CITY OF STAYTON

WATER MANAGEMENT AND CONSERVATION PLAN UPDATE

EXPIRES: 12/31/20

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KA 211030-025/b

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WATER MANAGEMENT AND CONSERVATION PLAN CHECKLIST

This checklist is provided as a guide to where each required report element is located within the body of the plan. "N/A" is used for sections that do not apply to the City of Stayton.

	Items and Tasks	OAR Reference	Section No.
WMCP Plan Elements			
✓	Notice to affected local government(s)	690-086-0125(5)	1.5
✓	Proposed WMCP update schedule	690-086-0125(6)	1.6
✓	Additional time to implement conservation benchmarks	690-086-0125(7)	N/A
Water Supplier Description			
✓	Supplier's source(s)	690-086-0140(1)	2.1 and 2.2
✓	Current service area and population served	690-086-0140(2)	2.3
✓	Assessment of adequacy and reliability of existing water supplies	690-086-0140(3)	2.4
✓	Present and historic water use	690-086-0140(4)	2.5
✓	Water rights inventory table and environmental resource issues	690-086-0140(5)	2.6
✓	Customers served and water use summary	690-086-0140(6)	2.7
✓	Interconnections with other systems	690-086-0140(7)	2.8
✓	System schematic	690-086-0140(8)	2.9
✓	Quantification of system leakage	690-086-0140(9)	2.10
Water Conservation Element			
✓	Progress report on implementation of conservation measures scheduled in a previously approved WMCP (*N/A if 1st WMCP*)	690-086-0150(1)	3.1
✓	Water use measurement and reporting program	690-086-0150(2)	3.2
✓	Currently implemented conservation measures	690-086-0150(3)	3.3
✓	Annual water audit	690-086-0150(4)(a)	3.4.1
✓	Full metering of system	690-086-0150(4)(b)	3.4.2
✓	Meter testing and maintenance program	690-086-0150(4)(c)	3.4.3
✓	Rate structure based on quantity of water metered	690-086-0150(4)(d)	3.4.4
✓	Leak detection program	690-086-0150(4)(e)	3.4.5
✓	Public education program	690-086-0150(4)(f)	3.4.6
✓	System leakage reduction program <15%	690-086-0150(5)	3.5
✓	System leakage reduction program <10%	690-086-0150(6)(a)	3.5
✓	Technical and financial assistance programs	690-086-0150(6)(b)	3.6.1
✓	Retrofit/replacement of inefficient fixtures	690-086-0150(6)(c)	3.6.2
✓	Rate structure and billing practices to encourage conservation	690-086-0150(6)(d)	3.6.3
✓	Reuse, recycling, and non-potable opportunities	690-086-0150(6)(e)	3.6.4
✓	Other proposed conservation measures	690-086-0150(6)(f)	3.6.5
Water Curtailment Element			
✓	Water supply assessment and description of past deficiencies	690-086-0160(1)	4.1
✓	Stages of alert	690-086-0160(2)	4.2
✓	Triggers for each stage of alert	690-086-0160(3)	4.3
✓	Curtailment actions	690-086-0160(4)	4.4
Water Supply Element			
✓	Future service area and population projections	690-086-0170(1)	5.1 and 5.2
✓	Schedule to fully exercise each permit (*i.e., certification*)	690-086-0170(2)	5.3
✓	Demand forecast	690-086-0170(3)	5.4
✓	Comparison of projected need and available sources	690-086-0170(4)	5.5
✓	Analysis of alternative sources	690-086-0170(5) and (8)	5.6
✓	Maximum rate and monthly volume quantification	690-086-0170(6)	5.7
✓	Mitigation actions under state and federal laws	690-086-0170(7)	5.8
✓	***Greenlight Water Request*** – Conservation measure schedule and cost effectiveness	690-086-0130(7)(a)	N/A
✓	***Greenlight Water Request*** – Justification that selected source is most feasible and appropriate	690-086-0130(7)(b)	N/A
✓	***Greenlight Water Request*** – Mitigation requirements	690-086-0130(7)(c)	N/A

SECTION 1

INTRODUCTION AND REPORT ELEMENTS

1.1 PURPOSE / PLAN REQUIREMENT

The City of Stayton, located in Marion County, presents its April 2018 Water Management and Conservation Plan (WMCP) to the Oregon Water Resources Department (OWRD) and interested parties. The City believes this WMCP outlines a plan to effectively manage its present water rights and provide a means for developing a comprehensive strategy for meeting its municipal water supply needs over the next 20 years. Moreover, the plan attempts to enhance management techniques of the State's water resources, including an increased effort to improve the efficiency of the water system, thereby meeting the intent of the regulations defined under Oregon Administrative Rule (OAR) 690-086.

The City is submitting this WMCP in response to the final order approving the City's previous WMCP on April 15, 2009. Approval of the WMCP triggered the need to prepare and submit an updated WMCP as directed under OAR Chapter 690 Division 086.

The City last submitted a WMCP in January 2006 which outlines benchmarks to be implemented to improve local management of water resources. Since that time, the City has made progress in meeting those benchmarks and is looking to coordinate this new plan with on-going efforts to comply with OAR 690-086 rules. This WMCP conforms with the City's 2006 Water Master Plan, and uses information developed during that planning effort and subsequent planning efforts.

1.2 PLAN ORGANIZATION

This WMCP is organized in a manner consistent with OAR 690-086.

- Section 2: Describes the water supply system, including key demographic information, water consumption, and the type of infrastructure present in the water system.
- Section 3: Identifies the conservation measures the City has implemented and proposed new measures with associated benchmarks for each new measure.
- Section 4: Describes the tools available to the City in the event of a water emergency, including a water curtailment plan.
- Section 5: Uses the information presented in Section 2 to forecast future demands, compare those demands to present water rights, and assesses the need for additional source water diversions.

1.3 SUMMARY OF DATA SOURCES

Throughout this WMCP are references to data, most of which were obtained from City files including water meter records for the City's well and water treatment plant, water consumption records, and land use planning. Historical data related to service area, such as connections and demand, were obtained from the City's utility billing system, the City's production data, and the City's 2006 Water Master Plan. Historic and future demographic data were also obtained from the Water Master Plan and Portland State University (PSU) population estimates. Additional records utilized include the 2012 Water Model Update and the 2014 Shallow Aquifer Evaluation. The PSU population estimates, 2006 Stayton WMCP, and 2014 Shallow Aquifer Evaluation report are included in Appendix B.

1.4 INPUT DURING PLAN DEVELOPMENT

To develop this WMCP, City staff have worked together with Keller Associates to examine a range of water management alternatives. A draft WMCP was also submitted to Marion County with a request for comments. The City Council reviewed and approved the conservation and curtailment measures outlined in this plan on April 16, 2018.

1.5 AFFECTED LOCAL GOVERNMENTS

The City provided notice of availability of the draft WMCP for review to all affected local governments (listed below), along with a request for comments related to consistency with the local governments' comprehensive land use plan:

- Marion County Planning Department
- City of Sublimity
- City of Salem
- Santiam Water Control District

A copy of the notification letter and the comments received are included in Appendix A of this WMCP.

1.6 PLAN UPDATE SCHEDULE

Following OAR 690-086-0125(6), the City proposes to submit an updated WMCP at the end of the 10-year period in 2028. In addition, the City will submit a progress report five years from now in 2023.

1.7 REQUEST FOR ADDITIONAL TIME FOR METERING OR BENCHMARKS

The City is not requesting an extension of time to implement metering or an established benchmark established in a previously approved WMCP.

SECTION 2

MUNICIPAL SUPPLIER DESCRIPTION

This section is written to address the requirements of OAR 690-086-0140. It describes the City's water sources, service area, population served, existing water rights, and demands for water. It also considers the adequacy and reliability of the City's existing water supply. This section also provides a description of the City's customers and their water use patterns, the water system, interconnections with other water suppliers, and a quantification of system leakage.

2.1 WATER SOURCES AND SYSTEM DESCRIPTION

2.1.1 Description of Water Sources

The City's water supply currently is sourced from the Stayton Ditch, which is fed from the Santiam River via a diversion structure situated about 1 mile east of the water treatment plant site. The diversion structure was constructed with the original water treatment facility in the early 1970's. This structure diverts water from the power canal through a manually cleaned coarse bar screen with 2-inch openings. The water is then conveyed down a channel through a slide gate valve into a vault with three stainless steel wire-wrapped fine well screens mounted horizontally. A fish screen is installed upstream of the diversion structure to prevent fish from entering the treatment plant.

The City owns a shallow groundwater well next to the Santiam River (75 Well) (see Figure 2-3 at the end of this section). The well is used only periodically to supplement peak flow demands and high turbidity events. The native soils along the riverbank provide adequate filtration prior to the groundwater being pumped to the treatment plant. The water is then treated to meet requirements defined by the Surface Water Treatment Rule. The 50 Well is another shallow groundwater well located near the treatment plant, which was previously used to supplement high turbidity events and peak demands. This well was taken offline in March 2010 due to biofouling-related complications in the well.

Information pertaining to the City's water rights is found in Section 2.6. A detailed description of all of the City's water rights is provided below in Table 2-7.

2.1.2 Source Treatment

The City of Stayton operates a surface water treatment plant (WTP) which is currently rated for 7.1 million gallons per day (MGD). The treatment plant is equipped with three slow sand filters, each with a 50 hp filtered water pump; four 1,430-gallon Sodium Hypochlorite tanks with three 5.0 gal/hr (max) diaphragm metering pumps; and a soda ash silo, volumetric feeder mixing tank, and two 50 gal/hr (max) diaphragm metering pumps. The treatment plant is fed by surface water from the N. Santiam River and a Ranney-type shallow ground water collector.

2.1.3 Transmission / Distribution

The City's water distribution system is comprised of a network of water pipes ranging in size from 1 to 24-inches in diameter and totaling approximately 45 miles. The total linear feet of each nominal pipe size is shown in Table 2-1 below. A breakdown of the various pipe materials is shown in Table 2-2 below.

Table 2-1: System Inventory by Pipe Size

Pipe Size	Total Length (FT)	% of Total
<3"	23,808	9.96%
3	3,722	1.56%
4	20,989	8.78%
6	47,528	19.89%
8	63,631	26.63%
10	29,324	12.27%
12	27,401	11.47%
14	630	0.26%
16	8,582	3.59%
18	3,911	1.64%
20	9,046	3.79%
24	52	0.02%
30	321	0.13%

Table 2-2: System Inventory by Pipe Material

Pipe Type	Total Length (FT)	% of Total
Asbestos Cement	77,658	32.50%
Cast Iron	2,446	1.02%
Ductile Iron	104,333	43.66%
Galvanized Iron	10,390	4.35%
PVC	13,845	5.79%
Steel	29,569	12.37%
OMB	134	0.06%
Copper	316	0.13%
Unknown	251	0.11%

The distribution system is approximately 44% ductile iron pipe, 32% asbestos concrete pipe, 12% steel pipe, and 12% other materials such as galvanized iron, copper, and PVC.

2.1.4 Finished Water Storage

The City has a total of 5.9 million gallons of water storage in three storage facilities summarized in Table 2-3 below.

Table 2-3: System Storage Capacity

Facility	Size (MG)
Schedule M Reservoir	(1.0) offline
Pine Street Reservoir	5.0
WTP Reservoir	0.5
Regis Reservoir	0.4
Total Storage	**5.9**

2.2 INTERGOVERNMENTAL AGREEMENTS

The City of Stayton has a mutual water agreement with the City of Salem to buy and sell safe drinking water to and from each other during emergency situations, including any surplus safe drinking water when needed. Outlined in the agreement, the City of Stayton agrees to sell water at $0.581 per 1,000 gallons. The City of Salem agrees to sell water at $0.4679 per 1,000 gallons. A complete copy of the agreement is included in Appendix C.

The City of Stayton also has an agreement with the Santiam Water Control District. This agreement outlines the terms and conditions which the City must meet in order to use and draw water from the District's power canal. These terms and conditions include compensation for the District improving power canal infrastructure such as a fish screen and bypass facilities for the power canal, as well as annual operation and maintenance of the power canal. A copy of the agreement can be found in Appendix C.

2.3 CURRENT POPULATION AND SERVICE AREA

The City of Stayton is a small community located in northwestern Oregon at the confluence of the Santiam Canyon and the Willamette Valley, approximately 14 miles east of Salem. The City contains approximately 1,950 acres within its limits. The 2010 census reported a total population of 7,644 people and 2,882 occupied housing units. This indicates an average household size of 2.65 people per household.

The City currently serves drinking water to a population of approximately 7,770 within its municipal boundary. This estimate is based on the existing estimated population of 7,770 with the understanding that the City provides water to all residents within the city limits. The 2006 Water Management Conservation Plan indicated the City's population was growing at approximately 2.6% from 1970 to 2000. According to population records kept by Portland State University (PSU), the annual population growth rate slowed to an estimated 0.2% from 2010 to 2017. PSU's population forecast through 2067 shows an average growth rate of 0.8%. However, this is still much less than was estimated in the previous WMCP report in 2006. Table 2-4 and Table 2-5 compare the historical and forecasted population growth of Stayton and Marion County.

Table 2-4: Stayton Historical Population Growth (PSU)

Year	Stayton		Marion County	
Year	Pop.	%	Pop.	%
2010	7,644		315,335	
2011	7,660	0.2%	318,150	0.9%
2012	7,660	0.0%	320,495	0.7%
2013	7,685	0.3%	322,880	0.7%
2014	7,700	0.2%	326,150	1.0%
2015	7,725	0.3%	329,770	1.1%
2016	7,745	0.3%	333,950	1.3%
2017	7,770	0.3%	339,200	1.6%
Average		0.2%		1.0%

Table 2-5: Stayton Forecasted Population Growth (PSU)

Year	Stayton		Marion County	
Year	Pop.	%	Pop.	%
2022	8,479	0.8%	355,326	1.0%
2027	8,833	0.8%	373,791	1.0%
2030	9,053	0.8%	385,328	1.0%
2035	9,432	0.8%	405,352	1.0%
2040	9,773	0.7%	420,565	0.7%
2050	10,493	0.7%	452,725	0.7%
2060	11,266	0.7%	487,345	0.7%
2067	11,841	0.7%	513,142	0.7%
Average		0.8%		0.8%

The population in the City of Stayton, according to PSU's 2017 Coordinated Population Forecast report and as shown in Table 2-5 above, is expected to grow at approximately the same rate as Marion County.

