Final

Water Management and Conservation Plan

Clackamas River Water

May 2022

Prepared by:
GSI Water Solutions, Inc.
1600 SW Western Boulevard, Suite 240, Corvallis, OR 97333

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Oregon
Kate Brown, Governor

Water Resources Department
North Mall Office Building
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Salem, OR 97301
Phone: 503-986-0900
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www.Oregon.gov/OWRD

May 24, 2022

Clackamas River Water
Attn: Todd Heidgerken
16770 SE 82nd Drive
Clackamas, OR 97015-2439

Subject: Water Management and Conservation Plan

Dear Todd:

Enclosed; please find the final order approving your Water Management and Conservation Plan and authorizing the diversion of up to **8.9 cfs** of water under **Permit G-6728**.

The attached final order specifies that the Clackamas River Water's (CRW) plan shall remain in effect until **May 24, 2032**. Additionally, CRW is required to submit a progress report to the Department by **May 24, 2027**, detailing progress made toward the implementation of conservation benchmarks scheduled in the plan. Finally, CRW must submit an updated Water Management and Conservation Plan to the Department by **November 24, 2031**.

NOTE: *The deadline established in the attached final order for submittal of an updated water management and conservation plan (consistent with OAR Chapter 690, Division 086) shall not relieve the Clackamas River Water 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.*

We appreciate your cooperation in this effort. Please do not hesitate to contact me at 503-979-9544 or *Kerri.H.Cope@water.oregon.gov* if you have any questions.

Sincerely,

Kerri H. Cope

Kerri Cope
Water Management and Conservation Analyst
Water Right Services Division

Enclosure

cc: WMCP File
Application #G-6228 (Permit #G-6728)
Watermaster District 20, Amy Landvoigt
GSI Water Solutions, Inc. Attn: Tim Henkle (*via email thenkle@gsiws.com*)

BEFORE THE WATER RESOURCES DEPARTMENT
OF THE
STATE OF OREGON

In the Matter of the Proposed Water Management and Conservation Plan for Clackamas River Water, Clackamas 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 and conservation plan may authorize the diversion and use of water under a permit extended pursuant to OAR Chapter 690, Division 315.

Findings of Fact

1. Clackamas River Water (CRW) submitted a Water Management and Conservation Plan (plan) to the Water Resources Department (Department) on December 17, 2021. The required statutory fee for review of the plan was received by the Department on December 22, 2021. The plan was required by a condition set forth under CRW's previously approved plan (Sp. Or. Vol. 85, Pgs. 986-988) issued on January 30, 2012.

2. The Department published notice of receipt of the plan on December 28, 2021, as required under OAR Chapter 690, Division 086. No comments were received.

3. The Department provided written comments on the plan to CRW on February 11, 2022 and May 6, 2022. In response, CRW submitted a revised plan on April 21, 2022 and a final revised plan on May 9, 2022.

4. The Department reviewed the final revised plan and finds that it contains all of the elements required under OAR 690-086-0125 and OAR 690-086-0130.

5. The projections of future water need in the plan demonstrate a need for 6.8 cfs of water available under Permit G-6728 to help meet overall projected 20-year demands and provide a source of backup supply. These projections are reasonable and consistent with CRW's land use plan.

6. The system is fully metered, and the rate structure includes a base rate and volumetric charge. Unaccounted-for water is estimated at 8.2 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 final revised plan includes 5-year benchmarks for implementation or continuation of the following water conservation programs and activities: annual water audit; meter testing and maintenance program; a leak detection program; a public education program; technical and financial assistance; a retrofit and a fixture replacement assistance program and continuing to report abnormally high water use to customers.

8. The final revised plan includes 5-year benchmarks for evaluation, development, and implementation of programs to improve the annual water audit; explore re-establishing the residential meter replacement program; and explore reuse and recycling of water.

9. The final revised plan identifies the Clackamas River and one groundwater well as the primary source of CRW's water rights and accurately and completely describes the listed fish species that occur in Clackamas River in the vicinity of the CRW's point of diversion as well as the water quality parameters for which this portion of the Clackamas River has been 303(d) listed by the Oregon Department of Environmental Quality. CRW's groundwater source is not in a designated critical groundwater area.

10. 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.

11. The diversion of water under Permit G-6728 will be increased during the next 10 years and is consistent with OAR 690-086-0130(7), as follows:

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

    b. There are reliability and resource issues associated with obtaining any new water rights from the Clackamas River. Having full access to CRW's ground water source to provide a reliable redundant or primary source that can potentially reduce environmental impacts on the Clackamas River. Considering these factors, increased use from CRW's ground water source is the most feasible and appropriate water supply alternative to the supplier at this time; and

    c. CRW is currently not required to provide mitigation to address limitations or restrictions on the development of Permit G-6728, as no resource issues pertaining to the permit have been identified under OAR 690-086-0140(5)(i).

Conclusion of Law

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

Now, therefore, it is ORDERED:

Duration of Plan Approval:

1. The CRW Water Management and Conservation Plan is approved and shall remain in effect until **May 24, 2032**, unless this approval is rescinded pursuant to OAR 690-086-0920.

Development Limitation:

2. The limitation of the diversion of water under **Permit G-6728** established by the extension of time approved on December 15, 2009 is removed and, subject to other limitations or conditions of the permit, CRW is authorized to divert up to **8.9 cfs** (*out of the total permitted 8.9 cfs*) under **Permit G-6728**.

Plan Update Schedule:

3. CRW shall submit an updated plan meeting the requirements of OAR Chapter 690, Division 086 (*effective December 23, 2018*) within **10 years** and no later than **November 24, 2031.**

Progress Report Schedule:

4. CRW shall submit a progress report containing the information required under OAR 690-086-0120(4) by **May 24, 2027**.

Other Requirements for Plan Submittal:

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 CRW 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 day JUN 0 1 2022

Lisa J. Jaramillo, Transfer and Conservation Section Manager for
THOMAS M. BYLER, DIRECTOR
Oregon Water Resources

Mailing date: JUN 0 2 2022

Notice Regarding Service Members: Active duty service members have a right to stay these proceedings under the federal service members Civil Relief Act. For more information, contact the Oregon State Bar at 800-452-8260, the Oregon Military Department at 503-584-3571 or the nearest United States Armed Forces Legal Assistance Office through http://legalassistance.law.af.mil. The Oregon Military Department does not have a toll-free telephone number.

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Index of Exhibits

Appendices

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1. Municipal Water Supplier Plan Element

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

1.1 Overview

Clackamas River Water (CRW) was formed in 1995 when the Clackamas Water District and the Clairmont Water District consolidated. As a result, CRW operates under two state and federal Public Water System Identification Numbers: 4100187 ("Clackamas") for the area north of the Clackamas River, and 4100594 ("Clairmont") for the areas south of the Clackamas River.

CRW has a total of approximately 13,164 service connections. The service area is comprised of two sub-areas within the District. CRW's service area north of the river is primarily served by water from the Clackamas River, which is treated at CRW's water treatment plant (WTP). The remaining areas of the North System are served by wholesale water purchases from the North Clackamas County Water Commission (NCCWC)[1] and Oak Lodge Water District (OLWD). The remaining two-thirds of CRW's service area is located south of the river. CRW customers located in the South System receive wholesale water purchased from the South Fork Water Board (SFWB) owned by the Cities of Oregon City and West Linn. In 2020, CRW began supplying some of the South System customers with water from its WTP, including the Redland pressure zone.

The District can access groundwater from its Well No. 1, located near Abernathy Creek along Redland Road. Well No. 1 currently serves as a back-up supply.

CRW also provides treated water to the Sunrise Water Authority (SWA) on a wholesale basis, providing up to 2.5 million gallons per day (mgd). CRW currently furnishes water to SWA through an agreement with the NCCWC.

1.2 Plan Driver, Organization and Sources of Information

CRW is submitting this Water Management and Conservation Plan (WMCP) to meet a condition of Oregon Water Resources Department's (OWRD) final order approving CRW's previous WMCP. The Final Order requires CRW to submit an updated plan within 10 years of OWRD's final order issuance date and no later than July 30, 2021. Submittal of CRW's previous WMCP was a condition of the final order issued by OWRD approving the permit extension for CRW's groundwater Permit G-6728.

This WMCP fulfills the requirements of the Oregon Administrative Rules adopted by the Water Resources Commission in November 2018 (OAR Chapter 690, Division 86). It describes

[1] The NCCWC members include SWA, OLWD, and the City of Gladstone.

water management, water conservation and curtailment programs to guide the wise use and stewardship of CRW's water supply.

The plan is organized into the following sections, each addressing specific sections of OAR Chapter 690, Division 86:

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

In 2019, CRW published two water system master plans (WSMPs) that were developed with Carollo Engineering for the North and South Systems.[2] This WMCP draws upon these documents as primary sources of information, among other sources.

1.3 Affected Local Governments

This plan may affect the following local governmental agencies:

- Clackamas County
- City of Happy Valley
- City of Milwaukie
- Gladstone
- City of Portland
- City of Oregon City
- Johnson City
- METRO

Thirty days prior to submitting this WMCP to the Oregon Water Resources Department (OWRD), the draft plan was made 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. A copy of the letters requesting input are provided in Appendix A. No comments were received.

[2] *Clackamas River Water Water System Master Plans, North and South Systems*, Carollo (2019)

CRW also submitted a draft of this WMCP to the following entities as a courtesy:

- City of West Linn
- City of Lake Oswego
- Oak Lodge Water District (OLWD)
- North Clackamas County Water Commission (NCCWC)
- South Fork Water Board (SFWB)
- Sunrise Water Authority (SWA)

1.4 Plan Update Schedule

CRW anticipates submitting an update of this plan within 10 years of plan approval. As required by OAR Chapter 690, Division 86, a progress report will be submitted within five years from the approval of this plan.

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2. Municipal Water Supplier Description

This section includes an overview of CRW's water system, presents historical demand and consumption, and describes the District's sources of supply. This section satisfies the requirements of OAR 690-086-0140.

2.1 Terminology

System demand or *demand* refers to the total volume of raw (untreated) water produced from CRW's surface water source, groundwater source, and wholesale water purchases from SFWB.

Specific demand terms include:

- Average day demand (ADD): total annual demand divided by 365 days.
- Maximum day demand (MDD): the highest demand in a day during a calendar year.
- Maximum monthly demand (MMD): the demand measured during the calendar month with the highest total demand.
- Monthly demand: Monthly demand is expressed either as a total volume of demand per month or as an average daily demand per month by dividing the monthly volume by the number of days in the month.
- Peaking factor: a ratio of one demand to another. The most common peaking factor and the peaking factor used in this WMCP is MDD to ADD.

MDD is an important value for water system planning. CRW's supply facilities and water rights must be capable of meeting MDD. If MDD exceeds CRW's supply capacity on any given day, finished water storage levels will be reduced.

Consumption describes authorized uses, including metered and unmetered water uses.

Generally, demands and consumption in municipal systems are expressed in units of millions of gallons per day (mgd). They also may 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, it is typical to refer to the total quantity of water in million gallons (MG). Water use per person (per capita use) is expressed in gallons per person per day (gpcd).

2.2 Sources of Supply

OAR 690-086-0140(1)

CRW's primary source of supply is surface water from the Clackamas River. CRW also has a back-up water supply from groundwater (Well No. 1) located along Redland Road near

Oregon City. The Clackamas River Basin spans an area of approximately 940 square miles. The upper reaches of the basin are in the Mt. Hood National Forest.

CRW serves its North System with water diverted from the Clackamas River through two screened intakes maintained by CRW, and located at river mile 2.7. Raw water is treated at CRW's 30-million gallons per day (mgd) filtration WTP near the northern banks of the Clackamas River. In addition, the District relies on wholesale purchases from the NCCWC and OLWD to provide water to several hundred of CRW's customers located in three areas along the western edge of the North System's Mather pressure zone. One area is comprised of 122 CRW customers and is served by the NCCWC (labelled as "NCCWC" on Exhibit 2-1) and two areas include 245 CRW customers served by OLWD (labelled as "Oak Lodge" in Exhibit 2-1).

CRW serves some of its customers in the South System with water treated at its WTP, but the majority of its South System customers currently receive wholesale water purchased from the SFWB who also diverts water from the Clackamas River through a screened intake maintained by SFWB and located at river mile 1.5. SFWB operates a 25-mgd WTP located south of the Clackamas River.

Portions of the South System also can receive approximately 1.3 mgd of groundwater from Well No. 1 based on existing well capacity. CRW may also use Well No. 1 for Aquifer Storage and Recovery under ASR Limited License 003. CRW currently uses Well No. 1 as a back-up source of supply.

2.3 Service Area Description and Population

OAR 690-086-0140(2)

CRW's service area is located in Clackamas County, south of Portland and east of the Willamette River, in primarily unincorporated areas within the boundaries of the Portland Metropolitan Area (Metro), Clackamas County, and the Cities of Oregon City, Happy Valley, Gladstone, Milwaukie, Portland, and Johnson City. CRW's service area is divided into the North and South Systems geographically by the Clackamas River. Exhibit 2-1 presents a schematic of CRW's service area and includes major water system components and sources of supply.

The division of CRW's service area into two systems once reflected distinct sources of supplies for each system, with the North System being supplied with water from the Clackamas River treated at CRW's WTP, and the South System receiving water from the Clackamas River via wholesale purchases from SFWB and on occasion, groundwater from CRW's well.

The construction of distribution system infrastructure across the Clackamas River linked the two systems in 2020 and CRW began serving some South System customers directly at that time. That distinction in source of supplies between the two areas will become less apparent over the next six years as CRW continues to upgrade its infrastructure in the South System to

enable CRW to supply the majority of South System customers with water from its WTP. (More information about CRW's capital improvement plans is found in Section 2.10.)

CRW provides water to approximately 13,164 service connections, including those CRW customers that receive wholesale water provided by other water suppliers and water provided to CRW customers annexed into the City of Milwaukie in 2015. The District serves residential areas, commercial establishments, industrial facilities, public facilities such as schools and churches, irrigators, and one wholesale customer, SWA.

CRW's service area is approximately 41.6 square miles. The North System is approximately 11 square miles. As shown in Exhibit 2-2 obtained from CRW's North System WSMP, the North System shares borders with the City of Portland to the north, Sunrise Water Authority and Happy Valley to the east, the Clackamas River to the south, Gladstone to the southwest, and OLWD and Milwaukie to the west.

Most of CRW's North System service area is unincorporated, though it contains portions of the cities of Happy Valley and Milwaukie, and contains the City of Johnson City, and is entirely within the Portland Metropolitan Area urban growth boundary. CRW provides water service to portions of its service area located in Happy Valley and Milwaukie through intergovernmental agreements. The City of Johnson City is served by CRW as a commercial customer based on historical service decisions made by Johnson City.

The North System has an estimated population of 29,918 according to CRW's North System WSMP. The North System has a large residential population, and most of CRW's non-residential customers, including commercial and institutional customers, are located in this system. Additional information about CRW's customers is presented in Section 2.7.

The South System is approximately 31 square miles and has a service population of 19,928 according to CRW's South System WSMP. The South System is rural in nature and more sparsely populated than the North System. A majority of the South System is located in unincorporated portions of Clackamas County with the remainder located within Oregon City's UGB. As shown in Exhibit 2-3 obtained from CRW's South System WSMP, Oregon City lies to the west of CRW's South System service area.

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Exhibit 2-1. CRW Water System Schematic

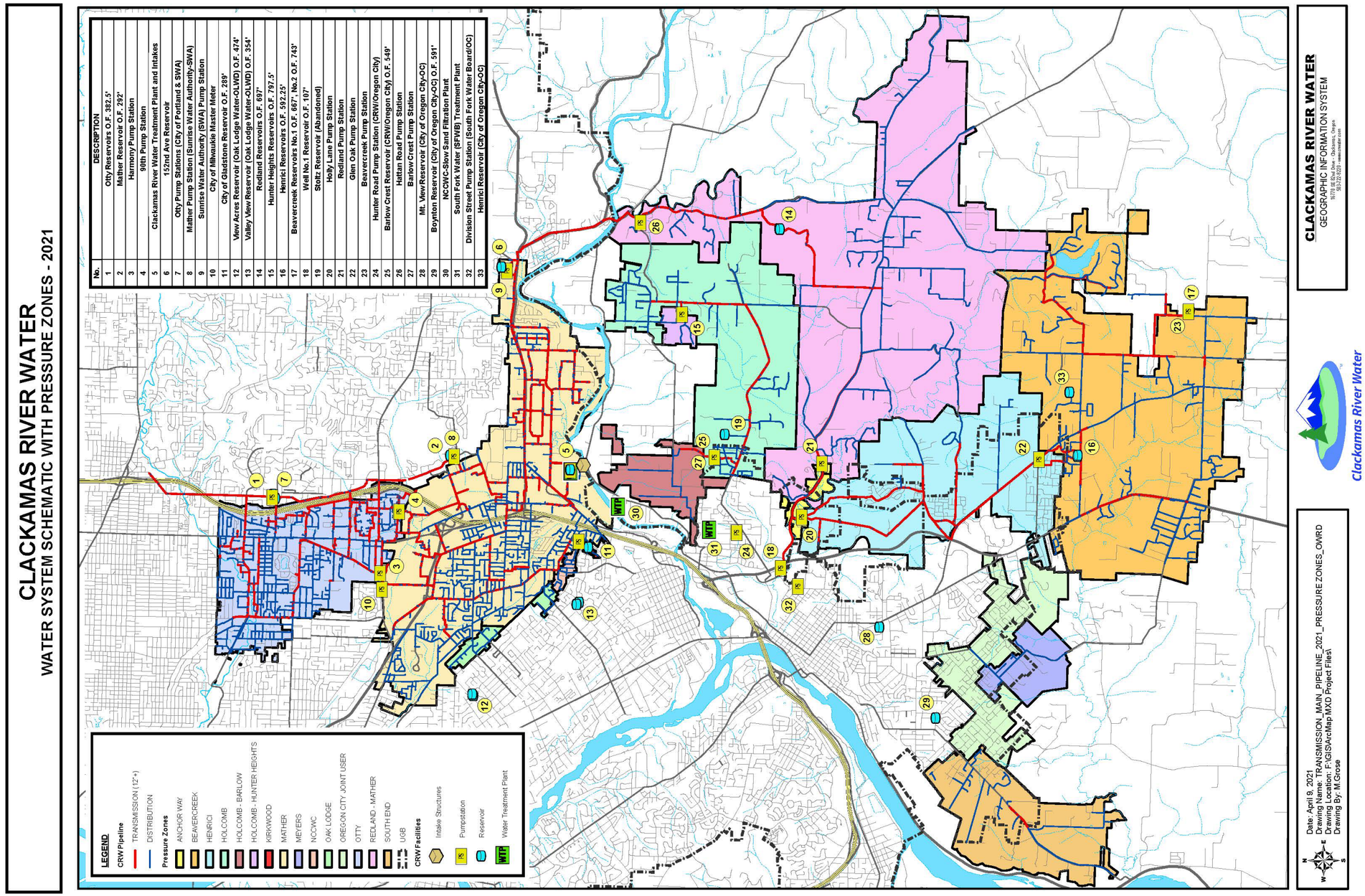

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Exhibit 2-2. CRW North System and Neighboring Areas

