will be implemented. A TMDL is a calculation of the amount of pollutant that water can receive while still meeting water quality standards and a method of allocating an acceptable pollutant load among municipal and industrial dischargers along the water body. Thus, a TMDL acts a regulatory tool used to help meet water quality standards to improve and protect streams.

Given the City's need to meet DEQ's TMDL standards, the City began working with a consultant in 2007 to conduct a TMDL Alternatives Evaluation for the discharge from the City's WWTP. The goals of this effort were to: (1) determine what complying with current and anticipated future regulations would involve, (2) assess the economic impacts of these regulations, and (3) evaluate alternatives to directly discharging wastewater effluent into the Willamette River. The TMDL Alternatives Evaluation proposed four alternatives, which the City shared with the public to gather feedback:

- **The East Alternative** involved pumping treated WWTP water east across the Willamette River for irrigation of Trysting Tree Golf Course and construction of a wetland natural treatment system at Orleans Natural Area.
- **The South Alternative** involved piping WWTP water 12 miles south to Greenberry Irrigation District for irrigation and constructing a wetland that would indirect discharge into Muddy Creek, a tributary of Willamette River.
- **The North Alternative** involved using recycled water on lands north of the WWTP along Highway 20, constructing wetlands east of Highway 20, and irrigating the grounds at the Hewlett Packard campus.
- **The West Alternative** involved pumping WWTP water to the OSU dairy to provide irrigation water for dairy operations.

In December 2011, the City Council's Urban Services Committee recommended to the City Council to accept the East Alternative, which would convey 1 mgd to the golf course for irrigation use and 7 mgd to a constructed wetland where water would leach through the permeable soils into the adjacent Willamette River.

Five-year Benchmark:

- The City will continue to use reclaimed water for operation of the wastewater reclamation facility and irrigation of the entire Public Works Department campus adjacent to the facility.
- During the next 5 years, the City will continue to explore opportunities for water reuse and recycling, such as expanded reuse of wastewater from the wastewater reclamation facility.

6. **Other Conservation Measures.** In addition to the conservation measures described above, the City has implemented several other measures that improve water use efficiency.

Ordinance Prohibiting Waste. The City has an ordinance prohibiting wasting water that authorizes discontinuing service to a customer whose wasteful or negligent water use is not corrected within 5 days of notice.

Cost Analyses of Other Water Conservation Measures. The City explored the cost effectiveness of pursuing three conservation measures: distribution of efficient pre-rinse spray nozzles for non-residential customers, rebates for installation of evapotranspiration-based irrigation controllers, and landscape irrigation audits for non-residential customers.

Water Conservation Opportunities Analysis. As described above under Background and Current Conservation Measures, the City worked with a consultant to conduct a water conservation analysis that examined opportunities to enhance the City's existing water conservation program. The analysis primarily focused on demand-side conservation measures and on hardware rather than behavior. The analysis also compiled demographic information for the City's service area, applied assumptions for customer participation rates for each conservation measure, calculated the savings achieved by shifting to more efficient hardware or behavior, and calculated the costs for those shifts. Water savings and associated costs were analyzed for a 20-year planning period under four scenarios: maximum water savings, current annual conservation budget, doubled annual conservation budget, and only conservation measures that cost less than the variable cost of production (see **Appendix B**).

The analysis showed that the current conservation budget scenario had comparatively reasonable cost-effectiveness and that the other scenarios either did not deliver a proportional increase in water savings for the cost or did not achieve much water savings. The City presented the results of the water conservation analysis to the Urban Services Committee of the City Council in 2010, and the City Council directed staff to pursue the current conservation budget scenario approach. This approach uses the City's current conservation budget to provide customers with 1.0 gpm bathroom aerators, 1.5 gpm showerheads, and toilet leak detection tablets, and to encourage customers to let their lawns go dormant in the summer.

Corvallis Sustainability Coalition's Water Action Team Water Conservation Project. The City has provided partial funding for a water conservation demonstration project at the First Alternative Natural Foods Co-op. The Corvallis Sustainability Coalition's

Water Action Team is spearheading the project, which has the goal of reducing the co-op's use of drinking water and its production of wastewater and stormwater by 50% annually. The project incorporated a water audit to identify infrastructure and process changes that could reduce the Co-op's water use, and then implementation of behavioral, technical, and system design changes, as well as outreach, to achieve water use reductions. The project began in 2008 and runs through July 2012, and an evaluation will follow.

Five-year Benchmark:

- Within the next 5 years, the City will explore implementing a "Dormant Lawn" program in the City to decrease peak season water use (based on analysis in the City's 2010 Water Use and Water Conservation Project report).

EXHIBIT 3-2. Summary of 2010 Benchmarks.

2010 Benchmarks	
Required Existing or Expanded Conservation Measures	
Annual water audit	The City will continue to audit its water system monthly and annually.
	Every 5 years, the City will review its water audit reports for accuracy and validity of assumptions, and if necessary, will institute protocols for correcting inaccurate data. The next review is scheduled for 2015.
	The City will evaluate how to incorporate data from meter testing and replacement activities and leak detection surveys into its annual water audit to help validate estimates of losses resulting from meter errors and leakage. Although the City does not currently include this information, the City has taken it into consideration for determining apparent water losses.
	The City views developing graphical information as a logical next step in its progress towards understanding and improving its water audit. Consequently, the City will develop graphical tools to locate deficiencies and to validate and/or disprove water production and consumption data and assumptions made within the report.
System-wide Metering	The City will continue to require all new connections to be metered.
Meter testing and maintenance	Test at least 80 percent of approximately 450 large meters in the system each year.
	Replace large and small meters as they fail.
	Replace older meters that fail with meters that have FlexNet technology.
Rate structure and unit-based billing program	The City will continue to bill customers based, in part, on the quantity of water metered at the service connection, utilizing an inclining block rate structure.
	The City will continue to evaluate its rates on an annual basis.
Leak detection and repair program	The City will continue to fund leak detection and repair or replacement and to carry out repairs or replacements in a timely manner.
	The City will continue to monitor the consumption records of its customers for evidence of leaks and inform customers when there is evidence that there could be a leak.
	The City will design and replace water pipelines as budget allows.
Public education	The City will continue its current public education efforts and will continually evaluate them and look for additional cost effective opportunities over the next five years.
	The City will continue to update its Web site and outreach materials as needed.
	The City will seek additional partnerships to promote water conservation.
Additional Conservation Measures	
Leak detection and pipeline repair and replacement	As described in Leak Detection and Repair under OAR 690-086-0150(4), the City will continue to fund leak detection and repair or replacement and to carry out repairs or replacements in a timely manner.
	The City will continue to monitor the consumption records of its customers for evidence of leaks.
	The City will design and replace water pipeline as described in subsection 5 above and as budget allows ($100,000 in even numbered years for design, $300,000 in odd numbered years for replacement; work until the money's gone for the biennium).
Technical and financial assistance	The Public Works Department or Water Utility will continue to work with the PRD to improve its water use efficiency through technical assistance.
	The City will continue to offer its financial assistance for timely leak detection and repairs.
	The City will audit a majority of the un-audited City-owned buildings within 5 years and the remainder within 10 years.
Retrofit/replacement of inefficient fixtures	Continue to offer free showerheads (1.5 gpm) for single family and multi-family customers, and start to offer free showerheads to non-residential customers.
	Continue to provide 1.0 gpm faucet aerators to single and multi-family customers.
	Continue to offer toilet leak detection tablets at the water utility billing office, the Public Works Department office, and on the door knobs of customers who are suspected of having a leak, along with a notice stating that a leak is suspected and the available resources to the customer.
	Continue to offer high efficiency toilet rebates.
	The City will decide whether to implement a rebate or incentive program to increase water efficiency in customer landscapes within one year, and if the City moves forward with the program, then it will have a design in place by 2015. However, this program is highly dependent on the ability of the City to secure funding, which is currently scarce.
Water rate structure and billing schedule	As stated in OAR 690-086-0150(4), the City will continue to bill customers based, in part, on the quantity of water metered at the service connection.
	The City will continue to evaluate its rates on an annual basis.
	The City will continue to include water conservation messages with city water service bills.
	The City will maintain its monthly billing schedule.
Reuse, recycling, and non-potable water opportunities	During the next five years, the City will continue to explore opportunities for water reuse and recycling, such as expanded reuse of wastewater from the wastewater reclamation facility.
Other conservation measures	Within the next five years, the City will explore implementing a "Dormant Lawn" program in the City to decrease peak season water use (based on the Water Conservation Opportunities Tech Memo analysis in the City's 2010 Water Use and Water Conservation Project report).

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4. Municipal Water Curtailment Element

This section satisfies the requirements of OAR 690-086-0160.

This rule requires a description of past supply deficiencies and current capacity limitation. It also requires inclusion of stages of alert and the associated triggers and curtailment actions for each stage.

Introduction

Water curtailment plans outline proactive measures that water suppliers may take to reduce demand and to find alternative supply during short-term water supply shortages. The intent of water curtailment plans is to minimize the impacts of water supply shortages, which may result from incidents such as: prolonged drought, mechanical or electrical equipment failure in the system, unanticipated catastrophic events (flooding, landslides, earthquakes and contamination), or events not under control of the water supplier (e.g., localized or area-wide power outages and intentional malevolent acts).

History of System Curtailment Episodes
OAR 690-086-0160(1)

The City Council adopted the City's first water curtailment plan in 1994. The curtailment plan was intended to prepare the City for a scenario where water treatment capacity is reduced and water stored in the system's reservoirs is used to meet the resulting production deficit on a peak day. Such a situation would put the City at risk of being unable to meet crisis water demands (i.e., a significant fire requiring large quantities of water or a spill in the Willamette River making the water unusable for an extended period of time).

Within the last decade, the City has not experienced water shortages resulting from a constrained source of supply. The City has needed to implement its curtailment plan only once, in July 1994, when the City put Stage 1 of the curtailment plan into effect as daily water demands exceeded production capacity for 4 consecutive days. Since that time, the nominal treatment capacity from the Taylor WTP has been increased to 21.0 mgd.

Curtailment Event Triggers and Stages
OAR 690-086-0160(2) and (3)

The City's curtailment plan is designed to preserve water supplies in the event of a temporary or sustained shortage and to ensure that delivery can be maintained. Situations that could create a supply shortage include, but are not limited to: an extended period of dry, hot weather; OWRD fish persistence conditions on Permit S-35551; contamination of source water supplies

(Willamette River or Rock Creek); interruption of commercial power supply to a critical part of the City water system (Taylor WTP or water pumping stations); major water transmission line break; reservoir failure; sabotage; earthquake; or other major catastrophic event.

If one or more of these scenarios creates the need for water curtailment, the actions taken will vary depending on time of year and the expected duration of the situation. The following guidelines will be considered during a curtailment event:

- Maximize public health and safety.
- Meet EPA Safe Drinking Water Act standards.
- Minimize disruption to the public.
- Protect and enhance the public's trust in the City
- Be consistent in phasing in curtailment measures as water shortage continues.
- Apply measures in a fair and equitable manner in the best interest of the public.
- Maximize coordination of responses with other departments within the City.
- Minimize impact on the environment.
- Limit City liability.

In general, the response to a water shortage is to develop strategies that create a reduction in daily demand for water.

This water curtailment plan identifies four stages of water shortage severity. These stages are designed to be initiated and implemented in progressive steps. The stages of water shortage severity range from an alert to the potential of a water shortage (Stage 1) to a critical water shortage threatening the ability of the City to deliver water to customers for life sustaining and safety needs (Stage 4). At each stage, restrictions imposed at the previous stage(s) remain in force. The curtailment plan also provides flexibility and enforcement capability. At any stage, additional restrictions can be imposed if deemed necessary, and stages can be skipped in some extreme cases (i.e., expectation of an extended water production capacity reduction). Should the plan have to be implemented, notification to the general public will be primarily through the local news media. In addition, direct contact will be made with large customers and institutions as the need requires.

Exhibit 4-1 presents the four curtailment stages, as well as their initiating conditions. The City's initiating conditions focus on reservoir water levels and deficit rates in the water supply system because conditions in the system and responses to those conditions can be clearly defined, rather than underlying drought-related causes of the water supply shortage. However, initiating conditions from other supply shortage scenarios also are included in **Exhibit 4-1**.

EXHIBIT 4-1
Curtailment Stages 1 through 4

Curtailment Stages	Initiating Conditions
Stage 1: **Early Warning for a Potential Water Supply Shortage**	• Maximum daily production does not exceed the daily demand • There is expectation of a potential supply deficiency
Stage 2: **Water Supply Shortage**	• Maximum production does not meet daily demand and reservoir storage falls to 90% capacity • Minor damage to the water system because of a natural disaster or vandalism • Failure of a minor part of the water system or a facility
Stage 3: **Severe Water Supply Shortage**	• Maximum production does not meet daily demand and reservoir storage falls to 80% capacity • Serious damage to the water system because of a natural disaster or vandalism • Failure of a significant part of the water system or a facility • Isolated contamination of the water supply
Stage 4: **Critical Water Shortage**	• Maximum production does not meet daily demand and reservoir storage falls to 60% capacity • Extensive damage to the water system because of a natural disaster or vandalism • Failure of a critical water system or a facility • Contamination of the entire water supply

Curtailment Plan Implementation and Enforcement
OAR 690-086-0160(4)

Stage 1: Early Warning for a Potential Water Supply Shortage

The Stage 1 warning is reached when maximum daily production meets, but does not exceed the daily demand, or when there is expectation of a potential supply deficiency. When such a situation occurs, the Water Operations Supervisor, Water Maintenance Supervisor, Utilities Division Manager, and on-duty water operations staff (the Water Utilities Management Team) will meet to assess the situation. If the Water Utilities Management Team determines that a potential water shortage exists, the team will consult with the Public Works Director (Director). Under a Stage 1 warning, the Director has the authority to activate some or all of the **voluntary curtailment** measures described below.

Actions for which the City has direct control are the easiest to curtail:

1. The City will limit water use for street sweeping, and hydrant and water line flushing.
2. The Parks and Recreation Department will irrigate at maximum efficiency.
3. The Fire Department will limit training exercises to those that do not use water.
4. The City will make conservation information available at the Public Library, Utility Billing and other City offices, to local news media, and to neighborhood associations.
5. The City will remind customers of Corvallis's water waste ordinance (See **Appendix D**, Municipal Code 3.01.250).

Stage 1 curtailment for citizens will be voluntary. The City will request that customers:

1. Reduce or eliminate nonessential water use.
2. Follow odd/even outdoor watering schedules based on street address.
3. Limit outdoor watering to the early morning or late evening.

Customers will be notified of the City's voluntary curtailment request through newspaper, radio messages, or in a water bill, depending on the timing.

Stage 2: Water Supply Shortage

A Stage 2 water shortage is reached when maximum production does not meet daily demand and reservoir storage falls to 90% capacity. The Water Utilities Management Team will assess the situation daily, and if the Water Utilities Management Team deems it necessary, the Director may initiate the following restrictions:

1. Activate a conservation hotline with information on the current water supply situation, voluntary curtailment measures, and conservation tips (541-766-6733).
2. Limit the PRD nonessential water use, and irrigate only in off-peak hours.
3. Limit hydrant and water main flushing to emergencies only.
4. Ask customers to **voluntarily restrict** all irrigation and other nonessential outdoor water use and to limit all outdoor water use to the hours between 8 p.m. and 8 a.m. The following practices are deemed nonessential:
    a. Watering or irrigating of lawns, grass or turf except for:
        - New installations after March 1 of the current calendar year.
        - Athletic fields frequently used for organized play.
        - Park and recreation areas of a particular significance and value to the community as approved by the City Manager.

   b. Use of City-supplied water to wash sidewalks, streets, driveways, walkways, parking lots or other impervious surfaces except where necessary for public health or safety.
5. Use of City-supplied water to wash vehicles (including boats and watercraft) except at facilities equipped with water re-circulation equipment or where necessary for public health or safety (e.g., garbage trucks or food transport) or as required by law.

Customers will be notified of the City's voluntary restrictions request through newspaper, radio messages, or in a water bill, depending on the timing.

Stage 3: Severe Water Supply Shortage

A Stage 3 water shortage is reached when maximum production does not meet daily demand and reservoir storage falls to 80% capacity. The Water Utilities Management Team will assess the situation daily. The Director will notify the City Manager and City Council of the shortage and report on what measures the City has implemented. At Stage 3, the Director may declare a Water Emergency (see **Appendix D**, Municipal Code 3.01.251). The Public Works Department will keep the media notified regularly about the status of the shortage to keep its customers informed, and the Director may initiate the following restrictions:

All outdoor nonessential water use **shall be prohibited** except where necessary for public health or safety or as noted in the exceptions below. Violators may be cited and water service may be discontinued for repeat violations per Municipal Code 3.01.252 (See **Appendix D**). The following practices are deemed nonessential:

1. Watering or irrigation of lawns, grass or turf will not occur unless it is:
   - New lawn, grass or turf that has been seeded or sodded after March 1 of the calendar year in which the restrictions are imposed, and in such cases watering may only occur until the vegetation is established. Such watering shall occur only between 8 p.m. and 8 a.m.
   - Park and recreation areas of a particular significance and value to the community as approved by the City Manager. Such watering will occur only between 8 p.m. and 8 a.m.
2. Use of City-supplied water to clean, fill, or maintain levels in decorative streams, ponds, or fountains unless it has a recirculating water system.
3. Use of City-supplied water to fill swimming, wading, or other pools with a capacity in excess of 100 gallons. Water may be added to swimming pools to replace volume lost because of evaporation and normal loss resulting from usage.
4. Use of City-supplied water to wash down sidewalks, streets, driveways, walkways, parking lots, or other impervious surfaced areas except where necessary for public health or safety.

5. Use of City-supplied water to wash vehicles (including boats and watercraft) except at facilities equipped with water re-circulation equipment. Washing of vehicles for public health and safety purposes (e.g., garbage trucks or food transport) is allowed as required by law.

Customers will be notified of the prohibited practices through newspaper, radio messages, or in a water bill, depending on the timing.

Stage 4: Critical Water Shortage

A Stage 4 water shortage is reached when maximum production does not meet daily demand and reservoir storage falls to 60% capacity. A water shortage of this severity threatens the ability of the City to deliver essential water supplies to its customers and provide adequate water storage and pressure for fire suppression, such that the restrictions are **mandatory**.

The Director will notify the City Manager and City Council of the shortage and submit a report of what measures are being implemented. At Stage 4, the Director may declare a Water Emergency (see **Appendix D**, Municipal Code 3.01.251). The Public Works Department will keep the media notified regularly about the status of the shortage to keep its customers informed, and may initiate the following restrictions:

1. All outdoor nonessential water use shall be prohibited except where necessary for public health or safety. Violators may be cited and water service discontinued for repeat violations per Municipal Code 3.01.252 (see Appendix D). Good Samaritan Hospital and The Corvallis Clinic will be provided with water as long as possible.
2. All large industrial and institutional accounts will restrict water use to fire protection and other critical functions only.
3. Customers who receive water service from the City, but who reside outside the City limits may have their water service disconnected temporarily.
4. The Fire Department will modify operations as necessary to maintain stored water levels and system water pressure for as long as possible. The Public Works Department will work closely with the Fire Department to alert it of areas where there may be low pressures or supply.
5. In the event that a service level or other area of the City is without water, potable water will be made available at appropriate locations within the City limits. Water will be trucked to these sites and dispensed free of charge to City water customers.

The water emergency will be in effect until the Director notifies the City Manager when, based on the City Manager's direction, the water shortage is deemed over and an emergency situation no longer exists.