The majority of the land use within the City is residential. Other designated areas within the City include commercial, downtown, public lands, and industrial. See Table 5-1 for a summary of land use types and acreage.

2.4 ADEQUACY AND RELIABILITY OF WATER RIGHTS / SUPPLY

This City holds nine water rights comprised of seven surface water rights and two groundwater rights. Out of the total water rights held by the City, two rights have associated completion dates. Permit number S-12033 has an authorized completion date of 10/1/2042, and permit number S-52447 has an authorized completion date of 10/1/2094. The City is not currently authorized to exercise the 25 cfs winter water right associated with Permit S-52447.

In order to receive authorization to divert water under Permit S-52447, evidence of a need for a specific quantity or rate of diversion of water must be approved as part of a future WMCP. The City has determined, based on population projections and water demand forecasting, that diversion under Permit S-52447 is not needed at this time. It is recommended that the population projection and demand forecast provided in this WMCP be reevaluated in the future (before October 1, 2094) to determine the need for additional water under Permit S-52447.

The City has indicated that over the past several years, observed water levels in the Santiam River have gradually been declining. The 75 Well, which once was able to produce approximately 1MGD is now on average producing 0.6 MGD. GSI Water Solutions was hired to evaluate the capacity of the shallow aquifer which supplies water to the 75 Well. Additionally, the evaluation included assessing the feasibility of adding a new infiltration gallery near the 75 Well to meet a target capacity of 1.4 MGD. The result of the analysis indicated that the aquifer is capable of supporting a 1,000-gpm infiltration gallery system. The GSI evaluation report is included in Appendix B.

2.5 WATER USE RECORDS

The surface water rights all have the same point of diversion, approximately 1,800 feet South and 2,830 feet East from the West ¼ Corner Section 11. Well 2, otherwise referred to as the 50 Well, is located near the water treatment plant. The infiltration trench is located near the Santiam River. The 50 Well was taken offline in March 2010 due to biofouling. The City holds a water right (G-173) at the 50 Well point of diversion allowing water to be used at a rate of 3 cubic feet per second (cfs). With the 50 Well offline, the City has no way to use the right and requires the point of diversion for that water right to be changed. Without the use of G-173, the City has year-round water rights up to 23.27 cfs. This equates to 10,894 gpm or 15.69 MGD, which is approximately twice as much as the current peak day demand of the City. Table 2-6 summarizes the average annual and maximum day production from the City's 75 Well and N. Santiam River from 2012 to 2017.

A review of usage indicates a peak day demand of 7,419,000 gallons per day, which occurred in July 2013. In general, peak usage occurs each year between May and September. The peaking factor was calculated to be 2.99 using the average annual demand of 2,478,857 gallons per day and the peak day demand mentioned previously.

Table 2-6: Average and Peak Day Production

Year	Average Day (gpd)	Peak Day (gpd)
2012	2,401,811	7,112,000
2013	2,478,857	7,419,000
2014	2,355,477	6,548,000
2015	2,318,170	6,621,000
2016	2,154,590	6,524,000
2017	2,155,161	6,581,000

2.6 INVENTORY OF WATER RIGHTS

Table 2-7 below summarizes the City's water use, broken down by the amount diverted under each of its water rights. The table includes all available information required under OAR 690-086-0140(5).

Table 2-7: Water Rights Inventory

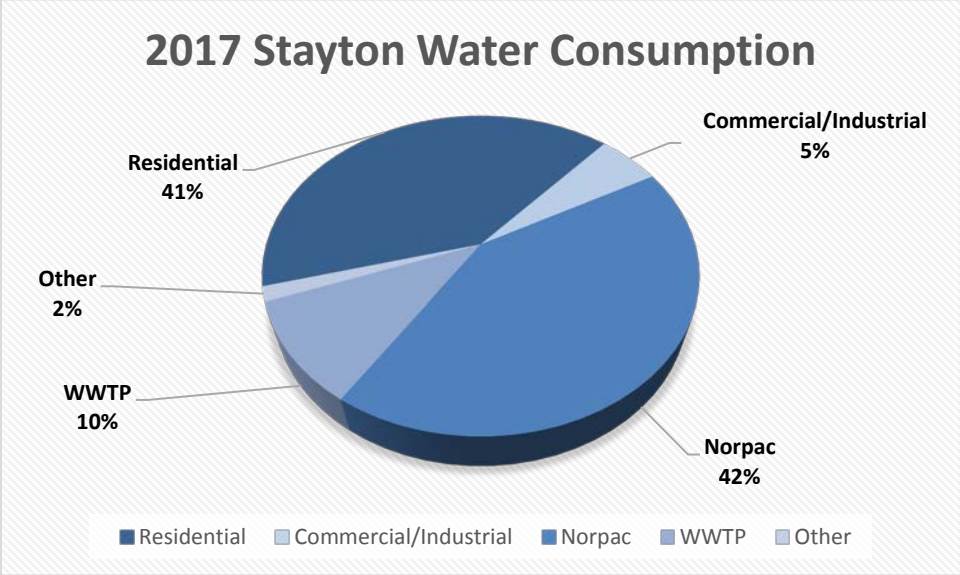
Application No.	Permit No.	Priority Date	Certificate No.	Transfer No.	Source	Use	Allowed Rate (cfs)	Actual Diversion				Authorized Completion Date	Notes/Environmental concerns
								Maximum Instantaneous Rate Diverted to Date (cfs)	Maximum Annual Quantity Diverted to Date (MG)	Average Monthly Diversion (MG)	Average Daily Diversion (MG)		
E-81	E-82	5/14/1909	80346	T-5883	N. Santiam	Municipal	2.78	1.64	164.97	11.67	0.28		Only useable May 1 – Sept 30, Limit to 779.5 AF
S-1508	S-1401	6/24/1911	80347	T-5884	N. Santiam	Municipal	0.82	0.82	75.14	7.58	0.22		Only useable May 1 – Sept 30, Limit to 230.6 AF
		5/14/1909	80348	T-5885	N. Santiam	Municipal	0.39	0.39	25.58	5.02	0.17		Only useable May 1 – Sept 30, Limit to 78.5 AF
		1907	80349	T-8871	N. Santiam	Municipal	0.6	0.6	82.21	11.63	0.39		Year round, no volume limit
S-9056	S-12033	5/7/1923		T-9192	N. Santiam	Municipal	10	4.43	226.37	13.17	0.52	10/1/2042	Year round, no volume limit
S-39297	S-29266	12/10/1963	57094		N. Santiam	Municipal	7	1.56	165.25	13.17	0.45		Year round, no volume limit
S-71584[1]	S-52477	5/13/1991			N. Santiam	Municipal	0.0	0	0	0	0	10/1/2094	Only useable Oct 1 – Apr 30; Not authorized as specified in the extension of time Final Order issued April 24, 2015
CLAIM GR-145	Gr-139	1930			Inf. Trench	Municipal	2.67	1.56	165.25	13.17	0.45		Requires relatively continuous use, without significant lapse
GR-270[2]	Gr-173	3/16/1956	24587		Well 2	Municipal	3	0	0	0	0		Not accessible

1. Water use from this permit is not currently authorized
2. Well 2 was taken offline, requiring a new point of diversion

2.7 CUSTOMER CHARACTERISTICS AND USE PATTERNS

The City provides water to a variety of users. The majority of the water consumed in Stayton can be split into five categories: residential, commercial/industrial, Norpac Foods, wastewater treatment plant, and "other". The "other" category encompasses all other users including churches, schools, construction water, City water use, and any additional water used for irrigation purposes. Figure 2-1 below describes the breakdown of water use among the five main categories described previously.

Figure 2-1: Water Use Statistics for 2017



Norpac Foods is a large industrial food processing company which is responsible for the majority of Stayton's water use - approximately 42%. Norpac, as presented in the 2006 WMCP, was responsible for 42.4% of the total water usage in the City in 2003. In the past few years, Norpac has made adjustments to their processes, which has resulted in water conservation. In 2003, Norpac used approximately 328,540,000 gallons. In 2017, Norpac used approximately 294,492,000 gallons - a difference of approximately 34,000,000 gallons (10%) from 2003.

The residential water use makes up 41% of the total water consumption. This portion of consumption has increased approximately 9% from 32.1% in 2003, as reported in the 2006 WMCP. Residential use also makes up approximately 88% of the total accounts. Table 2-8 below provides a summary of accounts and water usage by usage category. The wastewater treatment plant also currently uses a considerable amount of water (10%). Section 3.6.4 of this report describes a benchmark the City has set to investigate reuse, recycling, and non-potable opportunities.

Table 2-8: 2017 Water Accounts Summary

Account Type	# of Accounts	Usage (gal)
Residential	2,506	283,945,000
Commercial	201	34,284,000
Industrial (excluding Norpac)	18	3,985
Norpac	7	294,492,000
Churches	15	2,550,000
Schools	19	3,913,000
Construction	26	128,000
Irrigation	29	21,000
City	17	3,817,000
WWTP	1	71,001,000

Table 2-9 below lists the top commercial/industrial water consumers in Stayton for 2017. Norpac, as discussed previously, is the dominant water consumer in the city. The Santiam Memorial Hospital, which is categorized by the City as “Commercial”, is also a large water user compared to the rest of the top users. After Norpac and the Santiam Memorial Hospital, the other top users are made up of restaurants, stores, and small industrial users.

Table 2-9: Stayton Top 10 Commercial/Industrial Water Users (2017)

User	Ranking	Water Usage (gal)
Norpac Foods	1	294,492,000
Wastewater Treatment Plant	2	71,001,000
Santiam Memorial Hospital	3	6,740,000
River Ranch Restaurants	4	1,130,000
Santiam Cleanery Inc	5	1,119,000
Arco AM/PM	6	919,000
Roth’s IGA	7	737,000
A&W	8	688,000
PacifiCorp Facilities	9	683,000
Safeway Stores	10	670,000

The information summarized in Table 2-9 indicates that the majority of the top water users, excluding Norpac, the wastewater treatment plant, and Santiam Memorial Hospital, consume on average approximately 850,000 gallons per year, which is approximately eight times less than Santiam Memorial Hospital and about 360 times less than Norpac. Excluding Norpac, the wastewater treatment plant, and the hospital, the average top commercial/industrial user consumes less than 0.12% of the total water produced.

2.8 INTERCONNECTIONS WITH OTHER WATER SUPPLY SYSTEMS

The City, in the event of an emergency, uses an inter-tie with the City of Salem's distribution system. The inter-tie includes an 18-inch pipeline which connects the City's Schedule "M" booster station to a Salem-owned 54-inch transmission line. Water upstream of the inter-tie is treated and chlorine and turbidity levels are continuously monitored by Salem's SCADA system.

2.9 SYSTEM SCHEMATIC

See the system schematic (Figure 2-4) at the end of this section.

2.10 WATER LOSSES AND NON-REVENUE WATER

According to the 2006 WMCP, unaccounted for water in Stayton's system was 30.2% in 2001, 30.4% in 2002, and 21.6% in 2003. The dramatic drop in unaccounted for water from 2002 to 2003 suggests the City was making changes to reduce water loss and more fully account for water usage. The City only maintains water consumption records for the previous three years. At the time this report was produced, there were only two whole years of available consumption data available (2016 and 2017). Table 2-10 below presents the City's water loss for 2016 and 2017.

Table 2-10: Water Loss Summary

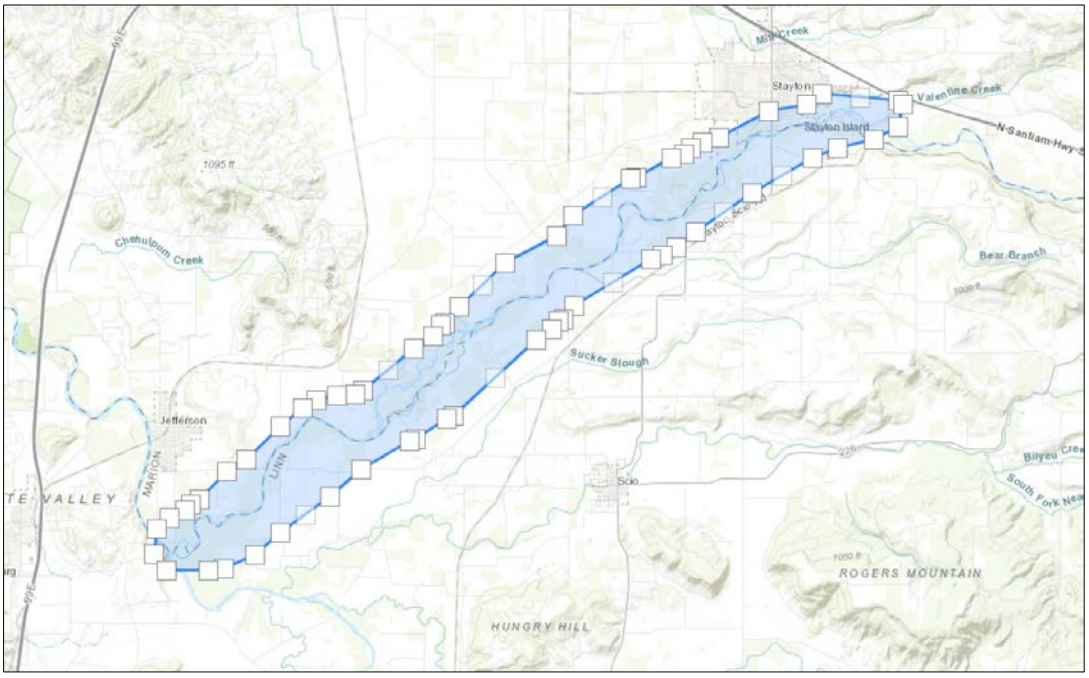
Year	Production	Consumption	% Unaccounted for Water
2016	786,633,746	703,394,000	11%
2017	786,888,000	698,136,000	11%

The two years of available production and consumption data appear to be fairly consistent. Overall system unaccounted for water appears to be approximately 11%, which is a dramatic improvement from the water losses described previously for 2001 to 2003. This is a result of the City's efforts to meter their system, perform leakage tests, and repair/replace needed pipes and meters through funds made available through the use of a replacement budget (implementation measures identified in the previous WMCP). The City has proposed benchmarks in Section 3, including adding meters, performing annual water audits, and increasing public education on water conservation which is intended to reduce unaccounted for water to below 10%.