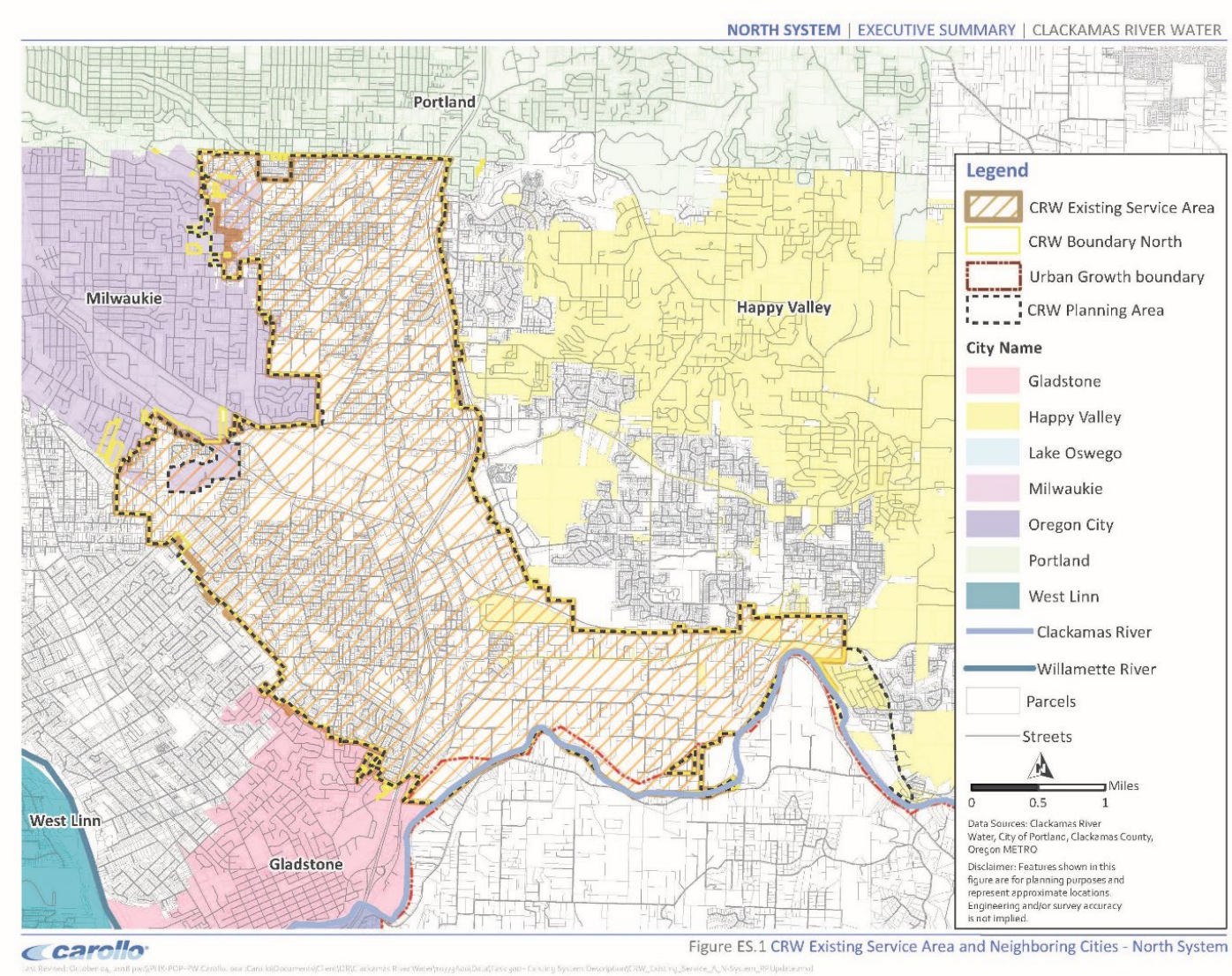

Figure ES.1 CRW Existing Service Area and Neighboring Cities - North System

Exhibit 2-3. CRW South System and Neighboring Areas

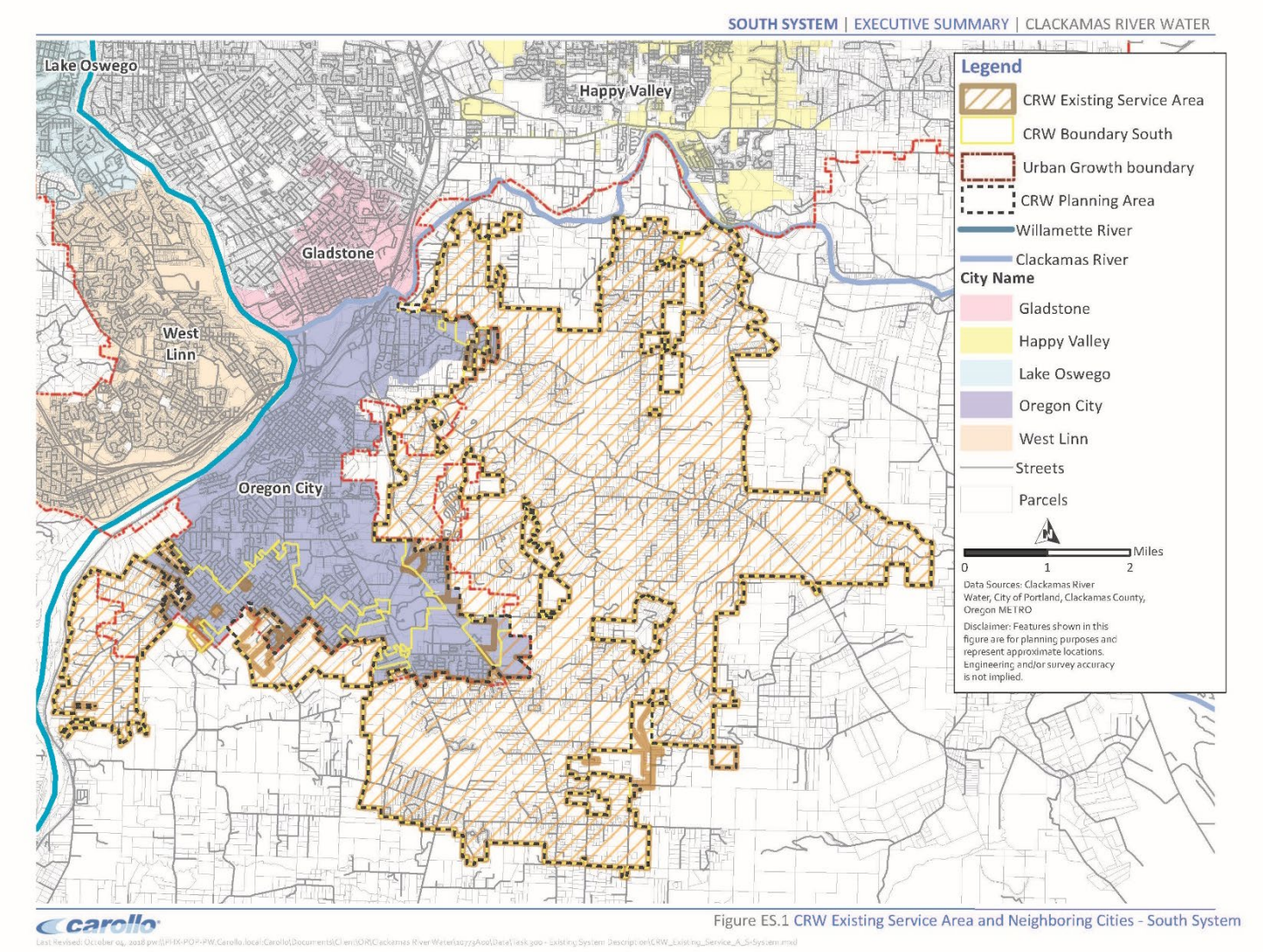

Figure ES.1 CRW Existing Service Area and Neighboring Cities - South System

2.4 Interconnections with Other Systems

OAR 690-086-0140(7)

CRW's water system is interconnected with several other systems as shown in Exhibit 2-4. CRW benefits from these interconnections because they allow for the exchange of water for use as emergency sources of supply during shortage events. In addition to emergency interconnections, some of CRW's interconnections with other providers allow CRW to supply wholesale water to its customers, including interconnections with the SFWB, OLWD, NCCWC, and Oregon City.

CRW provides water from SFWB to CRW's Holcomb-Barlow, Holcomb, and Holcomb-Hunter Heights pressure zones using: 1) shared transmission main piping and a reservoir with Oregon City and 2) Oregon City's distribution system via two interconnections located at the Forsythe Master Meter and at the Barlow Crest Pump Station (see Exhibit 2-4, locations A and B). CRW's interconnection with SFWB at Anchor Way, location C in Exhibit 2-4, allows service to the Redland-Mather, Beavercreek, and Henrici pressure zones.

CRW's Oregon City Joint Users pressure zone is served at location F in Exhibit 2-4 with water purchased from SFWB and water wheeled via the Oregon City distribution system to this zone. The South End and Meyers pressure zones utilize the Oregon City transmission system to wheel water from SFWB, with the interconnection at Impala and South End Roads identified in Exhibit 2-4 at location G.

CRW's largest customer and only wholesale customer is SWA which purchases 2.5 mgd under an existing contract. Though CRW has several interconnections with SWA, the primary interconnection used to provide water to SWA is at Pump Station 10, located along Morning Way (see Exhibit 2-4 location 7).

The major water providers of the Clackamas River Basin have an intricate system of interconnections as a means to distribute water from provider to provider for wholesale water or emergency supply. A schematic of these interconnections is provided in Exhibit 2-5.

As shown in Exhibit 2-5, CRW has bi-directional interconnections for emergency supply with the Cities of Gladstone, Portland, and Milwaukie and OLWD. Also shown in Exhibit 2-5 is CRW's connection with SWA that is used to provide wholesale water to SWA.

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Exhibit 2-4. Interconnections with Other Water Systems

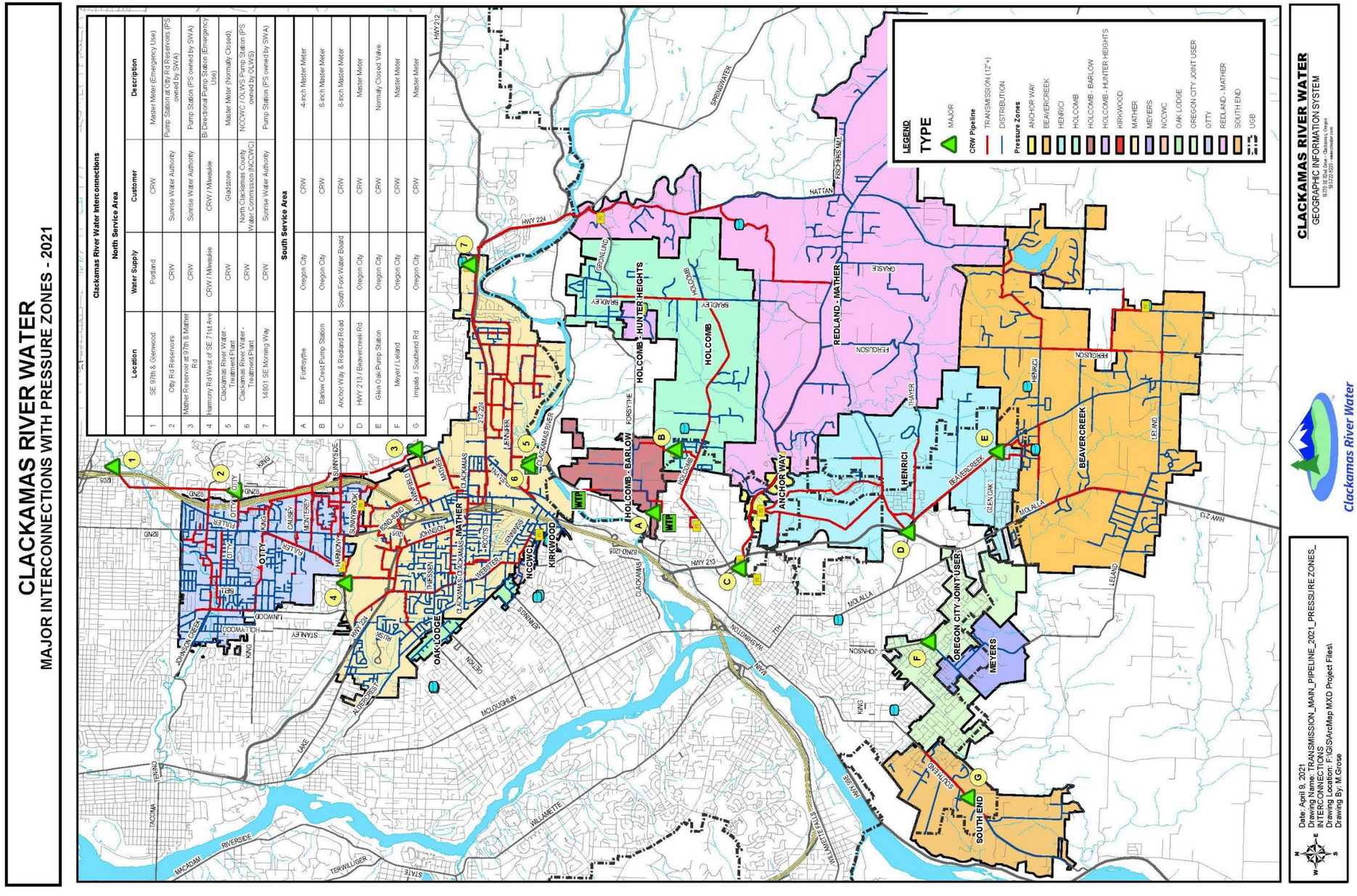

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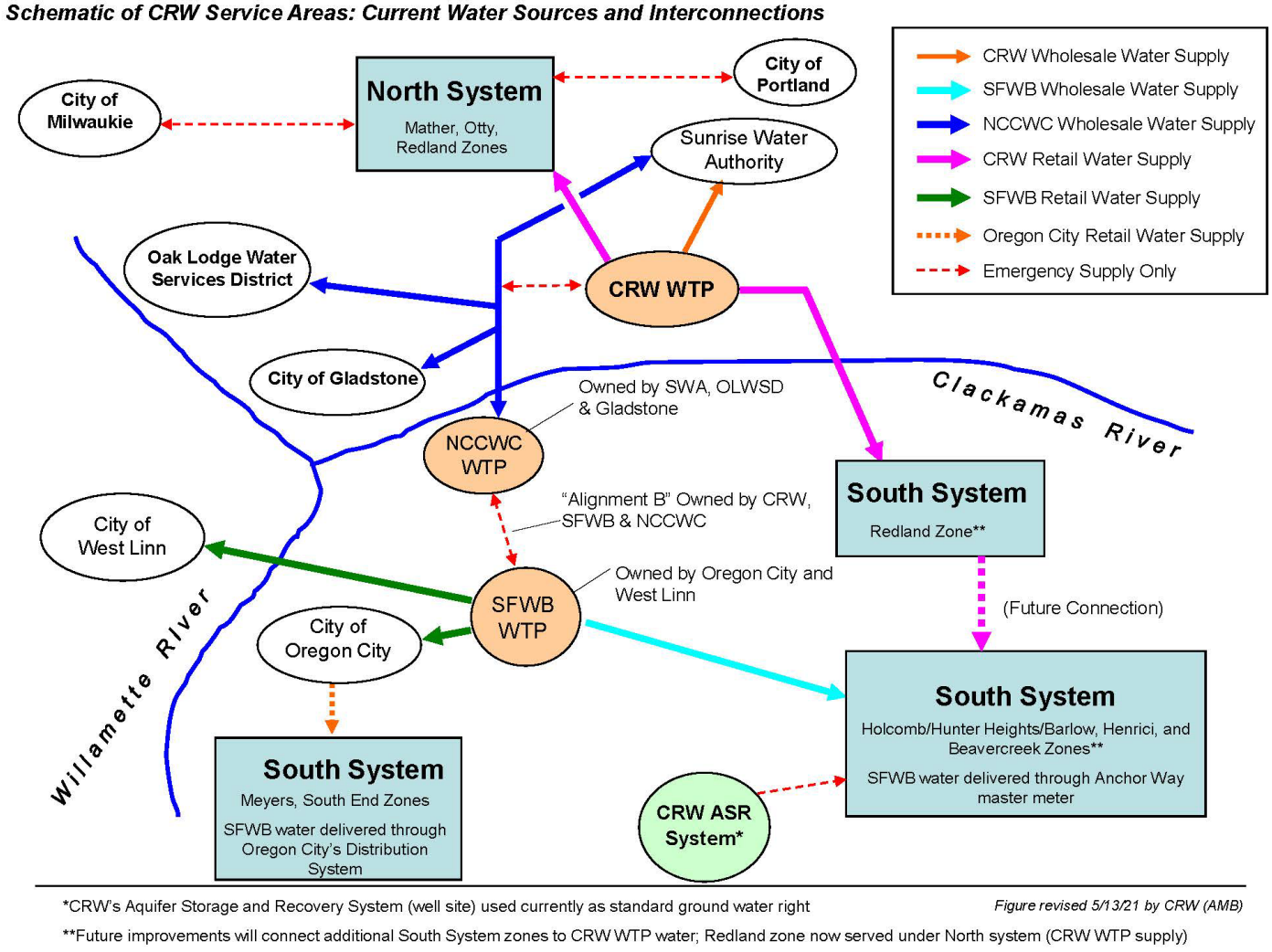
Exhibit 2-5. Schematic of Regional Water Sources and Interconnections



*CRW's Aquifer Storage and Recovery System (well site) used currently as standard ground water right

Figure revised 5/13/21 by CRW (AMB)

**Future improvements will connect additional South System zones to CRW WTP water; Redland zone now served under North system (CRW WTP supply)

2.5 Intergovernmental Agreements

OAR 690-086-0140(1)

CRW has numerous intergovernmental agreements that include water supply agreements (both sales and purchase), emergency water supply, and collaborative agreements. Appendix B summarizes the key terms of these agreements.

. CRW is currently negotiating with the NCCWC for a long-term contract to continue to provide wholesale water to SWA. Members of NCCWC include SWA, Oak Lodge Water Services District (OLWSD), and the City of Gladstone. The parties are seeking an increase (to a potential total of 10 mgd) to the current wholesale purchase rate, which currently stands at 2.5 mgd. The parties are continuing to operate under the existing agreement, which was set to expire December 2021, but was extended for six months until a new agreement is executed.

CRW is a member of two regional entities as noted in Appendix B. CRW is a member of the Clackamas River Water Providers (CRWP), a consortium of water utilities that supply water from the Clackamas River. Other members include the City of Lake Oswego, SFWB, SWA, City of Estacada, and NCCWC. The purpose of the consortium is to coordinate and fund water resource planning, management and conservation outreach programs. CRW is also one of the original members of the Regional Water Providers' Consortium (RWPC) which is comprised of 24 water providers from the Portland metropolitan region. The RWPC provides a variety of benefits to members, including the coordination of water supply management and stewardship, among other benefits.

2.6 Historical Water Demands

OAR 690-086-0140(4)

CRW meets its water demand with treated surface water from the CRW WTP, purchased wholesale water from SFWB, NCCWC, and OLWD, and groundwater (back-up supply only). Exhibit 2-6 summarizes CRW's demand for the North System, South System, and overall system for 2016 through 2020 using several measures, including average day, maximum day, and maximum month demands and annual demands and peaking factors. Demand values for the North System were obtained from reads taken at CRW's master meter that measures raw (untreated) water entering the WTP diverted from the Clackamas River and wholesale water purchases from the NCCWC and OLWD. The North System has significantly more demand compared to the South System, accounting for 82 percent of overall system demand which is explained by the greater number of customers in the North System. In addition, Exhibit 2-6 incorporates wholesale water sales to SWA in the North System and wholesale water purchases from SFWB in the South System volumes. Both the North and South Systems had relatively consistent overall demand, ADD, and MDD over the nine year period.

CRW's total annual demand averaged 3,220.0 MG over the five year period and ranged from 3,160.9 MG (2019) to 3,236.7 MG (2016). Total demand was relatively consistent year to year during this time period, despite a growing service area population. Because ADD is derived from annual demands, changes in ADD mirrored the changes in annual demands. The average ADD for the period was 8.8 mgd.

The total system demand average MDD was 17.1 mgd, and ranged from 16.2 mgd (2018) to 17.7 mgd (2016). MDD for the overall system represents the sum of the MDDs for the North and South Systems. CRW's peaking factor averaged 1.9 over this period, which is within the range of some neighboring water systems. For comparison, the City of Lake Oswego's average peaking factor was approximately 2.5 from 2003 to 2017[3], and the City of Oregon City[4] (a member of South Fork Water Board) was approximately 1.8 from 2004 to 2008. MDD for the South System was estimated by multiplying ADD by an estimated peaking factor of 2.7. The South System MDD was estimated because the master meter at the CRW-SFWB interconnection, which measures wholesale purchases from SFWB, does not store instantaneous demands. The peaking factor of 2.7 is based on CRW's observations of meter reads during periods of high demand.

CRW's MMD from 2016 to 2020 occurred in July or August of each year, which is the typical pattern for water providers in western Oregon.

[3] City of Lake Oswego Water Management and Conservation Plan Draft (2019).

[4] City of Oregon City Water Distribution System Master Plan (2012)

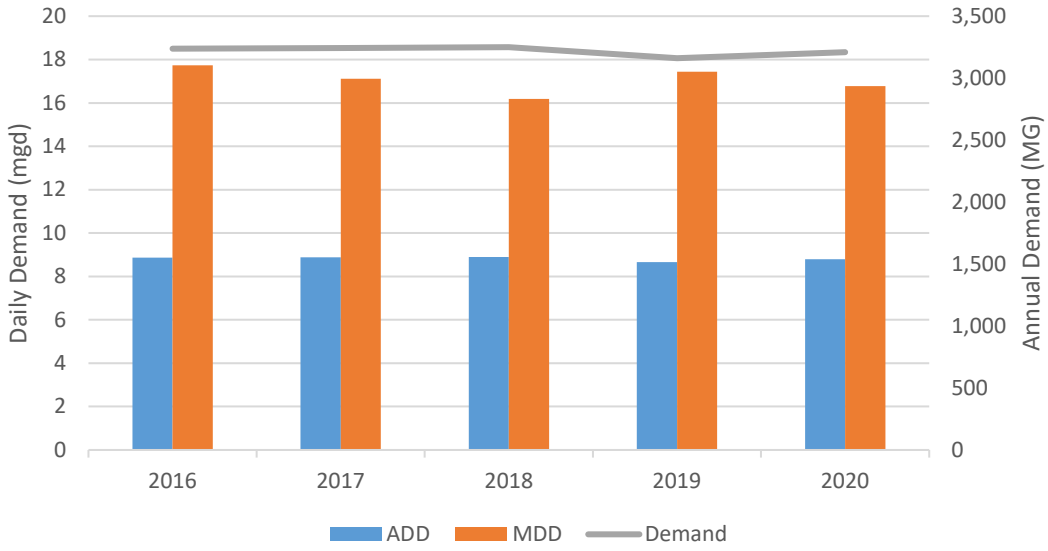
Exhibit 2-6. Annual Demands, 2016-2020

	North Service Area Demand				South Service Area Demand				Overall System Demand					
Year	Demand (MG)	ADD (mgd)	MDD (mgd)	Peaking Factor	Demand (MG)	ADD (mgd)	MDD (mgd)	Peaking Factor[1]	Demand (MG)	ADD (mgd)	MDD (mgd)	Peaking Factor	MMD (MG)[2]	MMD Month
2016	2,649.4	7.3	13.4	1.8	587.3	1.6	4.3	2.7	3,236.7	8.9	17.7	2.0	376.4	Aug
2017	2,648.8	7.3	12.7	1.8	594.5	1.6	4.4	2.7	3,243.3	8.9	17.1	1.9	383.1	Jul
2018	2,647.2	7.3	11.7	1.6	602.6	1.7	4.5	2.7	3,249.9	8.9	16.2	1.8	381.3	Jul
2019	2,603.5	7.1	13.3	1.9	557.4	1.5	4.1	2.7	3,160.9	8.7	17.4	2.0	365.7	Aug
2020	2,670.7	7.3	12.8	1.7	538.5	1.5	4.0	2.7	3,209.2	8.8	16.8	1.9	370.8	Aug
Average	**2,643.9**	**7.2**	**12.8**	**1.8**	**576.1**	**1.6**	**4.3**	**2.7**	**3,220.0**	**8.8**	**17.1**	**1.9**	**375.5**	**-**

[1]An estimated Peaking Factor of 2.7 for the South Service Area was used to estimate MDD
[2]Max Month Demand was not available from 2012-2015

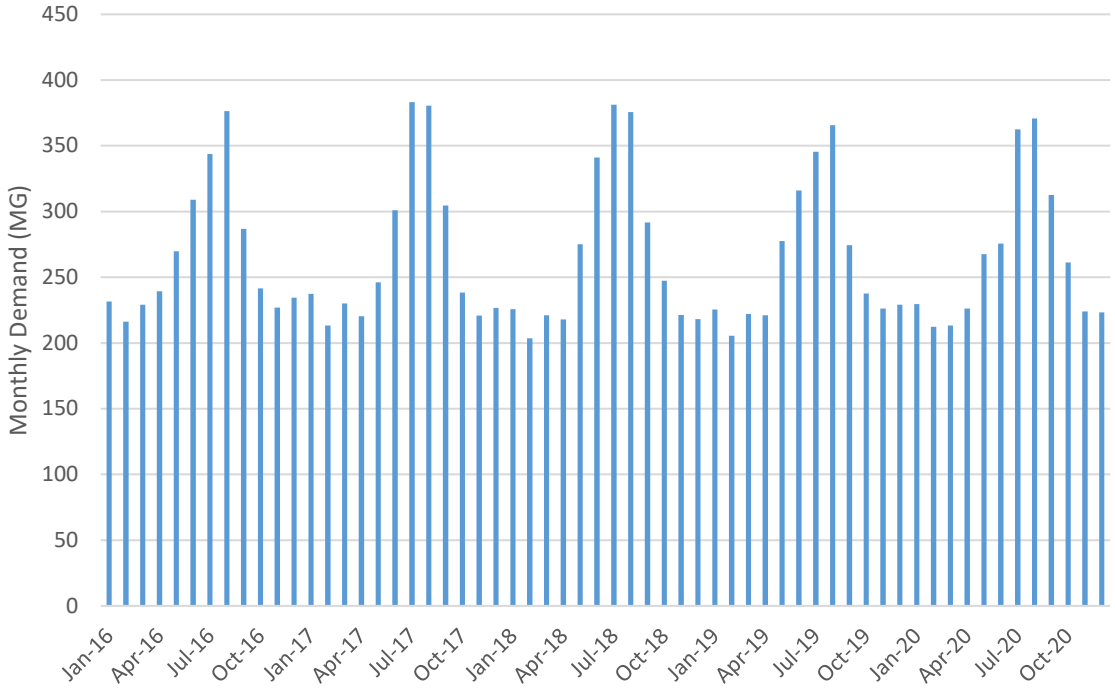
Exhibit 2-7 presents a chart of demand volumes for the overall system, and ADD and MDD volumes that are found in Exhibit 2-6.