5. Municipal Water Supply Element

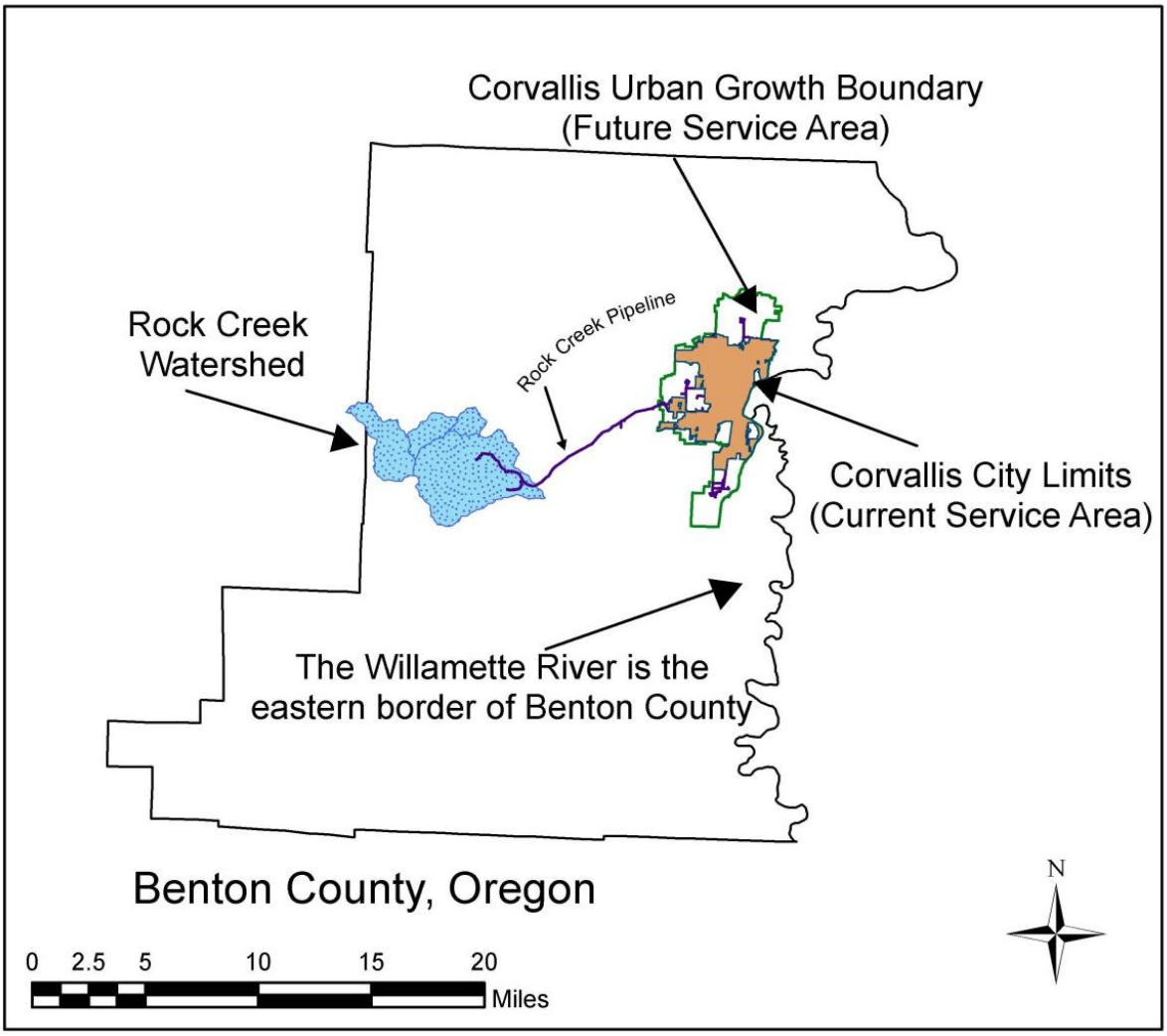
This section satisfies the requirements of OAR 690-086-0170.

This rule requires descriptions of the City's current and future water delivery areas and population projections, demand projections for 10 and 20 years, and the schedule for when the City expects to fully exercise its water rights. The rule also requires comparison of the City's projected water needs and the available sources of supply, an analysis of alternative sources of water, and a description of required mitigation actions.

Delineation of Water Delivery Areas
OAR 690-086-0170(1)

Exhibit 5-1 shows the City's future water delivery area, which is delineated by the UGB and includes the City's current water delivery area, and is described in Section 2.

EXHIBIT 5-1
City of Corvallis Current and Future Water Delivery Area



Population Projections
OAR 690-086-0170(1)

Exhibit 5-2 summarizes the City's projected water delivery area population within its current and future water delivery area (UGB) in the next 20 years**.** The UGB encompasses 28.1 square miles (17,965 acres), including the lands within the current City limits and several properties outside of the current City limits (the municipal airport and associated properties to the south and Crescent Valley High School to the north). Planning for the City's water distribution system is based on providing service to all areas within the UGB up to an elevation of 560 feet above msl.

EXHIBIT 5-2
Population Projections for the City's Water Delivery Area

Year	Projected Population
2010	55,370
2011	56,079
2012	56,797
2013	57,524
2014	58,260
2015	59,006
2016	59,761
2017	60,526
2018	61,301
2019	62,085
2020	62,880
2021	63,685
2022	64,500
2023	65,325
2024	66,162
2025	67,009
2026	67,866
2027	68,735
2028	69,615
2029	70,506
2030	71,408
2031	72,322
2032	73,248

The population projections are based on an average annual growth rate of 1.28% from 2000 to 2009 (Average annual growth rate=(((55,125-49440)/49440)*100)/9) using data from Portland State University's PRC, as shown in **Exhibit 5-3**. The highlighted years are the 10-year and 20-year projections.

EXHIBIT 5-3
Historical Population of the City's Water Delivery Area

Year	Population
2000	49,440
2001	51,040
2002	52,450
2003	52,950
2004	52,590
2005	53,165
2006	53,900
2007	54,890
2008	54,880
2009	55,125

Demand Forecast

OAR 690-086-0170(3)

Projected MDD often is used as an estimate of how much water a municipality uses on a peak day. The City uses the Taylor WTP to meet peak needs. The Taylor WTP records the daily volume that it produces (in mgd). Because the volume is produced in less than 24 hours, the hours of operation must be considered to estimate the instantaneous rate of diversion from the source. Therefore, to accurately reflect the City's projected water needs, both the volume of the projected MDD and the projected maximum day instantaneous rate of diversion from the Willamette River (in cfs) are included in this analysis.

The projected maximum day instantaneous rate of diversion from the Willamette River was estimated using the following steps:

1. Estimates of the projected MDD (volume) were calculated by multiplying the projected populations by the maximum day per capita demand of 304 gpcd during the period 2005 to 2009.
2. The ratio between the maximum day volume (stated as a rate) and the instantaneous rate of diversion (considering the length of time the WTP ran) then was calculated. This calculation was completed for notable peak days in the City's records and it revealed that the instantaneous rate of diversion was as much as 1.9 times greater than the total water production volume (stated as a rate) on a peak day. For example, on August 16, 2008, the Taylor WTP produced 11 MG. If the diversion was stated as a rate without regard to time, it would be 11 mgd. If, however, the calculation

reflects that the water was produced during 13 hours that day (rather than 24 hours), the instantaneous rate is 21 mgd. The ratio between these two rates (21:11) is 1.9. Given that the calculated instantaneous rates of diversion ranged from being essentially equal to water production (or a value of 1) up to 1.9 times greater, the middle value of that range of 1.45 was chosen as a reasonable ratio for planning purposes.

3. The estimates of the maximum day projected instantaneous rate of diversion from the Willamette River were calculated by multiplying the projected MDD (volumes) by the 1.45 ratio.

Demand from the City of Philomath is not included in the projected MDD because its water purchases will not account for more than 60 MG annually. This volume represents only 2% of the City of Corvallis' average annual water use from 2005 to 2009 and only approximately 0.3% of the City of Corvallis' water use in 2009. In addition, the City of Philomath has an interconnection with the Rock Creek WTP water supply, which is excluded from the projections based on assumptions that production limitations in the Rock Creek Watershed on peak days or loss of its use as a water source because of low flows in summer or contamination, Rock Creek WTP failure, or other triggers of water shortages described in Section 4.

Exhibit 5-4 shows the City's projected MDD and projected maximum day instantaneous rate of diversion from the Willamette River within its current and future water delivery area during the next 20 years calculated using the above described methods.

EXHIBIT 5-4
City of Corvallis Projected MDD and Projected Maximum Day Instantaneous Rate of Diversion from the Willamette River

Year	Population	Projected MDD (volume in MG)	Projected Instantaneous Rate of Diversion (mgd)	Projected Instantaneous Rate of Diversion (cfs)
2009	55,125	16.2	23.5	36.4
2010	55,370	16.8	24.4	37.8
2011	56,079	17.0	24.7	38.2
2012	56,797	17.3	25.0	38.7
2013	57,524	17.5	25.4	39.2
2014	58,260	17.7	25.7	39.7
2015	59,006	17.9	26.0	40.2
2016	59,761	18.2	26.3	40.8
2017	60,526	18.4	26.7	41.3
2018	61,301	18.6	27.0	41.8
2019	62,085	18.9	27.4	42.3
2020	62,880	19.1	27.7	42.9
2021	63,685	19.4	28.1	43.4
2022	**64,500**	**19.6**	**28.4**	**44.0**
2023	65,325	19.9	28.8	44.5
2024	66,162	20.1	29.2	45.1
2025	67,009	20.4	29.5	45.7
2026	67,866	20.6	29.9	46.3
2027	68,735	20.9	30.3	46.9
2028	69,615	21.2	30.7	47.5
2029	70,506	21.4	31.1	48.1
2030	71,408	21.7	31.5	48.7
2031	72,322	22.0	31.9	49.3
2032	**73,248**	**22.3**	**32.3**	**49.9**

Schedule to Exercise Permits and Comparison of Projected Need to Available Sources

OAR 690-086-0170(2) and (4)

As described in Section 2, the City currently holds eight surface water rights for municipal purposes. Certificate 59051 (25 cfs, 16.2 mgd), Certificate 84008 (18.3 cfs, 11.8 mgd), and Permit S-35551 (46.7 cfs, 30.2 mgd) authorize the use of Willamette River water, for a total of up to 90 cfs (58.2 mgd). Certificates 50182 (1.93 cfs, 1.25 mgd), 2356 (4 cfs, 2.59 mgd), 3245 (1.5 cfs, 0.97 mgd), and 33339 (4.7 cfs, 3.04 mgd)) authorize the use of water from the Rock Creek Watershed, for a total of 12.1 cfs (7.8 mgd). These surface water rights allow diversion of up to 102.1 cfs (66.0 mgd) for municipal purposes. Additionally, Certificate 33340 authorizes 257 AF of storage in the Rock Creek Watershed. The City also holds three groundwater rights (Certificate 24694, Certificate 37061, and GR-272) for municipal purposes. However, water quality issues have precluded their active use for municipal purposes, as described in Section 2.

For the purpose of further analysis of peak day demands, only the Willamette River water rights are considered because of the peak season production limitations in the Rock Creek Watershed and water quality issues with the City's municipal groundwater rights, as described in Section 2. Analyzing only the Willamette River water rights is also a means of ensuring sufficient water supply in case the Rock Creek Watershed source becomes unavailable for reasons described in Section 4, such as major transmission line breaks, sabotage, earthquakes, and a WTP system failure.

Exhibit 5-5 shows the City's projected MDD, projected MDD instantaneous rate of diversion from the Willamette River, and Willamette River surface water rights.

EXHIBIT 5-5
City of Corvallis Projected MDD, Projected MDD Instantaneous Rate of Diversion from the Willamette River, and Willamette River Surface Water Rights

Year	Population	Projected MDD (mgd)	Projected MDD Instantaneous Rate of Diversion (mgd)	Projected MDD Instantaneous Rate of Diversion (cfs)
2009	55,125	16.2	23.5	36.4
2010	55,370	16.8	24.4	37.8
2011	56,079	17.0	24.7	38.2
2012	56,797	17.3	25.0	38.7
2013	57,524	17.5	25.4	39.2
2014	58,260	17.7	25.7	39.7
2015	59,006	17.9	26.0	40.2
2016	59,761	18.2	26.3	40.8
2017	60,526	18.4	26.7	41.3
2018	61,301	18.6	27.0	41.8
2019	62,085	18.9	27.4	42.3
2020	62,880	19.1	27.7	42.9
2021	63,685	19.4	28.1	43.4
2022	**64,500**	**19.6**	**28.4**	**44.0**
2023	65,325	19.9	28.8	44.5
2024	66,162	20.1	29.2	45.1
2025	67009	20.4	29.5	45.7
2026	67,866	20.6	29.9	46.3
2027	68,735	20.9	30.3	46.9
2028	69,615	21.2	30.7	47.5
2029	70,506	21.4	31.1	48.1
2030	71,408	21.7	31.5	48.7
2031	72,322	22.0	31.9	49.3
2032	**73,248**	**22.3**	**32.3**	**49.9**

* Green = Use of Certificate 59051and Certificate 84008.
Purple = Use of Certificate 59051, Certificate 84008, and Permit S-35551.

As shown in **Exhibit 5-5**, the City will need to expand use of *extended permit* S-35551 by 2021 when the maximum day instantaneous rate of diversion will reach 43.4 cfs (28.1 mgd). The City is projected to reach an instantaneous rate of diversion of 49.9 cfs (32.3 mgd) by 2032, which will require the use of approximately 6.6 cfs (4.3 mgd) under Permit S-35551 to meet projected demand. Currently, the City does not have access to the undeveloped portion of

Permit S-35551. Therefore, the City is requesting access to 6.6 cfs of "green light water" under *extended permit* S-35551.

As stated in OWRD's June 15, 2010 Final Order approving the extension of time for Permit S-35551, the City anticipates that it will beneficially use the unperfected portion of the permit (46.7 cfs) by October 1, 2061.

Alternative Sources
OAR 690-086-170 (5)

OAR 690-086-0170(5) requires an analysis of alternative sources of water if any expansion or initial diversion of water allocated under existing permits is necessary to meet future water demand. The following subsections analyze the extent to which the City can meet its projected water need through other alternatives.

(a) Conservation Measures

As described in Section 3, the City is implementing a variety of water conservation measures to reach its stated water conservation goal of 2.1% annual water savings during the 20-year planning period (2010-2030) of the City's 2010 Water Use and Water Conservation Project report, which the City adopted as its goal in 2010. The goal is based on spending the proportional equivalent of the current conservation budget on an annual basis through 2030. This conservation goal involves the City using its current conservation budget to provide customers with 1.0 gpm bathroom aerators, 1.5 gpm showerheads, and toilet leak detection tablets, and to encourage customers to let their lawns go dormant in the summer. The cost per ccf saved during the measure life is estimated at $0.22. After 2030, the City intends to maintain a water conservation program, but the conservation goal will be reassessed.

Considering a 2.1% conservation savings, the City is projected to reach a maximum day instantaneous rate of diversion of 43.6 cfs (28.2 mgd) by 2023 and 48.9 cfs (31.6 mgd) by 2032. Under this scenario, the City will need to initiate diversion of water under Permit S-35551 in 2023 and will require up to approximately 5.6 cfs (4.3 mgd) under Permit S-35551 by 2032. Based on these demand projections, implementation of the City's conservation savings goals will delay, but will not eliminate, the need for additional water use under Permit S-35551. Given that the City's conservation savings goal of 2.1% may not be achieved despite its best efforts, the City is still requesting access to 6.6 cfs of "green light water" under *extended permit* S-35551.

(b) Interconnections

The City does not have interconnections that will reduce its need to expand its diversion of water under Permit S-35551. The City's interconnection with the City of Philomath only provides water to the City of Philomath and no other interconnection opportunities with other water suppliers are currently feasible.

(c) Cost effectiveness

OAR 690-086-170(c) requires an assessment of whether the projected water needs can be satisfied through other conservation measures that would provide water at a cost that is equal or less than the cost of other identified sources.

The City has a robust water conservation program, described in detail in Section 3. However, even if the City achieves annual water savings of 2.1% at a cost per ccf saved of $0.22 through its investments in water conservation, the City still is projected to need access to water under Permit S-35551 during the planning period, as described above**.** Furthermore, the analysis of conservation savings program options, described in the City's Water Conservation Opportunities Tech Memo, found that doubling the current conservation budget would only produce 2.3% annual water savings at a cost per ccf saved of $0.34. The conservation analysis further determined that implementing a large suite of conservation measures would only produce 4.2% water savings at a cost per ccf saved of $1.58. The average annual cost of the large suite of conservation would be 14 times greater ($267,000) than the average annual cost of the current conservation budget ($19,000). Neither of the more expensive water conservation program options precludes the need to initiate water use under Permit S-35551 before 2032.

In addition, the City's incremental cost of producing more water is $0.12 per ccf, less than the cost per ccf saved by implementing the majority of the conservation program options. The conservation analysis for a program focused on measures that cost less than the variable cost of production showed only a 0.2% water savings at a cost per ccf of $0.08.

Initiating water use under Permit S-35551 is the most cost-effective and achievable means of meeting the City's projected maximum day instantaneous rate of diversion. The implementation of conservation measures at equal or lower costs cannot eliminate the need to initiate water use under Permit S-35551.

Quantification of Maximum Rate and Monthly Volume
OAR 690-086-0170(6)

OAR 690-086-0170(6) requires a quantification of the maximum rate of withdrawal and maximum monthly use if any expansion or initial diversion of water allocated under an existing permit is necessary to meet demands in the 20-year planning horizon. As previously described, the projected maximum day instantaneous rate of diversion in 2032 without conservation savings is 49.9 cfs (32.3 mgd) and with 2.1% conservation savings is 48.9 cfs (31.6 mgd). Currently, the City only has access to up to 43.3 cfs from the Willamette River, which is the combined maximum authorized rate of Certificates 59051 and 84008. Consequently, within the next 20 years, the City will need to initiate diversion under Permit S-35551, regardless of whether conservation savings goals are met. Assuming those goals are not met, the City will need to divert up to 6.6 cfs (4.3 mgd) under Permit S-35551 by 2032.

Assuming that water is diverted under Permit S-35551 at a rate of 6.6 cfs (4.3 mgd), 24 hours per day for 31 days during the maximum month (likely July or August), the City's maximum monthly volume for this water right would be approximately 133 MG.

Mitigation Actions under State and Federal Law
OAR 690-086-0170(7)

Under OAR 690-086-0170(7), for expanded or initial diversion of water under an existing permit, the water supplier is to describe mitigation actions it is taking to comply with legal requirements of the Endangered Species Act, Clean Water Act, and other applicable state or federal environmental regulation. The City currently is not required to take any mitigation actions under state or federal law. The final order on the City's extension application for Permit S-35551, however, did include "fish persistence" conditions.

New Water Rights
OAR 690-086-0170(8)

Under OAR 690-086-0170(8), an analysis of alternative sources of additional water is required if acquisition of new water rights will be necessary within the next 20 years to meet the projected water demands. As shown in the above analysis, the City's water rights are sufficient to meet projected demands during the next 20 years, and consequently, the City currently has no plans to acquire additional water rights within that timeframe.

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Appendix A

Letters to Local Governments and Comments

From: Taratoot, Mark [mailto:Mark.Taratoot@ci.corvallis.or.us]
Sent: Tuesday, May 29, 2012 3:46 PM
To: Steckel, Mary; Gibb, Ken; VERRET Greg J; DIXON Jay; JARAMILLO Annabelle E; MODRELL Linda L; Randy Kugler
Cc: Penpraze, Tom; 'Suzanne Moellendorf'
Subject: Updated Water Management and Conservation Plan for the City of Corvallis
Importance: High

May 29, 2012

Dear Ms. Steckel, Mr. Gibb, Mr. Dixon, Ms. Jaramillo, Ms. Modrell, and Mr. Kugler:

The City of Corvallis has developed a Draft Updated Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rule Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier shall make its Draft Updated WMCP available for review by affected local governments and seek comments relating to consistency with the local governments' comprehensive land use plans. I have placed a PDF copy of the WMCP for your review is located on the City of Corvallis website. It will be available for 30 days and then removed. You can access the WMCP at the following URL: http://www.ci.corvallis.or.us/downloads/pw/Corvallis_WMCP_draft_May_2012.pdf

Please provide any comments to Tom Penpraze at Tom.Penpraze@corvallisoregon.gov within 30 days of the date of this e-mail, and please carbon copy the comments to me at Mark.Taratoot@corvallisoregon.gov. If the plan appears consistent with your agency's Comprehensive Land Use Plan, an e-mail to that effect would be appreciated.

If you have any questions, please feel free to contact Tom or me at 541-766-6916. Thank you for your interest.

Sincerely,

Mark Taratoot
Water Resources Specialist
City of Corvallis

--
Mark Taratoot
Water Resources Specialist
Corvallis Public Works
PO Box 1083
Corvallis OR 97339-1083
541-766-6916

From: Randy Kugler [mailto:philomath.admin@ci.philomath.or.us]
Sent: Monday, June 04, 2012 12:00 PM
To: Taratoot, Mark
Subject: FW: Updated Water Management and Conservation Plan for the City of Corvallis

Mark,

Thank you for the opportunity to comment. I am satisfied with what I see and my Public Works Director only had the following comment/question. If you could respond as to how you interpret this Section applying to our relationship, I would appreciate it. Otherwise, we look forward to continuing working together with Corvallis and appreciate access to this resource.