2.11 ENVIRONMENTAL RESOURCE ISSUE OF CONCERN

The 2006 WMCP report outlined the list of species identified as candidate species and species of concern which are affected by the North Santiam River, including streamflow-dependent species. This list provided in the previous WMCP acknowledges the help of the U.S. Fish and Wildlife Service (USFWS). Using the USFWS Information for Planning and Consultation web tool, an area of approximately 15.5 square miles was delineated along the North Santiam River from just north of Stayton down to where the North Santiam River meets the Santiam River, as shown in Figure 2-2 below.

Figure 2-2: Area of Delineation Along N. Santiam River



Below is list of species which are found to be endangered in the delineated area.

Fish

- Bull trout (State listed Sensitive)
- Chinook Salmon (State listed Sensitive Critical)
- Steelhead – Winter/Coastal Rainbow Trout (State listed Sensitive)
- Coastal Cutthroat Salmon (State listed Sensitive)
- Oregon Chub (State listed Sensitive)
- Western Brook Lamprey (State listed Sensitive)
- Pacific Lamprey (State listed Sensitive)
- Columbia River Chum Salmon (Federally listed Threatened)
- Lower Columbia River Chinook Salmon (Federally listed Threatened)
- Lower Columbia River Coho Salmon (Federally listed Threatened)
- Lower Columbia River Steelhead (Federally listed Threatened)
- Upper Willamette River Chinook Salmon (Federally listed Threatened)
- Upper Willamette River Steelhead (Federally listed Threatened)

Birds

- Marbled Murrelet
- Northern Spotted Owl
- Streaked Horned Lark
- Yellow-billed Cuckoo

Insects

- Fender's Blue Butterfly

Flowering Plants

- Willamette Daisy
- Water Howellia
- Bradshaw's Desert-parsley
- Kincaid's Lupine
- Nelson's Checker-mallow

Additionally, the Native Fish Society (https://nativefishsociety.org/watersheds/north-santiam-river) has indicated that the Winter Steelhead and Spring Chinook fish are ESA-listed.

A fish screen was installed to isolate the plant from any fish species. The previous WMCP report indicated that the US Fish and Wildlife also approved the biological opinion completed for the fish screen project.

2.12 WATER QUALITY LIMITED SOURCES

The Environmental Protection Agency (EPA) produces a Watershed Quality Assessment Report (https://ofmpub.epa.gov/waters10/attains_state.control?p_state=OR&p_cycle=2006) which identifies impaired bodies of water within each watershed. According to the EPA, the North Santiam River contains portions which are listed as "Good" and other reaches that are listed as "Impaired". Causes of impairment include nutrients and temperature. There currently are no TMDL's available for either of these impairments along their respective river reaches. Table 2-11 provided below identifies the status of each portion of the Santiam River. The City's water source is the North Santiam River and therefore is not in a critical groundwater area. The City does operate a shallow alluvial aquifer well that is geographically located in limited groundwater areas but is not from the aquifer of concern.

Table 2-11: North Santiam River TMDL Status

Waterbody Name	Waterbody ID	Location	Size	Units	Status	Cause of Impairement	TMDL
North Santiam River: Mm 0-26.5	OR_1230064446868_0_26.5	North Santiam: 17090005	26.5	Miles	Impaired	Nutrients	Needed
North Santiam River: Mm 0-38.8	OR_1230064446868_0_38.8	North Santiam: 17090005	38.8	Miles	Impaired	Dissolved Oxygen, Temperature, water temperature	Needed
North Santiam River: Mm 0-45.3	OR_1230064446868_0_45.3	North Santiam: 17090005	45.3	Miles	Impaired	Temperature, Water Temperature	Needed
North Santiam River: Mm 0-64.2	OR_1230064446868_0_64.2	North Santiam: 17090005	64.2	Miles	Good		
North Santiam River: Mm 0-90.1	OR_1230064446868_0_90.1	North Santiam: 17090005	90.1	Miles	Good		
North Santiam River: Mm 26.5-47.9	OR_1230064446868_26.5_47.9	North Santiam: 17090005	21.4	Miles	Good		
North Santiam River: Mm 26.5-90.1	OR_1230064446868_26.5_90.1	North Santiam: 17090005	63.6	Miles	Good		
North Santiam River: Mm 45.3-90.1	OR_1230064446868_45.3_90.1	North Santiam: 17090005	44.8	Miles	Good		
North Santiam River: Mm 60.9-90.1	OR_1230064446868_60.9_90.1	North Santiam: 17090005	29.2	Miles	Good		

Figure 2-3: Location of 75 Well

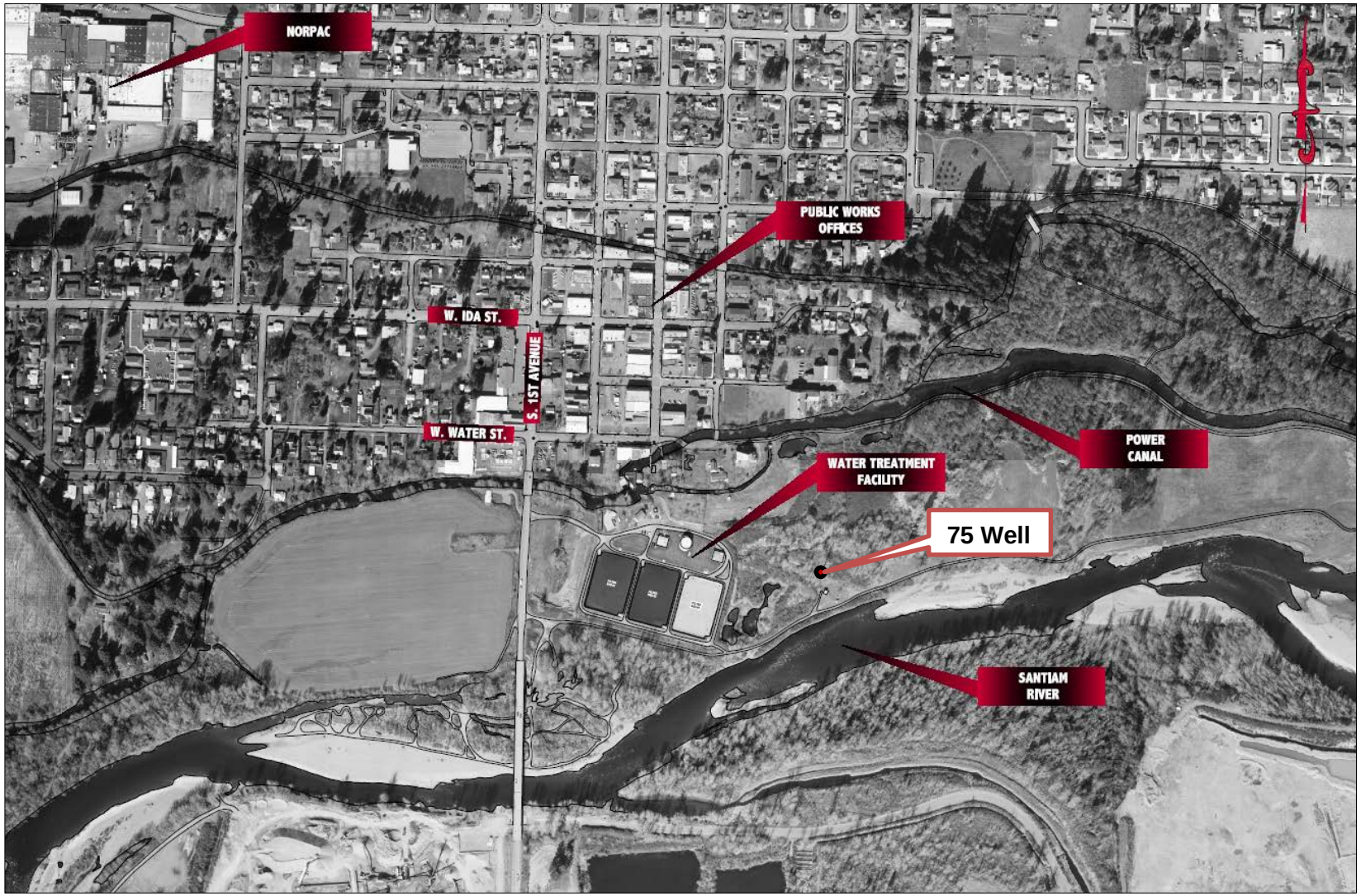
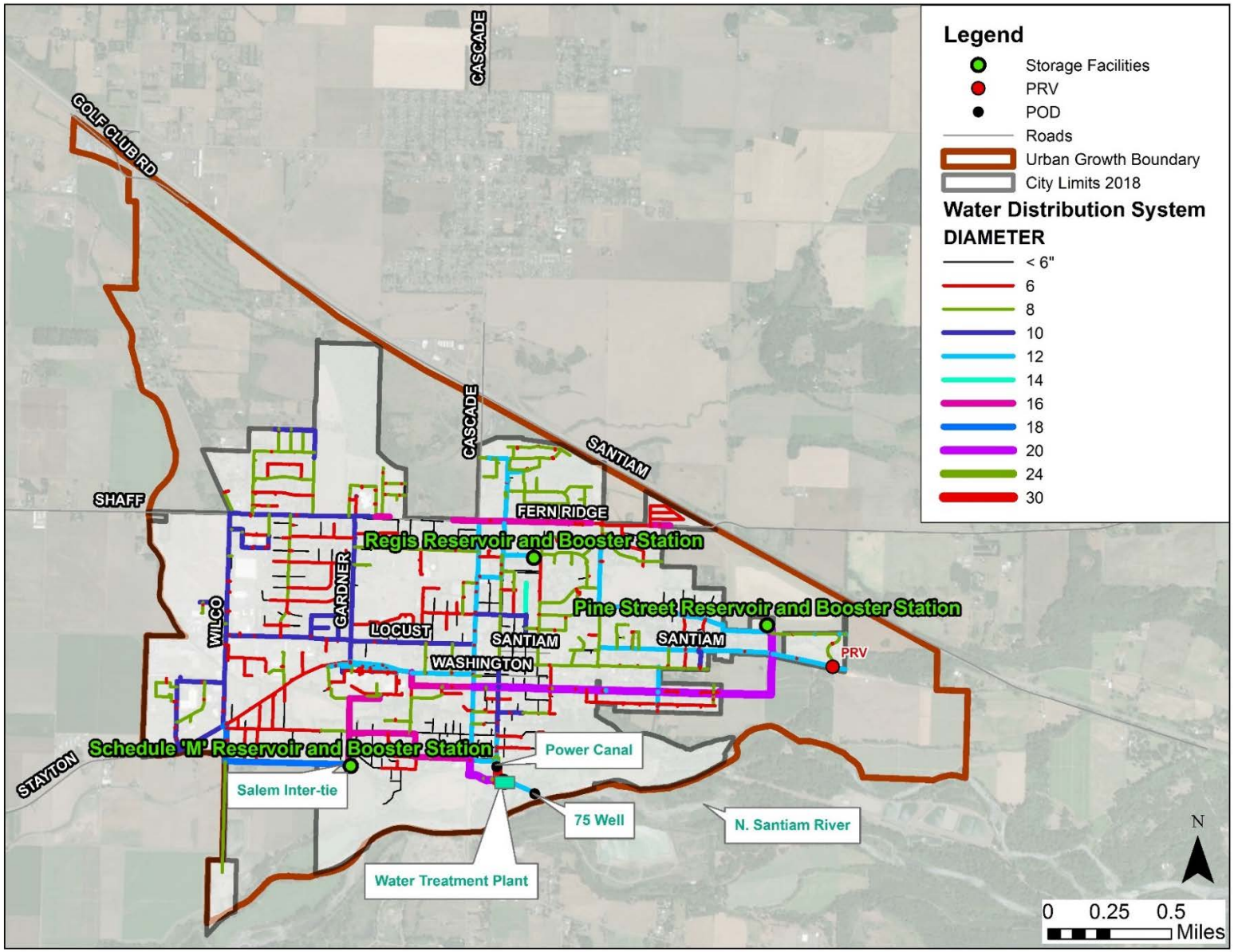


Figure 2-4: System Schematic



SECTION 3

WATER CONSERVATION ELEMENT

This section is written to address the requirements of OAR 690-086-0150. It provides a status report on conservation measures scheduled for implementation in the City's previously approved WMCP, describes the City's current water conservation program, and outlines the City's benchmarks for meeting required conservation measures not currently implemented, if any.

In 2006, the City of Stayton submitted a Water Management and Conservation Plan (WMCP) to the Oregon Water Resources Department (OWRD) describing, among other things, methods of water conservation which the City would plan to implement. Since that time, the City has been successful at improving their overall conservation efforts, and is in the process of planning, implementing and completing various benchmarks outlined in the previous WMCP as well as in this update.