Exhibit 2-7. Overall Demand, ADD, and MDD (2016-2020)



Monthly demand is shown in Exhibit 2-8. CRW's monthly demand over the five year period shows distinct increases during the summer months of June through September compared to other months. These increases reflect the seasonal nature of CRW's water use as a result of outdoor uses of water generally. Consumption by customer class is discussed later in this section.

Exhibit 2-8. Monthly Water Demands, 2016-2020



2.7 Customer Description and Use Characteristics

OAR 690-086-0140(6)

CRW organizes its water service accounts by customer category. CRW has multiple customer classes, but has aggregated these into four broad categories: Single Family Residential, Multi-Family Residential, Commercial/Industrial, and Authorized Unbilled Use. The first customer category, Single Family Residential, comprises the greatest number of customer accounts. The Commercial/Industrial category comprises the second greatest number of customer accounts, and represents water consumed by commercial businesses such as retail stores and industry such as manufacturing. The Authorized Unbilled Use customer category has the third greatest number of customer accounts and includes uses such as fire and hydrant flushing. Multi-Family Residential has the fewest number of customer accounts, and is comprised of water used in multi-family residences such as apartment buildings and trailer parks. In addition to these customer types, CRW also sells wholesale water to SWA. Exhibit 2-9 gives the number of customer accounts in each customer class as of December 2020.

Exhibit 2-9. Customer Categories and Number of Accounts, December 2020

Customer Category	Count	Percent of All Accounts
Single Family Residential	11,469	87.12%
Multi-Family Residential	238	1.81%
Commercial/Industrial	1,083	8.23%
Authorized Unbilled Use	374	2.84%
Wholesale	1	0.01%
Total	13,164	100.00%

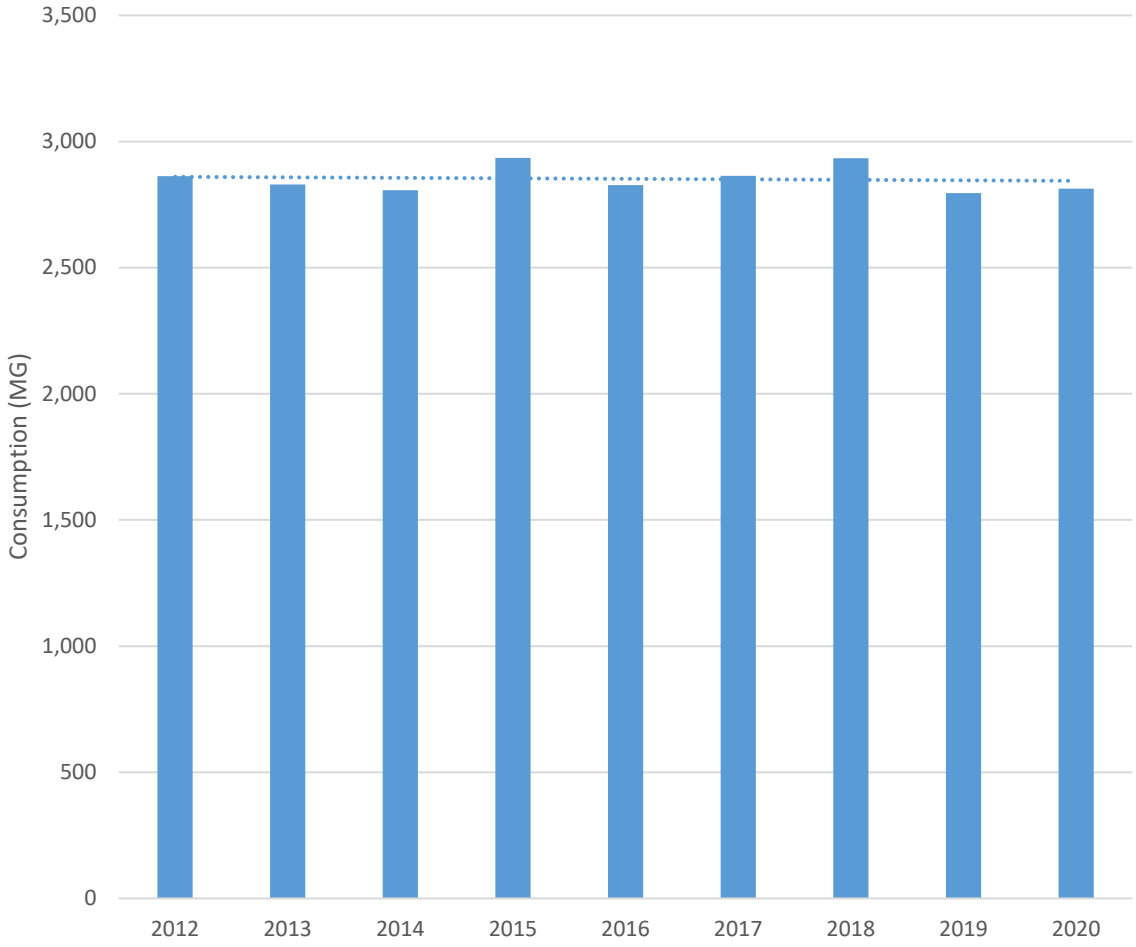
Exhibit 2-10 provides total annual consumption for each customer class and wholesale water sold to SWA for calendar years 2012 through 2020. The consumption data available for the years 2012 to 2016 shown in Exhibit 2-10 did not exactly match the data provided in the 2016 WMCP progress report. Therefore, the updated consumption data obtained during development of this WMCP are used instead.

Exhibit 2-10. Historical Annual Metered Consumption by Customer Category, 2012-2020

Year	Single Family Residential (MG)	Multi-Family Residential (MG)	Commercial/Industrial (MG)	Wholesale Water (MG)	Authorized Unbilled Use (MG)	Total Consumption (including wholesale) (MG)
2012	853.8	418.6	650.6	939.3	0.1	2,862.4
2013	854.3	407.6	652.0	915.7	0.0	2,829.7
2014	845.8	401.7	637.2	922.5	0.0	2,807.2
2015	891.5	439.6	691.9	912.2	0.0	2,935.2
2016	843.2	415.1	656.2	913.2	0.0	2,827.6
2017	858.6	429.9	663.9	912.2	0.0	2,864.5
2018	898.7	433.1	709.0	913.7	0.0	2,954.4
2019	833.5	403.3	664.4	912.3	0.0	2,813.5
2020	891.7	397.3	621.1	924.4	0.0	2,834.4

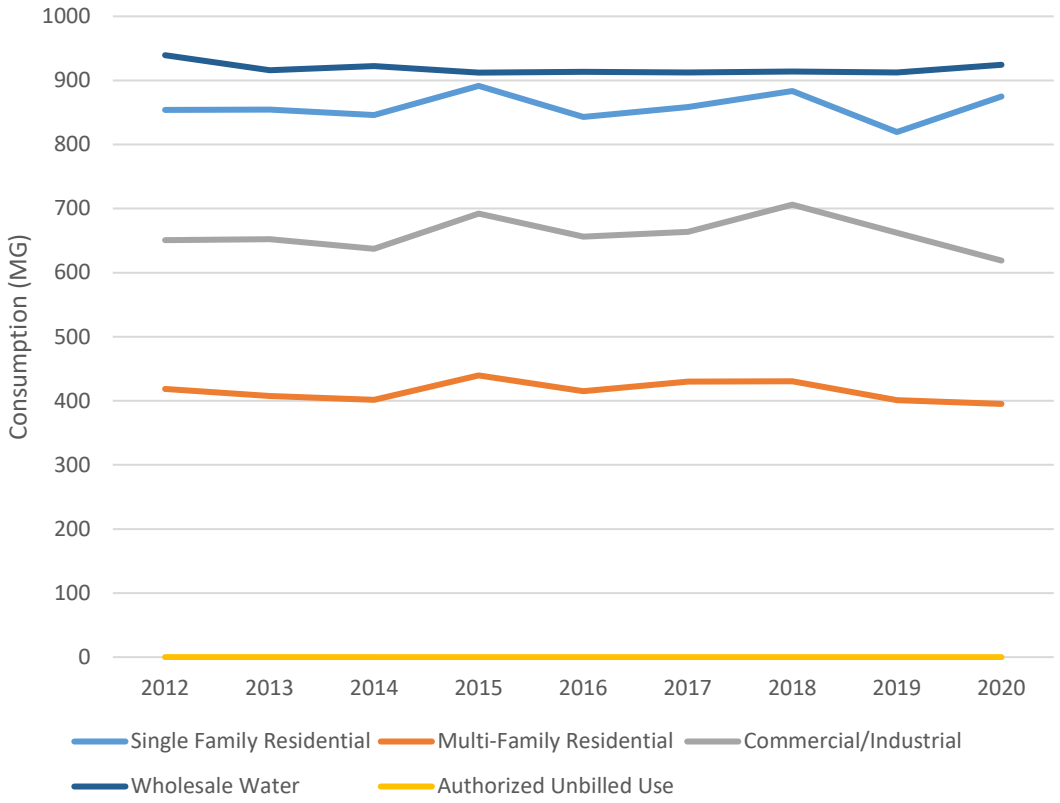
Exhibit 2-11 graphically depicts consumption volumes from Exhibit 2-10, but does not include wholesale sales to SWA.

Exhibit 2-11. Historical Total Annual Metered Consumption by Customer Category (without Wholesale), 2012-2020



Over this nine year period, metered consumption for all customer categories and purchased wholesale water remained relatively flat. Consumption by customer category from 2012-2020 is illustrated in Exhibit 2-12.

Exhibit 2-12. Consumption by Customer Category, 2012 through 2020



Annual fluctuations in total consumption are generally driven by outdoor water use and the individual or combined effects of the following weather-related factors, which increase outdoor use of water, such as irrigation of residential landscaping.

- Maximum temperatures
- Several consecutive days at high temperatures
- Low precipitation levels
- Extended consecutive days without precipitation

These factors may have played a role in CRW's annual residential consumption patterns by influencing outdoor water use in combination with other factors. For example, residential water use decreased around 2019 (a wetter year) and increased moving into 2020 (a drier year).

Exhibit 2-13 presents a pie chart showing the percentage of water used by each customer category in 2020. In this year, wholesale water sold to SWA accounted for 33 percent of the total water use. Single Family Residential water accounted for the next highest percentage of use, which was 31 percent. Multi-Family Residential use accounted for 14 percent, while Commercial/Industrial accounted for 22 percent. Authorized Unbilled Uses accounted for less than one percent in this year.

Exhibit 2-13. Percentage of Water Used by Customer Category, 2020

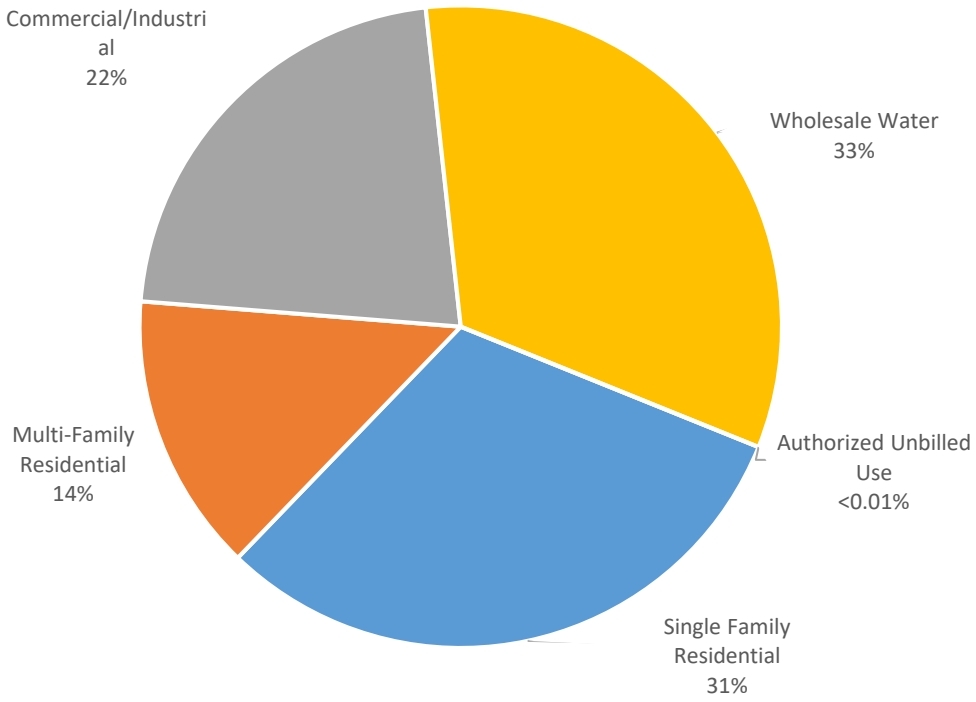


Exhibit 2-14 shows the consumption volumes by customer class presented in CRW's 2012 WMCP. In the previous WMCP, metered consumption averaged 3,329.8 MG annually from 2005 through 2009 whereas consumption from 2012 through 2020 averaged 2,852.1 MG, a decrease of approximately 14 percent. Due to the use of two more customer classes (Irrigation and Other) for the period 2005 through 2009 compared to the period 2012 to 2020, comparisons of individual customer categories would not provide useful results.

Exhibit 2-14. Summary of Annual Consumption by Customer Category (MG), 2005-2009

Year	Single-Family	Multi-Family[1]	Commercial & Industrial[2]	Wholesale	Irrigation	Other[3]	Total
2005	924	501	717	1,563	51	54	3,809
2006	1,044	525	714	1,135	50	64	3,532
2007	976	450	600	1,047	51	48	3,172
2008	928	440	588	985	45	48	3,034
2009	1,046	447	565	940	50	53	3,102

[1] Includes Trailer Parks accounts
[2] Includes Medical accounts
[3] Includes Government, Churches, School District, District, and Fire Service accounts

2.8 Water Loss

OAR 690-086-0140(9)

Exhibit 2-15 shows the results of annual water audits for 2016 through 2020. CRW calculates annual water loss by subtracting the sum of annual metered customer consumption plus authorized unbilled volumes and process water[5] from annual demand. Annual metered customer consumption includes consumption of each of CRW's customer categories previously discussed, including water sold to CRW's wholesale customer SWA. Demand includes water produced from CRW's surface and groundwater sources, plus wholesale purchases from SFWB, NCCWC, and OLWD. The water loss percentage is calculated by dividing the resulting water loss volume by the demand volume.

Exhibit 2-15. Water Loss, 2016 - 2020

Year	Production (MG)	Consumption (MG)	Process Water and Authorized Unbilled (MG)	Loss (MG)	Loss (%)
2016	3,236.7	2,827.6	85.7	323.5	10.0%
2017	3,243.3	2,864.5	142.5	236.3	7.3%
2018	3,249.9	2,954.4	144.9	150.6	4.6%
2019	3,160.9	2,813.5	110.3	237.1	7.5%
2020	3,209.2	2,834.4	111.8	262.9	8.2%
Average	**3,220.0**	**2,858.9**	**119.0**	**242.1**	**7.5%**

CRW's water loss averaged 7.5% over the five year period and was estimated to be 8.2 percent in 2020, below the industry standard of 10 percent. CRW attributes its water losses to apparent losses, such as meter inaccuracies or utility billing errors, and some real losses, such as typical distribution system leakage. Water loss and the reasons for CRW's low water loss is described further in Section 3.

CRW's draft WMCP submitted to OWRD for review did not include the full accounting of metered process water for 2020. CRW re-calculated water loss for 2020 using the entire volume of process water by increasing the "process water and authorized unbilled" volume identified in Exhibit 2-15 to 111.8 MG. This recalculation revised CRW's 2020 water loss to 8.2 percent and the five year average water loss to 7.5 percent.

2.9 Water Rights

2.9.1 Water Right Introduction

Under Oregon water law, with few exceptions, the use of public water (both ground and surface water) requires a water right permit from OWRD. The administration of water rights

[5] Process water is water used at the WTP during the water treatment process. This water is not used to meet demand, but returned to the river following treatment.

by OWRD is based on the doctrine of prior appropriation. Under this doctrine, the first person to have obtained a water right permit (the senior appropriator) is the last to be limited in low water conditions. The date of application for the water right permit usually establishes the "priority date" or place in line of an appropriator. In times of shortage, the senior appropriator can demand the full amount of their water right regardless of the needs of junior appropriators. If there is surplus beyond the needs of the senior appropriator, the next most senior appropriator can take as much as needed to satisfy their right and so on down the line until there is no surplus. A state officer (an OWRD Watermaster) oversees which junior appropriators must stop using water so that senior users' needs can be satisfied.

The right to use water is typically first granted in the form of a water use permit. The permit describes the priority date, the amount of water that can be used, the location and type of water use and often a number of water use conditions. The permit allows the water user to develop the infrastructure needed to put the water to full beneficial use – a requirement of Oregon water law. When the report of beneficial use, called a Claim of Beneficial Use (COBU), is approved by OWRD, a water right certificate is issued confirming the status of the right. Obtaining a water right certificate is the best way to ensure the protection of the use, particularly since municipal water use certificates are not subject to cancellation due to non-use.

Water use permits typically have timelines for making full beneficial use of the water. If more time is needed than provided in the permit, the permit holder may request an "extension of time" from OWRD.

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

2.9.2 Water Rights Held by Clackamas River Water

OAR 690-086-0140(5)

Exhibit 2-16 provides a summary of CRW's water rights. CRW holds three surface water right certificates authorizing the total use of up to 46.5 cfs (30.1 mgd) from the Clackamas River for municipal use. These certificates are numbered 37794, 79899, and 84072, and have priority dates of 1962, 1968, and 1969, respectively. The authorized point of diversion (POD) for all surface water rights held by CRW is the CRW WTP intake structure on the Clackamas River at approximately RM 2.7.

By virtue of consolidation with Clairmont Water District, CRW also holds one municipal groundwater permit (G-6728) for 8.9 cfs (5.8 mgd) for a well (Clairmont Well No. 1; now referred to as Well No. 1) completed in the Columbia River Basalt Group (CRBG) located near

Abernathy Creek in the vicinity of Oregon City. The current development deadline for Permit G-6728 is October 1, 2029. Well No. 1 is also associated with ASR Limited License 003 (LL-003). Under this limited license, CRW is authorized to store up to 200 million gallons of surface water in the basalt aquifer using 6 injection wells (including Well No. 1). The limited license has a number of conditions for monitoring and reporting.

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Exhibit 2-16. Water Rights Table

Source	Priority Date	Application, Permit, and Certificate Numbers	Quantity		Type of Use	Authorized Date for Completion	Max. Rate of Withdrawal to Date	Annual Quantity Diverted to Date (MG)[1]	2020 Withdrawal	Five-Year Avg. Withdrawal (2016-2020)
			Authorized Rate	Authorized Volume						
Clackamas River	4/25/1962	App: S-37245 Permit: S-27925 Cert: 37794	15.0 cfs [9.7 mgd]	N//A	Municipal	N/A	15.0 cfs [9.7 mgd]	2,735.2	228 MG/mo 7.5 mgd	219 MG/mo 7.3 mgd
Clackamas River	5/20/1968	App: S-44939 Permit: S-33586 Cert: 79899	25.0 cfs [16.2 mgd]	N/A	Municipal	N/A	25.0 cfs [16.2 mgd]			
Clackamas River	5/23/1969	App: S-46072 Permit: S-34426 Cert: 84072	6.5 cfs [4.2 mgd]	N/A	Municipal	N/A	6.5 cfs [4.2 mgd]			
Well near Abernathy Cr., tributary to the Willamette R.	7/13/1973	App: G-6228 Permit: G-6728	8.9 cfs	N/A	Municipal	Oct. 1, 2029	2.1 cfs [1.4 mgd]	174,400.0	8,600 gal/mo, 280 gal/day	9,500 gal/mo, 317 gal/day
Clackamas River	N/A	LL-003	32.1 cfs	200 MG	Municipal	Mar. 8, 2027	7.0 cfs [4.5 mgd]	120.4[2]	0	0

[1] Maximum volume of water obtained from a review of the previous five years of demand.

[2] Golder Associates and MWH, *Clackamas River Water ASR Pilot Testing* (February 13, 2003)

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2.9.3 Aquatic Resource Concerns

OAR 690-086-0140(5)(i)

CRW's water rights authorize diversion from the Clackamas River near river mile 2.7 and appropriating groundwater from one well located in the South System (see Exhibit 2-1). OAR 690-086-140(5) requires CRW to identify the following for each of these water sources: 1) any listing of the source as water quality limited (and the water quality parameters for which the source was listed); 2) any streamflow-dependent species listed by a state or federal agency as sensitive, threatened or endangered that are present in the source; and 3) any designation of the source as being in a critical groundwater area.

The Clackamas River has been an important source of drinking water for decades. Numerous cities, such as the Cities of Lake Oswego, Oregon City, West Linn, Happy Valley, and Milwaukie, and water authorities and districts, like CRW, rely on the river as a source of supply. Land development has impacted the Clackamas River basin over time, changing the water quality of the river. However, over the last 50 years, federal and state laws, such as the federal Clean Water Act, were promulgated and revised to protect water quality in drinking water sources like the Clackamas River. These and other laws ensure that the water quality of streams are monitored and that pollutants are regulated. In addition, other federal legislation, like the Safe Drinking Water Act, ensure surface water treated at the WTPs of water providers, for example CRW, SFWB, and NCCWC, regularly meet or exceed federal and state drinking water standards.

As part of a federal and state effort to protect Oregon streams from pollutants, every two years the Clean Water Act requires Oregon Department of Environmental Quality's (DEQ) to assess or re-assess water quality and report to the Environmental Protection Agency on the condition of Oregon's waters. The Clean Water Act Section 303(d) requires the DEQ to identify waters that do not meet water quality standards and where a Total Maximum Daily Load (TMDL) pollutant load limit needs to be developed for additional regulation.

In 2010, the Clackamas River, from Wade Creek to the confluence with the Willamette River, Assessment Unit OR_SR_1709001106_02_104597, was placed on DEQ's 303(d) list as an impaired water body for some water quality parameters. In DEQ's 2018/2020 Integrated Report, DEQ categorized this segment as a Category 5 water quality limited stream due to elevated year-round water temperatures and during salmon spawning, reduced dissolved oxygen levels, and presence of methylmercury.[6]

The Clackamas River may support listed streamflow dependent fish species. These species and their state and federal listing statuses are provided in Exhibit 2-17.

[6] Source: Oregon Department of Environmental Quality's (DEQ) Assessment Database from DEQ's 2018/20 Integrated Report

Exhibit 2-17. Listed Fish Species

Listed Fish Species	State Status	Federal Status
Fall Chinook salmon	Sensitive Critical	Threatened
Spring Chinook salmon	Sensitive Critical	Threatened
Coho salmon	-	Threatened
Steelhead - Winter / Coastal Rainbow Trout	Sensitive Critical	Threatened
Steelhead - Summer / Coastal Rainbow Trout	Sensitive Critical	Threatened
Lower Columbia River Steelhead	-	Threatened
Pacific Brook Lamprey	Sensitive	-
Pacific Lamprey	Sensitive	-
Western Brook Lamprey	Sensitive	-
Western River Lamprey	Sensitive	-
Columbia River Chum Salmon	Sensitive Critical	Threatened
Coastal Cutthroat Trout	Sensitive	-
Oregon Chub	Sensitive	-
White Sturgeon	Sensitive	-

CRW's Well No. 1 is not in a critical groundwater area.