Regards,
Randy Kugler
City Manager

From: Kevin Fear
Sent: Friday, June 01, 2012 9:21 AM
To: Randy Kugler
Subject: RE: Updated Water Management and Conservation Plan for the City of Corvallis

I finished perusing this this morning.

I think the only question I would have would be on Section 4, page 4-6, Stage 4: Critical Water Shortage, #3 "Customers who receive water service from the City, but who reside outside the City limits may have their water service disconnected temporarily".
I'm not clear on whether this would refer to us or not. I would think that if Corvallis is in a critical water shortage, we would be too, unless some major catastrophe occurred to one of their treatment plants, but they do take them down in the summer for maintenance and seem to be fine with all their water rights and storage so I would think it would a be water shortage and it would affect us both.
Other than that I didn't see anything that really pertained to us.

From: Taratoot, Mark [mailto:Mark.Taratoot@corvallisoregon.gov]
Sent: Friday, June 15, 2012 12:07 PM
To: 'Randy Kugler'
Cc: Penpraze, Tom; Rigwood, Brian; Suzanne Moellendorf
Subject: RE: Updated Water Management and Conservation Plan for the City of Corvallis

Good afternoon Mr. Kugler,

Thank you for your review of our draft Water Management and Conservation Plan. I am pleased that the City of Philomath agrees our program planning is satisfactory.

Public Works Director Fear asked about a portion of the Water Curtailment Element (Section 4) that describes potential temporary service disconnection during a severe water supply shortage. Section 6.1 of the Intergovernmental Agreement for purchase of treated water speaks to that issue. Specifically, It states that:

> *Notwithstanding section 2.1, above, if CORVALLIS is not able to provide treated water in the quantity required by PHILOMATH due to drought, contamination, loss of permit, or other act of nature, god or third party, then the amount of water provided to PHILOMATH shall be curtailed in the same matter as set out in the CORVALLIS WATER CURTAILMENT PROGRAM, Exhibit A, for first level reductions for Corvallis ratepayers.*

The specific wording Mr. Fear asked about is taken directly from the Emergency Water Curtailment Plan. You can find the most current copy of the Water Curtailment Plan (revised March 2005) here: http://www.ci.corvallis.or.us/index.php?option=com_content&task=view&id=842&Itemid=2942

As the City of Corvallis strives to maintain sufficient water for the needs of all our customers, I hope to never see a time when the curtailment plan must be activated. To my knowledge, it was activated only once. That was during a time when our Taylor Water Treatment Plant maximum output was reduced due to new water quality regulations. We added a chlorine contact basin to the plant soon thereafter, and the plant was re-rated to a higher flow that should sustain our needs.

Thanks again to you and Mr. Fear for your thorough review of our plan.

--
Mark Taratoot
Water Resources Specialist
Corvallis Public Works
PO Box 1083
Corvallis OR 97339-1083
541-766-6916

Appendix B

City of Corvallis 2010 Water Use and Water Conservation Project

Report

City of Corvallis
Water Use and Water Conservation Project

August 2010

Prepared for

City of Corvallis

CORVALLIS
ENHANCING COMMUNITY LIVABILITY
THROUGH IMPROVED WATER QUALITY

Prepared by

GSI Water Solutions, Inc.

CH2MHILL

HDR

Section 3

Memorandum: Water Conservation Opportunities

Technical Memorandum

To:	**Mark Taratoot, Brian Rigwood, and Tom Penpraze; City of Corvallis**
From:	**Kelly O'Rourke; HDR**
CC:	**Ronan Igloria and Joe Miller; HDR**
	Adam Sussman and Suzanne Moellendorf; GSI
Date:	**June 25, 2010**
Subject:	**Water Conservation Opportunities** **HDR Project #139157**

HDR performed a water conservation analysis project for the City of Corvallis that resulted in this technical memorandum (Memorandum #3). The work was done as a sub-consultant to GSI Water Solutions, Inc. (GSI). The purpose of the project was to examine opportunities to enhance Corvallis' existing water conservation program. The scope of HDR's work focused on demand-side conservation measures. The information will be used to potentially refine the City's program and to update portions of its *Water Management and Conservation Plan*.

HDR is a national architectural, engineering and consulting firm with strong expertise in water utility planning, including water conservation planning. HDR has worked on a variety of conservation projects and tracks conservation techniques and trends nationally. Through our offices in Oregon and Washington, HDR has performed water conservation work for numerous Pacific Northwest utilities ranging from large regional water suppliers such as Seattle Public Utilities, to medium-sized utilities such as the City of Hillsboro, OR, to smaller utilities such as the City of Pullman, WA.

This technical memorandum is presented in the following three sections:

1. **Conservation Background:** This section provides an overview regarding water conservation, a summary of Corvallis' current water conservation efforts, and a discussion of the impacts of conservation on other utility functions or City departments.

2. **Analysis Methodology:** This section describes the methodology used to analyze the measures, describes the measures analyzed, documents key assumptions, and documents demographic and consumption data inputs.

3. **Results and Conclusions:** This section provides results of the initial analysis for each individual measure, provides results of four conservation "packages", and provides conclusions regarding the analysis.

1. Conservation Background

1.1. Conservation Overview

Water conservation is defined as the management of water resources so as to eliminate waste and maximize efficient use of the resource. Conservation can be divided into many categories, as shown in Table 1. It is important to understand these categories since the cost structure, longevity of savings, certainty of savings, and social impacts vary across the categories.

Table 1 Conservation Categories

Measures *(Saves water)*		Incentives *(Motivates Customers to save water)*		
Hardware	Behavior	Educational	Financial	Regulatory
More efficient equipment. *Example: Install high efficiency toilets.*	More efficient behaviors. *Example: Take shorter showers.*	Explain why and how to save water. *Example: Conservation tips brochure.*	Make saving water financially attractive. *Example: Use inverted block rate structure.*	Require conservation actions. *Example: Require retrofit to code upon resale.*

Conservation is first divided into two categories: measures and incentives. Measures save water in and of themselves, while incentives motivate customers to save water. Measures are divided into hardware and behavior. Hardware measures entail using more efficient equipment, while behavioral measures entail promoting behavior changes toward more efficient practices. Hardware measures tend to be more expensive, but have longer lasting savings and a higher certainty of savings, compared to behavioral measures. Incentives can be divided into three categories: educational, financial, and regulatory. Educational incentives explain why and how to save water. Financial incentives make saving water financially attractive. Regulatory incentives are mandatory requirements for conservation actions. Examples for each type of measure and incentive are provided in Table 1.

Conservation can be achieved on both the supply-side and demand-side. Supply-side conservation is associated with a utility's conveyance and distribution infrastructure such as leak detection and repair. Demand-side conservation is associated with the water user such as homeowners installing high efficiency toilets.

A utility's conservation program should reflect the reasons why the utility is implementing conservation and the utility's water use patterns. Typical conservation drivers include: 1) meeting regulatory requirements, 2) demonstrating stewardship, 3) decreasing operating costs, 4) deferring/avoiding capital costs, and 5) extending available supplies. The utility's conservation drivers and water use patterns shape which measures and incentives to implement, the saving goal, the appropriate budget, and whether to focus on supply-side or demand-side efforts.

Table 2 shows how a utility's conservation driver determines the strategy for its conservation program.

Table 2 Conservation Driver Determines Conservation Strategy

Conservation Driver	Conservation Program Strategy
Meet Regulatory Requirement	Implement the required level of conservation.
Demonstrate Stewardship	Implement more than the required level of conservation.
Decrease Operating Costs	Implement conservation that is more cost-effective than the variable cost of supplying water.
Defer/Avoid Capital Costs	Implement the amount of conservation necessary to obtain the savings required to defer/avoid capital costs.
Extend Available Supplies	Implement conservation that is more cost-effective than the cost of developing new traditional supply.

1.2. Corvallis' Current Conservation Program

Corvallis' primary driver for implementing a conservation program is to apply sound stewardship of the water resource. The City has sufficient water rights and infrastructure capacity, and the water source has sufficient capacity, to accommodate current demands as well as anticipated future demands for some time.

Corvallis' current conservation program is well rounded in that it features both supply-side and demand-side efforts and includes both measures and incentives. Major elements of the plan include: water use audits, meter accuracy testing, leak detection, inverted block rate structure, water conservation measure rebate programs, and public education and outreach. The City's *Water Management and Conservation Plan*, developed in conformance with the requirements specified in Oregon Administrative Rules Chapter 690, Division 086, was approved by the Oregon Water Resources Department in September 2007.

A summary of the demand-side conservation measures currently being implemented is provided below. A more detailed summary of Corvallis' entire conservation program can be found in the *Existing Conservation Measures Memorandum* prepared by GSI.

- Residential clotheswasher rebates
- Residential bathroom faucet aerators - 1.0 and 1.5 gallon per minute (gpm)
- Residential kitchen faucet aerators - 1.5 and 2.2 gallon per minute (gpm)
- Residential showerheads - 1.5 gpm
- Residential high efficiency toilet rebates - 1.28 gallons per flush
- Residential toilet leak detection
- Residential outdoor irrigation audits.
- Residential and non-residential water audits.

The measures focus on residential customer categories since single family and multifamily customers constitute the majority of water use in the City's service area. Corvallis communicates program goals and elements through the City's website, the City's monthly newsletter, the annual water quality report, community festivals, and messages on "city services" bills.

The budget for the City's conservation program is currently approximately $30,000 annually. That budget number covers direct (e.g., rebates) and indirect (e.g., marketing) costs, but does not include staffing costs.

Given Corvallis' conservation driver of stewardship, the City appears to be implementing a reasonable conservation program. However, if desired by utility management, the implementation level of these measures could be raised by increasing marketing activities and allocating additional budget in order to increase the number of participants.

1.3. Impacts on Other Utility Functions or City Departments

A water conservation program has the potential to impact other utility functions or City departments. Therefore, conservation programs should be carefully planned and implemented in coordination with those utility functions or departments.

Conservation affects the water utility's revenues, since the commodity portion of the water bill is linked to customers' water consumption. The wastewater utility bill is also based on water consumption.

In theory, conservation programs with significant savings could reduce wastewater flows that will have an impact on that utility's revenues. This can also have an unintended impact on wastewater piping system hydraulics, and can cause pipe blockages, resulting in service disruption and increased maintenance costs. However, the water savings would have to be considerable to have this effect.

Coordination with the Parks department might be necessary in order to show the community that the City is doing its own part to use water efficiently. The Parks department is the largest City owned water user, primarily for park and recreation area turf watering. An aggressive water conservation program implemented here could result in substantial summer water savings. Additionally, since the Parks department does not pay for its water use, water savings from Parks would not result in decreased revenue and in fact would result in less wear and tear and associated operations and maintenance costs on the water system.

The impacts of a conservation program on revenue are typically the most important cross-utility issue. Therefore, a discussion of this topic is provided below.

Corvallis currently has an increasing block rate structure in place for all of its revenue generating water customers, with the block sizing and pricing varying by customer class (i.e., single family, multifamily, commercial, and irrigation). Given this rate structure, a further reduction in consumption by Corvallis' customers could result in a revenue reduction for the water utility that might require rate adjustments to offset, to provide sufficient revenue to meet the utility's fixed costs to operate and maintain the infrastructure (plants, pipes, pumps, tanks) and meet overhead costs (operation and maintenance staff, meter reading, billing, administrative service charges).

In addition, given that wastewater services are billed based on water consumption, it would be prudent to review the possible impacts to the wastewater utility revenues.

The City charges the water and wastewater utilities a 5% franchise fee based on metered consumption that is paid into the City's General Fund. A reduction in utility revenue will also result in a reduction in franchise fees.

The measures analyzed for this project apply to all customers and apply to both indoor and outdoor use. Some of the measures apply year round and others only apply during the outdoor watering period. The reduction in consumption due to conservation will vary by customer class and measure.

Corvallis' single family, multifamily, and irrigation rate structure is a three block increasing rate structure. For the multifamily rate structure, the size of the blocks adjusts with larger meter sizes. The single family and irrigation block sizes do not adjust. Given the types of measures under consideration, it is reasonable to expect that Corvallis would see a reduction in all three of the blocks for the single family customers. Block 3 is where Corvallis can achieve the most savings given this is typically outdoor watering and more discretionary in nature. Outdoor watering is also the area where most customers become more inefficient in their use as a result of not having appropriate irrigation systems, efficient systems, or watering habits.

Corvallis' commercial customer rate structure is a two block increasing rate structure depending on the size of the meter. As the meter size increases, the size of the blocks increases to reflect greater usage. Generally speaking, businesses attempt to be efficient water users to minimize costs. As a result, the impact to commercial consumption may be less than the reduction in single family/multifamily consumption.

For modest conservation programs with modest levels of water savings, the resulting revenue impact would be minimal. However, aggressive conservation programs with high levels of water savings can have significant impacts to revenue and rate adjustments may be necessary to meet necessary revenue levels.

In order to determine the actual revenue impacts of a particular conservation program, and to mitigate against those impacts by proper rate structure design, a detailed review of the revenue generation of each consumption block with assumed conservation savings would need to be developed.

2. Analysis Methodology

2.1. Basic Method

The methodology for determining water savings and costs for Corvallis is generally the same for all conservation measures. The basic method is to compile demographic information for Corvallis' service area, apply assumptions for customer participation rates for each conservation measure, calculate the savings achieved by shifting to more efficient hardware or behavior, and calculate the costs for those shifts.

HDR's proprietary Water Conservation Measure Analysis Model was used for this analysis. The model is an Excel-based tool that estimates the water savings and costs for various demand-side water conservation measures. The spreadsheet is pre-loaded with a set of commonly analyzed conservation measures. The spreadsheet is then customized for clients by entering client-specific data (e.g., planning period, demographics, water consumption) and selecting

which of the pre-loaded measures should be analyzed. The spreadsheet analyzes the measures and provides summary tables and graphs. Various program "packages" can also be created based on the analyzed measures.

The initial results from the model are simply the outcomes of the analysis for every conservation measure, considered independently of the other measures. Those results, by themselves, do not tell Corvallis which measures should be implemented. In addition, those results cannot be summed up, because different measures may have overlapping water savings. The initial results must be coupled with Corvallis' conservation driver and screened through various criteria in order to determine which measures and/or groups of measures ("packages") are most appropriate for Corvallis.

The screening criteria that can be used to evaluate the measures include the following:

- **Available Program Budget:** The conservation program budget impacts program choices. Corvallis has a current conservation budget of approximately $30,000 annually.

- **Magnitude of Annual Water Savings:** This is the annual savings in gallons per day at full implementation.

- **Magnitude of Peak Season Water Savings:** This is the peak season savings in gallons per day at full implementation. Note that peak season savings are obtained from both measures that obtain year round savings (e.g. toilet rebates) and measures that only obtain savings during the peak season (e.g., irrigation system controllers).

- **Cost Effectiveness:** The cost-effectiveness of measures can range widely. For Corvallis, it ranges from $0.07 to $102.74 per ccf of saved water. Typically indoor measures are more cost-effective than outdoor measures.

- **Customer Categories:** It may, or may not, be preferable to provide programs for each customer category (i.e., single family, multifamily, non-residential).

- **Certainty of Savings:** Measures that focus on hardware have a higher certainty of savings compared to measures that focus on behavior. Once a customer installs a piece of hardware (e.g., high-efficiency showerhead), the savings are generally assured for the lifespan of that hardware. However, if a customer enacts a water saving behavior (e.g., taking shorter showers), it is easy for the customer to convert back to their non-conserving behavior.

- **Administrative Complexity:** The impact on staff workload should be considered. Measures that could be implemented together (e.g., single family showerheads and single family bathroom faucet aerators) may have added value in workload efficiencies (as well as in cost efficiencies).

- **Customer Acceptance:** Certain measures may have higher customer acceptance. For example, when measures with different flow rates are analyzed, typically the models with higher flow rates have higher customer acceptance.

Corvallis' primary conservation driver of demonstrating stewardship guides their conservation strategy in that the City's conservation program should ideally be more robust than the state requirements. However, the exact level beyond the state requirements is not defined and is a

subjective determination. Therefore, the Conservation Model's "package tool" was used to group subsets of measures that represent potentially desirable scenarios. The following four packages were developed for Corvallis.

- **Package #1 – Conservation Potential Assessment:** This package was designed to show the maximum water savings available, given certain assumptions such as participation rates. This package is intended to provide a bookend of the high end of potential savings. This package was assembled by including all of the analyzed measures, except that certain mutually exclusive measures have been omitted.

- **Package #2 – Current Conservation Budget**: This package was designed to reflect the most cost-effective use of Corvallis' current conservation budget, given the analyzed measures. The package has an average cost of approximately $30,000 a year during the five-year initial implementation period. This package was assembled primarily by ranking measures by their cost-effectiveness and adding measures to the package based on cost-effectiveness until the $30,000 level was met. However, issues related to program complexity and customer acceptance were also incorporated.

- **Package #3 – Double Current Conservation Budget:** This package was designed to reflect an enhanced level of conservation by doubling the current conservation budget. This package was assembled using the same process as for Package #2, except that the budget level was set at approximately $60,000 per year during the five-year initial implementation period.

- **Package #4 – Less Than Variable Cost of Production:** This package was designed to reflect conservation measures that cost less than the variable cost of production. The cost of production includes both fixed and variable costs. Fixed costs are those that do not vary based on the volume of water produced. Examples include staff salaries and debt obligations. Variable costs include those that do vary based on the volume of water produced. Examples include chemical and energy pumping costs. Any conservation that can be implemented for less than the variable cost of production will save Corvallis money. According to the City's *Water Management and Conservation Plan, Appendix 16*, Corvallis' variable cost of production is $0.12 per ccf. Therefore, this package was assembled by including all conservation measures with a cost-effectiveness better than $0.12 per ccf of saved water.

2.2. Measures Analyzed

A total of 25 measures were analyzed for the project. These measures were selected because they: 1) are the measures most commonly implemented both nationally and in the Pacific Northwest, 2) typically have the highest customer acceptance levels, and 3) typically are the most cost-effective measures. The measures are described below.

- **Clotheswashers - Efficient Residential Capacity (In Unit)**: Provide partial rebates to replace less efficient residential-capacity clotheswashers (located in housing units) with more efficient models. The participation rate for this measure was set at 25%.
- **Clotheswashers - Efficient Residential Capacity (Common Area):** Provide partial rebates to replace less efficient residential-capacity clotheswashers (in common laundry areas) with more efficient models. The participation rate for this measure was set at 25%.

- **Clotheswashers - Efficient Commercial Capacity:** Provide partial rebates to replace less efficient commercial-capacity clotheswashers with more efficient models. The participation rate for this measure was set at 25%.
- **Clotheswashers - Decrease Partial Loads:** Encourage customers to reduce partial loads of laundry, thereby reducing the number of loads by 10%. The participation rate for this measure was set at 10%.
- **Faucets - 0.5 gpm Bathroom Aerators (Residential):** Provide free 0.5 gpm bathroom faucet aerators, which for the residential customer category is more efficient than the maximum of 2.5 gpm allowed under the plumbing code. The participation rate for this measure was set at 10%.
- **Faucets - 0.5 gpm Bathroom Aerators (Non-Residential):** Provide free 0.5 gpm bathroom faucet aerators, which for the non-residential customer category is the maximum allowed under the plumbing code. Brings non-code customers up to code. The participation rate for this measure was set at 30%.
- **Faucets - 1.0 gpm Bathroom Aerators:** Provide free 1.0 gpm bathroom faucet aerators, which for the residential customer category is more efficient than the maximum of 2.5 gpm allowed under the plumbing code. The participation rate for this measure was set at 25%.
- **Faucets - 1.5 gpm Bathroom Aerators:** Provide free 1.5 gpm bathroom faucet aerators, which for the residential customer category is more efficient than the maximum of 2.5 gpm allowed under the plumbing code. The participation rate for this measure was set at 25%.
- **Faucets - Decrease Use:** Encourage customers to reduce unnecessary faucet use, such as running the water while brushing teeth, thereby reducing combined bathroom and kitchen faucet use by 10%. The participation rate for this measure was set at 10%.
- **Showerhead 1.5 gpm:** Provide free 1.5 gpm showerheads, which is more efficient than the maximum of 2.5 gpm allowed under the plumbing code. The participation rate for this measure was set at 25%.
- **Showerhead 2.0 gpm:** Provide free 2.0 gpm showerheads, which is more efficient than the maximum of 2.5 gpm allowed under the plumbing code. The participation rate for this measure was set at 25%.
- **Showerheads - Decrease Use:** Encourage customers to reduce showering time by 10%. The participation rate for this measure was set at 10%.
- **Spray Valves - 1.25 gpm Pre-Rinse Spray Valve:** Provide free, direct installation of 1.25 gpm pre-rinse spray valves, which is more efficient than the maximum of 1.6 gpm allowed under the plumbing code. Pre-rinse spray valves are used in commercial kitchens to rinse dishes prior to loading into dishwashers**.** The participation rate for this measure was set at 95%.
- **Toilets - 1.28 gpf High Efficiency Toilets (HET):** Provide partial rebates to install High Efficiency Toilets (HETs), which is better than the maximum of 1.6 gpf allowed under the plumbing code. HETs are defined as toilets flushing at a maximum of 1.28 gpf. HETs include both dual flush toilets and pressure assist tank style toilets. The participation rate for this measure was set at 10%.