From the previous WMCP submission, Stayton's population has grown to where the City must meet higher standards of water conservation outlined in OAR 690-086-1050. As the population continues to grow, the demand for water increases and new conservation methods must be established to ensure the future residents within the City have enough water. As a result, many of Stayton's newly established benchmarks, outlined later in this report, are associated with investigation and planning efforts to identify new ways to conserve water in a sustainable, cost-effective manner.

On the following pages, the City details its new conservation program per OAR 690-086 rules. For easy reference, organization of this section of this WMCP closely matches the organization of the new rules.

3.1 STATUS REPORT – SCHEDULE CONSERVATION MEASURES

In 2006, the City of Stayton set several water conservation benchmarks, which are outlined in the 2006 WMCP report. Table 3-1 summarizes those benchmarks and provides an update for each benchmark.

Table 3-1: 2006 Benchmarks Update

Benchmark	Description	Update
Meter Installation	Beginning January 2005, meter all connections within 5 years	The City needs six additional meters to have a fully metered City irrigation system; see Section 3.4.3.
Meter Testing	Beginning January 2005, test 200 (+,-) meters annually	The City tests meters larger than 3". Problematic residential meters are identified by the monthly billing reports.
Meter Replacement	Beginning January 2006, replace 160 meters every year (complete replacement in 20 years)	The City replaces approximately 150 to 160 meters annually.
Water Audit	Beginning January 2006, complete an annual water audit	The City was unable to complete water audits from 2006 to 2015. The City has made improvements including performing annual water audits for 2016 and 2017; the City is also in the process of developing spreadsheets to better track and store information for future water audits.
Leak Detection	Beginning January 2006, the City will perform leak detection on all ductile iron and steel pipes and perform a comprehensive study within the next five years	The City first completed a leak detection study between 2008 and 2009 which analyzed leaks throughout the entire town. Leak detection was completed again between 2015 and 2017.
Leak Repair	Beginning January 2006, the City will create an annual pipe replacement budget, which over the next 20+ years will allow the City to replace pipes	The City developed a pipeline replacement budget.
Public Education	Beginning January 2006, the City will increase public awareness of water conservation, including adding statements on bills, distributing flyers, and having flyers available at City Hall and Public Works buildings	The City produces a consumer confidence report. Occasionally the City includes a conservation reminder, typically in the summer.

3.2 WATER USE MEASUREMENT AND REPORTING PROGRAM

Stayton's water use reporting is done in compliance with OAR 690-085. The report is submitted annually by December 31st on the form provided by OWRD using the "Flow Meter Method" approved by the Department in OAR 690-085-0015 (5).

A flow meter at the water treatment plant records the finish water leaving the plant. Flow meters are also positioned on the intake side of the treatment plant as well as downstream from the discharge head of the 75 Well. The production water from the Power Canal is calculated by subtracting the 75 Well flow from the treatment plant influent flow. Flow monitors are read daily by City personnel. The City has observed that the water treatment plant influent flow meter varies in accuracy. Influent water in the transmission line only flows partially full, which may contribute to inaccurate measurements. The City also believes the influent flow meter itself is not accurate.

3.3 OTHER CURRENTLY IMPLEMENTED CONSERVATION MEASURES

The City has met the majority of the previously established benchmarks from the previous WMCP. The City's population increase has triggered the need to meet new WMCP requirements. The City has thus established several additional benchmarks to improve water conservation. These benchmarks are outlined below.

3.4 BASIC CONSERVATION MEASURES REQUIRED OF ALL SUPPLIERS

The conservation program described within the following subsections was developed by the City and accounts for the characteristics of historical demand patterns and customer demographics.

The City's available water rights currently meet annual average and peak period demands. However, the City recognizes the need to conserve water. To do so, the City is planning to undertake several new conservation actions over the next ten years. Details of those plans are outlined in the following subsections.

3.4.1 Annual Water Audit

Unaccounted for water in Stayton's distribution can occur from several sources, the most probable being inaccurate meters and leaky pipes. By performing annual water audits, the City will be able to track the results of pipeline improvements as well as identify future locations where improvements may be necessary to reduce leakage. The City currently is working on developing a spreadsheet to better help manage information collected for the water audit.

> ***Five-Year Benchmark:*** *The City will continue to perform annual water audits to more closely track water loss.*

3.4.2 System-Wide Metering

Currently, most of the City's connections include a water meter. There are also flow meters upstream and downstream of the treatment plant, at 75 Well, and at the inter-tie with Salem's distribution system. The City does not currently have meters on various public connections, such as City parks and other public facilities. The City desires to meter all unmetered connections to better account for system wide water use.

> ***Five-Year Benchmark:*** *By April 2023, the City will install water meters on all unmetered, active connections.*

3.4.3 Meter Testing and Maintenance

Meter testing and maintenance is currently performed every three years on meters greater than three inches. Testing includes using a hose bib meter and comparing the readings. Other meters are checked on an "as needed" basis. If the City determines that a meter is in need of repair, the City will replace the meter. The City feels this has been an effective way to manage the City's meters and will continue to practice this method of accounting and water conservation.

> ***Five-Year Benchmark:*** *The City will continue to test and maintain meters as described above.*

3.4.4 Water Rate Structure

The City currently charges residential users a base rate of $11.71 per dwelling unit, a meter equivalent charge of $6.79 for a ¾-inch meter or $17.01 for a 1-inch meter, a fire standby charge of $4.96 and a commodity charge of $1.15 per 1,000 gallons of water used. This equates to a total base rate of $23.46 per month plus $1.15 per 1,000 gallons.

Commercial and industrial water service charge is comprised of a base fee of $11.71, a meter equivalent charge based on meter size, a fire standby charge based on the square footage of the

building served by the meter, and a commodity charge of $1.15 per 1,000 gallons of water used. Below, Table 3-2 shows the breakdown in water utility cost for residential and commercial users.

Table 3-2: Current Billing Model

Meter Size	Charge	Meter Size	Charge	Sq Footage of Building	Charge
3/4"	$6.79	3"	$101.72	0-3,086 sq ft	$4.96
1"	$17.01	4"	$169.53	3087-12,345 sq ft	$20.47
1¼"	$25.42	6"	$338.97	12,346-27.777 sq ft	$133.10
1½"	$33.93	10"	$779.72	27,778-49,392 sq ft	$315.56
2"	$54.21			49,393 sq ft or larger	$616.35

The City currently meets the requirements outlined in OAR 690-086-0150(4)(d). However, because the City has increased in population since the previous WMCP was approved, the City is required to add a benchmark to address the new standard. This benchmark is described in Section 3.6.3.

3.4.5 Leak Detection

The leak detection plan outlined in the 2006 WMCP identified system losses to be at an average of 29%. Currently, the City experiences an average annual system loss of 11%. The City currently evaluates each half of the town every two years using acoustic technology. As leaks are identified, they are added to a worklist and systematically repaired/replaced.

> ***Five-Year Benchmark:*** *The City will continue to evaluate leaks every two years as described above.*

3.4.6 Public Education

The City recognizes its responsibility in the promotion of water conservation. The City has made brochures available at the Public Works building and has been involved with an Energy Trust program where water efficient shower heads were distributed to the public. Additionally, the City desires to establish a public education plan to better promote water conservation.

> ***Five-Year Benchmark:*** *The City will work to establish a public education program by April 2023.*

3.5 LEAK REPAIR / LINE REPLACEMENT PROGRAM

The City evaluates half of the town's water system using acoustic technology every two years to identify leaks. As leaks are identified, patching techniques are implemented. If patching doesn't fix the leak, then the City replaces the line. For leaks on metered residential services, the City sends a notification to the affected resident, who then becomes responsible for the improvement. The City also targets the replacement of existing AC and steel pipe. To date, approximately 8,270 feet of AC pipe and about 17,500 feet of steel pipe have been replaced since the previous WMCP report. The City has established a waterline replacement program, including a budget from which funds are used for improvements.

> ***Five-Year Benchmark:*** *The City will continue to carry out the existing program repairing leaks and replacing older problematic piping and services.*

3.6 ENHANCED CONSERVATION MEASURES

The City has recently increased in population to approximately 7,770, which requires the City to establish benchmarks for technical and financial assistance programs, programs which promote the retrofit or replacement of inefficient water fixtures, updating rate structure and billing practices, and evaluating reuse and recycling and non-potable opportunities. As this is the first time the City has been required to meet these additional requirements, many of the benchmarks proposed below are planning related in nature, with the goal of having a plan prepared within the next five years. The additional areas requiring benchmarks are included below.

3.6.1 TECHNICAL AND FINANCIAL ASSISTANCE PROGRAMS

The criteria outlined under OAR 690-085-0150(6) states that the City is required to evaluate and consider implementing a program to offer technical and financial assistance to encourage and aid its residential, commercial, and industrial customers in implementation of conservation measures. The City has discussed rebate and cost sharing programs as well as training programs and concluded that there are not enough financial resources to support these programs. However, after discussion, the City has elected to develop a brochure that provides technical information on water saving methods, which can be made available at public events and in public buildings.

> ***Five-Year Benchmark:*** *The City will develop a brochure which contains technical information on water saving methods by April 2023.*

3.6.2 RETROFIT / REPLACEMENT OF INEFFICIENT FIXTURES

The City has reviewed recommendations for developing a retrofit/replacement program as described under OAR 690-086-510(6)(c). The City currently replaces old fixtures in city buildings with new water-efficient fixtures on an “as needed” basis. The City has elected to adopt this methodology into their benchmark.

> ***Five-Year Benchmark:*** *The City will continue to replace old/inefficient fixtures in City buildings on an “as needed” basis with more efficient fixtures.*

3.6.3 RATE STRUCTURE / BILLING PRACTICES FOR CONSERVATION

The City recognizes there are additional requirements related to rate structure set forth in OAR 690-086-0150(6)(d). The City has reviewed suggested alternative rate structures which meet the new requirements set forth to encourage users to conserve more water. The City desires to investigate changing their billing structure to an inclining block rate structure, where the cost of water increases as usage increases.

> ***Five-Year Benchmark:*** *The City staff will work with the City Council to look at changing the existing billing structure to the inclining block rate structure. City staff will propose an inclining block rate structure or similar rate structure to the City Council for consent before April 2023.*

3.6.4 REUSE, RECYCLING, NON-POTABLE OPPORTUNITIES

The requirements in OAR 690-086-0150(6)(e) state that water suppliers are to evaluate and consider implementing programs to make use of water reuse, water recycling, and non-potable water opportunities. The City will soon be undergoing a wastewater masterplan update, which the City anticipates will include an evaluation of reuse, recycling, and non-potable opportunities. The City desires to evaluate the results and recommendations outlined in the master plan update, and then decide which recommendations will work best based on City financial resources and manpower.

> ***Five-Year Benchmark:*** *The City will review the results and recommendations for reuse, recycling, and non-potable opportunities outlined in the wastewater masterplan update before April 2023. The City will make a plan according to financial resources and available manpower to carry out the recommendations.*

3.6.5 OTHER PROPOSED CONSERVATION MEASURES

The City does not have any additional conservation methods to propose at this time.

3.7 SUMMARY OF 5-YEAR BENCHMARKS

A summary of the relevant benchmarks for the City's ongoing and planned conservation activities are outlined in Table 3-3.

Table 3-3: 5-Year Conservation Benchmarks

Benchmark	Date	Frequency
Annual Water Audits	April 2023	Annually
Fully Metered System	April 2023	N/A
Meter Testing and Maintenance	---	Ongoing
Propose New Rate Structure	April 2023	N/A
Leak Detection	---	Ongoing (2 years)
Public Education Program	April 2023	N/A
Leak Repair/Line Replacement	---	Ongoing
Technical Brochure	April 2023	N/A
Replacement of Inefficient Fixtures	---	Ongoing
Reuse, Recycling, Non-Potable Eval.	April 2023	N/A

SECTION 4
WATER CURTAILMENT PLAN ELEMENT

This section is written to address the requirements of OAR 690-086-0160. It provides a description of past supply deficiencies and current capacity limitation. It also outlines the City's water curtailment plan that identifies the different stages of alert along with the associated triggers and water curtailment actions for each alert stage.

The City of Stayton's water supply originates from the North Santiam River. Because this source is surface water, it is more susceptible to seasonal fluctuations, turbidity problems, and contamination. The water system is susceptible to mechanical and electrical failures at the water treatment plant or in the distribution system. In addition, all water systems can be potentially negatively impacted by natural disasters.

The previous WMCP outlined a water curtailment plan which was accepted and approved by OWRD. In 2018, the City re-evaluated the outlined curtailment procedures of the plan during historical water shortages since the plan's adoption. The City was pleased with the plan and has elected to continue to implement its outlined procedures as necessary. Details of the plan are provided in following sections.

4.1 HISTORY OF PAST SYSTEM CURTAILMENT EVENTS

The City has experienced water shortages in the past due to fluctuations in climate, maintenance, and contamination. Below are examples of when water shortages occurred. Out of each of these events, only once did the City impose water curtailment. Below is a more detailed explanation of water shortages in Stayton.

The City of Stayton experienced a two-year drought, which is said to reoccur approximately every 10 years. During the drought period, levels in the North Santiam River dropped below normal depths causing the City to self-impose a curtailment on watering at public parks. The City also made efforts to inform the residents and businesses to be mindful of their water consumption. However, no other curtailments were imposed. Production data from the treatment plant ultimately suggests that water usage behavior did not change dramatically as a result of the drought.

Another cause of temporary water shortage is annual maintenance work on the Power Canal, lasting approximately 3 to 5 days. During the maintenance, the City relies on the 75 Well and on the water they receive from the Salem inter-tie, estimated at approximately 5.5 MG to 9.0 MG. No water curtailment has been implemented while the maintenance has been performed.

In December of last year, a truck spill occurred upstream from the City's point of diversion, an event which is estimated by City officials to occur once every five to seven years. During this event, the City stopped treating water from the Power Canal and used water from the 75 Well, existing storage, and the Salem inter-tie until it was certain that the City's point of diversion from the Santiam River had not been contaminated. During this time, no water curtailment orders were issued.