2.10 Evaluation of Water Rights/Supply

OAR 690-086-0140(3)

CRW holds 46.5 cfs (30.1 mgd) of certificated water rights from the Clackamas River. The degree to which CRW's water rights are adequate and reliable depends on stream flows in the Clackamas River and the seniority of these rights.

There is significant flow in the Clackamas River, even during the driest months of the year. According to stream flow records from 2000 to 2020 taken near the mouth of the Clackamas River at United States Geologic Survey (USGS) gage 14211010—about 2.5 miles downstream from CRW's point of diversion (POD)—Clackamas River flows have ranged from 673 to 50,000 cfs during the high-flow months of November through April, and from 626 to 10,700 cfs during low-flow months July through September.

There are many water rights on the Clackamas River, including those that authorize diversion for irrigation, industrial use, and municipal use, as well as those that make use of water in-stream, such as for power production and fish protection.

Downstream of CRW's POD, there are three municipal entities that divert sizeable water quantities: SFWB, NCCWC, and Lake Oswego. Both SFWB and Lake Oswego hold water rights that are senior to CRW. In addition, there is an instream water right held by the State of Oregon (Certificate 59491) that includes the reach where CRW's POD is located and is senior to CRW's Certificate 84072. The instream right has a priority date of August 26, 1968 and authorizes protection of 400 cfs from July 1 through September 15, and 640 cfs from September 16 through June 30. These levels are intended to protect aquatic life in the Clackamas River and its tributaries above USGS gage 14209500 (Clackamas River

above Three Lynx Creek at River Mile 48) to the mouth. Based on priority date and abundant stream flow, CRW's water right Certificate 37794 (priority date April 25, 1962) for 15 cfs (9.7 mgd) is highly reliable. While this right is junior to SFWB's 60 cfs Permit S-22581 on the Clackamas River, it is senior to the instream water right. Certificate 79899 for 25 cfs (16.2 mgd) also appears reliable based on historical stream flows given its priority date of May 20, 1968. While this right is junior to SFWB's Permit S-22581 and Lake Oswego's 25 cfs Permit S-32410 and 25 cfs Certificate 78332, it is senior to the instream water right.

Based on a review of gage data from June 2001 to December 2020,[7] mean daily flows have not dropped below the rates specified in instream water right Certificate 59491 (measured at USGS gage 14211010 located near Oregon City and the mouth of the Clackamas River). A longer history of streamflow is available from USGS gage 14210000 located near Estacada (approximately 20 miles upstream of CRW's POD). Since 1970, during the peak season, mean daily flow at this gage was lower than the 640 cfs rate of instream water right Certificate 59591 on 30 days (4% of the time), all occurring between September 16 and September 30. Outside of the peak season, mean daily flows have dropped below the 640 cfs instream water right during October with the same frequency (4%).

The most recent time period that flows dropped below the instream water right was in 2020, when mean daily flows at USGS gage 14210000 were below the instream water right rate on three days between September 16 and September 22, 2020. However, flows below USGS gage 14211000 at Estacada increase substantially in the 20 miles down to CRW's POD because of the contributions of many tributaries, including Eagle Creek, Deep Creek, Richardson Creek, Clear Creek, and Rock Creek.

CRW's third surface water right, Certificate 84072 (6.5 cfs, 4.2 mgd) has a priority date May 23, 1969 and is junior to downstream water rights held by SFWB and Lake Oswego and to the instream water right. Certificate 84072 has not been regulated by the Watermaster in the past 20 years to satisfy this senior instream water right. Even if CRW's Certificate 84072 is regulated in the future to protect use under the instream water right, this regulation would not preclude CRW from using Certificate 84072 for domestic use because instream water right certificate 59491 is conditioned not to have priority over domestic use. Domestic use is defined by OWRD as the use of water for human consumption, household purposes, and domestic animal consumption related to residential use of the property.

Though Certificate 84072 has been reliable for CRW historically, some uncertainty exists in regard to the long-term reliability of this right. While historical flow measurements at the mouth of the river—and closer to and below CRW's POD—have exceeded 640 cfs for the last 20 years, CRW does not discount the possibility that its Certificate 84072 may be regulated in favor of the senior instream right in light of continued development of water rights by senior downstream water right holders (SFWB and Lake Oswego) and reduced peak season flows related to climate change. Regarding climate change, the 2019 Willamette Basin Review Feasibility Study published by the U.S. Army Corps of Engineers reports that while there is no consensus about whether the Willamette River basin's climate will become wetter or drier on an annual basis, seasonal differences are predicted in the form of warmer and drier summers in the Willamette Basin[8]. The potential for reduced precipitation in the summer and hotter weather

[7] Stream flows measurements recorded at USGS gage 14211010 start in June 2001.

[8] *Willamette Basin Review Feasibility Study* (U.S. Army Corps of Engineers, 2019

suggests reduced summer flows in the Clackamas River. Though this water right represents a much smaller diversion than CRW's other rights (6 cfs, 3.9 mgd), this right increases in importance for CRW over time as CRW's demand increases due to growth within its service area.

CRW's groundwater supply includes Permit G-6728. While Permit G-6728 authorizes CRW to appropriate 8.9 cfs at Well No. 1, taste and odor concerns along with higher corrosivity levels have limited CRW's use of this right. Currently, CRW relies on this right as a back-up source of supply. The well was drilled in 1973 and current well capacity limits use to approximately 920 gpm (1.3 mgd or 2.0 cfs). In the future, CRW may elect to resolve capacity and water quality limitations so that CRW may rely on this right to serve a larger role in CRW's supply strategy, for example as an additional primary source of supply or a more significant source of back-up supply. CRW has evaluated treatment to improve water quality, however it was determined that treatment technology needed to resolve water quality issues is cost-prohibitive at this time (see WSMP for the South System). The District also evaluated the option to relocate the point of appropriation through permit amendment to a location with improved water quality.[9] The results of the evaluation suggested several potentially favorable options in the area and recommended CRW perform exploratory testing at new well locations within the CRBG. Well locations that meet CRW's criteria and are constructed would be added to Permit G-6728 through the permit amendment process.

As CRW enhances its distribution system in the South System area in order to replace wholesale purchases from SFWB with its own source of surface water supply, CRW may turn to Permit G-6728 as a more important source of supply. As one example, CRW could use Permit G-6728 (8.9 cfs) in the future to offset any reductions in surface water supply in cases when CRW's Certificate 84072 is regulated in favor of the senior instream right.

CRW has not used ASR limited license (LL-003) as a source of supply. Taste and odor issues that affect groundwater also affected water recovered from the well using the ASR system. CRW intends to explore more options to develop its ASR system.

2.11 System Description

OAR 690-086-0140(8)

A water system schematic is provided in Exhibit 2-1. The components of the City's system are described below. CRW's water system includes infrastructure typical of water providers that have surface and groundwater sources and a large service area. CRW diverts surface water from the Clackamas River at one location using two intakes. Using both intakes, up to 24.3 mgd of raw surface water can be pumped from the river using four pumps. Water gravity feeds to CRW's low lift pump station through 30-inch and 36–inch diameter pipelines buried beneath the Clackamas River. The plant, located along Mangan Drive north of the river and approximately 300 yards from the intakes, was constructed in 1964 with an initial capacity of 10 mgd. Water is pumped to the WTP from the low lift pump station through one 36"-diameter CCP raw water line. The WTP capacity was expanded to 20 mgd in 1972, and to its current

[9] *Preliminary Groundwater Evaluation in the Vicinity of the Clackamas River Water District Technical Memorandum*, GSI Water Solutions, February 10, 2011

capacity of 30 mgd in 1991. Treatment includes addition of chemical agents to promote coagulation, filtration, and disinfection. The CRW WTP achieves high water use efficiency, producing finished water at a rate of approximately 96 percent of pumped raw water. The finished water pump station has a firm capacity of approximately 20 mgd. Before water is sent to the distribution system, treated water is stored in a 1 MG clearwell. Filter backwash and basin cleaning water generated at the WTP is currently managed through dechlorination, settling and decanting the clear water from four designated waste settling ponds, followed by release to a natural pond. The water from the natural pond is released to the Clackamas River downstream of CRW's POD as authorized by a National Pollutant Discharge Elimination System (NPDES) Permit held by CRW.

CRW's groundwater well, Well No. 1, is located outside of CRW's service area, to the west of the South System near the confluence of the Clackamas and Willamette Rivers. The well has a capacity of 1.3 mgd and can serve the Redland, Henrici, and Beavercreek pressure zones. Water quality concerns limit CRW's use of this well to emergency purposes. Well No. 1 is also authorized under ASR Limited License 003, however CRW has not recovered water through its ASR limited license since initial testing of the system.

Overall, the CRW distribution system has approximately 260 miles of pipeline, 14 reservoirs with a nominal capacity of 24.08 MG, and 11 pump stations.[10]

Historically, CRW served the North System with water from CRW's WTP and the South System through wholesale water purchases from SFWB. (SFWB diverts water from the Clackamas River and treats raw water at SFWB's WTP located in the City of Oregon City through connections with the SFWB and Oregon City distribution systems.) With CRW's recent construction of the 152nd Reservoir and associated transmission line crossing the river, CRW now serves the Redland Pressure Zone with treated water from its WTP. The District plans to continue upgrading its South System distribution system such that CRW will be capable of supplying water to most of its other customers in the South System over the next six years, thereby reducing wholesale purchases from SFWB. Following the completion of these distribution system enhancement plans, only about 550 customers in the southern-most area of CRW's South System will continue to receive water from the SFWB.

[10] CRW co-owns the Barlow Crest Reservoir and associated pump station, both of which are included in the totals presented here.

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3. Water Conservation Element

This section satisfies the requirements of OAR 690-086-0150 by describing CRW's historical water conservation program over the previous ten years and through the establishment of new or maintenance of existing measures over the next ten years.

3.1 Conservation Measures Progress Report

OAR 690-086-0150 (1)

CRW has an established conservation program designed to help CRW customers and CRW operations to use water wisely. Over the last five years, CRW enhanced this program by incorporating a wider array of measures, many of which went beyond the minimum measures required by OWRD's WMCP rules. These program enhancements occurred primarily after Clackamas River Water Providers (CRWP) began managing several components of CRW's program in 2018 on CRW's behalf, namely public education and outreach, customer technical and financial assistance, and private fixture retrofit or replacement. Prior to 2018, CRW performed these measures in-house.

Table 3-1 describes CRW's progress in meeting its conservation measure benchmarks established in CRW's 2012 WMCP and provides examples of CRW's efforts.[11] The information is duplicated from the District's 2016 WMCP progress report, with updates to reflect activities since publication of that document.

Exhibit 3-1. Conservation Benchmark Progress

Conservation Benchmark Name	2012 Conservation Benchmark Summary	2021 Conservation Benchmark Status
Water Audit	-By 2012, CRW will establish procedures that integrate the water data currently being captured into a water audit process. That data will reflect the multiple District Metered Zones (DMA) already established within CRW boundaries. -Guidelines established in the American Water Works Association (AWWA) manual titled Water Audits and Leak Detection (M-36, AWWA 1990), along with the AWWA Research Foundation, Leakage Management Technologies	-CRW has a number of pressure zones that can be considered District Metered Areas (DMAs). CRW has continued to develop capabilities for data collection and reporting of water statistics for each of these DMAs, in order to improve the prioritization of pipe replacement and leak detection efforts. -CRW currently conducts annual water audits utilizing a systematic and documented methodology following guidelines established in the AWWA M-36 manual that is based on the amount of

[11] All CRWP programs and services provided to CRW's customers are described in CRWP's annual report. The most recent report was published in 2020 for fiscal year 2019/20 and can be accessed at: https://www.clackamasproviders.org/wp-content/uploads/2021/09/CRWP_Annual_Report_FY_2020-21-Final.pdf

Conservation Benchmark Name	2012 Conservation Benchmark Summary	2021 Conservation Benchmark Status
	manual will be utilized to establish Water Management and Conservation data.	water produced/purchased versus water sold.
Metering	-All customers served by CRW are metered. CRW will continue to require meters for all new customers. -CRW will continue to require metering of hydrant water used by contractors.	-CRW's system is fully metered and CRW continues to require meters for all development within its service area. -Hydrant use by contractors is metered and will continue to be metered.
Meter Testing and Replacement	-CRW will continue annual testing and repair of production meters and all meters 3-inches and larger.	-Production (master) meters are tested annually and repaired as needed. All meters 3-inches and larger are tested annually and repaired as needed. All retail meters are monitored for abnormal usage by billing staff. If a meter is found to be malfunctioning it is repaired or replaced. The number of meters that are replaced are reported monthly and shared with the Board and posted on the CRW website.
Rate Structure	-CRW will consider conservation as it evaluates future rate changes. -CRW will continue to provide graphical 12-month water use histories on customer bills so that customers can compare current with past water use.	-CRW administers a four-tiered, inclining block rate structure which promotes conservation, and considers conservation when setting rates. -CRW provides graphical 12-month water use histories on customer bills so that customers can compare current with past water use.
Leak Detection Program	-The entire system will be surveyed once annually with acoustic leak detection equipment and problem areas will continue to receive additional attention.	-In recent years, CRW has been unable to inspect the entire system annually. However, over the past year efforts to focus on leak detection by DMA (see above) has proven successful, and leak detection inspection activities have increased by 50% from past years. Leak detection efforts are reported monthly and shared with the Board and posted on the CRW website. As an alternative supplemental leak detection effort, satellite detection methods (remote sensing and geographic information systems) have been researched for obtaining a system-wide survey, however

Conservation Benchmark Name	2012 Conservation Benchmark Summary	2021 Conservation Benchmark Status
		budget limitations have made this infeasible at this time.
Leak Replacements	-Identified leaks will be repaired promptly. -Continue documentation of repaired leaks including location, pipe material, type of leak, and estimated leakage rate for each repaired leak.	-Approximately 110 leak repairs have been completed in the last 5 years, on various piping sizes and materials as described in Section 3.4.5. Additionally, CRW has completed several long-standing leak-prone main replacements (2,000 LF on Forsythe Rd and 2,000 LF on 82nd Drive, among others). As part of CRW 2019 Water System Master Plan CRW identified "programmatic" projects targeting undersized, outdated and potentially leaking main replacements. The District's 6-year capital plan and capital planning strategy will target these types of main replacements. A leak repair program continues to target risk areas with the intent to address leaks prior to failure. -CRW continues to document repaired leaks including location, pipe material, type of leak, and estimated leakage rate for each repaired leak.
Public Education	-Place increased emphasis on youth water conservation education by directly employing companies to conduct public school class and assembly presentations.	-CRW provides full public outreach and conservation services through participation in and financial support of the CRWP Public Outreach and Education program, and partnership with the Regional Water Providers Consortium (RWPC).
Technical and Financial Assistance	-Provide technical assistance regarding implementation of water conservation measures to its Industrial, Commercial, and Residential customers.	-CRW provides technical assistance regarding implementation of water conservation measures and promotes the use of efficient water fixtures. Highlights include a residential outdoor water audit program that was launched in 2018 and distribution of indoor water audit kits. In addition, CRW includes conservation tips for industrial and commercial customers.

Conservation Benchmark Name	2012 Conservation Benchmark Summary	2021 Conservation Benchmark Status
Fixture Retrofit and Replacement Assistance	-Promote the value of low flow toilet fixtures, washing machines and dishwashers while directing and helping facilitate customer access to existing State and Federal Energy Rebate Incentives.	-The CRWP offers rebates for high efficiency toilets, clothes washers, hose bib timers, irrigation rain switches, irrigation spray nozzles, Smart irrigation controllers, and home water monitoring devices. These rebates are available to residents within CRW's service area and small businesses, defined as having up to 50 employees.
Rate Structure and Schedule	-CRW will consider conservation as it evaluates future rate changes. -CRW will continue to provide graphical 12-month water use histories on customer bills so that customers can compare current with past water use.	-See above for a description under Rate Structure of how CRW met these benchmarks
Reuse, Recycling, Non-Potable Water Opportunities	-Explore reuse, recycling, non-potable water opportunities	-CRW functions only as a drinking water provider and does not currently have access to reclaimed water for non-potable water use opportunities. CRW manages water from the Water Treatment Plant filter backwash and basin cleaning process. Water used for these processes are returned to the river after settling and dechlorination. It is not currently feasible or appropriate to reuse the water for other purposes.

3.2 Other Conservation Measures

OAR 690-086-0150(3) & (5)(e)

CRW continues to track customers' water use history using its utility billing software and reports abnormally high water use to customers, encouraging them to investigate possible leaks and promptly repair their plumbing if leaks are found.

3.3 Measurement and Reporting Program

OAR 690-086-0150(2)

CRW's water measurement and reporting program complies with the measurement and reporting standards in OAR Chapter 690, Division 85. CRW measures the water appropriated from its surface and

groundwater sources via its telemetry system. CRW annually tests and calibrates, repairs, or replaces production meters as needed in order to maintain them within industry accuracy standards.

Annually, CRW submits monthly water use measurements to OWRD. OWRD publishes this data at https://apps.wrd.state.or.us/apps/wr/wateruse_query/.

3.4 Required Conservation Programs

OAR 690-086-0150(4)

The Administrative Rules for Water Management and Conservation Plans require that all water suppliers establish five-year benchmarks for implementing the following required conservation measures:

- Annual water audit
- System-wide metering
- Meter testing and maintenance
- Unit-based billing program
- Water loss
- Public education

During the next five years, CRW plans to initiate, continue, or expand these conservation measures to meet these requirements, as described below.

3.4.1 Water Audit

OWRD defines a water audit as an analysis of the water system that includes a thorough accounting of all water entering and leaving the system. CRW describes its method of performing its annual water audit to determine water loss in Section 2.7. To summarize, CRW calculates annual water loss by subtracting the sum of annual metered customer consumption plus authorized unbilled volumes and process water from annual demand. Total annual loss volume is divided by annual demand to obtain the percentage of loss. As shown in Section 2.7, CRW's average water loss over the previous five years was 7.5 percent and 8.2 percent in 2020.

CRW is currently evaluating several options for improving its method of conducting water audits. The District intends on identifying and collecting data that allow for a more detailed analysis of water loss for a number of pressure zones known as District Metered Areas (DMA). CRW will document a systematic process used to capture this data. The goal of this data collection effort is to better identify areas with higher water losses and to be able to focus efforts in these areas to reduce these losses. Finally, CRW is exploring how the additional usage of AWWA water audit tools, (as described in AWWA's M36 publication, for example), can be incorporated into their water audit methodology in order to improve water use efficiency.

Five-Year Benchmarks

CRW will continue to improve its annual water audit by:

- Establishing DMAs.
- Identifying the data to collect, the collection method, and how the data will be compiled into the District's water audit.
- Documenting a systematic process used to capture the data and calculate water loss.
- Evaluating ways to better incorporate the AWWA water audit tools into water audits.

3.4.2 System-Wide Metering

All customers served by CRW are metered, and meters are required for all new development within CRW's service area. Hydrant use by contractors will continue to be metered.

Five-Year Benchmarks

- Continue to require meters for all service connections within CRW's service area.
- Continue metering hydrant use by contractors.

3.4.3 Meter Testing and Maintenance

CRW has an active meter repair and maintenance program for its master meters and meters located at retail and wholesale service connections. CRW annually tests its master meters located at the points of diversion (Clackamas River) and appropriation (Well No. 1) and at the WTP where untreated (raw) water enters the WTP. In addition, CRW annually tests the master meter located at the interconnection with SFWB. CRW will calibrate, repair, or replace these meters if testing reveals that the accuracy of any of the meters does not meet manufacturer specifications or fall within the range accepted as the industry standard. Similarly, all retail meters three inches and larger are tested annually and repaired or replaced as needed. All retail meters, regardless of size, are monitored for abnormal usage by billing staff on an ongoing basis.

For all retail meters, the utility billing system flags accounts with consumption volumes significantly dissimilar to historical consumption volumes. Upon discovery, billing staff provide CRW maintenance staff a list of meters suspected of malfunction and CRW maintenance staff inspect these meters. If suspect meters are found to be malfunctioning, CRW will repair or replace these meters.

Historically, CRW's residential meter replacement program included replacing meters when meters reached a pre-determined volume read or reached 15 to 20 years in age. Currently, CRW does not use these parameters to identify when residential meters will be replaced, but replaces these meters on an as-needed basis as described above. The number of meters replaced are reported monthly to the Board. CRW will consider re-instituting a residential (small) meter replacement program with redefined parameters for the timing of replacement.

Five-Year Benchmarks

- CRW will continue to repair and replace meters as needed.
- CRW will continue to test master meters located at CRW's point of diversion, appropriation, WTP (untreated water), and SFWB interconnection and retail meters three inches and larger annually and repair or replace these meters as needed.
- CRW will explore the possibility of re-establishing a residential meter replacement program.

3.4.4 Unit-Based Billing

CRW has adopted a water rate structure that is based, in part, on the quantity of water used. In addition to a charge based on meter size, CRW uses a four-tiered volume charge for the Residential class and a two-tiered volume charge for all other retail classes that increase based on the amount of water metered at the service connections. These inclining block rate structures provide a cost incentive to water users to conserve water. All customer meters are read bimonthly and customers are charged bimonthly for water use. Current water rates are provided in Appendix C.

Five-Year Benchmark

- Continue use of an inclining block rate structure that is based, at least in part, on the quantity of water used.

3.4.5 Water Loss

As presented in Section 2.7, CRW's average water loss over the previous five years was 7.5 percent and 8.2 percent in 2020. CRW attributes its ongoing low annual water losses to (among other measures) proactive leak detection, leak repair, meter testing, and meter maintenance programs, as described below. (Meter inspection and maintenance is discussed in Section 3.4.3).

CRW has maintained a robust leak detection and line replacement program which has helped keep water losses below 10 percent and is committed to maintaining and enhancing these programs in the future, as described below.

CRW continues to invest in acoustic leak detection equipment as technology support sunsets on existing, outdated equipment. In 2011, CRW invested $3,900 in acoustic leak survey equipment, and an additional $31,000 in 2015 in new leak correlation equipment and training. CRW utilizes this equipment to survey waterlines known to have a history of leaks, or lines constructed of materials and age that are prone to leaks. In CRW's system, these piping materials include steel, galvanized steel, and cast iron. In 2020 CRW implemented the use of GIS mapping to track completion of annual leak surveys. CRW will continue to routinely monitor areas prone to leaks during drier periods, and will check these as part of routine maintenance at other times of the year. CRW typically surveys waterlines that are less prone to leakage after the higher-risk, leak prone areas are addressed.

CRW has researched innovative measures to detect leaks. As an alternative supplemental leak detection effort, satellite detection methods were researched as a means to perform a system-wide leak detection survey. CRW determined that this method is infeasible at this time due to implementation costs.