- **Toilets - 1.6 gpf Ultra Low Flow Toilets (ULFT):** Provide partial rebates to replace less efficient toilets with 1.6 gpf Ultra Low Flow Toilets (ULFT), which is the maximum allowed under the plumbing code. Brings non-code customers up to code. The participation rate for this measure was set at 30%.
- **Toilets - Decrease Flushes:** Encourage customers to reduce unnecessary toilet flushing, such as flushing trash, thereby reducing toilet flushes by 10%. The participation rate for this measure was set at 10%.
- **Toilets - Leak Detection:** Provide free toilet leak detection dye tablets to determine if toilets leak and provide information on how to fix leaks. The participation rate for this measure was set at 25%.
- **Urinals - Waterless Models:** Provide partial rebates to install waterless urinals, which is better than the maximum of 1.0 gpf allowed under the plumbing code. The participation rate for this measure was set at 5%.
- **Urinals - 0.5 gpf Models:** Provide partial rebates to install 0.5 gpf urinals, which is better than the maximum of 1.0 gpf allowed under the plumbing code. The participation rate for this measure was set at 25%.
- **Urinals - 1.0 gpf Models:** Provide partial rebates to replace less efficient urinals with 1.0 gpf urinals, which is the maximum allowed under the plumbing code. Brings non-code customers up to code. The participation rate for this measure was set at 30%.
- **Irrigation Controllers - ET Model:** Provide partial rebates for evapotranspiration (ET) based irrigation controllers, which link irrigation to weather conditions. The participation rate for this measure was set at 25%.
- **Irrigation Controllers - Rain Sensors:** Provide free rain sensors, which turn off automatic irrigation systems when it is raining. This is only applicable to irrigation systems that can use rain sensors. The participation rate for this measure was set at 25%.
- **Lawn Dormant:** Encourage customers to let their lawn go dormant in the summer. It should be noted that allowing lawns to go dormant during the summer does not eliminate lawn watering completely. Dormant lawns still require some water to stay alive. The participation rate for this measure was set at 10%.
- **Outdoor Audit:** Provide free irrigation audits to improve the efficiency of irrigation systems. Efficiencies can be achieved through hardware improvements or operational changes. The audits are performed by a contracted professional landscape irrigation auditor. The participation rate for this measure was set at 25%.
- **Outdoor Irrigation Kits:** Provide free outdoor irrigation kits with devices and information to improve the irrigation efficiency of manual irrigation techniques. Kits typically include items such as a watering timer and shut-off device, a spring-loaded hose nozzle, a rain gauge, hose washers, and a conservation brochure. The participation rate for this measure was set at 25%.

2.3. Key Assumptions

There are several key assumptions that are fundamental to the analysis. Those assumptions are explained below.

- **Planning Period:** A planning period of 2012 to 2031 (twenty years) was used. The planning period is the period of interest for analyzing water conservation savings and costs. The planning period is different than the initial implementation period (see below). For example, Corvallis may distribute showerheads for five years (the initial implementation period), but may be interested in seeing how the savings and costs associated with those showerheads play out over 20 years (the planning period).

- **Initial Implementation Period:** An initial implementation period of 2012 to 2016 (five years) was used. The initial implementation period is the period when the conservation program will be implemented (aside from any renewals, see below). The initial implementation period is for the entire conservation program (i.e., all measures), rather than for any individual measure (e.g, just high-efficiency showerheads). Therefore, the last year of the initial implementation period is the last year that any one measure is initially implemented. A multi-year implementation period reflects the budgetary and administrative reality that Corvallis would most likely not implement all measures immediately.

- **Implementation Schedule:** A steady, even-paced implementation schedule was assumed for all measures. The implementation schedule is the rate at which the measures are implemented during the initial implementation period. Since the initial implementation period is five years, this means that measures were applied to 20% of the potential customers each year until they reach full implementation in the fifth year. This means that the gallons per day savings increase over the first five years, then remain constant. An even implementation provides a consistent program budget for each year in the initial implementation period.

- **Renew Measure:** Measures are renewed if necessary to maintain savings over the planning period. Measure renewal is necessary if the measure lifespan is shorter than the planning period and if Corvallis wants to maintain the savings during the planning period. For example, the outdoor audit measure has a lifespan of five years, which means that since Corvallis' planning period is 20 years, the savings from the outdoor audits will disappear after five years unless Corvallis renews the measure and gives customers another outdoor audit in five years. Measure renewal has the benefit of maintaining savings, however it means that Corvallis pays to implement a measure more than once to the same customer.

- **Participation Rates:** Participation rates were selected to represent moderate program implementation levels. In the modeling analysis, participation rates represent the percent of target customers (those with the applicable hardware or behavior that have not already implemented the measure) that participate in the program. For example, for the HET toilet measure, the participation rate is the percent of customers that do not already have a HET toilet that are assumed to participate in Corvallis' HET toilet program. Participation rates are dependent on many factors including marketing and distribution techniques. Moderate level marketing and distribution techniques were assumed for the analysis.

  The participation rates are a subjective assessment of the relative attractiveness of the measures to customers. The rates were established using professional judgment based on HDR's experience with other communities. The following participation rates were used for the analysis:

- 5% = unattractive to customers
- 10% = not very attractive to customers
- 25% = fairly attractive to customers
- 30% = very attractive to customers

- **Free Riders:** The concept of free ridership was addressed in the analysis. Free riders are customers that participate in Corvallis' conservation program, even though they would have implemented the measure anyway. For example, a free rider is a customer who takes a rebate for an efficient clotheswasher, but who was going to buy that clotheswasher regardless of whether Corvallis offered a rebate program.

  When free ridership is addressed in the analysis, the savings associated with free riders are excluded from the cost-effectiveness calculations, which provides a more accurate representation of the true cost-effectiveness of the conservation program. This impacts two values in the model: 1) "Savings For All Customers Over Measure Life (ccf)" and 2) "Cost per ccf Saved Over Measures Life." Those two numbers do not include water savings from free riders. Aside from those two numbers, all other numbers in the model include effects from free riders.

  The free ridership percentages are a subjective assessment of the relative level of free ridership for measures. The percentages were established using professional judgment based on HDR's experience with other communities. The following free ridership percentages were used for the analysis:

  - 5% = no reason to assume much free ridership
  - 15% = higher level of free ridership is expected
  - 25% = measures bringing customers up to current plumbing code

2.4. Consumption and Demographic Data Inputs

Consumption Data

The water consumption data required for the Conservation Measure Analysis model are provided in Table 3. Water consumption data is used to calculate the Peak Season Increased Use (PSIU), which is the annual amount of water used in the summer months above the base use (i.e., winter water average use). The PSIU is used in the savings formulas for outdoor measures. Three years of water consumption data for Corvallis is provided in Table 3. A graphical representation of that data, including the distinction between base use and the PSIU, is provided in Figure 1, Figure 2, and Figure 3.

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Table 3 Corvallis Water Consumption (gallons)

Month	Single Family[1]			Multifamily[2]			Non-Residential[3]		
	2007	2008	2009	2007	2008	2009	2007	2008	2009
Jan	50,262,595	48,399,078	50,890,999	31,054,379	29,384,620	32,848,323	68,594,037	63,259,336	66,411,081
Feb	55,232,223	50,507,972	50,610,461	37,172,341	34,725,306	34,595,885	72,202,872	135,902,838	63,995,466
Mar	47,790,872	47,869,423	48,627,996	33,534,331	33,533,583	35,717,286	65,985,412	66,013,092	63,648,348
Apr	47,143,766	46,208,641	45,985,707	31,885,518	31,869,808	33,306,160	66,114,834	65,772,204	63,052,860
May	53,760,710	52,736,561	50,899,228	35,263,938	35,572,155	34,122,337	71,786,180	72,274,689	62,904,737
June	86,231,243	70,554,807	68,063,634	42,034,991	36,606,777	36,194,574	101,888,976	86,222,266	75,698,743
July	121,090,458	113,876,530	111,695,819	45,567,519	44,699,723	44,551,599	119,679,542	118,950,892	105,077,378
Aug	143,193,821	150,666,592	142,038,007	48,227,763	47,617,313	47,395,127	142,341,735	146,363,521	143,926,959
Sep	144,291,284	132,737,627	140,439,317	49,732,192	46,305,894	48,346,711	141,570,444	134,748,520	134,565,984
Oct	102,803,902	108,510,409	105,041,469	42,407,545	44,749,846	43,846,889	116,542,759	122,370,458	103,573,697
Nov	58,282,227	65,926,313	69,740,126	33,746,791	39,349,312	39,343,327	80,244,198	92,204,073	78,597,630
Dec	53,285,667	52,574,972	51,972,003	35,349,221	35,733,745	36,103,306	69,493,253	67,655,172	64,134,613
Total	**963,368,767**	**940,568,924**	**936,004,766**	**465,976,528**	**460,148,081**	**466,371,525**	**1,116,444,241**	**1,171,737,060**	**1,025,587,496**

1. Includes all billing categories that are single family in nature.

2. Includes multifamily and fraternity/sorority.

3. Includes various commercial categories, city facilities, and schools.

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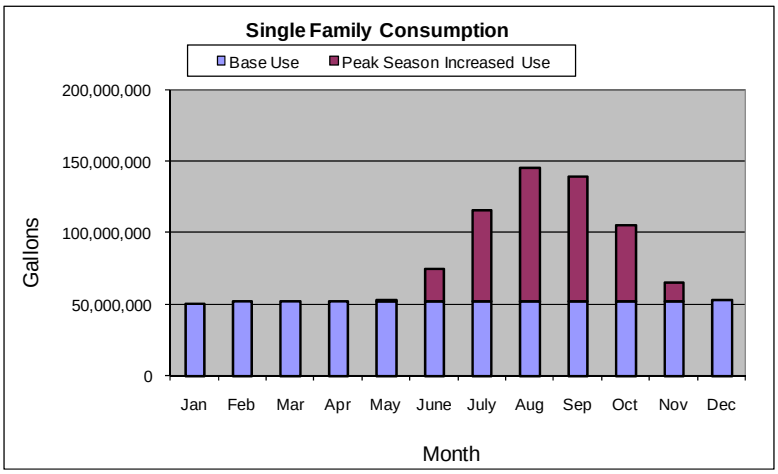

Figure 1 Single Family Consumption

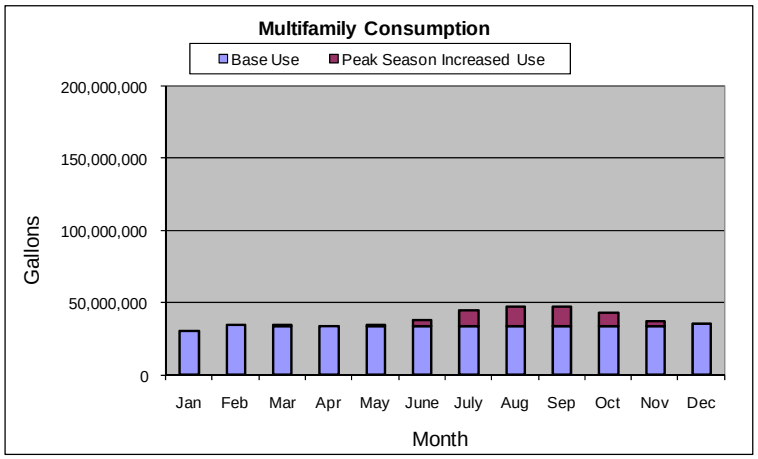

Figure 2 Multifamily Consumption

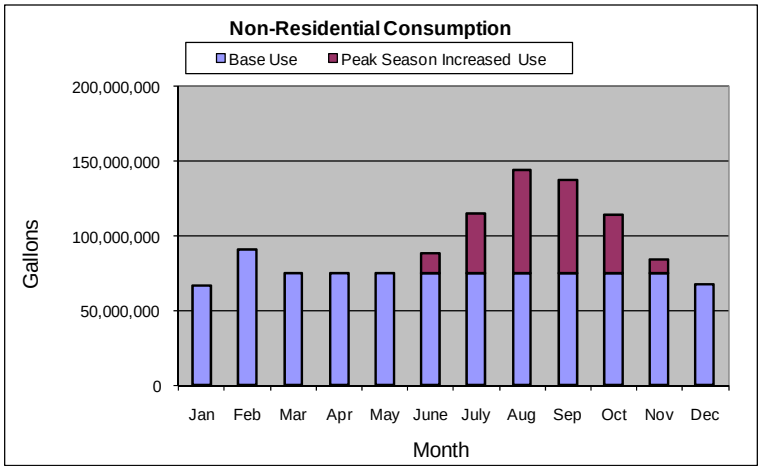

Figure 3 Non-Residential Consumption

Demographic Data

The demographic data required for the Conservation Measure Analysis model are provided in Table 4. These data were developed by GSI, Inc. using information from City of Corvallis staff, as well as other sources.

Table 4 Demographics

Demographic Unit	First Initial Implementation Year ("Existing" Demographics)		Last Initial Implementation Year		Change Between First and Last Year ("Future" Demographics)	
Year	2012	a	2016	a	5	h
Single Family Households (SF HH) and Accounts	12,923	b	13,565	b	642	h
Persons Per SF HH	2.26	c	2.26	c	0.00	h
Multifamily Households (MF HH)	10,671	d	11,202	d	531	h
Multifamily Accounts	1,407	e	1,477	e	70	h
Persons Per MF HH	2.26	c	2.26	c	0.00	h
Non-Residential (NR) Accounts	1,958	f	2,055	f	97	h
Employees	40,747	g	41,091	g	344	h
Employees Per NR Account	21	h	20	h	-1	h

Footnotes:

a. Provided by client via Measure Selection worksheet.

b. Provided to HDR by GSI: Based on data from utility billing system. Used the Single Family Accounts 2009 average and applied the 2000-2009 average annual growth rate of 1.22% from Portland State University Population Research Center data for the 2012 and 2016 projections.

c. Provided to HDR by GSI: Number from US Census. (Note: It is understood from City of Corvallis staff that this number is a weighted average that takes into account that OSU students are not present year round.)

d. Provided to HDR by GSI: Based on data from Land Development Information Report (August 2008), pg 13. Applied the 2000-2009 average annual growth rate of 1.22% from Portland State University Population Research Center data, for the 2012 and 2016 projections for the 2012 and 2016 projections.

e. Provided to HDR by GSI: Based on 2009 data from utility billing system. Used the Multifamily Accounts 2009 average and applied the 2000-2009 average annual growth rate of 1.22% from Portland State University Population Research Center data for the 2012 and 2016 projections.

f. Provided to HDR by GSI: Based on 2009 data from utility billing system. Used the Non-residential Accounts 2009 average and applied the 2000-2009 average annual growth rate of 1.22% from Portland State University Population Research Center data for the 2012 and 2016 projections.

g. Provided to HDR by GSI: Based on data from the Bureau of Labor Statistics (BLS) within the United States Department of Labor. Interpolated the 2012 & 2016 values using the BLS annual average employment data from 2000-2009. Note that several data sources were considered for this information including: 1. Corvallis Buildable Land Inventory and Land Need Analysis (1998), 2. US Census (2000), 3. US Census 2006-2008 American Community Survey (2008), 4. US Bureau of Labor Statistics (2009), 5. Corvallis Buildable Land Inventory and Land Need Analysis (1998), and 6. Oregon Employment Department Workforce Analysis Benton/Linn Trends (May 2010). The data was not consistent across the sources. In particular, the US Census numbers were considerably lower than the rest of the sources. The US Bureau of Labor Statistics data was used since the BLS specializes in employment evaluation and the data was fairly current.

h. Calculation.

3. Results and Conclusions

3.1. Initial Results for Individual Measures

The results of the initial analysis for each individual measure are provided in Table 5. (The table is located at the end of this Tech Memo since it is 11 x 17 in size.) The results represent the highest level of water savings (and associated costs) that can be expected from each analyzed measure, given certain assumptions such as participation rates. It should be noted that additional savings might be obtainable from measures not included in the model, such as supply-side measures (e.g., leak detection) or more aggressive demand-side measures, however that would require continued spending.

The savings and costs in Table 5 cannot be totaled since there is some overlap due to mutually exclusive measures. For example, the analysis includes 0.5, 1.0, and 1.5 gpm faucet aerator measures. Those measures were analyzed independently of each other. Corvallis would most likely choose to implement only one of those measures, therefore the savings and costs from the non-selected measures need to be disregarded. If Corvallis implemented all three measures, the participation rates (and thus savings and costs) for all three measures would need to be reduced. (See Section 3.2 for a package that omits overlapping measures.)

There are four sets of mutually exclusive measures, as described below:

- **Mutually Exclusive Set #1 – Residential Bathroom Faucet Aerators:** Three versions of residential bathroom faucet aerators were analyzed: 0.5 gpm, 1.0 gpm, and 1.5 gpm. All three versions are more efficient than the plumbing code of 2.5 gpm.

- **Mutually Exclusive Set #2 - Showerheads:** Two versions of showerheads were analyzed: 1.5 gpm and 2.0 gpm. Both versions are more efficient than the plumbing code of 2.5 gpm.

- **Mutually Exclusive Set #3 – Toilets:** Two versions of toilets were analyzed: 1.28 gpf and 1.6 gpf. The 1.6 gpf version brings customers up to the plumbing code and the 1.28 gpf version goes beyond code.

- **Mutually Exclusive Set #4 - Urinals:** Three versions of urinals were analyzed: waterless, 0.5 gpf, and 1.0 gpf. The 1.0 gpf version brings customers up to the plumbing code, while the other two versions go beyond code.

Key definitions related to Table 5 (as well as Table 6 to Table 9) are provided below:

- **Participating Customers:** The number of customers with the applicable fixture or behavior that have not already implemented the measure and that participate in the program. For example, the number of single family households with showers that do not already have an efficient model that participate in the utility's showerhead program.

- **Savings Generating Customers:** The number of customers that generate savings. For measures that only require one step to achieve savings (e.g., toilet rebates), this is the same as the number of participating customers. For measures that require two steps to achieve savings, this is the number of customers that perform both steps and

therefore achieve the savings. For example, the number of single family households that take the utility's showerhead and follow through and install it.

- **Devices / Rebates / Audits:** The number of devices, rebates, or audits that will be distributed or performed. For example, the number of toilet rebates. This number can be higher than the number of participating customers since often there are multiple fixtures per customer and due to renewals.

- **Savings For All Customers At Full Implementation (gpd):** This is the gallons per day savings for all customers once the program has been fully implemented. This value is presented for both the average annual and peak season time periods.

- **Savings For All Customers Over Measure Life (ccf):** This is the total savings, in 100s of cubic feet, that are obtained by the measure over the measure lifespan (or multiple lifespans if the measure is renewed). This is the savings number that is used to calculate the cost-effectiveness of the measure.

- **Total Cost Over Planning Period:** This is the total cost for a measure over the planning period and includes direct and indirect costs, including the impacts of renewals if applicable. Direct costs include costs related to devices, rebates, and audits. Indirect costs include costs related to marketing and distribution. Note that staff costs are not included in the costs. This number is a key input to the measure cost effectiveness calculation.

- **Cost per CCF Saved Over Measure Life:** This is the cost effectiveness of the measure. It is calculated by dividing the "Savings For All Customers Over Measure Life (ccf)" into the "Total Cost Over Planning Period." This number can be used to compare measures to one another, or to compare conservation to other sources of supply.