In each of these events, water was shut off from the source while existing storage in the City's storage tanks was used along with water from the Salem inter-tie or the 75 Well. While the City is looking for a secondary source of water, such as a deep well to supply water, the aforementioned methods to supply water have worked and will continue to be implemented in the future.

4.2 STAGES OF ALERT FOR WATER CURTAILMENT

The City's curtailment plan is comprised of four stages of alert: Mild, Moderate, Critical, and Emergency. Each state of alert is outlined in detail in Table 4-1.

4.3 TRIGGERS FOR WATER CURTAILMENT

Each of the City's four stages of alert is triggered by a pre-determined level of severity of water shortage, which is based upon the amount of water being pumped from the Santiam River and shallow well as compared to the capacity of the system. The trigger for each stage of alert is described in Table 4-1 below.

4.4 WATER CURTAILMENT ACTIONS

The specific water curtailment measures that will be implemented under each stage of alert upon enactment of the water curtailment plan are outlined in Table 4-1 below.

Table 4-1: Water Curtailment Plan

Stage	Trigger	Goal	Curtailment Measures
Mild	Determination made by the public works director that a potential for a water shortage exists	Public awareness and 5% reduction in consumption	• Activate Curtailment Plan • Public education (via flyer distribution, media, city water bill, city website) • Voluntary irrigation schedule based on house numbers
Moderate	Determination made by the public works director that water shortage exists	10% reduction in consumption	• Continue with “Mild” stage measures except where noted below • Transition of irrigation schedule from voluntary to mandatory • Eliminate line flushing and City parks irrigation • Request businesses to reduce consumption by 10%
Critical	Determination made by the public works director that there is a critical water supply shortage that threatens the City’s ability to deliver water supplies	15% reduction in consumption	• Continue with “Moderate” stage measures except where noted below • Restrict use of water in pools • Restrict outdoor irrigation with City water • Ban washing vehicles with City water • Encourage a reduction in industrial water use
Emergency	Water plant failure resulting in loss of production capacity	50% reduction in consumption	• Prohibit all irrigation • Impose industrial restrictions

SECTION 5
MUNICIPAL WATER SUPPLY ELEMENT

This section is written to address requirements of OAR 690-086-0170 and OAR 690-086-0130(7). It provides a description of the City's current and future service area and population projections. It details the City's projected 10 and 20 year demands for water and identifies when the City expects to fully exercise its water rights. This section also compares the City's projected water needs against their existing available sources of supply, analyzes potential alternative water sources, and describes required mitigation actions.

5.1 DELINEATION OF CURRENT / FUTURE WATER SERVICE AREAS

Based on City records, the primary land uses within the City's current service area are residential, public, industrial, commercial, and downtown. Table 5-1 summarizes the total area for each land use category.

Table 5-1: City Land Use Summary

Zoning District	Acreage	% of Total
Downtown		
Central Core Mixed Use	8.29	0.42%
Downtown Commercial Mixed Use	4.70	0.24%
Downtown Medium Density Residential	7.34	0.38%
Downtown Residential Mixed Use	22.31	1.14%
Subtotal	42.63	2.18%
Residential		
Low Density	701.04	35.92%
Medium Density	215.13	11.02%
High Density	43.33	2.22%
Subtotal	959.50	49.16%
Commercial		
Commercial General	74.98	3.84%
Commerce Park	2.46	0.13%
Commercial Retail	34.02	1.74%
Interchange Development	8.07	0.41%
Subtotal	119.53	6.12%
Industrial		
Industrial/Agricultural	67.00	3.43%
Industrial Commercial	14.93	0.76%
Light Industrial	320.28	16.41%
Subtotal	402.21	20.61%
Public		
Public/Semi Public	428.01	21.93%
Subtotal	428.01	21.93%
Total	1,951.88	100.00%

It is anticipated that the City's major land use will continue to be residential. The City's long-term growth should not significantly affect the current distribution of land use, and as such, each customer class should continue to exhibit the same share of the City's total water consumption.

The City's water service area boundaries coincide with those of its City limits. The City anticipates that no growth will occur outside the city limits given the slow rate of growth. If growth were to drastically increase, the City has identified approximately 1,160 acres outside the City's limits for growth within the urban growth boundary (UGB). However, the City does not anticipate any expansion beyond the existing boundaries (see Figure 2-4).

5.2 POPULATION PROJECTIONS / ANTICIPATED DEVELOPMENT

The City's present (2017) population is estimated at 7,770. The planning rate selected by the City for population forecasting comes from the Marion County Coordinated Population Forecast, produced by Portland State University. The report estimates Stayton's population growth to increase at a rate of 0.8% from 2017 until 2035 and then at 0.7% from 2035 through 2067. Stayton's growth rate corresponds with the overall trend in Marion County's population through 2067. Table 5-2 presents historical and forecasted population in Stayton.

Table 5-2: 20-Year Population Projection

Population Projections	
Year	**Population**
2010	7,644
2011	7,660
2012	7,660
2013	7,685
2014	7,700
2015	7,725
2016	7,745
2017	7,770
2027	8,833
2037	9,567

5.3 SCHEDULE FOR FULLY EXERCISING WATER USE PERMITS

The City currently operates under nine water rights – two of which are not certified. In order to solidify these permitted rights, the City must be able to show beneficial use for each permit; however, the City does not expect to prove beneficial use within the next 20 years. The 20-year projected maximum day demand is about 6,414 gpm, and the combined water right permits allow for approximately 10,444 gpm.

5.4 DEMAND FORECAST

Future water demands are calculated by comparing the last five years of water production data and population (2013-2017) and identifying the maximum day per capita demand for each month to establish a monthly per capita demand projection. The future demands are summarized in Table 5-3. Maximum day values are used to forecast demands because this is the planning criteria used for planning water projects. Using the maximum day for each month also allows the City to verify they have adequate water rights to meet the maximum demands on a monthly basis, as some of the City's water rights have seasonal use restrictions.

Table 5-3: Historical and Projected Demands by Month

	Max Daily GPM By Month							Projected GPM		
	2013	2014	2015	2016	2017	Max Day	Max GPM (Design)	2017*	2027 **	2037 **
Annual Population	7,685	7,700	7,725	7,745	7,770			7,770	8,833	9,567
January	2,054,000	2,090,000	2,575,000	2,613,000	2,387,000	2,613,000	1,815	1,658	2,070	2,241
February	2,243,000	2,236,000	2,309,000	2,381,000	2,049,000	2,381,000	1,653	1,423	1,886	2,042
March	2,507,000	1,554,000	1,866,000	1,797,000	2,384,000	2,507,000	1,741	1,656	2,001	2,167
April	2,512,000	2,321,000	2,418,000	1,914,000	3,799,000	3,799,000	2,638	2,638	2,999	3,248
May	3,013,000	2,564,000	3,320,000	3,065,000	2,638,000	3,320,000	2,306	1,832	2,636	2,855
June	3,746,000	3,148,000	3,272,000	3,064,000	3,319,000	3,746,000	2,601	2,305	2,990	3,238
July	7,419,000	6,371,000	6,557,000	6,524,000	6,202,000	7,419,000	5,152	4,307	5,922	**6,414**
August	6,058,000	6,548,000	6,334,000	6,266,000	6,581,000	6,581,000	4,570	4,570	5,196	5,627
Sepetember	6,026,000	6,284,000	6,621,000	5,906,000	5,813,000	6,621,000	4,598	4,037	5,258	5,694
October	5,117,000	5,531,000	4,777,000	4,681,000	3,334,000	5,531,000	3,841	2,315	4,406	4,772
November	2,809,000	2,857,000	2,511,000	2,670,000	2,472,000	2,857,000	1,984	1,717	2,276	2,465
December	2,047,000	2,211,000	2,224,000	2,765,000	2,547,000	2,765,000	1,920	1,769	2,190	2,372

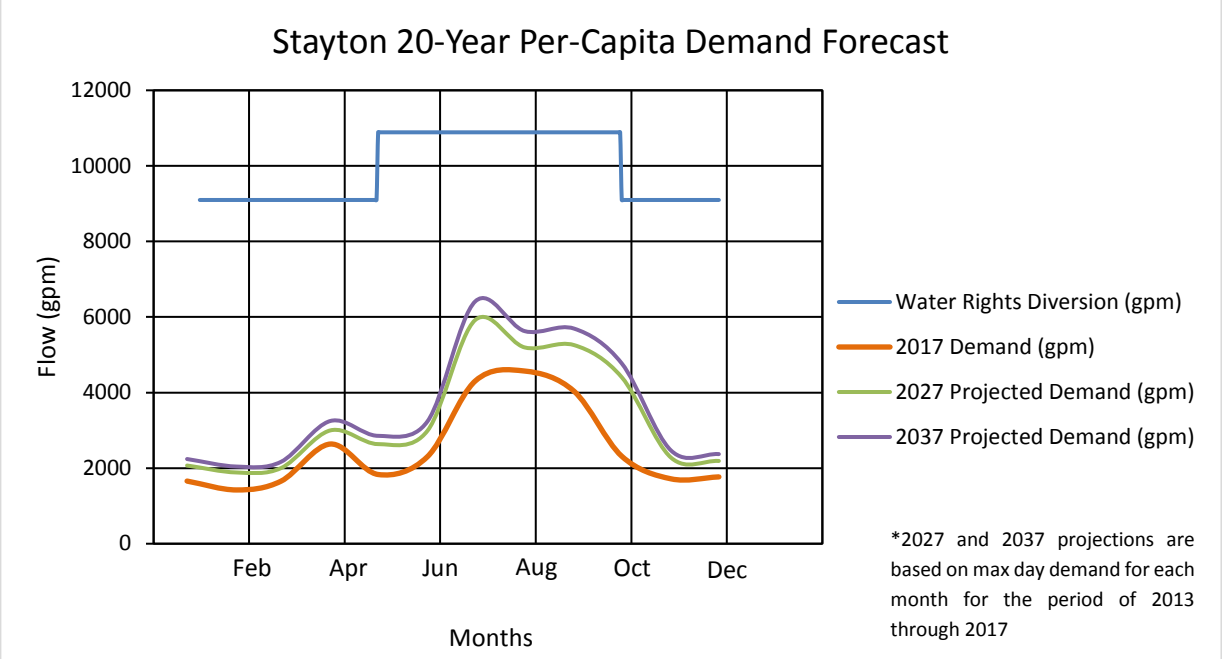
* Values based on maximum day demands for each month in 2017

** Values based on maximum day demand for each month from 2013 to 2017

5.5 COMPARISON OF PROJECTED NEED TO AVAILABLE SOURCES

The Power Canal intake has an estimated capacity of 7,000 gpm based on operations experience (see the 2006 Stayton Water Master Plan, Appendix B). The collector well (75 Well) previously had an estimated capacity of 800-1,200 gpm. However, within the last few years the City has seen the capacity of the 75 Well decline to approximately 410 gpm. The City's water rights sum to a total diversion of 10,444 gpm year-round, with an additional 1,791 gpm (limited to 1,088.6 AF) during the summer. The 11,221 gpm (25 cfs) wintertime diversion under Permit S-52477 is not currently authorized. Figure 5-1 below shows the sum of the current authorized diversion rates throughout the year.

Figure 5-1: Forecasted Water Rights Diversion and Demand



The City has enough available water rights (10.99 cfs) to support demands for the next 20 years. However, the treatment plant is only rated for 7.1 MGD. As such, the City will need to evaluate and provide upgrades to the plant, such as the discharge pumps which limit the plant's production capacity.

Table 5-4 below lists the quantity of water allowed from each of the City's water sources. It also identifies the current reliable production capacity and limiting factors (if any) for each of those sources.

Table 5-4: Water Supply Capacity Per Water Right

Source	Certificate No.	Permit No.	Permitted Quantity (cfs)	Available Reliable Supply Capacity (cfs)	Limiting Factors
N. Santiam River	80346	E-82	2.78	2.78	Potential low river levels; high turbidity
N. Santiam River	80347	S-1401	0.82	0.82	Potential low river levels; high turbidity
N. Santiam River	80348		0.39	0.39	Potential low river levels; high turbidity
N. Santiam River	80349		0.6	0.6	Potential low river levels; high turbidity
N. Santiam River		S-12033	10	10	Potential low river levels; high turbidity; treatment plant capacity
N. Santiam River	57094	S-29266	7	7	Potential low river levels; high turbidity
N. Santiam River		S-52477	25	0*	Potential low river levels; high turbidity; treatment plant capacity
Inf. Trench (75 Well)		Gr-139	2.67	1.33**	Observed low well levels
Well 2	24587	Gr-173	3	0.00	Well 2 is offline
	Total Available Supply Capacity:			**10.99 cfs *****	

* Permit S-52477 is not authorized.
** Maximum diversion rate based on 2016-2017 daily production data from the 75 Well.
***The water treatment plant capacity limits total summertime water rights diversion (year-round diversion plus summertime diversion) to 10.99 cfs. The sum of the year-round water rights diversion rate is also limited to 10.99 cfs due to treatment plant capacity.

5.6 ALTERNATIVE SOURCES

In 2014, the City investigated the feasibility of constructing a new infiltration gallery near the 75 Well. A draft technical memo by GSI discussing details of the investigation is found in Appendix B. The results of the evaluation suggest the shallow aquifer in the vicinity of the existing 75 Well has capacity to support a 1,000 gpm infiltration gallery system.

While this option provides the City with additional water supply, the supply itself is supported by infiltration from the N. Santiam River. The City desires to diversify their water sources to ensure adequate supply in the event of drought or contamination; the N. Santiam River is susceptible to both of

the aforementioned conditions. Thus, the City is in discussions regarding the development of a deep groundwater well.

5.6.1 Conservation Measures

The City has implemented and will continue to put in place water conservation measures as outlined in Section 3. Water savings associated with the benchmarks outlined in this WMCP will help the City more effectively manage water resources and maintain water distribution infrastructure.