CRW intends to build upon its current leak detection program by establishing new leak detection program goals, including establishing the frequency and scope of leak detection throughout the water system. Combined with the improvements to CRW's means of identifying leaks as noted in Section 3.4.1, CRW is committing to employ a more systematic approach to its water loss reduction program.

The past five years of capital improvement projects have targeted key transmission mains and other distribution system line replacements and upgrades that in most cases replaced outdated, substandard and leak-prone water mains, among other projects. Of note were repairs to 12" and 16" steel, 18" concrete cylinder, and 10" cast iron pipes; as well as several 4" cast iron pipe repairs caused by overtaxing of the system during the 2020 wildfire response. CRW also continues to replace water mains as needed. The District expended roughly $25 million in the past five years on various water transmission main replacements and upgrades. Examples of completed main replacement projects include 4,000 lineal feet (LF) on Edgewood St, 5,000 LF on Potter Rd, 10,000 LF on Hattan Rd., 2,000 LF on Forsythe Rd., and 2,000 LF on 82nd Drive.

CRW updated its Water System Master Plan (WSMP) in 2019 and created a 6-year capital plan/capital planning strategy in 2021 that identified, among other improvements, "programmatic" projects targeting replacement of undersized, outdated, and potentially leaking mains. Based on this planning work, CRW continues to replace these mains in the 2021-23 budget period.

Five-Year Benchmarks

- Continue leak detection, leak repair, meter testing, and meter maintenance programs to help keep water losses to 10 percent or less.
- Continue use of water leak detection equipment to identify leaks.
- Establish new parameters for leak detection, including frequency and scope, and implement the revised program.
- Continue replacing mainlines based on CRW's WSMP and capital plan.

3.4.6 Public Education

This rule requires CRW to establish a public education program to encourage efficient indoor and outdoor water use that includes regular communication of the supplier's water conservation activities and schedule to customers. Public education is an important component of CRW's overall water conservation program. As previously noted, CRW is a partner in the CRWP and member of the RWPC. The RWPC offers a wide range of conservation-related programs to members. For example, the RWPC leads an annual multi-media summer campaign focused on efficient irrigation practices. Through these organizations, CRW customers are able to gain access to a wide array of educational services, but because there is programmatic overlap between these organizations, CRW has focused this WMCP on the conservation programs offered through the CRWP. The following are examples of CRWP services.

- Classroom presentations and assembly programs at schools in CRW's service area, such as the Ecology in Classrooms and Outdoors program at Bilquist Elementary School.
- Water Treatment Plant tours for the general public and area schools.

- Mini water education grants for teachers (up to $250 annually) for water conservation and other water-related projects. Funding can be used to buy materials for water related activities and help pay for field trips or trainings and courses.
- Free classroom presentations performed by CRWP staff, assembly programs performed by contractors, and education resources for teachers, such as water conservation curricula, including videos.
- Booths at community events, including the Celebrating Water and Clean Water festivals.
- Adult education courses through community groups.
- Technical training courses on irrigation system installation and maintenance for irrigation system contractors.
- Support and maintenance of water efficient demonstration gardens to demonstrate best irrigation practices.
- Extensive online presence via CRW, CRWP and RWPC websites that promote water conservation by educating users on the importance of water conservation. These websites also contain other educational information, for example:
    - indoor and outdoor water conservation tips,
    - information about upcoming conservation events and programs, and
    - outreach materials (brochures, pamphlets) on a variety of topics related to water efficiency.
- Participation in local events for children, including the Clean Water Festival and Clackamas County Celebrating Water events. CRWP staff perform classroom presentations during these events.
- Conservation messaging in CRW water bills.

In addition, the District promotes reductions in outdoor water use from mid-August through the fall and encourages customers to eliminate outdoor irrigation starting in late summer through CRWP's "Fish on the Run, Irrigation Done!" public outreach campaign. The primary purpose of this campaign is to help reduce diversions from the Clackamas River during peak fall salmon migrations. CRWP relies on webpages, written material, paid advertisements, audio public service announcements, a pledge of commitment to implement the measures of the campaign, and other components. A page from CRWP's website describing the pledge is provided in Appendix D.

Five-Year Benchmark

- Maintain an education program similar to the existing program as offered through CRWP and RWPC, with revisions intended to enhance the program as needed.

3.5 Additional Conservation Measures

OAR 690-086-0150(5)(a)-(d)

OAR 690-086-0150(5) requires municipal water suppliers that either: (a) serve a population greater than 1,000 and propose to expand or initiate diversion of water under an extended permit for which resource issues have been identified, or (b) serve a population greater than 7,500, to provide a description of the specific activities, along with a five-year schedule to implement several additional conservation measures.

The population within CRW's service area exceeds 7,500. Consequently, CRW is providing the following activities and five-year benchmarks related to the following additional measures:

- Technical and financial assistance programs
- Supplier financed retrofit or replacement of inefficient fixtures
- Rate structure and billing practices that encourage conservation
- Water reuse, recycling, and non-potable opportunities
- Other conservation measures

Conservation measures and five-year benchmarks for these additional conservation measures are described below.

3.5.1 Technical and Financial Assistance

CRW benefits from CRWP's wide array of technical and financial assistance programs. CRWP provides assistance to help CRW customers improve the efficiency of water use in both indoor and outdoor settings. Examples of some of CRWP's offerings include the following.

- Indoor: Provision of indoor water audit kits (via mail or online tools), dye tabs to test for toilet leaks, and online instructions and leak detection techniques.
- Outdoor: Information online about efficient irrigation practices and low water use landscaping info, residential landscape water audits offered.
- Rebates: CRW offers rebates via CRWP for the purchase of high efficiency toilets, washing machines, smart home water monitor, landscape rain sensors, and weather-based irrigation controllers.
- Conservation tips on CRW's website applicable to Commercial and Industrial customers.

Five-Year Benchmark

- Maintain technical and financial assistance services similar to those currently offered through CRWP, with revisions intended to improve the program as needed, and maintain conservation webpage tips for Commercial and Industrial customers.

3.5.2 Fixture Retrofit and Replacement Assistance

CRW utilizes the fixture retrofit and replacement assistance services provided by CRWP. Though CRW does not perform installation of fixtures, CRW provides an array of fixtures and devices for free to CRW customers through CRWP that are intended to improve efficient uses of water. Some examples of these include the following.

- Toilet fill cycle diverter
- Toilet tank displacement bag
- Shower head
- Faucet aerators
- Hose nozzle
- Shower timer
- Water gauge

Five-Year Benchmark

- Maintain fixture retrofit and replacement assistance similar to those currently offered through CRWP, with revisions intended to improve the program as needed.

3.5.3 Rate Structure and Schedule

CRW's inclining block rate structure is designed to encourage conservation because customers pay higher rates if they exceed set volume thresholds. Also, CRW provides graphical 12-month water use histories on customer bills so that customers can compare current with past water use, enabling customers to recognize potentially less efficient water use practices and identify potential leaks, among other benefits.

Five-Year Benchmark

- Continue using an inclining block rate structure.
- Continue providing 12 months of historical water use on customers' water utility bills.

3.5.4 Reuse, Recycling, Non-Potable Water Opportunities

CRW functions only as a drinking water provider and therefore does not have ready access to reclaimed water for non-potable water use opportunities, such as a wastewater treatment plant. CRW generates filter backwash and basin cleaning process water at its WTP. CRW has explored options to recycle filter backwash water and determined that reuse of this water can create a potential health concern without additional treatment and distribution system construction. The costs associated with these necessary modifications to the system relative to the volume of water recycled deem water recycling infeasible at this time.

While not a current priority due to the issues identified above and relative to other deficiencies, CRW may look to explore water reuse opportunities, such as the reuse of water for irrigation at its facilities, in the future.

The Oregon Department of Environmental Quality's (DEQ) greywater rules found in OAR 340-53 allow individual customers to collect and reuse greywater onsite for irrigation and other uses. The use of greywater can reduce usage of potable water. CRW will consider promoting these small-scale greywater reuse systems through its conservation program and may provide a link on CRW's conservation webpage to DEQ's informative greywater reuse webpage or utilize other promotional measures.

Five-Year Benchmark

- CRW will explore reuse, recycling, and non-potable water opportunities at its facilities if they become feasible.
- CRW will consider promoting state rules allowing the reuse of greywater at customers' properties.

Exhibit 3-2. Summary of 2021 Five-Year Water Conservation Measure Benchmarks

Conservation Measures	2021 Five-Year Benchmarks
Annual water audit	Establish DMAs.
	Identify the data to collect and the collection method and determine how the data will be compiled into the District's water audit.
	Document a systematic process used to capture the data and calculate water loss.
	Evaluate ways to better incorporate the AWWA water audit tools into water audits.
System-wide metering	Continue to require meters for all service connections within CRW's service area.
	Continue metering hydrant use by contractors.
Meter testing and maintenance program	Continue to repair and replace meters as needed.
	Continue to test master meters located at CRW's point of diversion, appropriation, WTP (untreated water), and SFWB interconnection and retail meters three inches and larger annually and repair or replace these meters as needed.
	CRW will explore the possibility of re-establishing a residential meter replacement program.
Unit-based billing	Continue use of an inclining block rate structure that is based, at least in part, on the quantity of water used.
Water loss analysis	Continue leak detection, leak repair, meter testing, and meter maintenance programs to help keep water losses to 10 percent or less.
	Continue use of water leak detection equipment to identify leaks.
	Establish new parameters for leak detection, including frequency and scope, and implement the revised program.
	Continue replacing mainlines based on CRW's WSMP and capital plan.
Public education	Maintain an education program similar to the existing program as offered through CRWP and RWPC, with revisions intended to enhance the program as needed.
Technical and financial assistance	Maintain technical and financial assistance services similar to those currently offered through CRWP, with revisions intended to improve the program as needed, and maintain conservation webpage tips for Commercial and Industrial customers.
Retrofit and replacement	Maintain fixture retrofit and replacement assistance similar to those currently offered through CRWP, with revisions intended to improve the program as needed.
Rate structure and billing schedule	Continue using an inclining block rate structure.
	Continue providing 12 months of historical water use on customers' water utility bills.
Reuse, recycling, non-potable water	Explore reuse, recycling, and non-potable water opportunities at its facilities if they become feasible.
	Consider promoting state rules allowing the reuse of greywater at customers' properties.
Other	Continue reporting abnormally high water use to customers, encouraging them to investigate possible leaks and promptly repair their plumbing if leaks are found.

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4. Water Curtailment Element

This section satisfies the requirements of OAR 690-086-0160 by describing CRW's capacity limitations and episodes of supply deficiencies, performing a capacity assessment, and describing elements of CRW's curtailment plan, including the stages of alert, potential initiating conditions, and associated curtailment actions.

4.1 Introduction

Clackamas River Water has prepared this water curtailment plan to address water shortages resulting from natural, human-made, or technological disasters. Two recent studies helped inform development of this plan. CRW considered the results of its Risk and Resiliency report (2020) and CRW's Addendum to the Clackamas County Multi-Jurisdictional Hazard Mitigation Plan (2021). In the former study, CRW identified that it was most vulnerable to earthquakes and cyber-attacks (of the SCADA system) and in the latter, earthquakes and wildfires.[12] All three of these events have the potential to impact CRW's operations and may result in water shortages. Other events were considered as well during development of this curtailment plan in order to ensure this plan could be useful in a wide variety of situations that could result in water shortages. The goal of this plan is to extend CRW's water supply during water shortages caused by one of these events through conservation, restrictions, and equitable usage, thereby protecting supplies for public health, fire protection and domestic use.

4.2 Capacity Limitations and Supply Deficiencies

OAR 690-086-0160 (1)

CRW does not have infrastructure capacity limitations associated with the diversion, treatment, or distribution of its Clackamas River source or with its SFWB interconnection (which provides wholesale purchases to some areas within CRW's South System). Well No. 1, also located in the South System, serves as a back-up source of supply. Although the capacity of the well is currently less than the water right authorizing use, the well can meet the ADD of the areas served by the well, as described below. CRW has not experienced supply deficiencies within the last ten years.

4.3 Capability Assessment

OAR 690-086-0160 (1)

For this plan, CRW performed an assessment of its capability to maintain water supply delivery during several unforeseen events that may cause water supply shortages. CRW has multiple options to address a variety of events that could lead to shortages, including the use of emergency storage volumes, Well No. 1, backup power supplies, and emergency interconnections with other water suppliers.

[12] Differences in results are due to differing criteria used to evaluate risks.

As described in CRW's WSMPs, CRW's goal is to maintain storage in reserve in its distribution system at all times for emergencies that is equal to two times the ADD of the area served (pressure zone or zones) in addition to volumes reserved to meet operational demands. These volumes are additional to volumes reserved for fire flow. During an emergency, CRW could use the storage volumes reserved for operational and emergency uses, thereby extending the duration in which CRW could meet demands during a shortage up to a period of several days. (As described below, usage of fire flow storage coupled with a trend of declining operational and emergency storage volumes would trigger implementation of CRW's curtailment plan.)

In the South System, CRW relies primarily on wholesale water purchases from SFWB to meet demands. In the event that the SFWB is not capable of providing enough water to meet these demands, CRW may utilize Well No. 1. This well can supply water to the Redland, Henrici, and Beavercreek pressure zones of the South System. The capacity of this well is 1.3 mgd which should be able to meet the ADD of these areas based on historical demand data.[13] (Though water from Well No. 1 is not used as a primary source of supply due to aesthetic issues, Well No. 1 water meets water quality standards and can be used safely as a potable supply.) The recent construction of distribution system improvements under CRW's Backbone Projects, now link CRW's South System to the WTP located in the North System. These improvements provide ADD and MDD to those parts of the South System to which it currently connects. Future improvements to the existing South System, to be completed by 2027, will enable CRW to meet the majority of the South System's demand.[14] CRW's interconnection with SFWB will continue to be used as a primary supply for a small number of customer accounts, as well as an emergency source of supply, following completion of these future improvements.

In the event of a power outage, CRW can maintain adequate power to its source and treatment facilities via a 2 MW diesel generator located at the WTP. In addition, CRW's pump stations have standby power sources in the form of propane generators, emergency receptacles capable of receiving emergency power from mobile generator units, or an onsite diesel generator (at one pump station).

Interconnections with neighboring water suppliers can help meet CRW demands during water supply shortages. According to CRW's 2020 Emergency Response Plan, the following interconnections (and rates of supply) may be used individually or in some combination to partially or fully meet demand: NCCWC (10 mgd), SWA (10 mgd), and the Cities of Portland (4 mgd), Milwaukie (1.2 mgd), and Oregon City[15]. The primary source of supply for all of these water suppliers (except for the Cities of Portland and Milwaukie) is the Clackamas River. During an event that reduces the water supply from the Clackamas River, CRW may not be able to rely on these interconnections as sources of supply except for the Portland and Milwaukie. The capacity of these interconnections will only allow CRW to meet just over half of its historical ADD of 8.7 mgd.

[13] The high scenario ADD for the Redland, Henrici, and Beavercreek pressure zones was 1.23 mgd in 2017 as noted in CRW Water System Master Plan, South System (2019), Table 3.16.

[14] CRW will continue to serve South System areas (including regular and "Joint User" customers) currently fed by SFWB water wheeled through Oregon City, following construction of any future South System improvements.

[15] Rate of supply not provided in CRW's Emergency Response Plan.

During an emergency situation, CRW also may bring in water by tank trucks. From these trucks, water would be dispensed to the customers in small containers or, if supply was sufficient, added to CRW's reservoirs.

Though CRW has planned to address some supply shortages through emergency storage volumes, backup power supply, interties with other water providers, and other solutions described above, the possibility exists that these solutions may not prevent a supply shortage. In response, CRW has adopted this curtailment plan to be implemented during a water shortage in order to extend available water supplies until normal production and delivery can be resumed.

4.4 Curtailment Stages

OAR 690-086-0160 (2) & (3)

CRW has four curtailment stages and each of these stages have initiating conditions, or triggers, that define when these stages are implemented. CRW has focused on storage levels in its distribution system reservoirs as the main driver for when these curtailment stages can be initiated since this is a key objective/measurable factor in determining available water supply. Specifically, declining trends of supplies reserved for operational and emergency needs, coupled with any use of volumes reserved for fire flow storage, would result in implementation of Stages 2 through 4 of the curtailment plan. Stage 1 is triggered when a declining trend in the combined operational and emergency storage levels is observed. In addition, CRW recognizes that there may be other factors that could trigger the appropriate level of response and has provided the flexibility to consider other factors (such as lack of chemical needed for treatment processes) as appropriate in order to modify this plan.

The stages are organized based on the level of severity of the water shortage event, such that the least severe impact of an event is addressed by the first stage of alert. CRW's response to a water shortage may escalate successively through each stage. Alternatively, a latter stage could be implemented directly, bypassing earlier stages (e.g. moving from stages 2 to 4), depending upon the event at hand. The four stages are listed in Exhibit 4-1. CRW will use triggers or initiating conditions as criteria to determine which stage to initiate, which are also presented in Exhibit 4-1. These initiating conditions may be changed by CRW to reflect the water shortage situation.

Exhibit 4-1. Water Curtailment Stages and Triggers

Stage	Stage Type	Triggers/Initiating Conditions
Shortage Alert	Voluntary	• Declining trend in storage volumes observed and anticipated to continue, potentially dropping below volumes required to maintain minimum fire flows in one or more reservoirs • Current or anticipated events that could result in the need for voluntary water curtailment measures
Serious Shortage	Mandatory	• Declining trend in storage and failure to replenish above the level required to maintain minimum fire flows in one or more reservoirs over a one day period • Current or anticipated events that could result in the need for serious water shortage curtailment measures
Severe Shortage	Mandatory	• A declining trend in storage and failure to replenish above the level required to maintain minimum fire flows in one or more reservoirs over a two day period • Current or anticipated events that could result in the need for severe water shortage curtailment measures
Emergency Shortage	Mandatory	• A declining trend in storage and failure to replenish above the level required to maintain minimum fire flows in one or more reservoirs over more than a two day period. • Immediate loss of one or more sources of supply or significant reduction in production capability of one or more sources of supply • Immediate failure or near failure of primary infrastructure (e.g. WTP or significant distribution line) resulting in major reduction of system capacity to meet demand • Current or anticipated events that could result in the need for emergency water shortage curtailment measures

4.5 Curtailment Measures

OAR 690-086-0160 (4)

The plan includes both voluntary and mandatory curtailment measures associated with each stage. These measures are intended to reduce demand during water shortages, thereby extending CRW's water supply to meet basic domestic needs and the needs to maintain the health and safety of the community. CRW may modify, add, or remove measures based upon the cause, severity, anticipated duration of the shortage, and other factors associated with the event. Moreover, the scope of the water shortage will determine if the measures are applied to the entire system, to specific water use sectors, or in those geographic areas that are directly impacted. The measures associated with each stage of alert are described below.

While most of the following measures prohibit specific nonessential uses of water, any prohibition may be disregarded if the use meets public health or safety requirements, including but not limited to abatement of fire or sanitation hazards, or to meet air quality standards mandated by the Oregon

Department of Environmental Quality (e.g. dust suppression), and the use maintains the public health, safety, and welfare of CRW's customers

4.5.1 Stage 1: Water Shortage Alert

Under the Water Shortage Alert stage, CRW will inform customers of the potential for a water shortage and the need for voluntary reductions in consumption by all water users. Stage 1 curtailment actions include the following:

- Reduce or eliminate CRW's non-essential uses of water, i.e. irrigation, flushing, etc.
- Request fire departments suspend trainings
- Request customers implement voluntary water conservation measures for indoor and outdoor uses.
- Request customers irrigate only between 8 pm to 10 am
- Ready emergency interconnections for activation and notify emergency water suppliers
- Contact wholesale customers notifying them of the existence or potential for water shortages and potential limits to be imposed

4.5.2 Stage 2: Serious Water Shortage

The Serious Water Shortage stage prohibits certain activities, and also includes a general request for customers to use water efficiently on a voluntary basis for certain uses by continuing to implement the actions under Stage 1. This stage emphasizes reduction or elimination of nonessential water uses. Stage 2 curtailment actions prohibit or limit water use as follows.

- Irrigate only between 8:00 pm and 10:00 am (mandatory)
- No water use for washing vehicles (cars, motorbikes, boats, etc.) except at a commercial washing facility that recycles wash water and for vehicles that must be cleaned to maintain public health and safety, such as food carriers and solid waste transfer vehicles
- No washing of sidewalks, walkways, driveways, parking lots, tennis courts, and other hard-surfaced areas
- Limit CRW uses of water and discontinue hydrant flushing, reduce nonessential cleaning using water, and curtail temporary access (e.g., for construction-related activities) to water at hydrants
- No washing of building and structure surfaces (e.g. roofs, decks, siding, gutters), except as needed for painting or construction
- No water use for a fountain or pond for aesthetic or scenic purposes, except for recirculating systems and where necessary to support fish life
- No water for dust control unless approved by CRW

In addition to the above mandatory water use restrictions, depending on the duration of the shortage event CRW may request that the top 10 irrigation customers limit watering to three days per week from 8 pm to 10 am, specifying which days the customers can irrigate. The intention of this measure enables the District to ensure that these irrigators do not irrigate concurrently, thereby contributing to peak demands.

4.5.3 Stage 3: Severe Water Shortage

The actions included in Stage 3: Severe Water Shortage builds upon the restrictions of Stage 2 by expanding the suite of mandatory prohibitions on non-essential water use. Under Stage 3, CRW may introduce the following additional mandatory water reduction measures.

- Prohibit all outdoor irrigation (exceptions include new lawn, grass or turf planted after March 1 of the calendar year in which restrictions are imposed, sod farms, high-use athletic fields or park and recreation areas specifically designated by the General Manager)
- No water used to fill, refill, or add to any indoor or outdoor pools, ponds, fountains, hot tubs, or water-using features that hold water
- No washing of building and structure surfaces (e.g. roofs, decks, siding)
- No water from hydrants for construction-related activities (except on a case-by case basis), fire drills, or any purpose other than fire-fighting
- Develop and implement voluntary or mandatory limitations on top 10 large commercial and industrial users of water, with limitations tailored to these users

4.5.4 Stage 4: Emergency Water Shortage

Stage 4 represents the most severe water shortage stage of alert that CRW can issue. When an Emergency Water Shortage is declared, all outdoor and indoor water uses not necessary to maintain the health, safety, and welfare of CRW's customers is prohibited. CRW may implement its ERP in response to an event which triggers an Emergency Water Shortage.[16] The ERP provides additional details regarding the logistics of response, for example, activation of an Incident Command System, and should be considered a companion document to this curtailment plan. CRW intends to incorporate elements of this curtailment plan into the ERP to help ensure the contents of this curtailment plan are tightly integrated with the procedures described in the ERP. For Emergency Water Shortages, CRW may coordinate with other water suppliers to initiate a joint response to a regional water shortage.

CRW's response to the event that caused an Emergency Water Shortage alert may include purchasing emergency supplies from other water providers, directing residents to a pre-designated water distribution location(s), supplying bottled water, and utilizing mobile water tanks to meet basic health and sanitation needs.