3.2. Package #1 – Conservation Potential Assessment

As described previously, this package was designed to show the maximum water savings available, given certain assumptions such as participation rates. This package is intended to provide a bookend of the high end of potential savings. As described previously, this package omits certain mutually exclusive measures. This allows the results to be summed for all the remaining measures. The decisions for which measures within a mutually exclusive set were included are explained below:

- **Mutually Exclusive Set #1 – Residential Bathroom Faucet Aerators:** The 1.0 gpm versions were included since they are more cost effective and save a larger volume of water compared to the 1.5 gpm version. The higher cost effectiveness is because the cost of the aerators is the same; however, the 1.0 gpm models save more water than the 1.5 gpm models. The 0.5 gpm versions were excluded since that flow rate may be less acceptable to customers.

- **Mutually Exclusive Set #2 - Showerheads:** The 1.5 gpm versions were included since they are more cost effective and save a larger volume of water compared to the 2.0 gpm version.

- **Mutually Exclusive Set #3 – Toilets:** The 1.28 gpf versions were included in since they are more cost effective compared to the 1.6 gpf version, help move customers beyond code and represent the aggressive incentive program Corvallis currently operates.

- **Mutually Exclusive Set #4 - Urinals:** The 0.5 gpf versions were included since, compared to the 1.0 gpf version, they are more cost effective, save a larger volume of water, and help move customers beyond code. The waterless versions were excluded since they are often less acceptable to customers.

The results for Package #1 are shown in Table 6. (The table is located at the end of this Tech Memo since it is 11 x 17 in size.) The analysis estimates the package would save approximately 323,000 gallons per day (gpd) on an annual average basis and 408,000 gpd on a peak season basis. The annual average savings number represents 4.2% of Corvallis' 2007 to 2009 average production (The 2007 to 2009 average production is 7,660,000 gpd per the April 13, 2010 *City of Corvallis Water Use* memo from GSI and CH2M Hill.) The total cost of achieving those savings is estimated at approximately $5.3 million over the course of the twenty-year planning period. Those total costs average to approximately $267,000 a year. However, as discussed below, the estimated annual costs vary throughout the planning period with higher annual costs toward the beginning and lower annual costs toward the end.

Several pie charts are provided to convey more information regarding the nature of the savings from this package. Figure 4 shows that almost 60% of the savings are from the single family customer category, with the remaining savings attributed to the multifamily and non-residential customer categories. Figure 5 shows that approximately two-thirds of the savings are associated with measures with year-round savings and approximately one-third are associated with measures focused only on peak season savings. Figure 6 shows that approximately two-thirds of the savings are associated with hardware measures and approximately one-third are associated with behavioral measures.

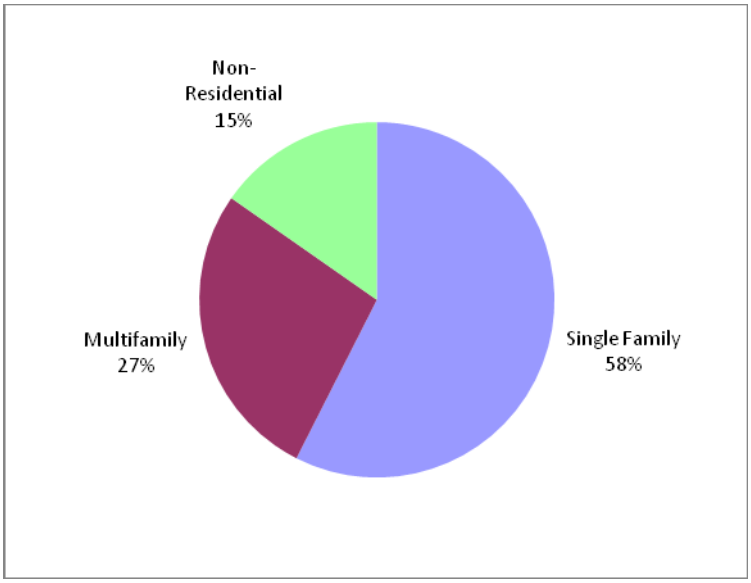

Figure 4 Savings by Customer Category (Package #1 – Conservation Potential Assessment)

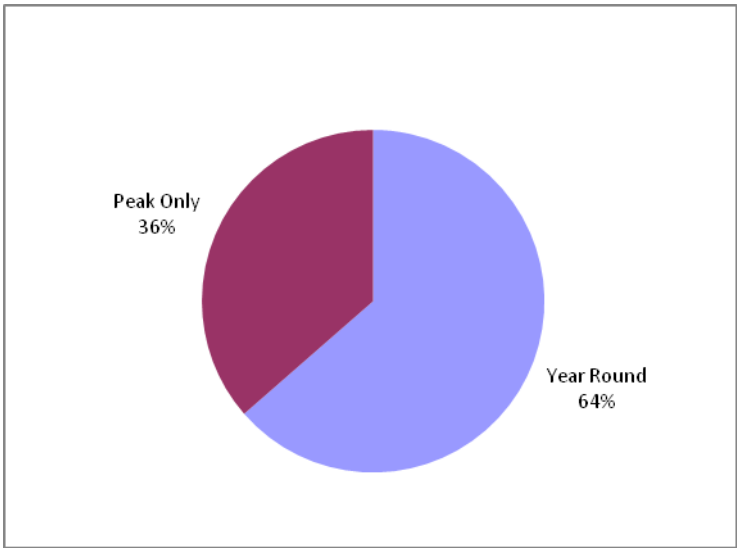

Figure 5 Savings by Seasonality (Package #1 – Conservation Potential Assessment)

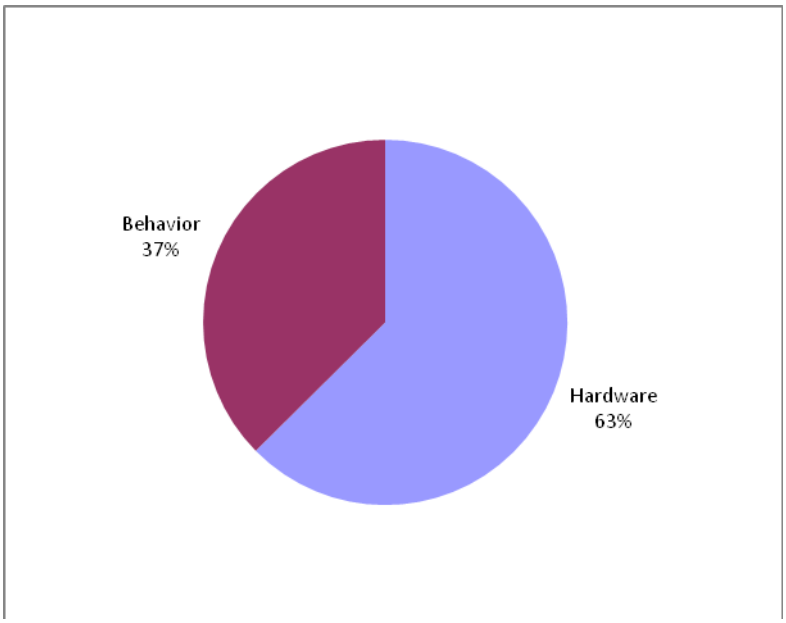

Figure 6 Savings by Hardware vs Behavior (Package #1 – Conservation Potential Assessment)

Figure 7 shows the gallons per day savings for each year. The figure shows how the gallons per day savings: 1) increase during the initial implementation period of 2012-2016, 2) reach their highest level by the last year of the initial implementation period, 3) stay at that level throughout the planning period until 2031, and 4) decline after the end of the planning period as the measures' lifespans expire and the measures are no longer renewed. Note that the savings could be preserved beyond the planning period, however that would require continued spending.

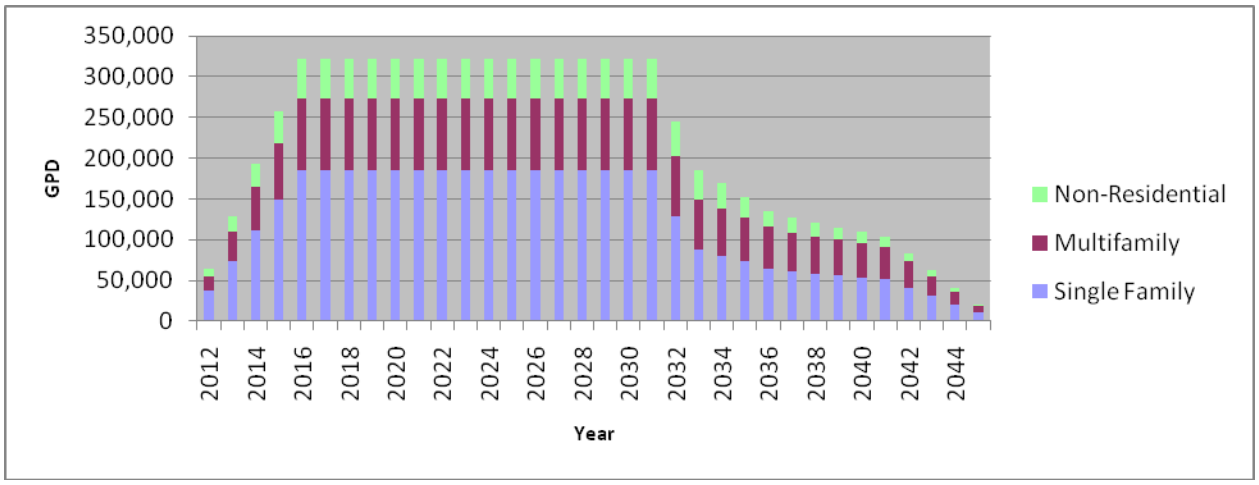

Figure 7 Total Savings Each Year (Package #1 – Conservation Potential Assessment)

Figure 8 shows the total costs (both direct and indirect costs) for each year during the planning period for each customer category. The figure shows how the costs: 1) are highest during the initial implementation period, 2) continue at a reduced level during the rest of the planning period due to measure renewal, and 3) end after the planning period.

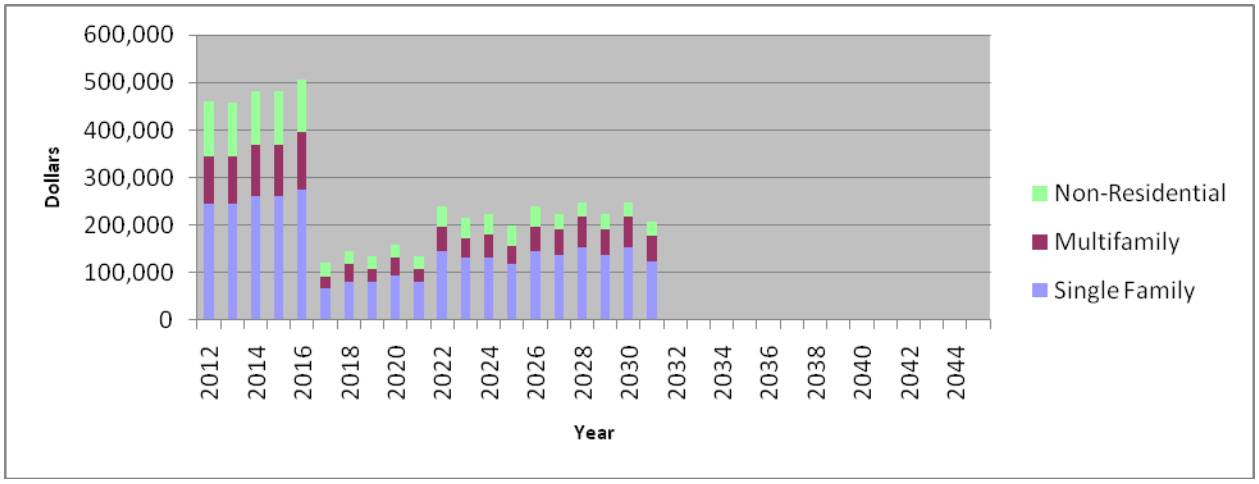

Figure 8 Total Costs Each Year (Package #1 – Conservation Potential Assessment)

3.3. Package #2 – Current Conservation Budget

As described previously, this package was designed to reflect the most cost-effective use of Corvallis' current conservation budget, given the analyzed measures. The package has an average cost of approximately $30,000 a year during the five-year initial implementation period.

The results for Package #2 are shown in Table 7. (The table is located at the end of this Tech Memo since it is 11 x 17 in size.) The analysis estimates the package would save approximately 164,000 gallons per day (gpd) on an annual average basis and 220,000 gpd on a peak season basis. The annual average savings number represents 2.1% of Corvallis' 2007 to 2009 average production (The 2007 to 2009 average production is 7,660,000 gpd per the April 13, 2010 *City of Corvallis Water Use* memo from GSI and CH2M Hill.) The total cost of achieving those savings is estimated at approximately $376,000 over the course of the twenty-year planning period. Those total costs average to approximately $19,000 a year. However, as discussed under Package #1, the estimated annual costs vary throughout the planning period with higher annual costs toward the beginning and lower annual costs toward the end.

Several pie charts are provided to convey more information regarding the nature of the savings from this package. Figure 9 shows that almost 70% of the savings are from the single family customer category, with the remaining savings attributed to the multifamily and non-residential customer categories. Figure 10 shows that approximately half of the savings are associated with measures with year-round savings and approximately half are associated with measures focused only on peak season savings. Figure 11 shows that approximately half of the savings are associated with hardware measures and approximately half are associated with behavioral measures.

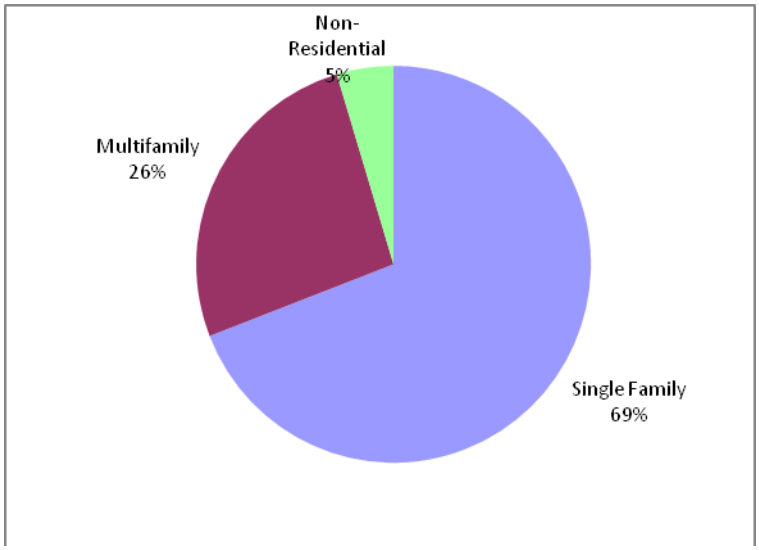

Figure 9 Savings by Customer Category (Package #2 – Current Conservation Budget)

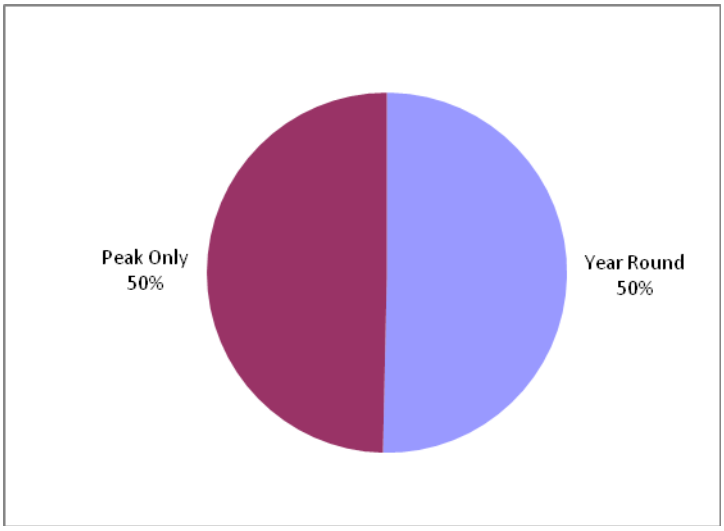

Figure 10 Savings by Seasonality (Package #2 – Current Conservation Budget)

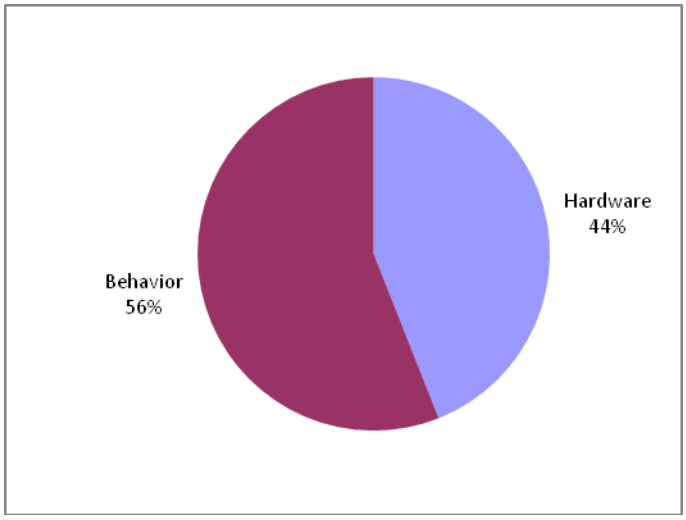

Figure 11 Savings by Hardware vs Behavior (Package #2 – Current Conservation Budget)

Figure 12 shows the gallons per day savings for each year. The pattern in the figure is similar to the pattern discussed under Package #1.

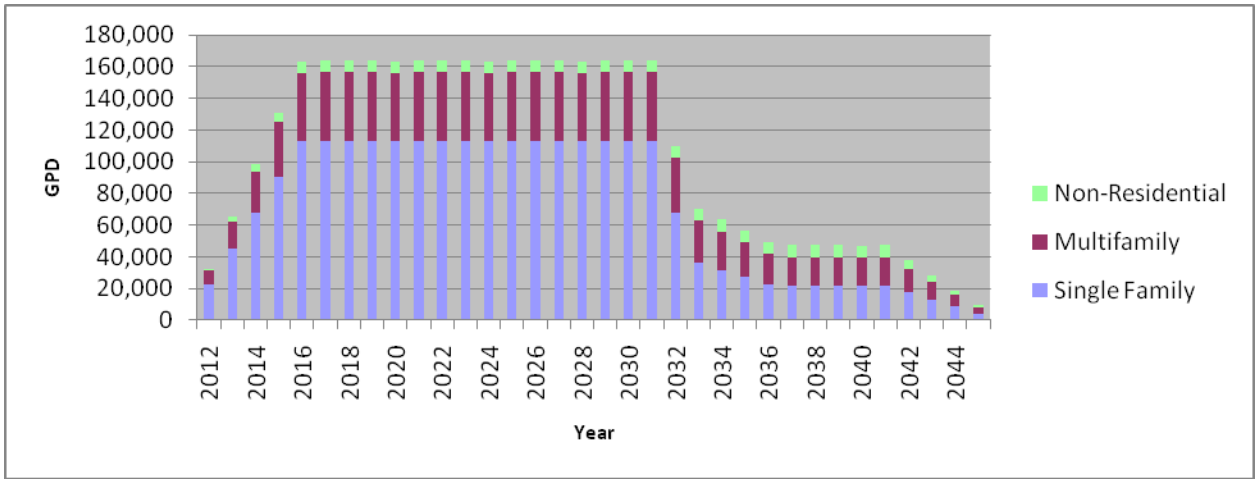

Figure 12 Total Savings Each Year (Package #2 – Current Conservation Budget)

Figure 13 shows the total costs (both direct and indirect costs) for each year during the planning period for each customer category. The pattern in the figure is similar to the pattern discussed under Package #1.