5.6.2 Interconnection / Regional Water Management

The City currently has an emergency inter-tie with the City of Salem, which it has used during water shortages. This inter-tie is made possible in part by the close proximity of Salem's point of diversion on the N. Santiam River, just upstream from the City's point of diversion. The inter-tie is located at the Schedule "M" storage and booster tank facility owned by the City. To connect to the next nearest city, Sublimity, the City would need at a minimum about ¾ mile of pipeline and would cross a canal, a highway, and a waterway. This is not a feasible option for the City at this time due to high construction costs. In the event that an inter-tie with Sublimity were further explored at a later date, the City would want to look closely at inter-tie complexity – mixing Sublimity's groundwater source with Stayton's surface water source could introduce water chemistry challenges, and different system operating pressures could necessitate a PRV to serve Stayton and a booster facility if Stayton's water were to be transferred to Sublimity.

5.6.3 Cost-Effectiveness

The City currently has winter water rights to supply the 20-year forecasted demand. The City currently supplies water to Norpac, who in 2006 was recorded as consuming over 40% of the total water consumed. In the event that another large industrial user should move to Stayton, assuming the City expands the existing treatment plant, the City would have more flexibility to provide for the increased demands using Permit S-52447. While the City has been and continues to implement water conservation techniques, the water saved by these techniques would not be enough to offset the increased demands. Therefore, extending Permit S-52447 continues to be in the City's long-term interest.

5.7 QUANTIFICATION OF MAXIMUM RATE AND MONTHLY VOLUME

As previously mentioned, the City is seeking an extension on its existing Permit S-52447. The maximum rate of this permit is 25 cfs. The current diversion rate with the capacity limitations at the treatment plant is 10.99 cfs which corresponds to a monthly volume of 220 MG, assuming 24-hour production for 31 days.

5.8 MITIGATION ACTIONS UNDER STATE AND FEDERAL LAW

The City is not currently required to take any mitigation actions under state or federal law related to Permit S-52447. The City is required, however, to have an approved, updated WMCP.

5.9 ACQUISITION OF NEW WATER RIGHTS

This rule requirement does not apply. The City does not anticipate needing to acquire new water rights within the next 20 years in order to meet its projected demands for water.

5.10 INCREASED DIVERSION OF WATER UNDER EXTENDED PERMITS

This rule requirement does not apply. The City does not anticipate needing to divert water under an extended permit at a maximum rate of diversion that is greater than the maximum rate of diversion authorized under the extension.

APPENDIX A

Letters and Comments

KELLER ASSOCIATES

Jake Nelson

From: Peter Olsen
Sent: Wednesday, March 21, 2018 3:14 PM
To: 'dbarnes@cityofsalem.net'
Cc: Lance S. Ludwick, PE (lludwick@ci.stayton.or.us)
Subject: Stayton Water Management and Conservation Plan

Mr. Barnes,

The City of Stayton was required to update their previous Water Management and Conservation Plan (WMCP) as a condition of a water right extension. One of the requirements of a WMCP is that the plan is made available for general comment to affected local governments. In addition, the affected local governments should be given the opportunity to comment concerning the consistency with the local government's comprehensive land use plan. We have identified the City of Salem as an affected local government, and request that you provide comments to the WMCP within the next 30 days. Following the comment period, the plan will be finalized and submitted to Oregon Water Resources Department.

The WMCP will be available on the City's website (http://www.staytonoregon.gov/).

Regards,

KELLER ASSOCIATES

PETER OLSEN, PE
Project Manager
OFFICE 503-364-2002 | CELL 503-910-2421
707 13TH Street SE, Suite 280, Salem, OR 97301
kellerassociates.com

Jake Nelson

From: Peter Olsen
Sent: Wednesday, March 21, 2018 3:14 PM
To: 'alan.frost@cityofsublimity.org'
Cc: Lance S. Ludwick, PE (lludwick@ci.stayton.or.us)
Subject: Stayton Water Management and Conservation Plan

Mr. Frost,

The City of Stayton was required to update their previous Water Management and Conservation Plan (WMCP) as a condition of a water right extension. One of the requirements of a WMCP is that the plan is made available for general comment to affected local governments. In addition, the affected local governments should be given the opportunity to comment concerning the consistency with the local government's comprehensive land use plan. We have identified the City of Sublimity as an affected local government, and request that you provide comments to the WMCP within the next 30 days. Following the comment period, the plan will be finalized and submitted to Oregon Water Resources Department.

The WMCP will be available on the City's website (http://www.staytonoregon.gov/).

Regards,

KELLER ASSOCIATES

PETER OLSEN, PE
Project Manager
OFFICE 503-364-2002 | CELL 503-910-2421
707 13TH Street SE, Suite 280, Salem, OR 97301
kellerassociates.com

Jake Nelson

From: Peter Olsen
Sent: Wednesday, March 21, 2018 3:14 PM
To: 'breich@co.marion.or.us'
Cc: Lance S. Ludwick, PE (lludwick@ci.stayton.or.us)
Subject: Stayton Water Management and Conservation Plan

Mr. Reich,

The City of Stayton was required to update their previous Water Management and Conservation Plan (WMCP) as a condition of a water right extension. One of the requirements of a WMCP is that the plan is made available for general comment to affected local governments. In addition, the affected local governments should be given the opportunity to comment concerning the consistency with the local government's comprehensive land use plan. We have identified Marion County as an affected local government, and request that you provide comments to the WMCP within the next 30 days. Following the comment period, the plan will be finalized and submitted to Oregon Water Resources Department.

The WMCP will be available on the City's website (http://www.staytonoregon.gov/).

Regards,

KELLER ASSOCIATES

PETER OLSEN, PE
Project Manager
OFFICE 503-364-2002 | CELL 503-910-2421
707 13TH Street SE, Suite 280, Salem, OR 97301
kellerassociates.com

Jake Nelson

From: Peter Olsen
Sent: Wednesday, March 21, 2018 3:14 PM
To: 'brents@santiamwater.com'
Cc: Lance S. Ludwick, PE (lludwick@ci.stayton.or.us)
Subject: Stayton Water Management and Conservation Plan

Mr. Stevenson,

The City of Stayton was required to update their previous Water Management and Conservation Plan (WMCP) as a condition of a water right extension. One of the requirements of a WMCP is that the plan is made available for general comment to affected local governments. In addition, the affected local governments should be given the opportunity to comment concerning the consistency with the local government's comprehensive land use plan. We have identified the Santiam Water Control District as an affected local government, and request that you provide comments to the WMCP within the next 30 days. Following the comment period, the plan will be finalized and submitted to Oregon Water Resources Department.

The WMCP will be available on the City's website (http://www.staytonoregon.gov/).

Regards,

KELLER ASSOCIATES

PETER OLSEN, PE
Project Manager
OFFICE 503-364-2002 | CELL 503-910-2421
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Marion County
OREGON

PUBLIC WORKS

March 23, 2018

Lance Ludwick, P.E.
City of Stayton Public Works Director
Via email to: lludwick@co.stayton.or.us

Dear Mr. Ludwick:

Thank you for providing a draft copy of the Water Management and Conservation Plan for the City of Stayton. As was pointed out, Oregon Administrative Rule Chapter 690, Division 86 requires that affected local governments be provided an opportunity to review the plan for consistency with their local comprehensive land use plan prior to the city submitting a draft plan to the Oregon Water Resources Department for review.

The Marion County Comprehensive Plan (MCCP) Urbanization Element, Environmental Goals encourage planning that does not exceed the capacity of water, energy, air and other resources. In addition, the MCCP Environmental Quality and Natural Resources Element, Goal C strives for the provision of an adequate quantity of water for beneficial uses within the county, including water for domestic, municipal, industrial, commercial and recreation uses. Goal D emphasizes the significance of educating property owners about the importance of the use of their property for water quality and quantity and encourages water conservation practices to hold water demand to a minimum through a public information program.

The Water Management and Conservation Plan for the City of Stayton is consistent with the Marion County Comprehensive Plan, as both plans recognize water to be a significant resource, encourage the provision of adequate water for residents' use, and support conservation practices when necessary.

Please do not hesitate to contact me if you have any questions.

Sincerely,

Brandon Reich
Senior Planner

Jake Nelson

From: Dwayne Barnes <DBarnes@cityofsalem.net>
Sent: Thursday, April 19, 2018 9:00 AM
To: Jake Nelson
Cc: Peter Olsen
Subject: RE: Stayton WMCP follow-up

I sent the document out to staff the day I received it, and have not received and comments. So, it appears we have no comments. Thanks for giving us the opportunity to review the plan.

Thanks,

-Dwayne | 503-588-6483

From: Jake Nelson [mailto:jnelson@Kellerassociates.com]
Sent: Wednesday, April 18, 2018 11:55 AM
To: Dwayne Barnes <DBarnes@cityofsalem.net>
Cc: Peter Olsen <polsen@Kellerassociates.com>
Subject: Stayton WMCP follow-up

Mr. Barnes,

I called and left a voice message for you earlier today regarding an email that you should have received on March 21st about the City of Stayton's Water Management and Conservation Plan (WMCP) update. The purpose of this email is to verify you have received that email and are aware that the comment period closes on Saturday April 21st . Following the comment period, the WMCP will be finalized and submitted to Oregon Water Resources Department. Any questions or comments can be directed to Peter Olsen at polsen@kellerassociates.com.

Thank you,

KELLER ASSOCIATES

JAKE NELSON, EI
Project Engineer
DIRECT 208-813-7582 | CELL 801-857-7222 | OFFICE 208-288-1992
131 SW 5th Ave, Suite A, Meridian, ID 83642
kellerassociates.com

APPENDIX B

Reports

KELLER ASSOCIATES

Coordinated Population Forecast

2017

Through

2067

Marion County

Urban Growth Boundaries (UGB) & Area Outside UGBs

Population Research Center
PORTLAND STATE UNIVERSITY

Photo Credit: Daffodils and cherry blossoms in front of the Oregon State Capitol in Salem (Photo No. marDA0019a). Gary Halvorson, Oregon State Archives http://arcweb.sos.state.or.us/pages/records/local/county/scenic/marion/154.html

Coordinated Population Forecast for Marion County, its Urban Growth Boundaries (UGB), and Area Outside UGBs 2017-2067

Prepared by

Population Research Center

College of Urban and Public Affairs

Portland State University

June 30, 2017

This project is funded by the State of Oregon through the Department of Land Conservation and Development (DLCD). The contents of this document do not necessarily reflect the views or policies of the State of Oregon.

Project Staff:

Jason R. Jurjevich, PhD. Assistant Director, Population Research Center & Acting Program Manager

Nicholas Chun, Population Forecast Program Analyst

Kevin Rancik, GIS & Research Analyst

Risa S. Proehl, Population Estimates Program Manager

Julia Michel, Graduate Research Assistant

Matt Harada, Undergraduate Research Assistant

Charles Rynerson, Census State Data Center Coordinator

Randy Morris, Research Analyst

The Population Research Center and project staff wish to acknowledge and express gratitude for support from the Forecast Advisory Committee (DLCD), the hard work of our staff Deborah Loftus and Emily Renfrow, data reviewers, and many people who contributed to the development of these forecasts by answering questions, lending insight, providing data, or giving feedback.

How to Read this Report

This report should be read with reference to the documents listed below—downloadable on the Forecast Program website (http://www.pdx.edu/prc/opfp).

Specifically, the reader should refer to the following documents:

- *Methods and Data for Developing Coordinated Population Forecasts*—Provides a detailed description and discussion of the forecast methods employed. This document also describes the assumptions that feed into these methods and determine the forecast output.
- *Forecast Tables*—Provides complete tables of population forecast numbers by county and all sub-areas within each county for each five-year interval of the forecast period (2017-2067).

Table of Contents

Table of Figures

Executive Summary

Historical

Different parts of the county experience differing growth patterns. Local trends within the UGBs and the area outside them collectively influence population growth rates for the county as a whole.

Marion County's total population has grown steadily since 2000, with an average annual growth rate of one percent between 2000 and 2010 (Figure 1). However, some of its sub-areas experienced more rapid population growth while others experienced opposite trends during the 2000s. Donald and Turner posted the highest average annual growth rates at 4.9 and 4.4 percent, respectively, during the 2000 to 2010 period. Concurrently, the Marion portions of Idanha and Lyons both experienced negative average annual growth rates at -6.3 and -6.2 percent, respectively.

Marion County's positive population growth in the 2000s was largely the result of substantial net in-migration. Meanwhile, an aging population not only led to an increase in deaths but also resulted in a smaller proportion of women in their childbearing years. This, along with more women choosing to have fewer children and having them at older ages has led to fewer births in recent years. The larger number of births relative to deaths caused a natural increase (more births than deaths) in every year from 2000 to 2015. While natural increase outweighed net in-migration for the majority of the 2000s, net in-migration largely increased in 2014 and 2015 and, in the latter year, outpaced natural increase (Figure 12).

Forecast

Total population in Marion County as a whole and in its sub-areas will likely grow at a slightly faster pace in the near-term (2017 to 2035) compared to the long-term (**Figure 1**). The tapering of growth rates is largely driven by an aging population—a demographic trend which is expected to contribute to a diminishing natural increase (more births than deaths). As natural increase lessens occurs, population growth will become increasingly reliant on net in-migration.

Even so, Marion County's total population is forecast to increase by more than 67,000 over the next 18 years (2017-2035) and by more than 175,000 over the entire 50 year forecast period (2017-2067). Sub-areas that showed stronger population growth in the 2000s are generally expected to experience slower rates of population growth during the forecast period, while sub-areas that experienced negative growth rates are expected to experience very slight positive growth rates with the exception of Lyons.