4.6 Curtailment Communication

Communication of a water shortage and the associated curtailment actions is critical to ensure timely and effective response by water users and wholesale customers (SWA currently). CRW will communicate specific actions users can take to reduce usage and may include a summary of the current water situation, the reasons for the requested reductions, and a warning that additional cutbacks may be required if voluntary or mandatory measures do not sufficiently reduce water usage. The following list identifies methods that CRW may use to communicate curtailment stages and actions to its customers.

[16] While the ERP is more likely to be activated during emergency events that warrant declaration of curtailment stage 4, it may also be used in response to curtailment stages 1, 2 or 3, as well.

- CRW's social media platforms to keep the public informed of curtailment need and actions that can be taken to reduce water use.
- Contact local media outlets and request they notify the public about the potential for water shortages or temporary interruptions to normal service delivery.
- Provide notice on water bills and through utility bill inserts.
- Write and send water curtailment letters to customers.
- Activate a CRW water conservation hotline that includes a pre-recorded message providing current status of the water shortage and references sources of water conservation tips (e.g. CRWP's webpage).
- Instruct field personnel to remind customers of voluntary or mandatory measures and shortage status during customer contacts.
- Use reader boards to direct users to sources of information about the water shortage and conservation measures.

4.7 Authority

Actions under Stages 2 through 4 of this plan may be initiated only after the General Manager or designee or Incident Command declares an emergency, with notification to the Board of Commissioners. Stage 1 may be initiated by the General Manager without a declaration of emergency. The General Manager or designee is responsible for executing the plan's provisions.

The Board may rescind an emergency declaration issued by the General Manager upon a finding that the emergency no longer exists, or that the original declaration was made in error.

4.8 Curtailment Plan Enforcement

4.8.1 Enforcement of Restrictions

If any customer of CRW fails to comply with the mandatory water use restrictions of this Curtailment Plan, the user shall be given a written notice of such violation. The notice will be delivered by first class mail to the premises at which the unlawful use is occurring, and/or to the mailing address for owners of rental properties as necessary. The user will be assessed a penalty in addition to the amounts due for service in accordance with CRW policy:

- First violation - Written notice of violation.
- Second violation - A fine will be added to the user's water bill.
- Third violation - The customer's water service will be terminated unless a variance is approved under the provisions of this Curtailment Plan, and restored only after the Water Shortage has been declared to be over by the Board of Commissioners.

4.8.2 Variances

Users who are unable to comply with CRW's mandatory water use restrictions may petition for a variance from restrictions by filing a petition with CRW within ten (10) working days after the issuance of the Proclamation requiring water use restrictions or within five (5) calendar days following notice of

violation. All petitions for variance shall complete the appropriate documentation as requested by CRW staff.

In order for the variance to be granted, the petitioner must demonstrate clearly that compliance with the Ordinance would result in significant economic or physical damage. The General Manager is authorized to grant variances. In addition, CRW is authorized to grant temporary variances for existing water uses otherwise prohibited under the Ordinance if it is determined that failure to grant such variances could cause an emergency condition adversely affecting health, sanitation, or fire protection for the public. No such variance shall be retroactive or otherwise justify any violation of this Ordinance occurring prior to the issuance of the variance. During the period from the date of filing the variance until decision by the General Manager, the customer may continue to use water in an amount not to exceed the user's average daily winter usage.

4.9 Seasonal Curtailment Alerts Supporting Fish Migration

CRW's organizational vision and one of the key organizational values adopted by the Board advocate environmental stewardship. This vision and value are integrated into CRW's culture and business practices. CRW's robust conservation program is a great example of CRW's commitment to environmental stewardship. Another prime example of this commitment is CRW's participation in the "Fish on the Run. Irrigation Done!" outreach campaign promoted by CRWP. This campaign is designed to help reduce diversions from the Clackamas River during peak fall Chinook and Coho salmon migrations. It is timed with the higher flow rate requirement (640 cfs) associated with the instream right on this reach of the Clackamas River by encouraging reductions in outdoor water use by customers from mid-August through mid-September. It also recommends cessation of outdoor water use from mid-September through the end of September. CRWP performs this outreach annually, regardless of river levels. The campaign uses a multi-media approach, relying on webpages, written material, audio public service announcements, a pledge of commitment to implement the measures of the "Fish on the Run. Irrigation Done" program, and other components. A page from CRWPs website describing the pledge is provided in Appendix D.

4.10 Drought Declaration

If a declaration of a severe drought is declared by the Governor per ORS 536.720, the Oregon Water Resources Commission may order political subdivisions within any drainage basin or subbasin to implement a water conservation or curtailment plan or both, approved under ORS 536.780. The conservation and curtailment elements of this WMCP meet these requirements. If CRW is within a severe drought area declared by the Governor, such as Clackamas County, CRW will consider whether curtailment measures are needed to meet system demands. If ordered to implement a water conservation or curtailment plan during a declared drought, CRW will comply by implementing the water conservation and curtailment provisions of this WMCP. Regardless of whether curtailment is needed, CRW will continue to encourage customers to conserve water.

5. Municipal Water Supply Element

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

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

5.1 Delineation of Service Area

OAR 690-086-0170 (1)

Exhibit 2-1 shows CRW's current service area. Future growth within CRW's service area is expected to occur as a result of infill (development of vacant properties or redevelopment on existing properties) within CRW's current boundary. CRW does not anticipate expansion of its service area over the 20-year planning period. Therefore, population and demand estimates were projected for the existing service area. The South System is expected to experience more growth than the North System through the planning period due to the greater amount of developable land.

5.2 Population and Water Use Projections

OAR 690-086-0170 (1)

Population projections were calculated for CRW's North and South Systems as part of CRW's 2019 North and South Systems' WSMPs. Population projections were developed for each WSMP using Oregon Metro Research Center (Metro) population growth projections forecasted for CRW's jurisdiction. The WSMPs projected CRW's population through 2040, and provided population forecasts in five year increments. To obtain population projection for the years 2031 and 2041 for this WMCP, CRW interpolated the projection for 2031 and extrapolated for 2041 using an exponential growth formula. Exhibit 5-1 gives population forecasts for CRW's North System, South System, and total population forecasts from 2020 through 2041.

Exhibit 5-1. Population Forecasts, 2031 and 2041

	2020 (Actual)	2030[19]	2031	2040[19]	2041	Overall Average Annual Growth[20]
North System	29,918	31,582	**31,747**	33,247	**33,416**	0.5%
South System	19,928	23,467	**23,811**	27,006	**27,375**	1.6%
Total	49,846	55,049	**55,557**	60,253	**60,791**	-

[19] Data from CRW's Water System Management Plans (2019).

[20] Overall Average Annual Growth presented in Exhibit 5-1 represents the average annual growth rate over the duration of the 21 year planning period

For 2020-2040 the annual average growth rate is projected to be 0.5 percent for the North System. The annual average growth rate is projected to be 1.6 percent from 2020 to 2041 for the South System. This translates into a real population growth rate of approximately 166 persons per year for the North System, and 354 persons per year for the South System. By 2041, the end of the planning period, CRW projects it will serve 60,791 persons, up from 49,846 persons in 2020.

5.3 Demand Forecast

OAR 690-086-0170(3)

CRW's WSMPs forecasted demand for the North and South Systems and these demands were used as the basis for the demand forecasts presented in this WMCP. CRW presented low, medium, and high demand scenarios for the North and South Systems in the WSMPs. As described in these WSMPs, CRW selected the medium demand scenarios. For this WMCP, CRW also based its future demands on the medium demand forecast scenario.

ADD was forecast in the WSMPs using historical customer account numbers, increasing these numbers using growth rates provided by Metro, converting account projections into equivalent housing unit projections, and then into ADD projections. MDD was calculated using a peaking factor to convert ADD into MDD. In the North System, CRW used a peaking factor of 2.05 to represent medium demand scenarios; in the South System, a peaking factor of 2.74 was used. The difference in peaking factors for the North and South Systems is a result of a higher percentage of residential customers in the South System. (Consumption by residential customers generally increases to a greater extent in the peak season when compared to most other customer classes). Descriptions of the forecast methodologies and forecast results presented in the WSMPs are provided in Appendices E and F.

Similar to the population forecasts previously described, demand forecasts for 2031 and 2041 were not provided in the WSMPs, therefore, 2031 demand was interpolated and 2041 was extrapolated, both using the exponential growth formula. Note that wholesale sales to SWA were kept at a constant projected 10 mgd for the years 2031 and 2041.

Most WSMPs, including CRW's, use finished water demands to perform master planning evaluations, such as the system analyses. For this WMCP, CRW adjusted these finished water demand forecasts to also account for process water used during treatment at the WTP to capture system demand. (By factoring WTP process water into the demand forecasts, CRW's WMCP forecast is able to describe raw water system demand, that is, the amount of water anticipated to be diverted from the river at the point

of diversion.) The average annual amount of process water used in the WTP during the last five years represents approximately 4.0 percent of all raw water use, therefore, the forecasted demands in this WMCP are slightly greater than the finished water demands presented in CRW's WSMPs.[17]

ADD and MDD projections for the medium scenario are summarized in Exhibit 5-2 for CRW's North and South Systems from 2031 to 2041. By 2041, CRW anticipates that its ADD will reach 17.9 mgd and MDD will be 27.2 mgd. For perspective, ADD observed by CRW in 2020 was 8.7 mgd and the 2020 MDD observed was 16.8 mgd. The large increase from 2020 to 2031 in both ADD and MDD relative to the increase from 2031 to 2041 is the anticipated increase in wholesale purchases of SWA from CRW of up to 10 mgd as noted in Section 2.5.

Exhibit 5-2. CRW Demand Forecast, Medium Scenario, 2031 and 2041[18]

	ADD (mgd)			MDD (mgd)		
	2020 (Actual)	2031	2041	2020 (Actual)	2031	2041
North System	7.2	15.2	15.5	12.8	20.0	20.7
South System	1.5	2.0	2.4	4.0	5.6	6.5
Total	8.7	17.2	17.9	16.8	25.6	27.2

Note: Due to rounding, totals may not be equivalent to the sum of the addends.

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

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

CRW holds three surface water right certificates authorizing the total use of up to 46.5 cfs (30.1 mgd) from the Clackamas River for municipal use. CRW will continue to rely on these surface water rights to meet future demands, which are projected to reach 42.1 cfs (27.2 mgd) by 2041 as described in Section 5.3. CRW holds one municipal groundwater permit (G-6728) authorized for 8.9 cfs (5.8 mgd) for appropriation at Well No. 1. CRW currently uses this well as a backup supply due to water quality issues, however, since these issues are largely aesthetic and the water meets water quality standards, Well No. 1 will continue to serve an important source of supply. This groundwater right represents one of the few backup sources of supply available to CRW that is not sourced from the Clackamas River.[19] In the event that the Clackamas River is not available or only partially available for diversions by CRW or by the water providers with whom CRW has interconnections, Permit G-6728 would become a critical source of back-up supply for CRW's South System. Depending upon the severity of an emergency water supply shortage, CRW could require the full use of Permit G-6728. Projected MDD for the South System by 2041 is 10.1 cfs (6.5 mgd), therefore access to the entire authorized rate of appropriation of Permit G-

[17] A small portion of CRW's customers (550) will continue to be served by SFWB following completion of CRW's project to expand service to the South System. Therefore, the estimated demand of these customers (257 gpd/EHU, according to the South System WSMP) was not increased to account for process water in the demand forecast.

[18] Data obtained and modified from the Water System Master Plans for CRW's 2019 North and South Systems.

[19] CRW's interconnection with the City of Portland also serves as a source of emergency supply, which relies on the Bull Run watershed and South Shore Wellfield for supply as well as the City of Milwaukie, which relies on groundwater.

6728 (8.9 cfs) may meet most of this MDD during an unforeseen event and all of projected 2041 ADD of 3.7 cfs (2.4 mgd).

In addition to serving as a backup supply, Permit G-6728 may be a long-term source for supply for CRW, particularly as overall demand nears the combined authorized rates of diversion of CRW's surface water sources as noted in Exhibit 5-2 (30.1 mgd of supply vs. 27.4 mgd of demand). The use of Permit G-6728 could provide a buffer of supply that would allow CRW to accommodate unforeseen increases in demand. Permit G-6728 may also be important to meet demand in the event that CRW's most junior certificate (84072) is regulated in favor of the senior downstream instream water right. The water quality issues of this source previously described may be improved through a variety of means, for example through treatment measures, by blending well water with treated water from the Clackamas River, or other methods deemed feasible by CRW that would allow CRW to regularly use Permit G-6728.

Therefore, in consideration of CRW's development of 2.1 cfs of Permit G-6287, CRW requests access to 6.8 cfs of "green light" water (8.9 – 2.1 cfs) under extended Permit G-6728 to meet emergency/back-up and redundant water supply needs within the 20 year planning period.

CRW intends to fully beneficially use the water authorized under Permit G-6278 within the planning period of this WMCP. The extended permit completion date is October 1, 2029. CRW likely will need to transfer the point of appropriation (POA) to one or more new locations and construct new well-related infrastructure prior to full development of this permit. The results of CRW's groundwater evaluation, as described in Section 2.10, revealed several favorable locations that could meet CRW's water quality standards and serve as one or more new points of appropriation for Permit G-6278. Following this evaluation, CRW postponed further project planning until CRW could complete the expansion of its distribution system "backbone", as described in Section 4.3. Following the anticipated completion of the backbone project in 2027, CRW intends to renew its efforts to identify suitable well locations and complete construction of one or more POAs with the goal of fully developing Permit G-6287 within 20 years. As needed,CRW may seek an additional extension of time to complete development of the permit.

5.5 Alternative Sources

OAR 690-086-0170 (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 District's future emergency and redundant water demands will be met, in part, on groundwater under Permit G-6728 during the 20 year planning period. Consequently, this rule applies.

CRW explored numerous alternative sources of supply over time and determined that it was in CRW's best interest to establish interconnections with many of the neighboring water providers in the immediate area with available supply. As such, CRW constructed and maintains interconnections with the City of Portland, NCCWC, SFWB, and other providers as described in Section 2. These interconnections allow for a significant amount of back-up supply to be potentially available during many types of water shortage events. Additional supplies from the Clackamas River may not prove beneficial in the event of a water shortage if the shortage is related to a limitation on the availability of supply from the river.

CRW has a robust conservation program in the region for its size, employing a full suite of conservation measures to help ensure that CRW and its customers use water efficiently as described in Section 3. CRW has committed to expanding its conservation program to include a more systematic approach to the identification of system leakage (see Section 3.4.5) with the intention of reducing CRW's water losses further. In consideration of CRW's already low water losses, CRW estimates that these measures may reduce demand by up to 1 percent, possibly leading to an MDD of 26.9 mgd (41.6 cfs) by 2041. In addition, CRW has developed a curtailment plan that includes curtailment measures intended to reduce demands and enable ongoing service to its customers to at least meet minimum demands during a water supply shortage. CRW recognizes that implementation of these conservation and curtailment measures will reduce demands on the Clackamas River, CRW's primary source of supply, but cannot preclude the need for back-up water supply during some shortage events and to meet redundant water supply needs. CRW's use of groundwater provides a reliable source for the District.

While CRW will incur well infrastructure construction and other costs in order to fully develop Permit G-6728, these costs are necessary to help CRW meet demand during water shortage events and to serve as a redundant supply. Additional conservation and curtailment measures, regardless of cost, cannot entirely avoid the need for full use of Permit G-6728.

5.6 Quantification of Maximum Rate and Monthly Volume

OAR 690-086-0170(6)

OAR 690-086-0170(6) requires a quantification of the maximum rate and maximum monthly volume of water to be diverted if expansion or initial diversion of water allocated under an existing permit is necessary to meet demands in the 20-year planning horizon. CRW is requesting full access to Permit G-6728, therefore this rule applies. Assuming Permit G-6728 is used at the maximum rate of appropriation of 8.9 cfs at 24 hours per day over a 30 day period, the monthly volume of water would equal approximately 23.1 million cubic feet (172.6 MG).

5.7 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 (ESA), Clean Water Act, and other applicable state or federal environmental regulations. CRW currently is not required to take mitigation actions for use of its groundwater authorized by Permit G-6728.

5.8 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. The District does not intend to acquire new water rights to meet its demands within the next 20 years, so the provisions of this section are not applicable.

Appendix A

Letters to Affected Local Governments and Other Entities

GSI Water Solutions, Inc.

October 27, 2021

Martha Fritzie
Clackamas County Planning and Zoning Division
150 Beavercreek Road Room #225
Oregon City, OR 97045
MFritzie@Clackamas.us

Subject: Water Management and Conservation Plan for Clackamas River Water

Dear Ms. Fritzie,

Clackamas River Water (CRW) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rules Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier will make its draft WMCP available for review by affected local governments and seek comments related to consistency with the local governments' comprehensive land use plans. We have provided you with an electronic version by email of CRW's draft WMCP for your review.

Please provide any comments to me within 30 days from the date of this letter. If the WMCP appears consistent with your Comprehensive Land Use Plan, a letter or email response to that effect would be appreciated. You may send your comments to me at asussman@gsiws.com.

If you have any questions, please feel free to contact me at 541-257-9001. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Adam Sussman
Principal Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

October 27, 2021

Michael D. Walter, Director
Economic and Community Development Division
16000 SE Misty Dr.
Happy Valley, OR 97086

Subject: Water Management and Conservation Plan for Clackamas River Water

Dear Mr. Walter,

Clackamas River Water (CRW) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rules Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier will make its draft WMCP available for review by affected local governments and seek comments related to consistency with the local governments' comprehensive land use plans. We have provided you with an electronic version by email of CRW's draft WMCP for your review.

Please provide any comments to me within 30 days from the date of this letter. If the WMCP appears consistent with your Comprehensive Land Use Plan, a letter or email response to that effect would be appreciated. You may send your comments to me at asussman@gsiws.com.

If you have any questions, please feel free to contact me at 541-257-9001. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Adam Sussman
Principal Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

October 27, 2021

Brett Kelver, Senior Planner
City of Milwaukie
10722 SE Main St.
Milwaukie, OR 97222

Subject: Water Management and Conservation Plan for Clackamas River Water

Dear Mr. Kelver,

Clackamas River Water (CRW) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rules Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier will make its draft WMCP available for review by affected local governments and seek comments related to consistency with the local governments' comprehensive land use plans. We have provided you with an electronic version by email of CRW's draft WMCP for your review.

Please provide any comments to me within 30 days from the date of this letter. If the WMCP appears consistent with your Comprehensive Land Use Plan, a letter or email response to that effect would be appreciated. You may send your comments to me at asussman@gsiws.com.

If you have any questions, please feel free to contact me at 541-257-9001. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Adam Sussman
Principal Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

October 27, 2021

Tami Bannick
City of Gladsone
18595 Portland Avenue
Gladstone, OR 97027

Subject: Water Management and Conservation Plan for Clackamas River Water

Dear Ms. Bannick,

Clackamas River Water (CRW) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rules Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier will make its draft WMCP available for review by affected local governments and seek comments related to consistency with the local governments' comprehensive land use plans. We have provided you with an electronic version by email of CRW's draft WMCP for your review.

Please provide any comments to me within 30 days from the date of this letter. If the WMCP appears consistent with your Comprehensive Land Use Plan, a letter or email response to that effect would be appreciated. You may send your comments to me at asussman@gsiws.com.

If you have any questions, please feel free to contact me at 541-257-9001. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Adam Sussman
Principal Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

October 27, 2021

Andrea Durbin, Director
Bureau of Planning and Sustainability
City of Portland
1810 SW Fifth Avenue
Suite 710
Portland, OR 97201

Subject: Water Management and Conservation Plan for Clackamas River Water

Dear Ms. Durbin,

Clackamas River Water (CRW) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rules Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier will make its draft WMCP available for review by affected local governments and seek comments related to consistency with the local governments' comprehensive land use plans. We have provided you with an electronic version by email of CRW's draft WMCP for your review.

Please provide any comments to me within 30 days from the date of this letter. If the WMCP appears consistent with your Comprehensive Land Use Plan, a letter or email response to that effect would be appreciated. You may send your comments to me at asussman@gsiws.com.

If you have any questions, please feel free to contact me at 541-257-9001. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Adam Sussman
Principal Water Resources Consultant
Enclosure

GSI Water Solutions, Inc.

October 27, 2021

Laura Terway, Director
Oregon City Community Development
625 Center Street
Oregon City, Oregon 97045

Subject: Water Management and Conservation Plan for Clackamas River Water

Dear Ms. Terway,

Clackamas River Water (CRW) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rules Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier will make its draft WMCP available for review by affected local governments and seek comments related to consistency with the local governments' comprehensive land use plans. We have provided you with an electronic version by email of CRW's draft WMCP for your review.

Please provide any comments to me within 30 days from the date of this letter. If the WMCP appears consistent with your Comprehensive Land Use Plan, a letter or email response to that effect would be appreciated. You may send your comments to me at asussman@gsiws.com.

If you have any questions, please feel free to contact me at 541-257-9001. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Adam Sussman
Principal Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

October 27, 2021

Johnson City Municipal Building
16121 SE 81st Ave
Johnson City OR 97267

Subject: Water Management and Conservation Plan for Clackamas River Water

To whom it may concern,

Clackamas River Water (CRW) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rules Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier will make its draft WMCP available for review by affected local governments and seek comments related to consistency with the local governments' comprehensive land use plans. We have provided you with an electronic version by email of CRW's draft WMCP for your review.

Please provide any comments to me within 30 days from the date of this letter. If the WMCP appears consistent with your Comprehensive Land Use Plan, a letter or email response to that effect would be appreciated. You may send your comments to me at asussman@gsiws.com.

If you have any questions, please feel free to contact me at 541-257-9001. Thank you for your interest.

Sincerely,
GSI Water Solutions Inc.

Adam Sussman
Principal Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

October 27, 2021

Elissa Gertler, Director
Metro Planning and Development
600 NE Grand Ave
Portland, OR 97232

Subject: Water Management and Conservation Plan for Clackamas River Water

Dear Ms. Gertler,

Clackamas River Water (CRW) has developed a draft Water Management and Conservation Plan (WMCP) to fulfill the requirements of Oregon Administrative Rules Chapter 690, Division 86 of the Oregon Water Resources Department.

Under these rules, the water supplier will make its draft WMCP available for review by affected local governments and seek comments related to consistency with the local governments' comprehensive land use plans. We have provided you with an electronic version by email of CRW's draft WMCP for your review.

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Sincerely,
GSI Water Solutions Inc.

Adam Sussman
Principal Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

October 27, 2021

Darren Wyss, Planning Manager
City of West Linn
22500 Salamo Rd
West Linn, OR 97068

Subject: Water Management and Conservation Plan for Clackamas River Water

Dear Mr. Wyss,

Clackamas River Water (CRW) has developed a draft 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 will make its Draft WMCP available for review by affected local governments and seek comments related to consistency with the local governments' comprehensive land use plans.

We have provided you with an electronic version of the CRW's draft WMCP as a courtesy. If you have any questions, please feel free to contact me at 541-257-9001 or asussman@gsiws.com.

Sincerely,
GSI Water Solutions Inc.

Adam Sussman
Principal Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

October 27, 2021

Scot Siegel, Community Development Director
City of Lake Oswego
PO Box 369
Lake Oswego, OR 97034
ssiegel@lakeoswego.city

Subject: Water Management and Conservation Plan for Clackamas River Water

Dear Mr. Siegel,

Clackamas River Water (CRW) has developed a draft 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 will make its Draft WMCP available for review by affected local governments and seek comments related to consistency with the local governments' comprehensive land use plans.