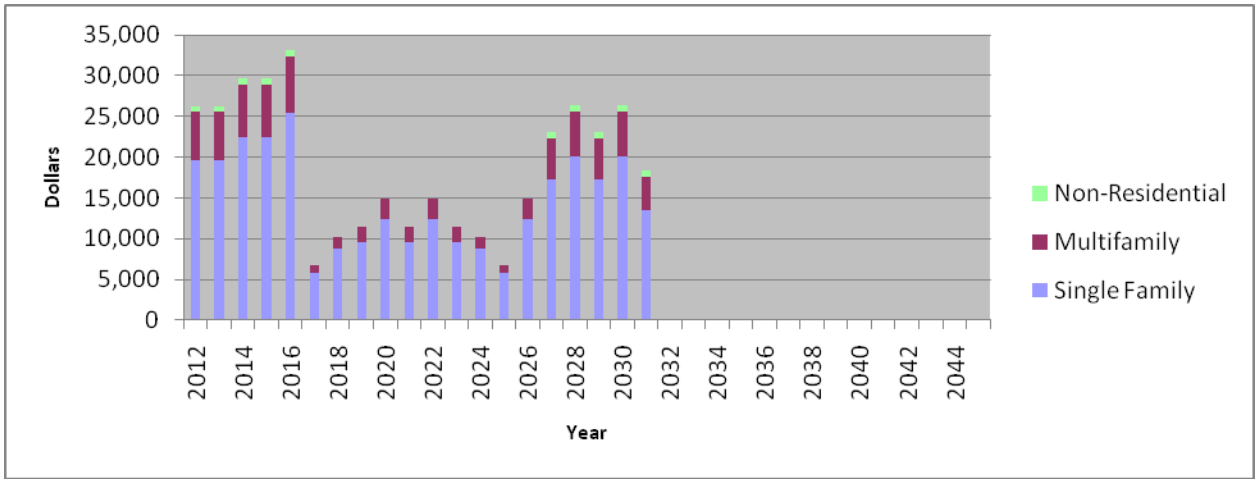

Figure 13 Total Costs Each Year (Package #2 – Current Conservation Budget)

3.4. Package #3 – Double of Current Conservation Budget

As described previously, this package was designed to reflect an enhanced level of conservation by doubling the current conservation budget. The package has an average cost of approximately $60,000 a year during the five-year initial implementation period.

The results for Package #3 are shown in Table 8. (The table is located at the end of this Tech Memo since it is 11 x 17 in size.) The analysis estimates the package would save approximately 180,000 gallons per day (gpd) on an annual average basis and 235,000 gpd on a peak season basis. The annual average savings number represents 2.3% of Corvallis' 2007 to 2009 average production (The 2007 to 2009 average production is 7,660,000 gpd per the April 13, 2010 *City of Corvallis Water Use* memo from GSI and CH2M Hill.) The total cost of achieving those savings is estimated at approximately $636,000 over the course of the twenty-year planning period. Those total costs average to approximately $32,000 a year. However, as discussed under Package #1, the estimated annual costs vary throughout the planning period with higher annual costs toward the beginning and lower annual costs toward the end.

Several pie charts are provided to convey more information regarding the nature of the savings from this package. Figure 14 shows that almost 70% of the savings are from the single family customer category, with the remaining savings attributed to the multifamily and non-residential customer categories. Figure 15 shows that approximately half of the savings are associated with measures with year-round savings and approximately half are associated with measures focused only on peak season savings. Figure 16 shows that approximately half of the savings are associated with hardware measures and approximately half are associated with behavioral measures.

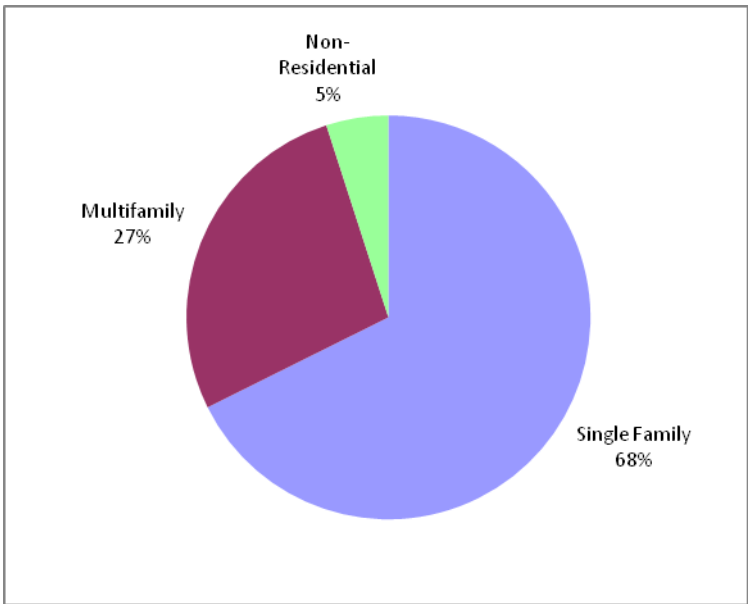

Figure 14 Savings by Customer Category (Package #3 – Double Current Conservation Budget)

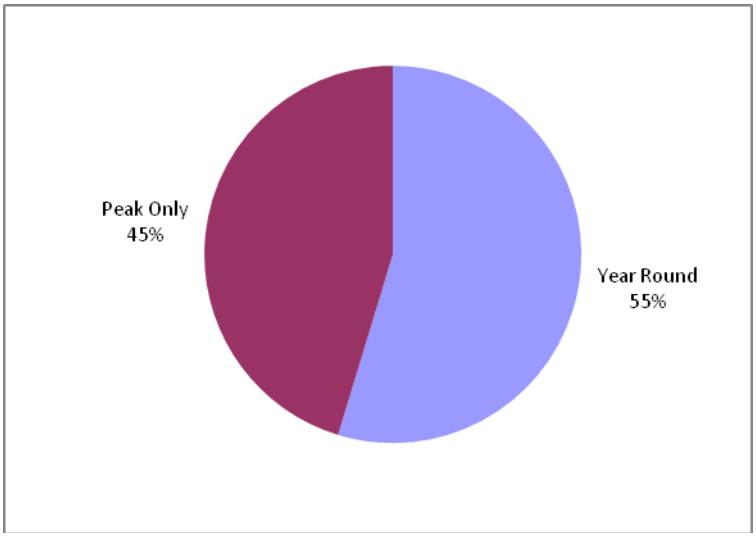

Figure 15 Savings by Seasonality (Package #3 – Double Current Conservation Budget)

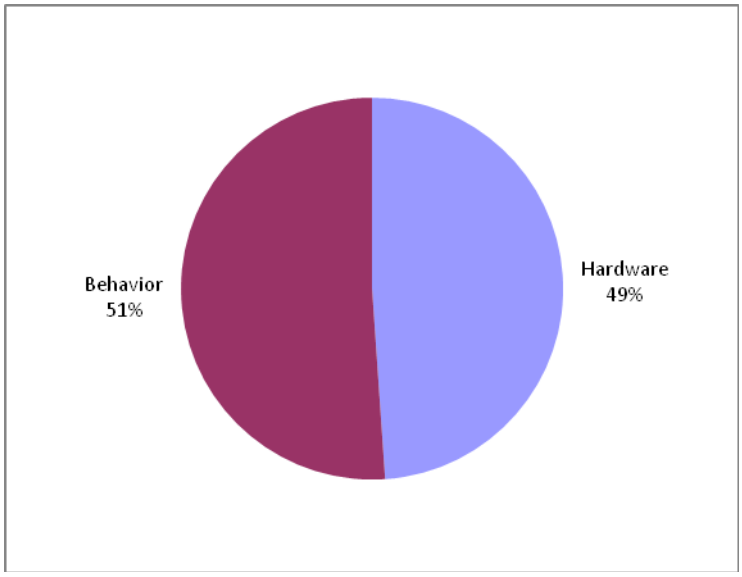

Figure 16 Savings by Hardware vs Behavior (Package #3 – Double Current Conservation Budget)

Figure 17 shows the gallons per day savings for each year. The pattern in the figure is similar to the pattern discussed under Package #1.

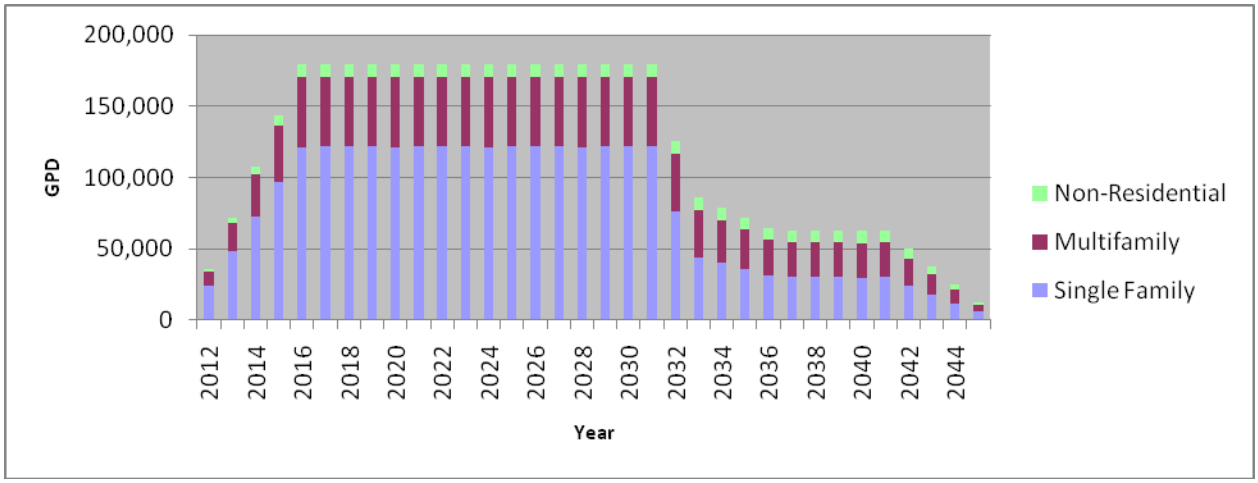

Figure 17 Total Savings Each Year (Package #3 – Double Current Conservation Budget)

Figure 18 shows the total costs (both direct and indirect costs) for each year during the planning period for each customer category. The pattern in the figure is similar to the pattern discussed under Package #1.

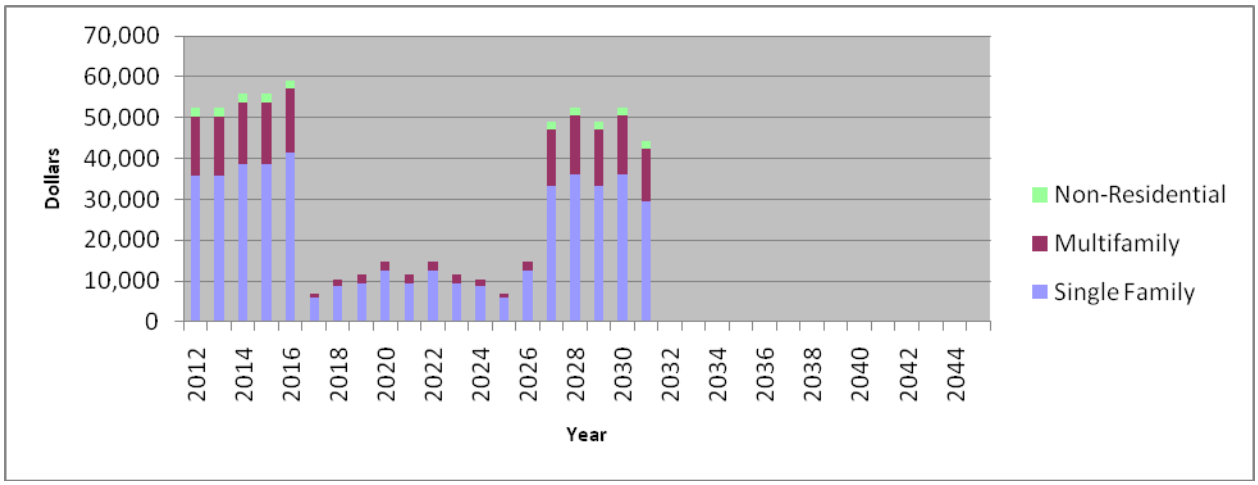

Figure 18 Total Costs Each Year (Package #3 – Double Current Conservation Budget)

3.5. Package #4 – Less than Variable Cost of Production

As described previously, this package was designed to reflect conservation measures that are less than the variable cost of production, which is $0.12 per ccf for Corvallis.

The results for Package #4 are shown in Table 9. (The table is located at the end of this Tech Memo since it is 11 x 17 in size.) The analysis estimates the package would save approximately 16,000 gallons per day (gpd) both on an annual average basis and on a peak season basis. The annual average savings number represents 0.2% of Corvallis' 2007 to 2009 average production (The 2007 to 2009 average production is 7,660,000 gpd per the April 13, 2010 *City of Corvallis Water Use* memo from GSI and CH2M Hill.) The total cost of achieving those savings is estimated at approximately $15,000 over the course of the twenty-year planning period. Those total costs average to approximately $750 a year. However, as discussed under Package #1, the estimated annual costs vary throughout the planning period with higher annual costs toward the beginning and lower annual costs toward the end.

Figure 19 shows that approximately half of the savings are from the multifamily customer category and approximately half are from the non-residential customer category. All of the savings are from hardware measures with year-round savings.

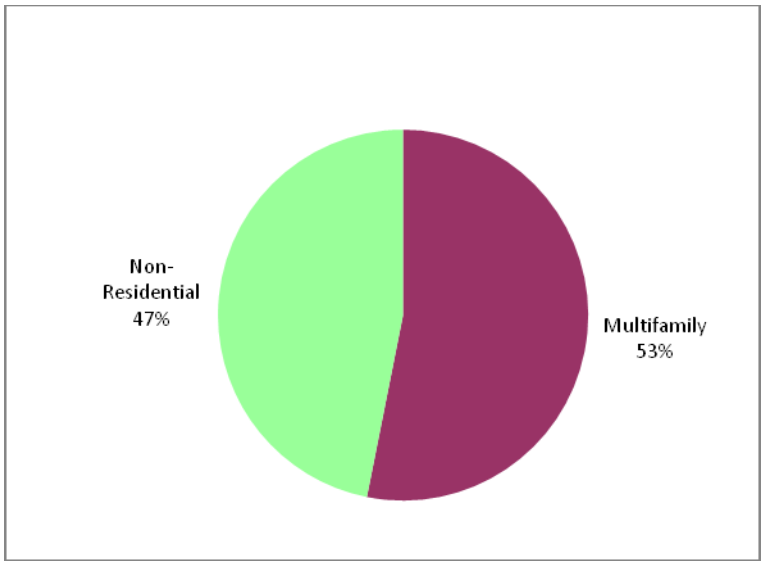

Figure 19 Savings by Customer Category (Package #4 – Less Than Variable Cost of Production)

Figure 20 shows the gallons per day savings for each year. The pattern in the figure is similar to the pattern discussed under Package #1.

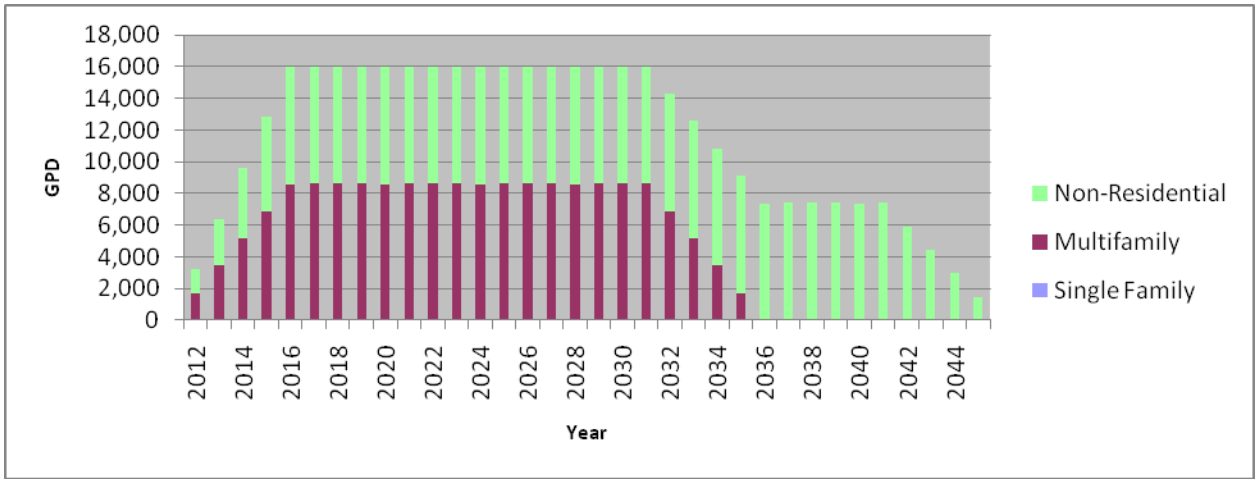

Figure 20 Total Savings Each Year (Package #4 – Less Than Variable Cost of Production)

Figure 21 shows the total costs (both direct and indirect costs) for each year during the planning period for each customer category. The pattern in the figure is similar to the pattern discussed under Package #1.

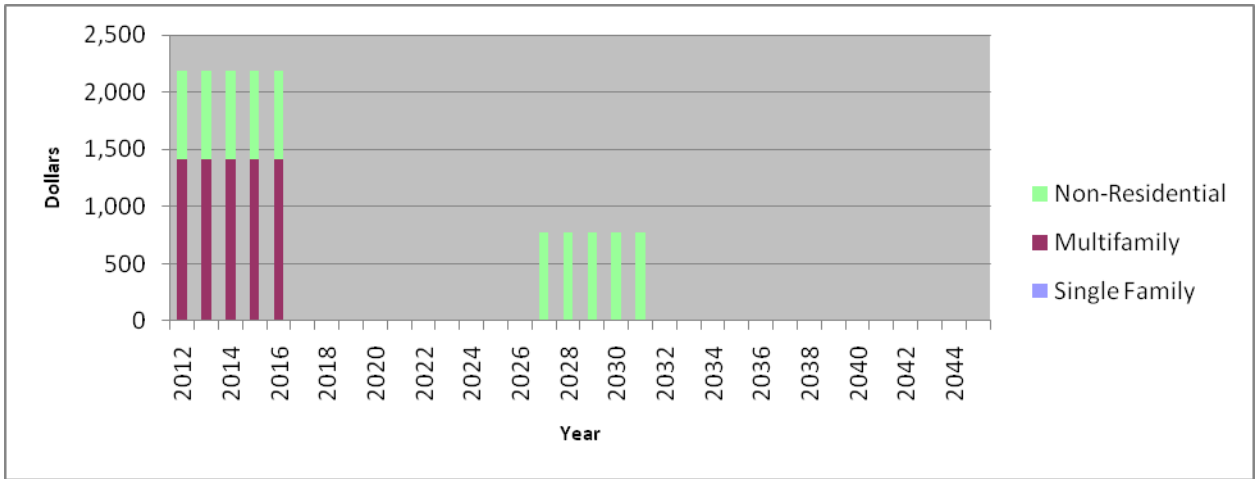

Figure 21 Total Costs Each Year (Package #4 – Less Than Variable Cost of Production)

3.6. Conclusions

As stated previously, demonstrating stewardship is the primary driver for Corvallis' conservation strategy. As a result, the City's conservation program should ideally be more robust than the state requirements. However, the exact level beyond the state requirements is not defined and is a subjective determination. A comparison of the four packages provides guidance as to which packages are most appropriate for Corvallis to pursue.

A summary of the results from the four conservation packages is provided in Table 10. A scatter plot of the average annual savings and the total cost over the planning period for each package is provided in Figure 21.

Table 10 Summary of Conservation Package Results

Package	Average Annual Savings		Peak Season Savings (gpd)	Total Cost Over Planning Period	Cost per CCF Saved Over Measure Life
	(gpd)	% of 2007-2009 Average Demand			
#1 - Conservation Potential Assessment	323,000	4.2%	408,000	$5,348,000	$1.58
#2 - Current Conservation Budget	164,000	2.1%	220,000	$376,000	$0.22
#3 - Double Current Conservation Budget	180,000	2.3%	235,000	$636,000	$0.34
#4 - Less Than Variable Cost of Production	16,000	0.2%	16,000	$15,000	$0.08

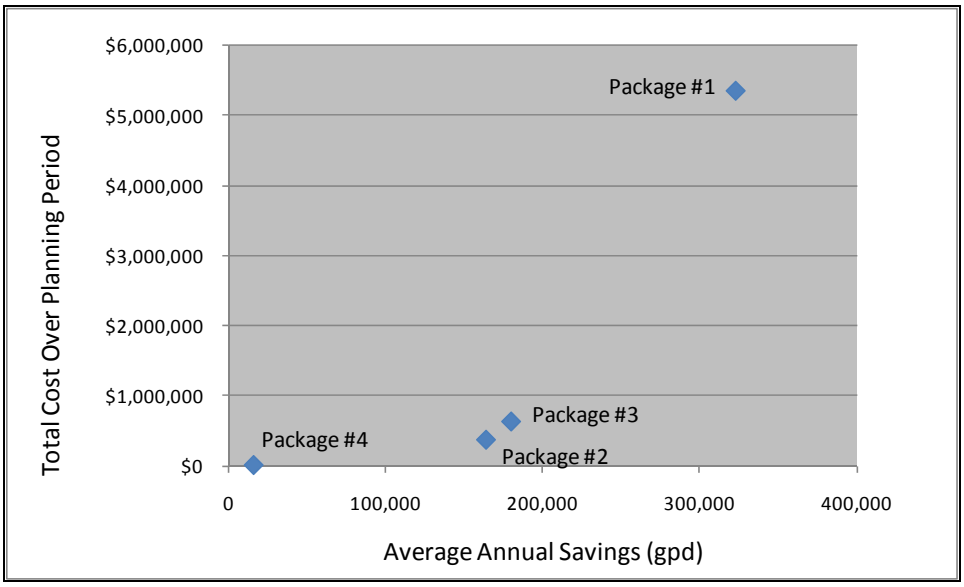

Figure 21 Comparison of Savings and Costs

Package #1, #2, and #3 likely go beyond the Oregon Water Resources Department's (OWRD) Water Management & Conservation Plan (WMCP) requirements related to demand-side conservation measures based on the number of measures and their implementation levels. (See the Existing Conservation Measures Memorandum prepared by GSI for information regarding OWRD's WMCP requirements.) Package #4 likely does not go beyond the state requirements since it only contains two measures and does not include the City's single family customer category. Therefore, based on savings alone, Packages #1, #2, and #3 could be selected as the City's conservation program.