Figure 1. Marion County and Sub-Areas—Historical and Forecast Populations, and Average Annual Growth Rates (AAGR)

	Historical			Forecast				
	2000	2010	AAGR (2000-2010)	2017	2035	2067	AAGR (2017-2035)	AAGR (2035-2067)
Marion County	*284,834*	*315,335*	*1.0%*	*337,773*	*405,352*	*513,142*	*1.0%*	*0.7%*
Aumsville UGB	3,083	3,643	1.7%	4,209	6,141	7,658	2.1%	0.7%
Aurora UGB	724	981	3.1%	1,028	1,321	1,622	1.4%	0.6%
Detroit UGB	262	202	-2.6%	216	227	237	0.3%	0.1%
Donald UGB	608	979	4.9%	994	1,555	2,150	2.5%	1.0%
Gates UGB (Marion)	429	432	0.1%	435	462	489	0.3%	0.2%
Gervais UGB	2,058	2,483	1.9%	2,657	3,346	3,850	1.3%	0.4%
Hubbard UGB	2,502	3,277	2.7%	3,375	4,074	5,195	1.1%	0.8%
Idanha UGB (Marion)	147	77	-6.3%	80	85	96	0.3%	0.4%
Jefferson UGB	2,547	3,174	2.2%	3,318	4,071	5,237	1.1%	0.8%
Lyons UGB (Marion)	100	53	-6.2%	53	53	53	0.0%	0.0%
Mill City UGB (Marion)	315	328	0.4%	309	333	371	0.4%	0.3%
Mount Angel UGB	3,204	3,450	0.7%	3,551	3,847	4,403	0.4%	0.4%
Salem/Keizer UGB (Marion)	183,579	203,995	1.1%	218,689	266,626	353,218	1.1%	0.9%
Scotts Mills UGB	321	361	1.2%	384	465	554	1.1%	0.5%
Silverton UGB	7,987	9,606	1.9%	10,214	13,076	16,889	1.4%	0.8%
St. Paul UGB	354	399	1.2%	401	441	517	0.5%	0.5%
Stayton UGB	6,996	7,892	1.2%	8,138	9,432	11,841	0.8%	0.7%
Sublimity UGB	2,142	2,681	2.3%	2,857	3,316	3,876	0.8%	0.5%
Turner UGB	1,201	1,854	4.4%	2,066	3,439	4,605	2.9%	0.9%
Woodburn UGB	20,934	24,871	1.7%	26,211	34,187	46,262	1.5%	0.9%
Outside UGBs	45,341	44,597	-0.2%	48,587	48,857	44,020	0.0%	-0.3%

Sources: U.S. Census Bureau, 2000 and 2010 Censuses; Forecast by Population Research Center (PRC).

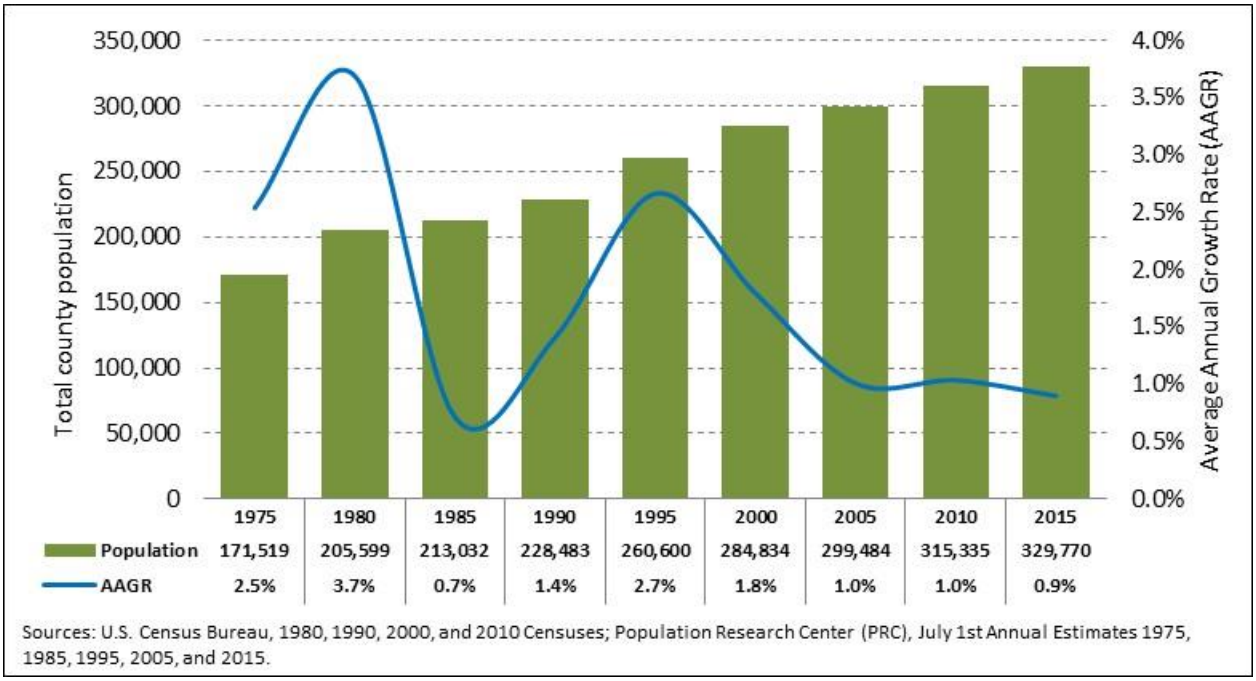
Historical Trends

Different growth patterns occur in different parts of Marion County. Each of Marion County's sub-areas were examined for any significant demographic characteristics or changes in population or housing growth that might influence their individual forecasts. Factors analyzed include age composition of the population, race and ethnicity, births, deaths, migration, the number of *housing units, housing occupancy,* and *persons per household (PPH)*. It should be noted that population trends of individual sub-areas often differ from those of the county as a whole. However, population growth rates for the county are collectively influenced by local trends within its sub-areas.

Population

Marion County's total population grew from roughly 171,500 in 1975 to about 329,800 in 2015 (**Figure 2**). During this 40-year period, the county experienced the highest growth rates during the late 1970s, which coincided with a period of relative economic prosperity. During the early 1980s, challenging economic conditions, both nationally and within the county, led to drastically slower population growth rates. During the early 1990s the county's population growth rates again increased, but challenging economic conditions late in the decade yielded declines in that rate. Still, Marion County experienced positive population growth between 2000 and 2015—averaging at about one percent per year.

Figure 2. Marion County—Total Population by Five-year Intervals (1975-2015)



Sources: U.S. Census Bureau, 1980, 1990, 2000, and 2010 Censuses; Population Research Center (PRC), July 1st Annual Estimates 1975, 1985, 1995, 2005, and 2015.

During the 2000s Marion County's average annual population growth rate stood at one percent (Figure 3). At the same time Donald and Turner recorded average annual growth rates of 4.9 and 4.4 percent, respectively. All other sub-areas that experienced positive growth rates, except for Mount Angel and the Marion portions of Gates and Mill City, grew at faster rates than the county as a whole. Detroit, the

Marion portions of Idanha and Lyons, and the area outside UGBs recorded population declines between 2000 and 2010.

Figure 3. Marion County and Sub-areas—Total Population and Average Annual Growth Rate (AAGR) (2000 and 2010)[1]

	2000	2010	AAGR (2000-2010)	Share of County 2000	Share of County 2010
Marion County	*284,834*	*315,335*	*1.0%*	*100.0%*	*100.0%*
Aumsville UGB	3,083	3,643	1.7%	1.1%	1.2%
Aurora UGB	724	981	3.1%	0.3%	0.3%
Detroit UGB	262	202	-2.6%	0.1%	0.1%
Donald UGB	608	979	4.9%	0.2%	0.3%
Gates UGB (Marion)	429	432	0.1%	0.2%	0.1%
Gervais UGB	2,058	2,483	1.9%	0.7%	0.8%
Hubbard UGB	2,502	3,277	2.7%	0.9%	1.0%
Idanha UGB (Marion)	147	77	-6.3%	0.1%	0.0%
Jefferson UGB	2,547	3,174	2.2%	0.9%	1.0%
Lyons UGB (Marion)	100	53	-6.2%	0.0%	0.0%
Mill City UGB (Marion)	315	328	0.4%	0.1%	0.1%
Mount Angel UGB	3,204	3,450	0.7%	1.1%	1.1%
Salem/Keizer UGB (Marion)	183,579	203,995	1.1%	64.5%	64.7%
Scotts Mills UGB	321	361	1.2%	0.1%	0.1%
Silverton UGB	7,987	9,606	1.9%	2.8%	3.0%
St. Paul UGB	354	399	1.2%	0.1%	0.1%
Stayton UGB	6,996	7,892	1.2%	2.5%	2.5%
Sublimity UGB	2,142	2,681	2.3%	0.8%	0.9%
Turner UGB	1,201	1,854	4.4%	0.4%	0.6%
Woodburn UGB	20,934	24,871	1.7%	7.3%	7.9%
Outside UGBs	45,341	44,597	-0.2%	15.9%	14.1%

Sources: U.S. Census Bureau, 2000 and 2010 Censuses.

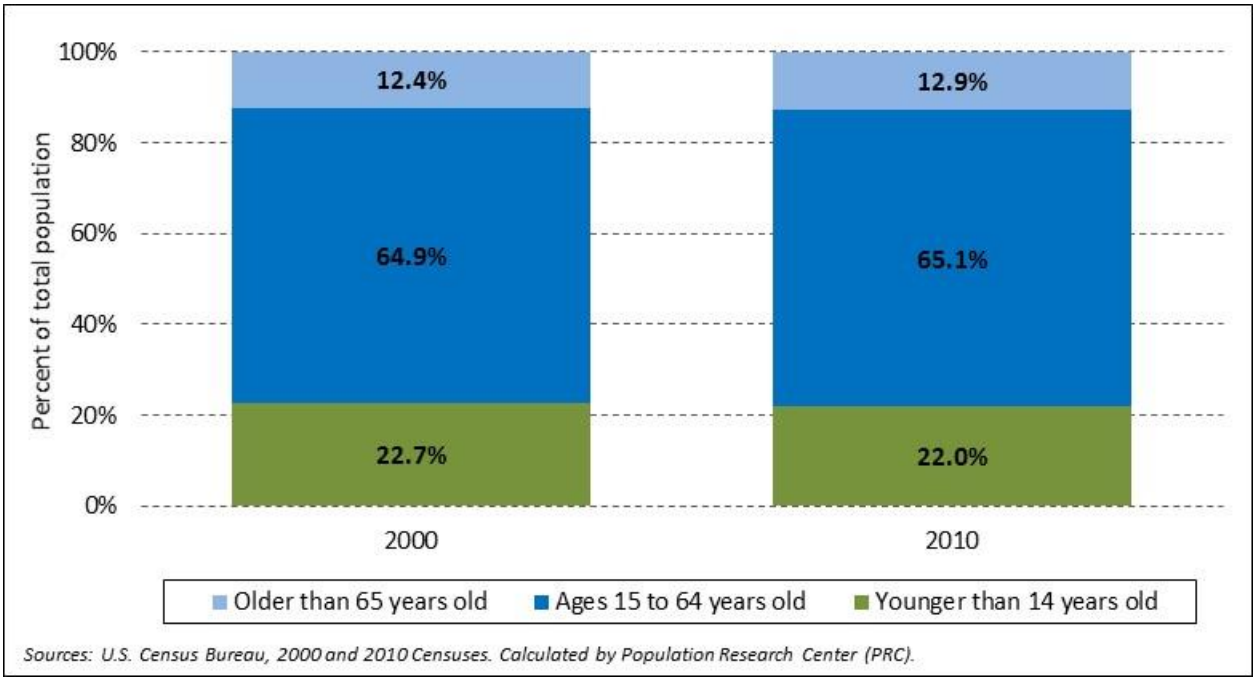
Age Structure of the Population

Marion County's population is aging, but at a much slower pace compared to most areas across Oregon. An aging population significantly influences the number of deaths but also yields a smaller proportion of women in their childbearing years, which may result in a decline in births. Indeed, between 2000 and 2010, births decreased while the proportion of the county population 65 and older increased in Marion County (**Figure 4**). The median age increased from 33.7 in 2000 to 35.1 in 2010 and to 36.2 in 2015, an

[1] When considering growth rates and population growth overall, it should be noted that a slowing of growth rates does not necessarily correspond to a slowing of population growth in absolute numbers. For example, if a UGB with a population of 100 grows by another 100 people, it has doubled in population. If it then grows by another 100 people during the next year, its relative growth is half of what it was before even though absolute growth stays the same.

increase that is smaller than observed statewide but larger than several other counties in the region during the same time frame.[2]

Figure 4. Marion County—Age Structure of the Population (2000 and 2010)



Race and Ethnicity

While the statewide population is aging, another demographic shift is occurring across Oregon: minority populations are growing as a share of the total population. A growing minority population affects both the number of births and average household size. The Hispanic population within Marion County increased substantially from 2000 to 2010 (**Figure 5**), while the white, non-Hispanic population decreased over the same time period. This increase in the Hispanic population and other minority populations brings with it several implications for future population change. First, both nationally and at the state level, fertility rates among Hispanic and minority women tend to be higher than among white, non-Hispanic women. However, it is important to note recent trends show these rates are quickly decreasing. Second, Hispanic and minority households tend to be larger relative to white, non-Hispanic households.

[2] Median age is sourced from the U.S. Census Bureau's 2000 and 2010 Censuses and 2011-2015 ACS 5-year Estimates.