We have provided you with an electronic version of the CRW's draft WMCP as a courtesy. If you have any questions, please feel free to contact me at 541-257-9001 or asussman@gsiws.com.

Sincerely,
GSI Water Solutions Inc.

Adam Sussman
Principal Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

October 27, 2021

Sarah Jo Chaplen
Oak Lodge Water Services District
Technical Services Department
14496 SE River Road
Oak Grove, OR 97267
sarahjo@olwsd.org

Subject: Water Management and Conservation Plan for Clackamas River Water

Dear Ms. Chaplen,

Clackamas River Water (CRW) has developed a draft 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 will make its Draft WMCP available for review by affected local governments and seek comments related to consistency with the local governments' comprehensive land use plans.

We have provided you with an electronic version of the CRW's draft WMCP as a courtesy. If you have any questions, please feel free to contact me at 541-257-9001 or asussman@gsiws.com.

Sincerely,
GSI Water Solutions Inc.

Adam Sussman
Principal Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

October 27, 2021

Wade Hathhorn, General Manager
Sunrise Water Authority
North Clackamas County Water Commission
10602 SE 129th Ave.
Happy Valley, OR 97086
whathhorn@sunrisewater.com

Subject: Water Management and Conservation Plan for Clackamas River Water

Dear Mr. Hathhorn,

Clackamas River Water (CRW) has developed a draft 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 will make its Draft WMCP available for review by affected local governments and seek comments related to consistency with the local governments' comprehensive land use plans.

We have provided you with an electronic version of the CRW's draft WMCP as a courtesy. If you have any questions, please feel free to contact me at 541-257-9001 or asussman@gsiws.com.

Sincerely,
GSI Water Solutions Inc.

Adam Sussman
Principal Water Resources Consultant

Enclosure

GSI Water Solutions, Inc.

October 27, 2021

John Collins
South Fork Water Board
15962 Hunter Ave.
Oregon City, Oregon
johnc@sfwb.org

Subject: Water Management and Conservation Plan for Clackamas River Water

Dear Mr. Collins,

Clackamas River Water (CRW) has developed a draft 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 will make its Draft WMCP available for review by affected local governments and seek comments related to consistency with the local governments' comprehensive land use plans.

We have provided you with an electronic version of the CRW's draft WMCP as a courtesy. If you have any questions, please feel free to contact me at 541-257-9001 or asussman@gsiws.com.

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Adam Sussman
Principal Water Resources Consultant

Enclosure

Appendix B

Summary of Intergovernmental Agreements

Appendix B: Summary of CRW's Intergovernmental Agreements

Contract Supplier	Supply Source	Contract Purchaser	Contract Dates	Duration	Termination Provisions		Terms	Current Cost
Clackamas River Water	Clackamas River	SWA/ NCCWC	In negotiation	TBD	TBD	Sales	TBD	TBD
SFWB	Clackamas River	CRW	Water Supply Agreement -- 2/15/1983-7/1/1998; Rates agreement – 5/13/2010 - 6/30/2011		Agreement termination by written notice given by either party to the other no later than 18 months prior to the termination of agreement	Purchase	SFWB subject to the prior and superior rights of Oregon City and West Linn, furnishes surplus water to CRW as needs of the cities permit. CRW & SFWB to negotiate future rates according to the process established in Sect 4.	Rates agreement – 9/1/2008-3/31/2010 $0.7400/ccf; 4/1/2010-6/30/2011 $0.7400/ccf
Oregon City Meyers/Leland Roads Master Meter	Clackamas River	CRW	(to be negotiated)			Purchase	Wholesale water agreement to serve South Leland Road	
Oregon City South End/ Impala	Clackamas River	CRW	2/8/2000-2/8/2020	20 years		Purchase	"The parties agree that the following water lines shall be jointly funded, connected, and used by the parties pursuant to the terms of this section and this agreement."	
Oregon City/ CRW HOPP Service Area	Clackamas River	CRW	4/22/98-4/28/2028	30 years	Terminated by mutual agreement. Sect 15	Purchase	"Wheeling Agreement. CRW and the City agree that the City shall wheel water through the newly constructed system to deliver water to CRW's system. The cost of wheeling the water will be based upon the pro rata share of operating, maintaining, repair and replacement of the jointly-constructed and owned facilities, and is to be accomplished by a separate agreement.	
Oregon Water/Wastewater Agency Response Network			6/20/2007	5 years – with automatic renewal	60 day written notice	Collaboration	Mutual aid and assistance agreement for the provision of emergency services related to water and wastewater utilities	See Article VI – Cost Reimbursement
Regional Water Providers Consortium		Consortium Members	1/13/2005	Perpetual – Unless otherwise notified	30 day written notice	Collaboration	"The parties shall make available to each other vehicles, equipment, machinery, related items and services…" according to the terms of the agreement.	
Clackamas River Water Providers		CRW, Lake Oswego, SFWB, SWA, Estacada, NCCW	5/10/2007	Perpetual – Unless otherwise notified	written notice	Collaboration	The purposes of CRWP: 1. Coordinate efforts regarding water resource planning, management, conservation and development of the waters of the Clackamas River on a sustainable basis. 3. Water resource activities that may include watershed assessments, water quality monitoring and analyses and water supply planning.	
CRW/NCCWC/SFWB	CRW/NCCWC/SFWB	CRW/NCCWC/SFWB	7/1/2001	Perpetual	General Managers to meet annually to revise.	Collaboration	This Joint Operating Plan states how NCCWC, SFWB and CRW will share water and resources.	

Appendix B: Summary of CRW's Intergovernmental Agreements

Contract Supplier	Supply Source	Contract Purchaser	Contract Dates	Duration	Termination Provisions		Terms	Current Cost
City of Oregon City	Interies between water systems	CRW	(To Be Negotiated)			Emergency Water Serv.	Provide emergency water as needed and as available to South Service Area	
Portland Water Bureau	18" intertie at Otty Road Reservoir	CRW	(To Be Negotiated)	N/A	N/A	Emergency Water Serv.	Provide emergency water as needed and as available to North Service Area	
CRW	Glen Oak Master Meter Intertie and 12" transmission main	City of Oregon City	10/13/16	On-going unless terminated		Sales (water provided from the Beavercreek pressure zone and if there isn't sufficient supply and CRW is unable to provide the water there is no liability to CRW but CRW is to provide best notice possible to the City)	CRW agrees to wheel to and provide through the Glen Oak Master Meter interties a supply of potable water to the City to allow the City to serve the property with sufficient water as defined in Section 6 (Est. Average Daily Demand= 83.3 gallons per minute; Est. Max daily Demand= 111.1 gallons per minute; fire flow requirements=1,562 gpm @ 20psi	
Regional Water Providers Consortium	Storage and maintenance of an Emergency Water Distribution System and trailer	CRW	5/2010	Renews automatically every 5 years	By mutual written notice by both parties of by 90 day written notice by one of the parties		CRW to maintain and store the equipment and make available to a consortium member at any time if available and resources available to deploy the equipment. Equipment if available can go to a non-consortium member if no consortium member is using the equipment	
CRW & SWA (ORS 190 Agreement)	Clackamas River Water	SWA	1/17/14	On-going unless terminated	Withdrawal of a member shall not be less than two years nor more than three years from the date of notice. Supply agreements between the commission and withdrawing member shall be in effect for 3 years after withdrawal date	sales	CRW to make up to 10 MGD of supply capacity available for use within the Commission and enter into a wholesale supply agreement with participating members for it's use. SWA currently intends to use 2.5 MGD of the 10 MGD available	
CRW & SWA	152nd Ave. 6 MG Reservoir	SWA	4/24/17	On-going unless terminated			SWA shared in the cost of design and construction of CRW's 152nd Ave. Reservoir designed to allow for additional water storage and associated pumping capacity desired by SWA. Parties also share proportionately in the operation, maintenance, and emergency repairs of the system. CRW operates the reservoir. SWA is allocated 2 MG with the other 4 MG allocated to CRW	
CRW & City of Happy Valley	Clackamas River		11/22/2013	On-going unless terminated	Either party may terminate with 180 days' notice or mutually by both parties in less than 80 days. Agreement can be		CRW shall provide domestic water service within the City, excluding any and all separate irrigation that the City may develop from local groundwater sources and excluding those areas of the City served by SWA, CRW is responsible for the construction, operation, repair and	

Appendix B: Summary of CRW's Intergovernmental Agreements

Contract Supplier	Supply Source	Contract Purchaser	Contract Dates	Duration	Termination Provisions		Terms	Current Cost
					superseded by an Urban Services Agreement		maintenance of all related infrastructure and facilities including any labor and materials required to provide service under the agreemnt	

Appendix C

CRW Water Rates

Clackamas River Water

Direct Retail Water Rates

Water Rate Effective Date: 5/1/21

Meter Size (Inches)	5/1/2021 Domestic Service Charges	5/1/2021 Fire Service
Full 3/4	$ 57.18	$ 59.85
1	78.67	59.85
1 1/2	112.41	71.59
2	151.01	85.29
3	235.52	121.25
4	372.86	193.23
6	698.82	337.20
8	1,579.44	481.52
10	2,484.74	769.81
12	3,002.02	949.76

Residential Commodity Charge (Volume) per 100 Cubit Feet	Volume	Rate 5/1/21
Block 1	1 - 4	$ 2.44
Block 2	5 - 8	$ 2.71
Block 3	9 - 24	$ 3.23
Block 4	25 & up	$ 4.11

Multu-Family, Commercial & Industrial	Volume	Rate 5/1/21
Block 1	c	$ 2.99
Block 2	d	$ 3.74

c-Volume up to 1.5 times average winter consumption
d-Volume above 1.5 times average winter consumption

Average winter consumption: Total consumption (volume) recorded on a customer's bills generated between December and March of each year.

These rates were approved with Ordinance 01-2020 on May 14, 2020 with an effective date of May 1, 2021 and will remain in effect on July 1, 2021.

Appendix D

Conservation Pledge

Clackamas River Water Providers

Working together to protect and conserve our drinking water.

Take the Pledge

TAKE THE PLEDGE!

Take the Pledge! If you live in Clackamas or Washington County and get your drinking water from the Clackamas River, we are asking our water customers to take a pledge to reduce or even stop outdoor watering by mid-September. If you care about protecting our river water for people, and fish here's your chance to be part of our ***"Fish On the Run, Irrigation Done"*** campaign to help migrating fish.

By taking part in our Pledge you will receive a **FREE** yard sign (below) letting neighbors know that you are doing your part to keep water in the Clackamas River for fish.

FISH ON THE RUN

IRRIGATION DONE!

Doing my part to keep water in the Clackamas River.

Clackamas River Water Providers

Working together to protect and conserve our drinking water.

www.clackamasproviders.org

I PLEDGE TO DO MY PART:

- **Beginning mid-August, each week remove one day of watering from my irrigation schedule.**
- **Let my lawn go dormant during the summer, which saves water reduces run-off and requires less mowing**
- **Take my car to a carwash that recycles and reuses the water**
- **Only water outside before 8am and after 8pm**
- **Make sure I stop outdoor watering by mid-September**

Fill out the application below and submit it to our office to take the pledge and receive your free yard sign.

APPLICATION Link

Link to Pledge Brochure/Form

Appendix E

Water System Master Plan North System Demand Forecast

3.5 Water Demand Projections

Projecting future water demand is a key part of a water system's planning process. Demand projections are used to identify system improvements such as supply, pumping, storage, and piping requirements.

This section summarizes ADD and MDD projections developed for CRW's water system using historical water demand trends and future demographic growth assumptions. Demand projections are presented as a range of demands that may be experienced in the future.

The demand projections are presented as a range in demands that may be experienced in the future. Low, medium, and high water demand projection scenarios were developed by adjusting various demand projection parameters. The medium demand projection scenario is used for the system analysis described in Chapter 6. The system analysis determines future pumping, storage, and distribution system deficiencies and identifies potential improvements to achieve CRW's established capacity criteria. The low and high projection scenarios provide a sense of the extent of uncertainty in the demand forecasts.

3.5.1 Demand Projection Methodology

Water demand projections were developed in the following steps, which are also summarized in Figure 3.9:

1. Increase historical water connection numbers for each pressure zone according to the zone-specific residential and non-residential growth rates derived from the demographic analysis.
2. Convert account projections into EHU projections and then into ADD projections using demand projection parameters derived from historical data, which consists of CRW's starting EHU value, MDD/ADD peaking factor, DSL, percent of Other Authorized Use, and large consumer demand.
3. Apply the MDD to ADD peaking factor to convert ADD to MDD.

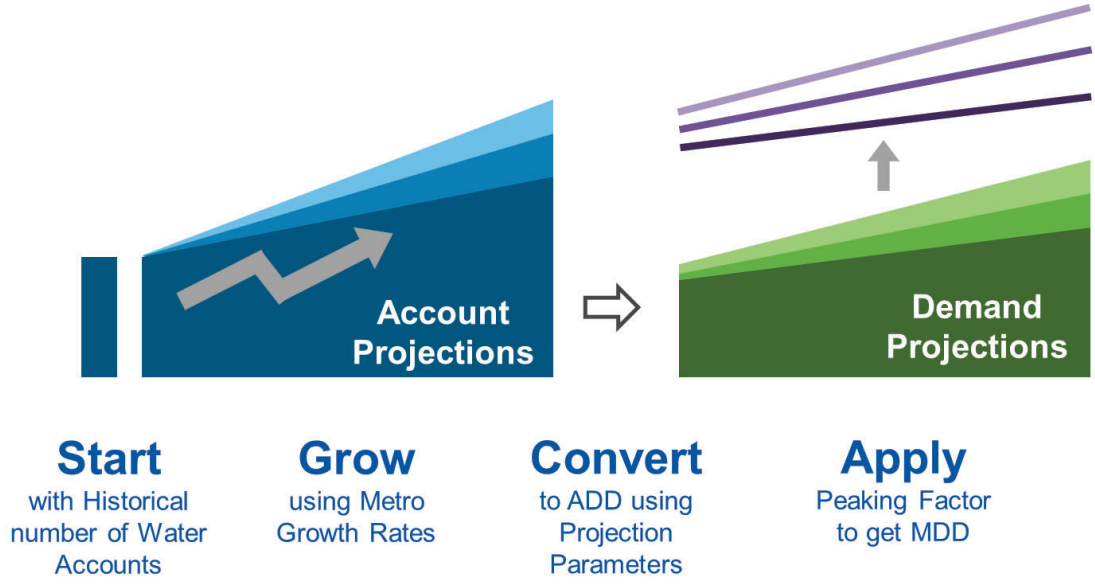

Figure 3.9 Demand Projection Methodology

3.5.2 Demand Projection Parameters

Numerous factors and assumptions affect the accuracy of the projected future water demands. To project CRW's future ADD and MDD, several parameters were used, all of which are listed in Table 3.13. Using historical data and assumptions, low, medium, and high parameters were established for each demand projection scenario. These parameters include the starting EHU value, peaking factor (MDD/ADD), DSL percentage, and Other Authorized Use.

These parameters were then used to develop the low, medium, and high demand forecasts. For each parameter, Table 3.13 summarizes the values selected to develop the range of demand projections. The following sections discuss demand projection in further detail.

Table 3.13 Projected Parameters, North System

Projected Scenario	Low		Medium		High	
Parameter	Parameter	Notes	Parameter	Notes	Parameter	Notes
Starting EHU Value (gpd/EHU)	160	Lowest year	166	Ave last 4 yrs	173	Hist. Ave.
Peaking Factor (MDD/ADD)	1.85	Hist. min.	2.05	Hist. Ave.	2.21	Ave last 4 yrs
DSL (Percent of Production)	7.50%	Hist. Ave.	7.5%	Hist. Ave.	10.00%	AWWA Stnd
Other Authorized Use (Percent of Production)	0.10%	25th %	0.17%	Hist. Ave.	0.23%	75th%

3.5.2.1 Starting EHU Value

CRW agreed that the starting EHU value in the North System would be the historically lowest EHU value for the SFR customer class, which was 160 in 2016. The medium scenario used the average of the previous four years, calculating an EHU value of 166, while the high scenario used the historical 10-year average for an EHU value of 173.

3.5.2.2 MDD to ADD Peaking Factor

Based on historical data, CRW decided that a peaking factor of 1.85 was the lowest it should plan for (the low demand projection scenario), since this was the North System's minimum peaking factor in the past ten years. The historical average of 2.05 was used for the medium demand scenario, and the historical average peaking factor over the last four years, 2.21, was used for the high demand scenario.

3.5.2.3 Distribution System Leakage

The low and medium demand scenarios had DSL that was 7.5 percent of the total water purchase, which corresponds to the historical average. The high demand scenario used the industry's maximum acceptable DSL value of 10 percent.

3.5.2.4 Other Authorized Use

Historical records helped select future Other Authorized Use estimations. The low demand scenario used the historical 25th percentile value of 0.10 percent; the medium demand scenario

used the historical average of 0.17 percent; and the high demand scenario used the historical 75th percentile of 0.23 percent.

3.5.2.5 Largest Consumers

For each scenario, it was recommended by CRW that the largest customers do not have any assumed growth in consumption. The only exception is the wholesale demand for Sunrise Water Authority (SWA), which was calculated separately by CRW using the SWA 20-year capital improvement plan. Table 3.14 shows the types of projects that SWA will complete and how the ADD and MDD will increase accordingly. By 2026, SWA is expected to require an ADD of 10 MGD. It should be noted that SWA may require as much as 16 mgd; however, for the purposes of this Master Plan, SWA's demand is limited to 10 mgd, since the existing CRWSC agreement between CRW and SWA.

Table 3.14 Projected Wholesale Demands for Sunrise Water Authority

Year	SWA 20-yr CIP ADD (mgd)	Location of Connection	MDD (mgd)
2017	2.5	Existing P.S. #10	2.5
2018-2020	4	Existing P.S. #10	4
2021-2025	6	Capacity Increase P.S. #10	6
2026-2030	10	P.S. #10 (6 MGD) & New Rock Creek P.S. (4 mgd)	10
2031-2035	10	P.S. #10 (6 MGD) & New Rock Creek P.S.(4 mgd)	10
2035-2054	10		10

Notes:
(1) Source: "Summary ADD_MDD_REVISED 12-21-2017_.xlsx" from CRW 12/21/17
(2) SWA Pump Station #10 future maximum capacity 6 MGD.
(3) Future Rock Creek Pump Station maximum capacity 10 MGD.

3.5.3 EHU, ADD and MDD Projections

When converting account projections to ADD projections, the first step is to convert the number of connections into the number of EHUs. To calculate the projected number of EHUs for the Service Area, the projected number of connections were multiplied by the number of EHUs per connection for each customer category.

To calculate ADD projections for each customer class, EHU projections were multiplied by EHU values unique to each demand projection scenario, as presented in Table 3.14. Non-revenue water consumption, including Other Authorized Use and DSL, was then added based on the low, medium, and high assumptions to establish total ADD projections. Finally, MDD projections were established by multiplying ADD projections with the appropriate MDD to ADD peaking factor for each demand projection scenario.

Tables 3.15, 3.16, and 3.17 show the EHU, ADD, and MDD projections of each pressure zone for low, medium, and high demand projection scenarios, respectively. Projections are presented for ten- and 20-year planning periods.

Table 3.15 Demand Projection Summary - Low Scenario

	EHUs			ADD (mgd) [1]			MDD (mgd) [1][2]		
Pressure Zone	**2017**	**2028**	**2038**	**2017**	**2028**	**2038**	**2017**	**2028**	**2038**
Mather Zone	25,626	27,038	27,809	4.70	12.40	12.50	6.50	14.40	14.60
Otty Zone	11,651	13,024	14,272	1.63	1.85	2.05	3.01	3.42	3.79
Kirkwood Zone	33	33	33	0.01	0.01	0.01	0.01	0.01	0.01
NCCWC Zone	162	166	170	0.03	0.03	0.03	0.05	0.05	0.05
Oak Lodge Zone	327	345	362	0.05	0.06	0.06	0.10	0.10	0.11
Total (North System)	**37,799**	**40,606**	**42,646**	**6.42**	**14.35**	**14.65**	**9.67**	**17.98**	**18.56**

Notes:
(1) MDD and ADD include wholesale demands and Other Authorized Use, which are not calculated by peaking factor.
(2) MDD is calculated based on the peaking factors in Table 3.13.

Table 3.16 Demand Projection Summary - Medium Scenario

	EHUs			ADD (mgd) [1]			MDD (mgd) [1][2]		
Pressure Zone	2017	2028	2038	2017	2028	2038	2017	2028	2038
Mather Zone	25,626	27,040	27,811	4.70	12.50	12.60	7.00	15.00	15.30
Otty Zone	11,654	13,028	14,277	1.68	1.91	2.12	3.41	3.88	4.30
Kirkwood Zone	33	33	33	0.01	0.01	0.01	0.01	0.01	0.01
NCCWC Zone	162	166	170	0.03	0.03	0.03	0.06	0.06	0.06
Oak Lodge Zone	327	345	362	0.05	0.06	0.06	0.11	0.12	0.12
Total (North System)	**37,802**	**40,612**	**42,653**	**6.48**	**14.51**	**14.82**	**10.60**	**19.07**	**19.79**

Notes:
(1) MDD and ADD include wholesale demands and Other Authorized Use, which are not calculated by peaking factor.
(2) MDD is calculated based on the peaking factors in Table 3.13.

Table 3.17 Demand Projection Summary - High Scenario

	EHUs			ADD (mgd)[1]			MDD (mgd)[1][2]		
Pressure Zone	2017	2028	2038	2017	2028	2038	2017	2028	2038
Mather Zone	26,068	27,445	28,239	6.40	12.60	12.70	9.20	15.80	16.10
Otty Zone	12,064	13,349	14,633	1.82	2.04	2.26	3.95	4.44	4.93
Kirkwood Zone	33	34	34	0.01	0.01	0.01	0.01	0.01	0.01
NCCWC Zone	167	171	175	0.03	0.03	0.03	0.06	0.07	0.07
Oak Lodge Zone	338	355	372	0.06	0.06	0.06	0.13	0.14	0.14
Total (North System)	**38,670**	**41,354**	**43,453**	**8.32**	**14.74**	**15.06**	**13.35**	**20.46**	**21.25**

Notes:
(1) MDD and ADD include wholesale demands and Other Authorized Use.
(2) MDD is calculated based on the peaking factors in Table 3.13.

Figure 3.10 shows a graph of the North System's historical ADD and MDD demands and the projected demands of the medium scenario, with low-to-high ranges for both ADD and MDD. The large increases in the projected demands at certain years are due to the projected wholesale demands for SWA. The North System's ADD was approximately 6.4 mgd in 2017. In 2038, ADD is estimated to be between 14.64 mgd and 15.1 mgd, and the medium demand scenario predicts approximately 14.8 mgd. In 2038, the North System's MDD is estimated to be between 18.6 mgd and 21.2 mgd, and the medium demand scenario predicts 19.8 mgd. These scenarios include the SWA demands.