However, taking costs into consideration, some of the packages appear to be more appropriate than others. In terms of water savings, Package #1 saves approximately 4% of the current demand, while Packages #2 and #3 each save approximately 2% of the current demand. The cost of Package #1 is significantly higher than Packages #2 and #3; it is nearly $5 million dollars more expensive. This is because it includes several individual measures with poor cost-effectiveness levels. While the overall cost-effectiveness level of Package #1 ($1.58 per ccf of saved water) is reasonable compared to many other utilities' conservation programs, there is not a clear reason why Corvallis would spend approximately $5 million more to save an additional 2% of water.

Packages #2 and #3 appear to be more reasonable options for the City to pursue. Both packages have very attractive cost-effectiveness levels at $0.22 and $0.34 per ccf of saved water. Package #2 would be reasonable to implement since it has better cost-effectiveness and it reflects the conservation budget Corvallis is currently spending. Package #3 could be reasonable to implement since it still has a very attractive cost-effectiveness level and it reflects an enhanced commitment to conservation compared to the City's current program. However the increased cost of Package #3 does not deliver a proportional increase in savings, compared with Package #2.

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Table 5 Analysis Results – All Measures

Conservation Measure	Sector	Seasonality	Hardware vs Behavior	Customer Definition	PARTICIPATION			SAVINGS			COSTS	
					All Customers			Savings For All Customers At Full Implementation (gpd)		Savings For All Customers Over Measure Life		
					Participating Customers	Savings Generating Customers	Devices / Rebates / Audits	Annual Average	Peak Season	CCF [1]	Total Cost Over Planning Period	Cost per CCF Saved Over Measure Life
Clotheswashers - Efficient Res. Capacity (In Unit)	SF	Year Round	Hardware	SF Households	2,325	2,325	4,650	29,531	29,531	367,456	$498,780	$1.36
Clotheswashers - Efficient Res. Capacity (In Unit)	MF	Year Round	Hardware	MF Households	860	860	1,720	10,923	10,923	135,919	$198,120	$1.46
Clotheswashers - Efficient Res. Capacity (Common Area)	MF	Year Round	Hardware	MF Households	860	860	344	10,923	10,923	135,919	$39,580	$0.29
Clotheswashers - Efficient Comm. Capacity	NR	Year Round	Hardware	NR Accounts	4	4	96	5,376	5,376	66,895	$30,120	$0.45
Faucets - 0.5 gpm Bathroom Aerators	SF	Year Round	Hardware	SF Households	1,357	1,018	3,393	8,551	8,551	79,262	$19,310	$0.24
Faucets - 0.5 gpm Bathroom Aerators	MF	Year Round	Hardware	MF Households	1,120	840	1,680	4,536	4,536	42,055	$4,300	$0.10
Faucets - 1.0 gpm Bathroom Aerators	SF	Year Round	Hardware	SF Households	3,391	2,543	8,478	16,024	16,024	148,583	$26,440	$0.18
Faucets - 1.0 gpm Bathroom Aerators	MF	Year Round	Hardware	MF Households	2,801	2,101	4,202	8,617	8,617	79,882	$7,050	$0.09
Showerhead 2.0 gpm	SF	Year Round	Hardware	SF Households	3,391	2,543	13,564	11,447	11,447	159,210	$76,620	$0.48
Showerhead 2.0 gpm	MF	Year Round	Hardware	MF Households	2,801	2,101	8,403	9,457	9,457	131,509	$30,900	$0.23
Showerhead 2.0 gpm	NR	Year Round	Hardware	NR Accounts	26	20	520	4,000	4,000	54,238	$7,720	$0.14
Toilets - 1.28 gpf High Efficiency Toilets (HET)	SF	Year Round	Hardware	SF Households	1,357	1,357	3,121	11,670	11,670	135,249	$328,030	$2.43
Toilets - 1.28 gpf High Efficiency Toilets (HET)	MF	Year Round	Hardware	MF Households	1,120	1,120	2,016	9,632	9,632	111,628	$204,220	$1.83
Toilets - 1.28 gpf High Efficiency Toilets (HET)	NR	Year Round	Hardware	NR Accounts	206	206	1,286	6,860	6,860	79,503	$196,170	$2.47
Urinals - 0.5 gpf Models	NR	Year Round	Hardware	NR Accounts	411	411	1,283	4,274	4,274	39,630	$131,770	$3.33
Urinals - Waterless Models	NR	Year Round	Hardware	NR Accounts	82	82	256	1,706	1,706	15,813	$41,540	$2.63
Clotheswashers - Decrease Partial Loads	SF	Year Round	Behavior	SF Households	1,227	1,227	0	3,926	3,926	33,491	$134,044	$4.00
Clotheswashers - Decrease Partial Loads	MF	Year Round	Behavior	MF Households	907	907	0	2,902	2,902	24,757	$112,240	$4.53
Faucets - Decrease Use	SF	Year Round	Behavior	SF Households	1,357	1,357	0	4,342	4,342	37,039	$134,044	$3.62
Faucets - Decrease Use	MF	Year Round	Behavior	MF Households	1,120	1,120	0	2,240	2,240	19,106	$112,240	$5.87
Showerheads - Decrease Use	SF	Year Round	Behavior	SF Households	1,357	1,357	0	2,714	2,714	23,150	$134,044	$5.79
Showerheads - Decrease Use	MF	Year Round	Behavior	MF Households	1,120	1,120	0	2,240	2,240	19,106	$112,240	$5.87
Toilets - Decrease Flushes	SF	Year Round	Behavior	SF Households	1,357	1,357	0	3,123	3,123	26,638	$134,044	$5.03
Toilets - Decrease Flushes	MF	Year Round	Behavior	MF Households	1,120	1,120	0	2,578	2,578	21,986	$112,240	$5.11
Irrigation Controllers - ET Model	SF	Peak Only	Hardware	SF Households	672	672	1,344	7,622	13,067	70,668	$366,480	$5.19
Irrigation Controllers - ET Model	MF	Peak Only	Hardware	MF Accounts	106	106	212	2,255	3,383	20,909	$111,160	$5.32
Irrigation Controllers - ET Model	NR	Peak Only	Hardware	NR Accounts	116	116	232	10,234	20,468	94,882	$122,340	$1.29
Irrigation Controllers - Rain Sensors	SF	Peak Only	Hardware	SF Households	566	566	1,132	2,140	3,668	19,840	$143,460	$7.23
Irrigation Controllers - Rain Sensors	MF	Peak Only	Hardware	MF Accounts	89	89	178	631	947	5,852	$22,940	$3.92
Irrigation Controllers - Rain Sensors	NR	Peak Only	Hardware	NR Accounts	98	98	196	2,882	5,764	26,720	$25,900	$0.97
Outdoor Irrigation Kits	SF	Peak Only	Hardware	SF Households	1,915	1,436	5,745	5,429	9,307	52,863	$158,610	$3.00
Outdoor Audit	SF	Peak Only	Behavior	SF Households	679	170	2,716	1,928	3,306	17,851	$739,960	$41.45
Outdoor Audit	MF	Peak Only	Behavior	MF Accounts	106	27	424	574	862	5,227	$116,320	$22.25
Outdoor Audit	NR	Peak Only	Behavior	NR Accounts	117	29	468	2,558	5,117	23,925	$480,240	$20.07
Lawn Dormant	SF	Peak Only	Behavior	SF Households	1,153	1,153	0	69,742	119,558	594,880	$134,044	$0.23
Lawn Dormant	MF	Peak Only	Behavior	MF Accounts	103	103	0	11,681	17,522	99,636	$22,816	$0.23
Faucets - 0.5 gpm Bathroom Aerators	NR	Year Round	Hardware	NR Accounts	47	35	147	875	875	323	$3,160	$9.80
Toilets - 1.6 gpf Ultra Low Flow Toilets (ULFT)	SF	Year Round	Hardware	SF Households	872	872	2,006	19,098	19,098	27,958	$165,220	$5.91
Toilets - 1.6 gpf Ultra Low Flow Toilets (ULFT)	MF	Year Round	Hardware	MF Households	720	720	1,296	15,769	15,769	23,084	$99,770	$4.32
Toilets - 1.6 gpf Ultra Low Flow Toilets (ULFT)	NR	Year Round	Hardware	NR Accounts	132	132	824	11,537	11,537	16,889	$64,900	$3.84
Urinals - 1.0 gpf Models	NR	Year Round	Hardware	NR Accounts	38	38	119	395	395	145	$14,860	$102.74
Toilets - Leak Detection	SF	Year Round	Behavior	SF Households	662	331	93,599	5,693	5,693	55,423	$55,920	$1.01
Toilets - Leak Detection	MF	Year Round	Behavior	MF Households	547	274	20,164	4,713	4,713	45,795	$14,160	$0.31
Faucets - 1.5 gpm Bathroom Aerators	SF	Year Round	Hardware	SF Households	3,391	2,543	8,478	10,938	10,938	101,424	$26,440	$0.26
Faucets - 1.5 gpm Bathroom Aerators	MF	Year Round	Hardware	MF Households	2,801	2,101	4,202	5,676	5,676	52,614	$7,050	$0.13
Showerhead 1.5 gpm	SF	Year Round	Hardware	SF Households	3,391	2,543	13,564	21,870	21,870	304,175	$76,620	$0.25
Showerhead 1.5 gpm	MF	Year Round	Hardware	MF Households	2,801	2,101	8,403	18,069	18,069	251,252	$30,900	$0.12
Showerhead 1.5 gpm	NR	Year Round	Hardware	NR Accounts	26	20	520	7,600	7,600	103,052	$7,720	$0.07
Spray Valves - 1.25 gpm Pre-Rinse Spray Valve	NR	Year Round	Hardware	NR Accounts	74	74	444	8,747	8,747	81,095	$70,240	$0.87

SF – Single Family, MF – Multifamiliy, NR – Non-Residential

1. Savings from free riders have been omitted from this column, since this number is used in the cost-effectiveness calculation.

Table 6 Analysis Results – Package #1 Conservation Potential Assessment

Conservation Measure	Sector	Seasonality	Hardware vs Behavior	Customer Definition	PARTICIPATION			SAVINGS			COSTS	
					All Customers			Savings For All Customers At Full Implementation (gpd)		Savings For All Customers Over Measure Life		
					Participating Customers	Savings Generating Customers	Devices / Rebates / Audits	Annual Average	Peak Season	CCF [1]	Total Cost Over Planning Period	Cost per CCF Saved Over Measure Life
Clotheswashers - Efficient Res. Capacity (In Unit)	SF	Year Round	Hardware	SF Households	2,325	2,325	4,650	29,531	29,531	367,456	$498,780	$1.36
Clotheswashers - Efficient Res. Capacity (In Unit)	MF	Year Round	Hardware	MF Households	860	860	1,720	10,923	10,923	135,919	$198,120	$1.46
Clotheswashers - Efficient Res. Capacity (Common Area)	MF	Year Round	Hardware	MF Households	860	860	344	10,923	10,923	135,919	$39,580	$0.29
Clotheswashers - Efficient Comm. Capacity	NR	Year Round	Hardware	NR Accounts	4	4	96	5,376	5,376	66,895	$30,120	$0.45
Faucets - 1.0 gpm Bathroom Aerators	SF	Year Round	Hardware	SF Households	3,391	2,543	8,478	16,024	16,024	148,583	$26,440	$0.18
Faucets - 1.0 gpm Bathroom Aerators	MF	Year Round	Hardware	MF Households	2,801	2,101	4,202	8,617	8,617	79,882	$7,050	$0.09
Toilets - 1.28 gpf High Efficiency Toilets (HET)	SF	Year Round	Hardware	SF Households	1,357	1,357	3,121	11,670	11,670	135,249	$328,030	$2.43
Toilets - 1.28 gpf High Efficiency Toilets (HET)	MF	Year Round	Hardware	MF Households	1,120	1,120	2,016	9,632	9,632	111,628	$204,220	$1.83
Toilets - 1.28 gpf High Efficiency Toilets (HET)	NR	Year Round	Hardware	NR Accounts	206	206	1,286	6,860	6,860	79,503	$196,170	$2.47
Urinals - 0.5 gpf Models	NR	Year Round	Hardware	NR Accounts	411	411	1,283	4,274	4,274	39,630	$131,770	$3.33
Clotheswashers - Decrease Partial Loads	SF	Year Round	Behavior	SF Households	1,227	1,227	0	3,926	3,926	33,491	$134,044	$4.00
Clotheswashers - Decrease Partial Loads	MF	Year Round	Behavior	MF Households	907	907	0	2,902	2,902	24,757	$112,240	$4.53
Faucets - Decrease Use	SF	Year Round	Behavior	SF Households	1,357	1,357	0	4,342	4,342	37,039	$134,044	$3.62
Faucets - Decrease Use	MF	Year Round	Behavior	MF Households	1,120	1,120	0	2,240	2,240	19,106	$112,240	$5.87
Showerheads - Decrease Use	SF	Year Round	Behavior	SF Households	1,357	1,357	0	2,714	2,714	23,150	$134,044	$5.79
Showerheads - Decrease Use	MF	Year Round	Behavior	MF Households	1,120	1,120	0	2,240	2,240	19,106	$112,240	$5.87
Toilets - Decrease Flushes	SF	Year Round	Behavior	SF Households	1,357	1,357	0	3,123	3,123	26,638	$134,044	$5.03
Toilets - Decrease Flushes	MF	Year Round	Behavior	MF Households	1,120	1,120	0	2,578	2,578	21,986	$112,240	$5.11
Irrigation Controllers - ET Model	SF	Peak Only	Hardware	SF Households	672	672	1,344	7,622	13,067	70,668	$366,480	$5.19
Irrigation Controllers - ET Model	MF	Peak Only	Hardware	MF Accounts	106	106	212	2,255	3,383	20,909	$111,160	$5.32
Irrigation Controllers - ET Model	NR	Peak Only	Hardware	NR Accounts	116	116	232	10,234	20,468	94,882	$122,340	$1.29
Irrigation Controllers - Rain Sensors	SF	Peak Only	Hardware	SF Households	566	566	1,132	2,140	3,668	19,840	$143,460	$7.23
Irrigation Controllers - Rain Sensors	MF	Peak Only	Hardware	MF Accounts	89	89	178	631	947	5,852	$22,940	$3.92
Irrigation Controllers - Rain Sensors	NR	Peak Only	Hardware	NR Accounts	98	98	196	2,882	5,764	26,720	$25,900	$0.97
Outdoor Irrigation Kits	SF	Peak Only	Hardware	SF Households	1,915	1,436	5,745	5,429	9,307	52,863	$158,610	$3.00
Outdoor Audit	SF	Peak Only	Behavior	SF Households	679	170	2,716	1,928	3,306	17,851	$739,960	$41.45
Outdoor Audit	MF	Peak Only	Behavior	MF Accounts	106	27	424	574	862	5,227	$116,320	$22.25
Outdoor Audit	NR	Peak Only	Behavior	NR Accounts	117	29	468	2,558	5,117	23,925	$480,240	$20.07
Lawn Dormant	SF	Peak Only	Behavior	SF Households	1,153	1,153	0	69,742	119,558	594,880	$134,044	$0.23
Lawn Dormant	MF	Peak Only	Behavior	MF Accounts	103	103	0	11,681	17,522	99,636	$22,816	$0.23
Faucets - 0.5 gpm Bathroom Aerators	NR	Year Round	Hardware	NR Accounts	47	35	147	875	875	323	$3,160	$9.80
Toilets - Leak Detection	SF	Year Round	Behavior	SF Households	662	331	93,599	5,693	5,693	55,423	$55,920	$1.01
Toilets - Leak Detection	MF	Year Round	Behavior	MF Households	547	274	20,164	4,713	4,713	45,795	$14,160	$0.31
Showerhead 1.5 gpm	SF	Year Round	Hardware	SF Households	3,391	2,543	13,564	21,870	21,870	304,175	$76,620	$0.25
Showerhead 1.5 gpm	MF	Year Round	Hardware	MF Households	2,801	2,101	8,403	18,069	18,069	251,252	$30,900	$0.12
Showerhead 1.5 gpm	NR	Year Round	Hardware	NR Accounts	26	20	520	7,600	7,600	103,052	$7,720	$0.07
Spray Valves - 1.25 gpm Pre-Rinse Spray Valve	NR	Year Round	Hardware	NR Accounts	74	74	444	8,747	8,747	81,095	$70,240	$0.87
Total					N/A	N/A	N/A	323,141	408,431	3,380,302	$5,348,406	$1.58

SF – Single Family, MF – Multifamiliy, NR – Non-Residential
1. Savings from free riders have been omitted from this column, since this number is used in the cost-effectiveness calculation.

Table 7 Analysis Results – Package #2 Current Conservation Budget

Conservation Measure	Sector	Seasonality	Hardware vs Behavior	Customer Definition	PARTICIPATION			SAVINGS			COSTS	
					All Customers			Savings For All Customers At Full Implementation (gpd)		Savings For All Customers Over Measure Life		
					Participating Customers	Savings Generating Customers	Devices / Rebates / Audits	Annual Average	Peak Season	CCF [1]	Total Cost Over Planning Period	Cost per CCF Saved Over Measure Life
Faucets - 1.0 gpm Bathroom Aerators	SF	Year Round	Hardware	SF Households	3,391	2,543	8,478	16,024	16,024	148,583	$26,440	$0.18
Faucets - 1.0 gpm Bathroom Aerators	MF	Year Round	Hardware	MF Households	2,801	2,101	4,202	8,617	8,617	79,882	$7,050	$0.09
Lawn Dormant	SF	Peak Only	Behavior	SF Households	1,153	1,153	0	69,742	119,558	594,880	$134,044	$0.23
Lawn Dormant	MF	Peak Only	Behavior	MF Accounts	103	103	0	11,681	17,522	99,636	$22,816	$0.23
Toilets - Leak Detection	SF	Year Round	Behavior	SF Households	662	331	93,599	5,693	5,693	55,423	$55,920	$1.01
Toilets - Leak Detection	MF	Year Round	Behavior	MF Households	547	274	20,164	4,713	4,713	45,795	$14,160	$0.31
Showerhead 1.5 gpm	SF	Year Round	Hardware	SF Households	3,391	2,543	13,564	21,870	21,870	304,175	$76,620	$0.25
Showerhead 1.5 gpm	MF	Year Round	Hardware	MF Households	2,801	2,101	8,403	18,069	18,069	251,252	$30,900	$0.12
Showerhead 1.5 gpm	NR	Year Round	Hardware	NR Accounts	26	20	520	7,600	7,600	103,052	$7,720	$0.07
Total					N/A	N/A	N/A	164,009	219,666	1,682,677	$375,670	$0.22

SF – Single Family, MF – Multifamiliy, NR – Non-Residential
1. Savings from free riders have been omitted from this column, since this number is used in the cost-effectiveness calculation.