3.5.3.1 Demand Projections - Without Wholesale

Given that the SWA alone has a projected ADD of 10 mgd by 2026, CRW wanted to understand the North System's demands without the wholesale customer included. In this case, by 2038, the North System's projected ADD of the low scenario would reach 4.6 mgd, while the high scenario would be approximately 5.1 mgd. The MDD in 2017 for the low scenario was approximately 7.2 mgd. By 2038, the MDD of the medium scenario would be approximately 9.8 mgd, within a range from 8.6 to 11.2 mgd.

Figure 3.11 shows the ADD and MDD projections for the North System without wholesale. The projected demands increase at a smoother rate because of the removal of the projected wholesale demand increases.

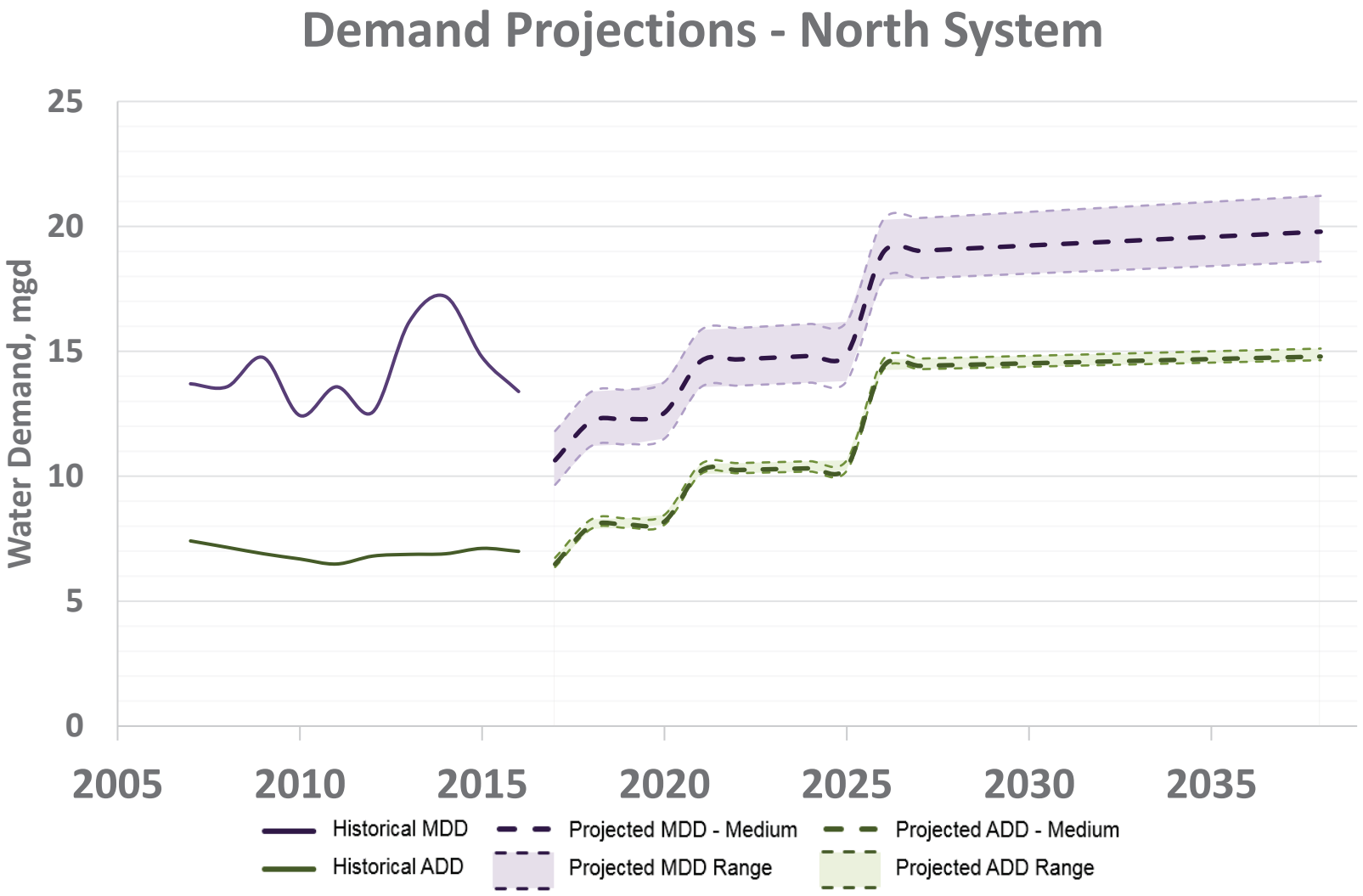

Figure 3.10 Demand Projections with Wholesale, North System

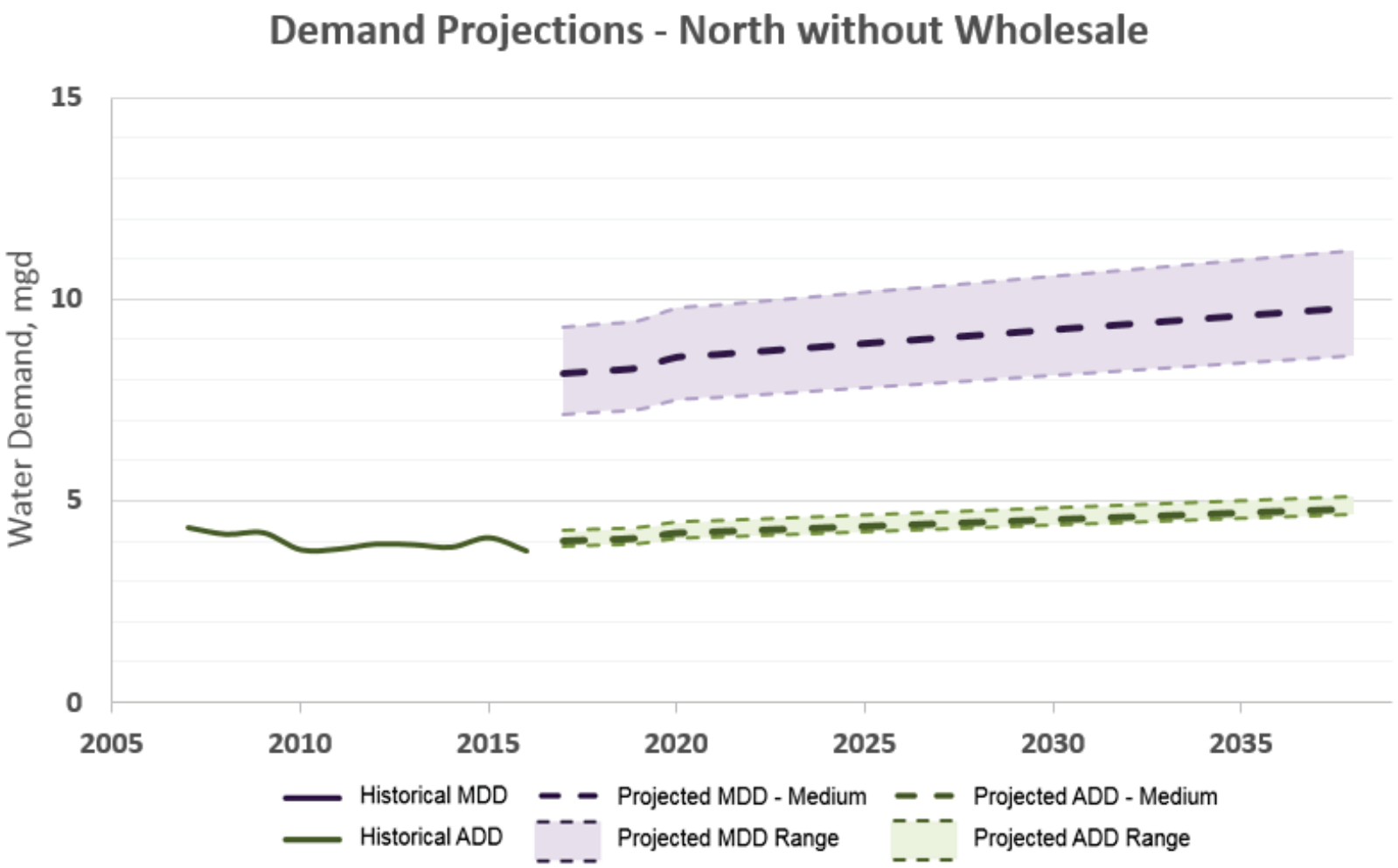

Figure 3.11 Demand Projections without Wholesale, North System

Appendix F

Water System Master Plan South System Demand Forecast

3.5 Water Demand Projections

Projecting future water demand is a key part of a water system's planning process. Demand projections are used to identify system improvements such as supply, pumping, storage, and piping requirements.

This section summarizes ADD and MDD projections developed for CRW's water system using historical water demand trends and future demographic growth assumptions. Demand projections are presented as a range of demands that may be experienced in the future.

The demand projections are presented as a range in demands that may be experienced in the future. Low, medium, and high water demand projection scenarios were developed by adjusting various demand projection parameters. The medium demand projection scenario is used for the system analysis described in Chapter 6. The system analysis determines future pumping, storage, and distribution system deficiencies and identifies potential improvements to achieve CRW's established capacity criteria. The low and high projection scenarios provide a sense of the extent of uncertainty in the demand forecasts.

3.5.1 Demand Projection Methodology

Water demand projections were developed in the following steps, which are also summarized in Figure 3.9:

1. Increase historical water connection numbers for each pressure zone according to the zone-specific residential and non-residential growth rates derived from the demographic analysis.
2. Convert account projections into EHU projections and then into ADD projections using demand projection parameters derived from historical data, which consists of CRW's starting EHU value, MDD/ADD peaking factor, DSL, percent of Other Authorized Use, and large consumer demand
3. Apply the MDD to ADD peaking factor to convert ADD to MDD.

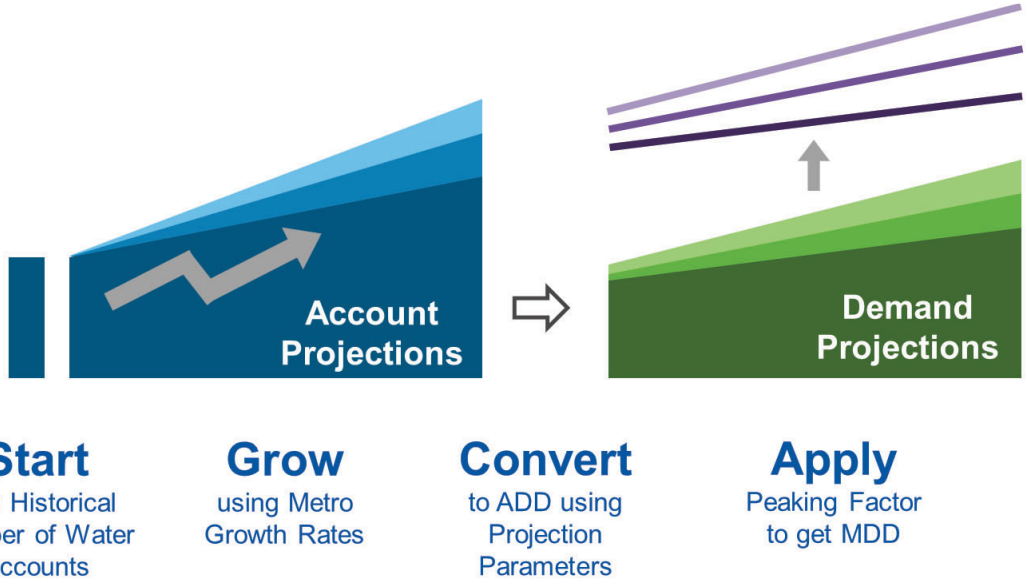

Figure 3.9 Demand Projection Methodology

3.5.2 Demand Projection Parameters

Numerous factors and assumptions affect the accuracy of the projected future water demands. To project CRW's future ADD and MDD, several parameters were used, all of which are listed in Table 3.13. These parameters include the starting EHU value, peaking factor (MDD/ADD), DSL percentage, and Other Authorized Use.

Using historical data and assumptions, low, medium, and high parameters were established for each demand projection scenario. These parameters were then used to develop the low, medium, and high demand forecasts. For each parameter, Table 3.13 summarizes the values selected to develop the range of demand projections. The following sections discuss demand projection in further detail.

Table 3.13 Projected Parameters, South System

Projected Scenario	Low		Medium		High	
Parameter	Parameter	Notes	Parameter	Notes	Parameter	Notes
Starting EHU Value (gpd/EHU)	230	lowest year	253	Ave last 4 years	257	Hist. Ave.
Peaking Factor (MDD/ADD)	2.38	SCADA data	2.74	SCADA data	3.05	SCADA data
DSL (Percent of Production)	10.00%	2011	14.4%	Annual Ave.	14.4%	Existing
Other Authorized Use (Percent of Production)	0.00%	25th %	0.00%	Hist. Ave.	0.00%	Max

3.5.2.1 Starting EHU Value

CRW agreed that the starting EHU value in the South System would be the historically lowest EHU value for the SFR customer class, which was 230 gpd/EHU in 2011. The medium scenario used the average of the previous four years, calculating an EHU value of 253, while the high scenario used the historical 10-year average for an EHU value of 257.

3.5.2.2 MDD to ADD Peaking Factor

Based on current SCADA data for the South System, which gives a more accurate representation than using the historical WTP production to find the peaking factor, CRW decided that a peaking factor of 2.38 was the lowest it should plan for in the future when analyzing the low demand projection scenario. Peaking factors of 2.74 and 3.05 were used for the medium and high demand scenarios, respectively.

3.5.2.3 Distribution System Leakage

On average, the low demand scenario's DSL took up 10 percent of the total water production annually, while the medium demand scenario took up 14.4 percent. According to CRW, the medium scenario's DSL will be reduced to 10 percent over 10 years and then remain flat. Meanwhile, the high demand scenario's DSL also used 14.4 percent of the total water production.

3.5.2.4 Other Authorized Use

For the South System, Other Authorized Use was set to zero for all scenarios.

3.5.2.5 Largest Consumers

For each scenario, CRW recommended that the largest customers do not have any assumed growth in consumption.

3.5.3 EHU, ADD, and MDD Projections

When converting account projections to ADD projections, the first step is to convert the number of connections into the number of EHUs. To calculate the projected number of EHUs for the RWSA, the projected number of connections were multiplied by the number of EHUs per connection for each customer category.

To calculate ADD projections for each customer class, EHU projections were multiplied by EHU values unique to each demand projection scenario, as presented in Table 3.13. To establish total ADD projections, non-revenue water consumption, including Other Authorized Use and DSL, was then added given the low, medium, and high assumptions. Finally, MDD projections were established by multiplying ADD projections with the appropriate MDD to ADD peaking factor for each demand projection scenario.

Tables 3.14, 3.15, and 3.16 show the EHU, ADD, and MDD projections of each pressure zone in the South System for low, medium, and high demand projection scenarios, respectively. Projections are presented for ten- and 20-year planning periods. ADD and MDD demands include DSL, which is not calculated from the peaking factors.

Figure 3.10 shows a graph of the South System's historical ADD and MDD demands and the projected demands of the medium scenario, with low-to-high ranges for both ADD and MDD. The ADD was approximately 1.4 mgd in 2017. In 2038, it is estimated to be between 1.9 and 2.2 mgd, while the medium demand scenario predicts 2.1 mgd. In 2038, MDD is estimated to be between 4.6 and 6.9 mgd, while the medium demand scenario predicts 5.7 mgd.

Table 3.14 South System Demand Projection Summary - Low Scenario

	EHUs			ADD (mgd)			MDD (mgd)(1)		
Pressure Zone	**2017**	**2028**	**2038**	**2017**	**2028**	**2038**	**2017**	**2028**	**2038**
Beavercreek Zone	2,098	2,537	2,936	0.48	0.58	0.68	1.15	1.39	1.61
Henrici Zone	1,008	1,160	1,298	0.22	0.26	0.29	0.53	0.61	0.69
Holcomb Zone	942	1,105	1,253	0.22	0.25	0.29	0.52	0.61	0.69
Barlow Zone	99	130	159	0.02	0.03	0.04	0.05	0.07	0.09
Hunter Heights Zone	88	92	95	0.02	0.02	0.02	0.05	0.05	0.05
Redland Zone	1,451	1,613	1,760	0.33	0.37	0.40	0.79	0.88	0.96
Meyers Zone	113	142	168	0.03	0.03	0.04	0.06	0.08	0.09
South End Zone	466	760	1,026	0.11	0.17	0.24	0.26	0.42	0.56
Total	**6,265**	**7,539**	**8,695**	**1.43**	**1.71**	**2.00**	**3.41**	**4.11**	**4.74**

Notes:
(1) Per CRW SCADA data, MDD is calculated based on the peaking factor in Table 3.13.

Table 3.15 South System Demand Projection Summary - Medium Scenario

	EHUs			ADD (mgd)			MDD (mgd) [1]		
Pressure Zone	**2017**	**2028**	**2038**	**2017**	**2028**	**2038**	**2017**	**2028**	**2038**
Beavercreek Zone	2,206	2,537	2,936	0.56	0.64	0.74	1.50	1.76	2.03
Henrici Zone	1,051	1,156	1,294	0.25	0.27	0.31	0.70	0.74	0.84
Holcomb Zone	990	1,105	1,253	0.25	0.28	0.32	0.70	0.77	0.87
Barlow Zone	104	130	159	0.03	0.03	0.04	0.10	0.09	0.11
Hunter Heights Zone	93	92	95	0.02	0.02	0.02	0.10	0.06	0.07
Redland Zone	1,526	1,613	1,760	0.39	0.41	0.45	1.10	1.12	1.22
Meyers Zone	118	142	168	0.03	0.04	0.04	0.10	0.10	0.12
South End Zone	490	760	1,026	0.12	0.19	0.26	0.30	0.53	0.71
Total	**6,578**	**7,535**	**8,691**	**1.65**	**1.88**	**2.18**	**4.60**	**5.17**	**5.97**

Notes:
(1) Per CRW SCADA data, MDD is calculated based on the peaking factor in Table 3.13.

Table 3.16 South System Demand Projection Summary - High Scenario

	EHUs			ADD (mgd)			MDD (mgd) [1]		
Pressure Zone	**2017**	**2028**	**2038**	**2017**	**2028**	**2038**	**2017**	**2028**	**2038**
Beavercreek Zone	2,248	2,668	3,087	0.58	0.69	0.79	1.76	2.09	2.42
Henrici Zone	1,065	1,210	1,355	0.25	0.29	0.33	0.77	0.88	0.99
Holcomb Zone	1,006	1,162	1,318	0.26	0.30	0.34	0.79	0.91	1.03
Barlow Zone	107	137	167	0.03	0.04	0.04	0.08	0.11	0.13
Hunter Heights Zone	93	96	100	0.02	0.02	0.03	0.07	0.08	0.08
Redland Zone	1,542	1,696	1,851	0.40	0.44	0.48	1.21	1.33	1.45
Meyers Zone	121	149	177	0.03	0.04	0.05	0.09	0.12	0.14
South End Zone	518	799	1,079	0.13	0.21	0.28	0.41	0.63	0.85
Total	**6,700**	**7,917**	**9,134**	**1.70**	**2.03**	**2.34**	**5.18**	**6.15**	**7.09**

Notes:
(1) Per CRW SCADA data, MDD is calculated based on the peaking factor in Table 3.13.

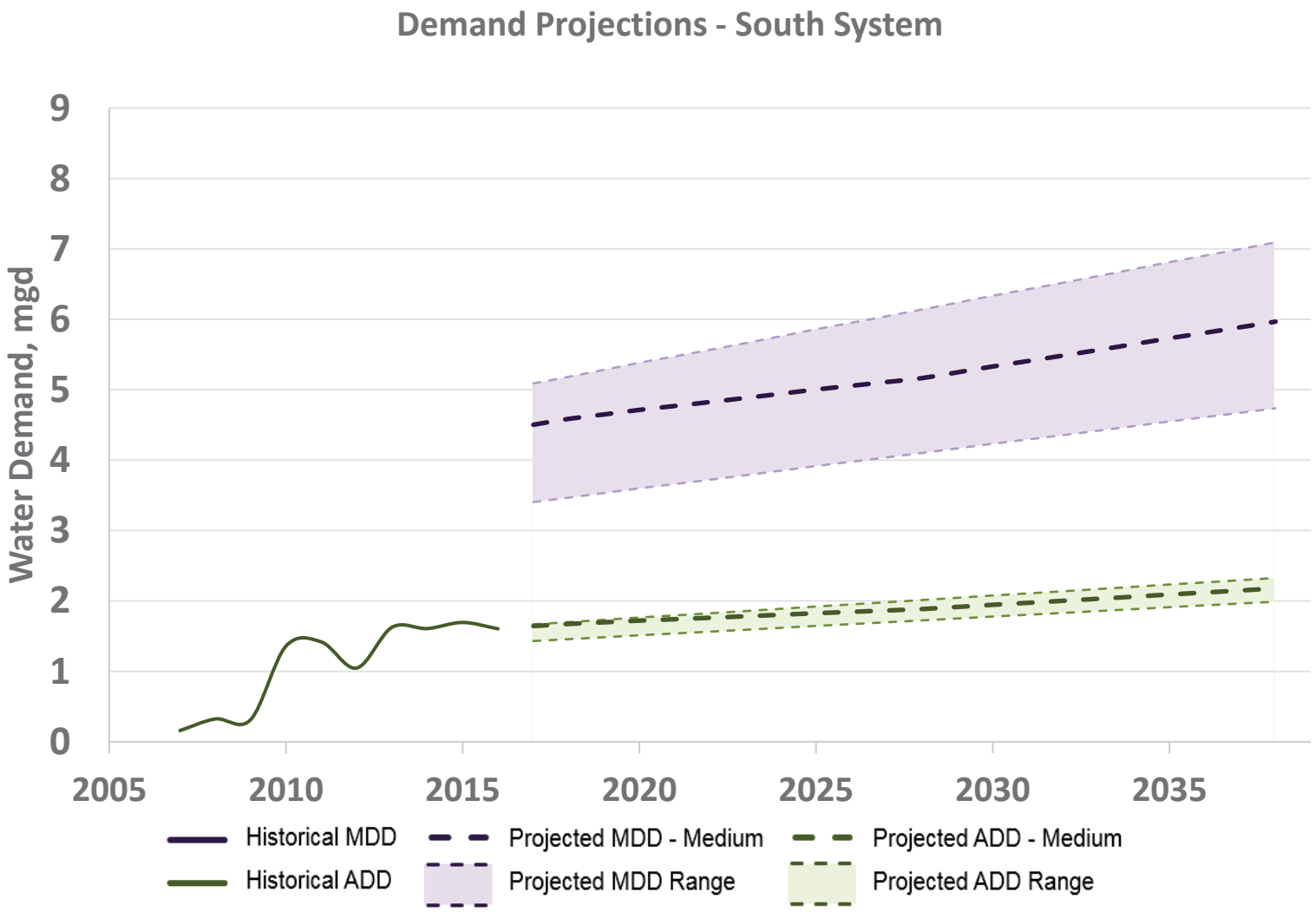

Figure 3.10 Demand Projections, South System