Table 8 Analysis Results - Package #3 Double Current Conservation Budget

Conservation Measure	Sector	Seasonality	Hardware vs Behavior	Customer Definition	PARTICIPATION			SAVINGS			COSTS	
					All Customers			Savings For All Customers At Full Implementation (gpd)		Savings For All Customers Over Measure Life		
					Participating Customers	Savings Generating Customers	Devices / Rebates / Audits	Annual Average	Peak Season	CCF [1]	Total Cost Over Planning Period	Cost per CCF Saved Over Measure Life
Clotheswashers - Efficient Res. Capacity (In Unit)	SF	Year Round	Hardware	SF Households	651	651	1,302	8,269	8,269	102,888	$160,640	$1.56
Clotheswashers - Efficient Res. Capacity (In Unit)	MF	Year Round	Hardware	MF Households	241	241	482	3,061	3,061	38,089	$73,080	$1.92
Clotheswashers - Efficient Res. Capacity (Common Area)	MF	Year Round	Hardware	MF Households	241	241	96	3,061	3,061	38,089	$14,660	$0.38
Clotheswashers - Efficient Comm. Capacity	NR	Year Round	Hardware	NR Accounts	1	1	24	1,344	1,344	16,724	$12,120	$0.72
Faucets - 1.0 gpm Bathroom Aerators	SF	Year Round	Hardware	SF Households	3,391	2,543	8,478	16,024	16,024	148,583	$26,440	$0.18
Faucets - 1.0 gpm Bathroom Aerators	MF	Year Round	Hardware	MF Households	2,801	2,101	4,202	8,617	8,617	79,882	$7,050	$0.09
Lawn Dormant	SF	Peak Only	Behavior	SF Households	1,153	1,153	0	69,742	119,558	594,880	$134,044	$0.23
Lawn Dormant	MF	Peak Only	Behavior	MF Accounts	103	103	0	11,681	17,522	99,636	$22,816	$0.23
Toilets - Leak Detection	SF	Year Round	Behavior	SF Households	662	331	93,599	5,693	5,693	55,423	$55,920	$1.01
Toilets - Leak Detection	MF	Year Round	Behavior	MF Households	547	274	20,164	4,713	4,713	45,795	$14,160	$0.31
Showerhead 1.5 gpm	SF	Year Round	Hardware	SF Households	3,391	2,543	13,564	21,870	21,870	304,175	$76,620	$0.25
Showerhead 1.5 gpm	MF	Year Round	Hardware	MF Households	2,801	2,101	8,403	18,069	18,069	251,252	$30,900	$0.12
Showerhead 1.5 gpm	NR	Year Round	Hardware	NR Accounts	26	20	520	7,600	7,600	103,052	$7,720	$0.07
Total					N/A	N/A	N/A	179,744	235,400	1,878,466	$636,170	$0.34

SF – Single Family, MF – Multifamiliy, NR – Non-Residential
1. Savings from free riders have been omitted from this column, since this number is used in the cost-effectiveness calculation.

Table 9 Analysis Results – Package #4 Less than Variable Cost of Production

Conservation Measure	Sector	Seasonality	Hardware vs Behavior	Customer Definition	PARTICIPATION			SAVINGS			COSTS	
					All Customers			Savings For All Customers At Full Implementation (gpd)		Savings For All Customers Over Measure Life		
					Participating Customers	Savings Generating Customers	Devices / Rebates / Audits	Annual Average	Peak Season	CCF [1]	Total Cost Over Planning Period	Cost per CCF Saved Over Measure Life
Faucets - 1.0 gpm Bathroom Aerators	MF	Year Round	Hardware	MF Households	2,801	2,101	4,202	8,617	8,617	79,882	$7,050	$0.09
Showerhead 1.5 gpm	NR	Year Round	Hardware	NR Accounts	26	20	520	7,600	7,600	103,052	$7,720	$0.07
Total					N/A	N/A	N/A	16,217	16,217	182,933	$14,770	$0.08

SF – Single Family, MF – Multifamiliy, NR – Non-Residential
1. Savings from free riders have been omitted from this column, since this number is used in the cost-effectiveness calculation.

Appendix C

City of Corvallis Municipal Code

3.06.140 Utility Services Rate

administrative procedure.

4] New Business or Change in Business Type. New businesses will be assigned a strength category during the permit process or when they establish a new utility services account. Businesses operating within the City that change the type of business conducted at a site will be assigned a strength category during the "Change of Occupancy" process.

4) Storm water service rates are based on impervious surface area. A user of storm water services is any person who discharges, or who causes or permits the discharge of, storm water runoff into the City's storm water system or who benefits from the City's storm water system as a special user. Any person occupying or having a right to occupy premises which are improved with impervious surfaces shall be presumed to be a user of storm water services. A person responsible for storm water charges under this Chapter may avoid incurring those charges by removing all impervious surfaces from any improved premises. The basis for calculating fees is the Equivalent Service Unit (ESU). Single family homes are all assumed to be one ESU and are billed as such; all other classes of customer have the property measured for the number of ESUs and are billed according to the number of ESUs, rounded to the nearest 0.10 ESU.

5) Fire Service Detector Meters. Fire Service Detector Meters are used to detect water flow. There are no consumption charges associated with fire service meters; however, the meters shall be read monthly, and when there is repeated flow through the meter the City shall investigate to determine the cause of the flow, and will charge the base and consumptive rates for the class of customer for usage for other than fire service purposes.

(Ord. 2011-04 §1, 02/07/2011; Ord. 2007-13 §2, 06/18/2007; Ord. 2006-07 §1, 04/03/2006)

Section 3.06.140 Utility services rates.

Effective for all utility bills rendered on or after February 1, 2012, service rates shall be as follows:

1) Rates for single family customers:

			Water Consumption Rates - per hcf			Wastewater Consumption Rate - per hcf		Storm Water
Meter Size	Base Rate	hcf	1st Level	2nd Level	3rd Level	Base Rate	All Usage	Per ESU
5/8" - 3/4"	$13.14	0-7	$1.41	$1.71	$1.76			
		8-13	1.85	2.15	2.20	$10.39	$3.09	$5.48
		≥ 14	2.34	2.64	2.69			
1.0"	18.91	0-7	$1.41	1.71	$1.76			
		8-13	1.85	2.15	2.20	$10.39	$3.09	$5.48
		≥ 14	2.34	2.64	2.69			
1.5"	28.54	0-7	$1.41	$1.71	$1.76			
		8-13	1.85	2.15	2.20	$10.39	$3.09	$5.48
		≥ 14	2.34	2.64	2.69			
2.0"	40.10	0-7	$1.41	$1.71	$1.76			
		8-13	1.85	2.15	2.20	$10.39	$3.09	$5.48
		≥ 14	2.34	2.64	2.69			
3.0"	70.91	0-7	$1.41	$1.71	$1.76			

City of Corvallis

		8-13	1.85	2.15	2.20	$10.39	$3.09	$5.48
		≥ 14	2.34	2.64	2.69			
4.0"	105.54	0-7	$1.41	$1.71	$1.76			
		8-13	1.85	2.15	2.20	$10.39	$3.09	$5.48
		≥ 14	2.34	2.64	2.69			
6.0"	201.81	0-7	$1.41	$1.71	$1.76			
		8-13	1.85	2.15	2.20	$10.39	$3.09	$5.48
		≥ 14	2.34	2.64	2.69			

2) Rates for irrigation meters:

Meter Size	Base Rate	hcf	Water Consumption Rates - per hcf 1st Level	2nd Level	3rd Level
5/8" - 3/4"	$12.69	0-7	$1.34	$1.64	$1.69
		8-13	1.75	2.05	2.10
		≥ 14	2.34	2.64	2.69
1.0"	18.93	0-7	$1.34	$1.64	$1.69
		8-13	1.75	2.05	2.10
		≥ 14	2.34	2.64	2.69
1.5"	29.29	0-7	$1.34	$1.64	$1.69
		8-13	1.75	2.05	2.10
		≥ 14	2.34	2.64	2.69
2.0"	41.72	0-7	$1.34	$1.64	$1.69
		8-13	1.75	2.05	2.10
		≥ 14	2.34	2.64	2.69
3.0"	74.91	0-7	$1.34	$1.64	$1.69
		8-13	1.75	2.05	2.10
		≥ 14	2.34	2.64	2.69
4.0"	112.20	0-7	$1.34	$1.64	$1.69
		8-13	1.75	2.05	2.10
		≥ 14	2.34	2.64	2.69
6.0"	215.88	0-7	$1.34	$1.64	$1.69
		8-13	1.75	2.05	2.10
		≥ 14	2.34	2.64	2.69
8.0"	340.28	0-7	$1.34	$1.64	$1.69
		8-13	1.75	2.05	2.10
		≥ 14	2.34	2.64	2.69
10.0"	485.41	0-7	$1.34	$1.64	$1.69
		8-13	1.75	2.05	2.10

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≥ 14	2.34	2.64	2.69

3) Rates for Multi-Family:

Meter Size	Base Rate	hcf	Water Consumption Rates - per hcf 1st Level	2nd Level	3rd Level	Wastewater Consumption Rate - per hcf Base Rate	All Usage	Storm Water Per ESU
5/8" - 3/4"	$20.32	0-7	$1.69	$1.99	$2.04			
		8-13	1.75	2.05	2.10	$10.39	$3.09	$5.48
		≥ 14	1.99	2.29	2.34			
1.0"	25.49	0-18	$1.69	$1.99	$2.04			
		19-33	1.75	2.05	2.10	$10.39	$3.09	$5.48
		≥ 34	1.99	2.29	2.34			
1.5"	34.13	0-35	$1.69	$1.99	$2.04			
		36-65	1.75	2.05	2.10	$10.39	$3.09	$5.48
		≥ 66	1.99	2.29	2.34			
2.0"	44.45	0-56	$1.69	$1.99	$2.04			
		57-104	1.75	2.05	2.10	$10.39	$3.09	$5.48
		≥ 105	1.99	2.29	2.34			
3.0"	72.07	0-112	$1.69	$1.99	$2.04			
		113-208	1.75	2.05	2.10	$10.39	$3.09	$5.48
		≥ 209	1.99	2.29	2.34			
4.0"	103.11	0-175	$1.69	$1.99	$2.04			
		176-325	1.75	2.05	2.10	$10.39	$3.09	$5.48
		≥ 326	1.99	2.29	2.34			
6.0"	189.38	0-350	$1.69	$1.99	$2.04			
		351-650	1.75	2.05	2.10	$10.39	$3.09	$5.48
		≥ 651	1.99	2.29	2.34			
8.0"	292.87	0-560	$1.60	$1.99	$2.04			
		561-1040	1.75	2.05	2.10	$10.39	$3.09	$5.48
		≥ 1041	1.99	2.29	2.34			
10.0"	413.63	0-805	$1.69	$1.99	$2.04			
		06-1495	1.75	2.05	2.10	$10.39	$3.09	$5.48
		≥ 1496	1.99	2.29	2.34			

4) Rates for Group Residential/Fraternity/Sorority (D = Domestic; M = Medium; H = High; VH = Very High)

	Water Consumption Rates -	Wastewater Consumption Rate -	Storm Water

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Meter Size	Base Rate	hcf	per hcf 1st Level	2nd Level	3rd Level	per hcf Base Rate	All Usage	Per ESU
5/8" - 3/4"	$20.32	0-7	$1.69	$1.99	$2.04		D - $3.09	
		8-13	1.75	2.05	2.10	$10.39	M - 3.60	$5.48
		≥ 14	1.99	2.29	2.34		H - 4.93	
							VH - 6.67	
1.0"	25.49	0-18	$1.69	$1.99	$2.04		D - $3.09	
		19-33	1.75	2.05	2.10	$10.39	M - 3.60	$5.48
		≥ 34	1.99	2.29	2.34		H - 4.93	
							VH - 6.67	
1.5"	34.13	0-35	$1.69	$1.99	$2.04		D - $3.09	
		36-65	1.75	2.05	2.10	$10.39	M - 3.60	$5.48
		≥ 66	1.99	2.29	2.34		H - 4.93	
							VH - 6.67	
2.0"	44.45	0-56	$1.69	$1.99	$2.04		D - $3.09	
		57-104	1.75	2.05	2.10	$10.39	M - 3.60	$5.48
		≥ 105	1.99	2.29	2.34		H - 4.93	
							VH - 6.67	
3.0"	72.07	0-112	$1.69	$1.99	$2.04		D - $3.09	
		113-208	1.75	2.05	2.10	$10.39	M - 3.60	$5.48
		≥ 209	1.99	2.29	2.34		H - 4.93	
							VH - 6.67	
4.0"	103.11	0-175	$1.69	$1.99	$2.04		D - $3.09	
		176-325	1.75	2.05	2.10	$10.39	M - 3.60	$5.48
		≥ 326	1.99	2.29	2.34		H - 4.93	
							VH - 6.67	
6.0"	189.38	0-350	$1.69	$1.99	$2.04		D - $3.09	
		351-650	1.75	2.05	2.10	$10.39	M - 3.60	$5.48
		≥ 651	1.99	2.29	2.34		H - 4.93	
							VH - 6.67	
8.0"	292.87	0-560	$1.69	$1.99	$2.04		D - $3.09	
		561-1040	1.75	2.05	2.10	$10.39	M - 3.60	$5.48
		≥ 1041	1.99	2.29	2.34		H - 4.93	
							VH - 6.67	
10.0"	413.63	0-805	$1.69	$1.99	$2.04		D - $3.09	
		06-1495	1.75	2.05	2.10	$10.39	M - 3.60	$5.48
		≥ 1496	1.99	2.29	2.34		H - 4.93	
							VH - 6.67	

5) Rates for Commercial and all other customers (D = Domestic; M = Medium; H = High; VH = Very High)

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Meter Size	Base Rate	hcf	Water Consumption Rates - per hcf 1st Level	2nd Level	3rd Level	Wastewater Consumption Rate - per hcf Base Rate	All Usage	Storm Water Per ESU
5/8" - 3/4"	$20.32	0-14	$1.69	$1.99	$2.04		D - $3.09	
		≥ 15	2.09	2.39	2.44	$10.39	M - 3.60	$5.48
							H - 4.93	
							VH - 6.67	
1.0"	25.49	0-43	$1.69	$1.99	$2.04		D - $3.09	
		≥ 44	2.09	2.39	2.44	$10.39	M - 3.60	$5.48
							H - 4.93	
							VH - 6.67	
1.5"	34.13	0-67	$1.69	$1.99	$2.04		D - $3.09	
		≥ 68	2.09	2.39	2.44	$10.39	M - 3.60	$5.48
							H - 4.93	
							VH - 6.67	
2.0"	44.45	0-179	$1.69	$1.99	$2.04		D - $3.09	
		≥ 180	2.09	2.39	2.44	$10.39	M - 3.60	$5.48
							H - 4.93	
							VH - 6.67	
3.0"	72.07	0-208	$1.69	$1.99	$2.04		D - $3.09	
		≥ 209	2.09	2.39	2.44	$10.39	M - 3.60	$5.48
							H - 4.93	
							VH - 6.67	
4.0"	103.11	0-341	$1.69	$1.99	$2.04		D - $3.09	
		≥ 342	2.09	2.39	2.44	$10.39	M - 3.60	$5.48
							H - 4.93	
							VH - 6.67	
6.0"	189.38	0-1,000	$1.69	$1.99	$2.04		D - $3.09	
		≥ 1,001	2.09	2.39	2.44	$10.39	M - 3.60	$5.48
							H - 4.93	
							VH - 6.67	
8.0"	292.87	0-1,040	$1.69	$1.99	$2.04		D - $3.09	
		≥1,041	2.09	2.39	2.44	$10.39	M - 3.60	$5.48
							H - 4.93	
							VH - 6.67	
10.0"	413.63	0-23,207	$1.69	$1.99	$2.04		D - $3.09	
		≥ 23,208	2.09	2.39	2.44	$10.39	M - 3.60	$5.48
							H - 4.93	
							VH - 6.67	

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12.0"	492.85	0-23,207	$1.69	$1.99	$2.04		D - $3.09	
		≥ 23,208	2.09	2.39	2.44	$10.39	M - 3.60	$5.48
							H - 4.93	
							VH - 6.67	

6) Rates for Fire Service:

a) Standby (minimum) charges for automatic fire service. Charges are based on wet or dry sprinkling systems without hose or other connections; combined systems will pay the regular service meter minimums and the regular meter rates:

1] 2": $2.00 per month
2] 3": $3.00 per month
3] 4": $4.00 per month
4] 6": $6.00 per month
5] 8": $8.00 per month

7) Properties without a Water Meter:

a) Single family property that does not have utility provided water service and therefore has no water meter, but that has connection to the utility's wastewater service shall pay $28.04 per month, plus the applicable storm water and other City services fees.

b) Multi-family unmetered rates shall be $28.04 per month for the one residential unit and $17.64 for each additional living unit above one, plus the applicable storm water and other City services fees.

c) Commercial accounts with wastewater service, but no water service, shall be billed as identified in section 3.060.050 (1)(c)[5].

d) Billing for accounts where there is wastewater service, but no water service shall be billed each month, regardless of whether or not the property is vacant, as long as the property remains connected to the utility's wastewater line.

e) As provided in ORS 454.225, when wastewater charges are not paid when due, the amounts thereof, together with interest at the statutory rate and penalties from the due date, may be recovered using the procedures provided in Section 3.06.080, in an action at law brought by the City, or certified and presented to the County Assessor.

f) The liability for all accounts billed for wastewater only shall be that of the person who applied for service.

g) The City shall recover its costs and any reasonable attorney's fees in any action to recover charges pursuant to this Section.

8) Storm Water Special User Unit (per ESU to the nearest 0.1 ESU): $1.12.

(Ord. 2011-19 §1, 12/19/2011; Ord. 2011-04 §1, 02/07/2011; Ord. 2010-29 §1, 12/06/2010; Ord. 2009-14 §1, 12/07/2009; Ord. 2008-19 §1, 12/01/2008; Ord. 2007-26 §1, 11/19/2007; Ord. 2007-02 §1, 02/05/2007; Ord. 2006-30 §1, 12/18/2006; Ord. 2006-07 §1, 04/03/2006)

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Appendix D

City of Corvallis Municipal Codes

3.01.250 Water waste

3.01.251 Declaration of water emergency

3.01.252 Water use contrary to emergency order prohibited

supply of water other than that furnished by the utility may obtain water at meter rates upon the following conditions and not otherwise. Under no circumstances shall a physical connection, direct or indirect, exist or be made in any manner, even temporarily, between the utility water supply and that of a private water supply. Where such a connection is found to exist, or where provision is made to connect the two systems by means of a spacer or otherwise, the utility water supply shall be shut off from the premises without notice. In case of such discontinuance, service shall not be re-established until satisfactory proof is furnished that the cross connection has been completely and permanently severed.
(Ord. 58-65 § 22, 1958)

Section 3.01.250 Water waste.

Where water is wastefully or negligently used on a customer's premises, the utility may discontinue the service if such conditions are not corrected within five days after giving the customer written notice.
(Ord. 2000-10 § 2, 05/15/2000; Ord. 58-65 § 23, 1958)

Section 3.01.251 Declaration of water emergency; order.

The utility may, by written order of the Public Works Director, declare a water emergency and impose such limits on water use or consumption as it deems necessary under the circumstances. The utility shall provide as much notice to the public of the order and limits imposed as is practicable under the circumstances. Any deficiency in the notice given shall not affect the validity of the order.
(Ord. 94-17 § 1, 06/06/94)

Section 3.01.252 Water use contrary to emergency order prohibited.

Use of water by any person contrary to the limits imposed by any water emergency order is prohibited. Each such use shall be considered a separate violation, punishable as described in section 3.01.310.
(Ord. 2000-10 § 2, 05/15/2000; Ord. 94-17 § 1, 06/06/94)

Section 3.01.260 Access to premises.

1) The utility or its duly authorized agents shall at all reasonable times have the right to enter or leave the customer's premises for any purpose properly connected with the service of water to the premises.

2) Any inspection or recommendation made by the utility or its agents on plumbing or appliances or use of water on the customer's premises, either as the result of a complaint or otherwise, will be made or offered without charge.
(Ord. 58-65 § 25, 1958)

Section 3.01.270 Interruption in service.

The utility shall not be liable for damage resulting from an interruption in service. Temporary shutdowns may be resorted to by the utility for improvements and repairs. Whenever possible, and as time permits, all customers affected will be notified prior to such shutdowns. In addition, the utility will not be liable for interruption, shortage or insufficiency of supply, or for any loss or damage occasioned thereby, if caused by accident, act of God, fire, strikes, riots, war or any other cause not within its control.
(Ord. 2000-10 § 2, 05/15/2000; Ord. 58-65 § 25, 1958)

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