Figure 5. Marion County—Hispanic or Latino and Race (2000 and 2010)

Hispanic or Latino and Race	2000		2010		Absolute Change	Relative Change
Total population	*284,834*	*100.0%*	*315,335*	*100.0%*	*30,501*	*10.7%*
Hispanic or Latino	48,714	17.1%	76,594	24.3%	27,880	57.2%
Not Hispanic or Latino	236,120	82.9%	238,741	75.7%	2,621	1.1%
White alone	217,880	76.5%	216,758	68.7%	-1,122	-0.5%
Black or African American alone	2,274	0.8%	2,906	0.9%	632	27.8%
American Indian and Alaska Native alone	3,326	1.2%	3,290	1.0%	-36	-1.1%
Asian alone	4,905	1.7%	5,790	1.8%	885	18.0%
Native Hawaiian and Other Pacific Islander alone	967	0.3%	2,254	0.7%	1,287	133.1%
Some Other Race alone	337	0.1%	411	0.1%	74	22.0%
Two or More Races	6,431	2.3%	7,332	2.3%	901	14.0%

Sources: U.S. Census Bureau, 2000 and 2010 Censuses.

Births

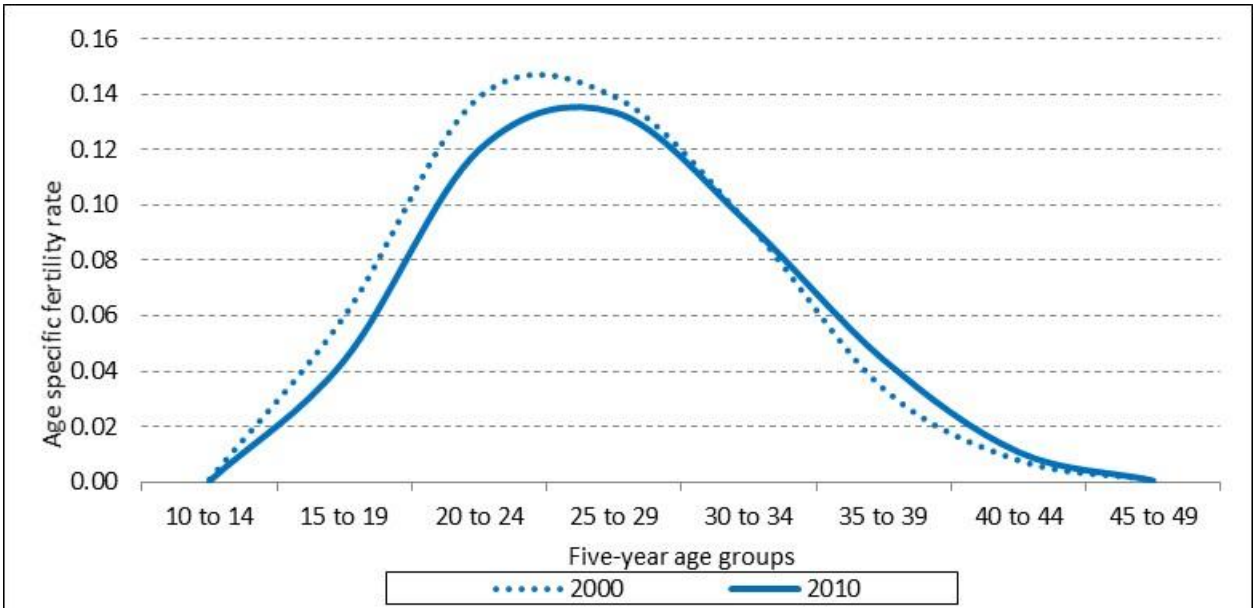
Although higher, historical fertility rates for Marion County mirror the decreasing trend of fertility rates in Oregon as a whole (**Figure 6**). At the same time, fertility for women over 30 years of age increased in both Marion County and Oregon (**Figure 7** and **Figure 8**). As **Figure 7** demonstrates, fertility rates for younger women in Marion County are lower in 2010 compared to earlier decades largely because women are having children at older ages. While age specific fertility largely mirrors statewide patterns, the county's total fertility rates remain well above *replacement fertility*, while for Oregon as a whole total fertility continues to fall.

Figure 6. Marion County and Oregon—Total Fertility Rates (2000 and 2010)

	2000	2010
Marion County	2.37	2.22
Oregon	1.98	1.80

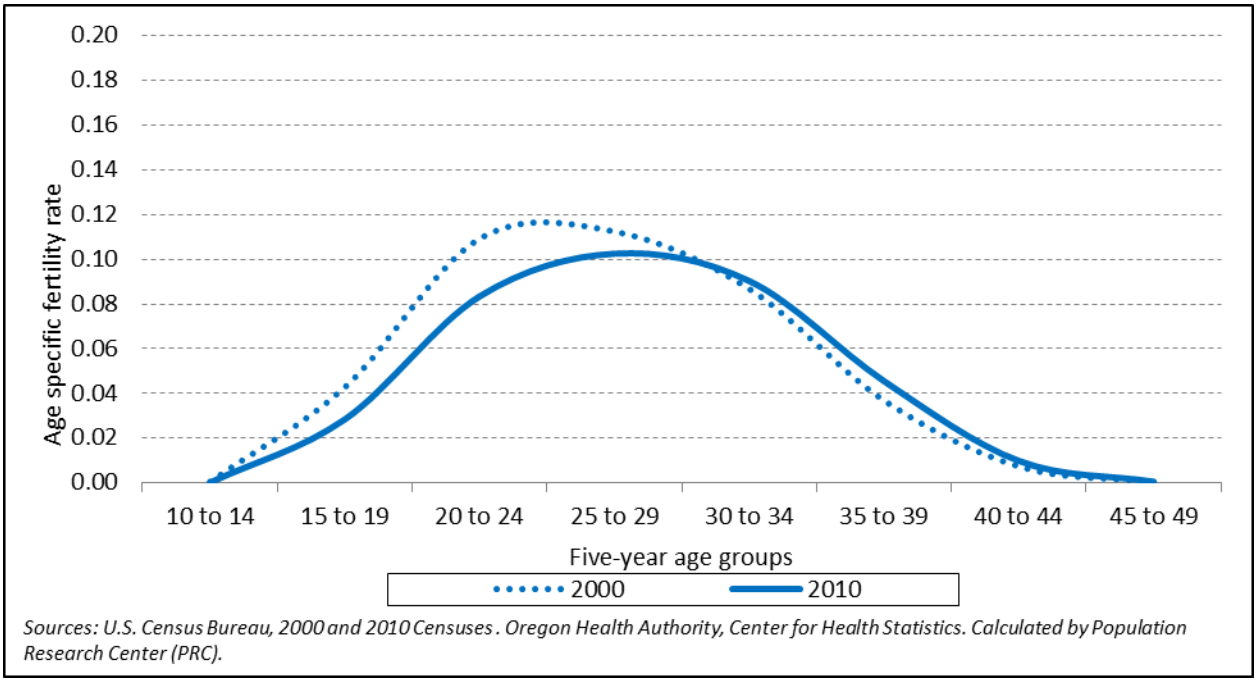
Sources: U.S. Census Bureau, 2000 and 2010 Censuses.
Oregon Health Authority, Center for Health Statistics.
Calculated by Population Research Center (PRC).

Figure 7. Marion County—Age Specific Fertility Rate (2000 and 2010)



Sources: U.S. Census Bureau, 2000 and 2010 Censuses . Oregon Health Authority, Center for Health Statistics. Calculated by Population Research Center (PRC).

Figure 8. Oregon—Age Specific Fertility Rate (2000 and 2010)



Sources: U.S. Census Bureau, 2000 and 2010 Censuses . Oregon Health Authority, Center for Health Statistics. Calculated by Population Research Center (PRC).

Figure 9 shows the number of births by the area in which the mother resides. Note that the number of births fluctuates from year to year. For example, a sub-area with an increase in births between two years may show a decrease during a different time period. Three of Marion County's most populous sub-

areas saw more births in 2010 than 2000, while the county as a whole, Stayton, all smaller UGBs, and the area outside UGBs recorded fewer births (**Figure 9**).

Figure 9. Marion County and Sub-Areas—Total Births (2000 and 2010)

	2000	2010	Absolute Change	Relative Change	Share of County 2000	Share of County 2010
Marion County	*4,659*	*4,626*	*-33*	*-0.7%*	*100.0%*	*100.0%*
Salem/Keizer (Marion)	3,004	3,138	134	4.5%	64.5%	67.8%
Silverton	126	130	4	3.2%	2.7%	2.8%
Stayton	117	102	-15	-12.8%	2.5%	2.2%
Woodburn	432	464	32	7.4%	9.3%	10.0%
Outside UGBs	454	419	-35	-7.7%	9.7%	9.1%
Smaller UGBs	526	373	-153	-29.1%	11.3%	8.1%

Sources: Oregon Health Authority, Center for Health Statistics. Aggregated by Population Research Center (PRC).

Note 1: For simplicity each UGB is referred to by its primary city's name.

Note 2: Smaller UGBs are those with populations less than 7,000 in forecast launch year.

Deaths

Though Marion County's population is aging, life expectancy increased in the 2000s.[3] For Marion County in 2000, life expectancy for males was 75 years and for females was 80 years. By 2010, life expectancy had slightly increased for both males and females to 77 and 81 years, respectively. For both Marion County and Oregon, the survival rates changed little between 2000 and 2010—underscoring the fact that mortality is the most stable component, relative to birth and migration rates, of population change. Even so, the total number of countywide deaths increased (**Figure 10**).

[3] Researchers have found evidence for a widening rural-urban gap in life expectancy; life expectancy declined for some rural areas in Oregon during the 2000's. This gap is particularly apparent between race and income groups and may be one explanation for the decline in life expectancy in the 2000s. See the following research article for more information. *Singh, Gopal K., and Mohammad Siahpush. "Widening rural-urban disparities in life expectancy, US, 1969-2009." American Journal of Preventative Medicine 46, no. 2 (2014): e19-e29.*

Figure 10. Marion County and Sub-Areas—Total Deaths (2000 and 2010)

	2000	2010	Absolute Change	Relative Change	Share of County 2000	Share of County 2010
Marion County	*2,440*	*2,533*	*93*	*3.8%*	*100.0%*	*100.0%*
Salem/Keizer (Marion)	1,459	1,560	101	6.9%	59.8%	61.6%
Silverton	NA	76	-	-	-	3.0%
Stayton	NA	49	-	-	-	1.9%
Woodburn	222	186	-36	-16.2%	9.1%	7.3%
Outside UGBs	691	332	-359	-52.0%	28.3%	13.1%
Smaller UGBs	68	330	262	385.3%	2.8%	13.0%

Sources: Oregon Health Authority, Center for Health Statistics. Aggregated by Population Research Center (PRC).

Note 1: For simplicity each UGB is referred to by its primary city's name.

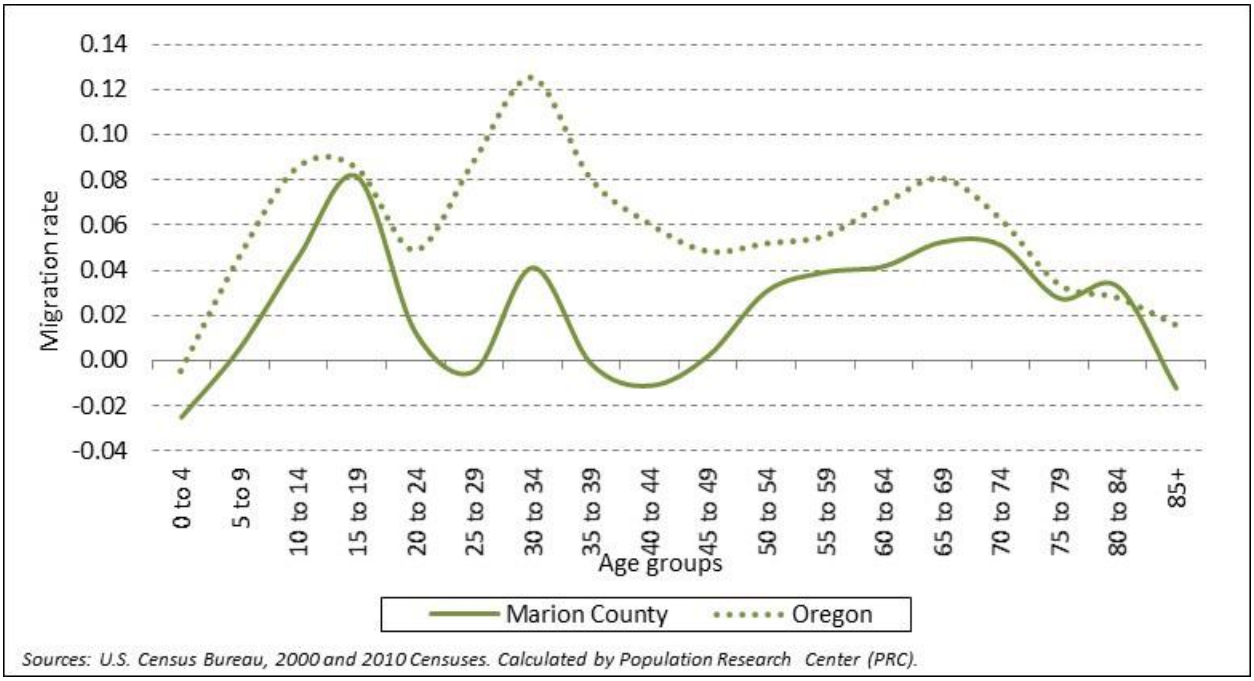
Note 2: All other areas includes all smaller UGBs (those with populations less than 7,000) and the area outside UGBs. Detailed, point level death data were unavailable for 2000, thus PRC was unable to assign deaths to some UGBs.

Migration

The propensity to migrate is strongly linked to age and stage of life. As such, age-specific migration rates are critically important for assessing these patterns across five-year age cohorts. **Figure 11** shows the historical age-specific migration rates by five-year age group, both for Marion County and Oregon. The migration rate is shown as the number of net in/out migrants per person by age group.

From 2000 to 2010, younger individuals (ages with the highest mobility levels) and elderly migrants moved into the county in search of employment, educational opportunities, housing, and, for the latter group, retirement. At the same time however, young children, post-graduates, and adults in their 40s moved out.

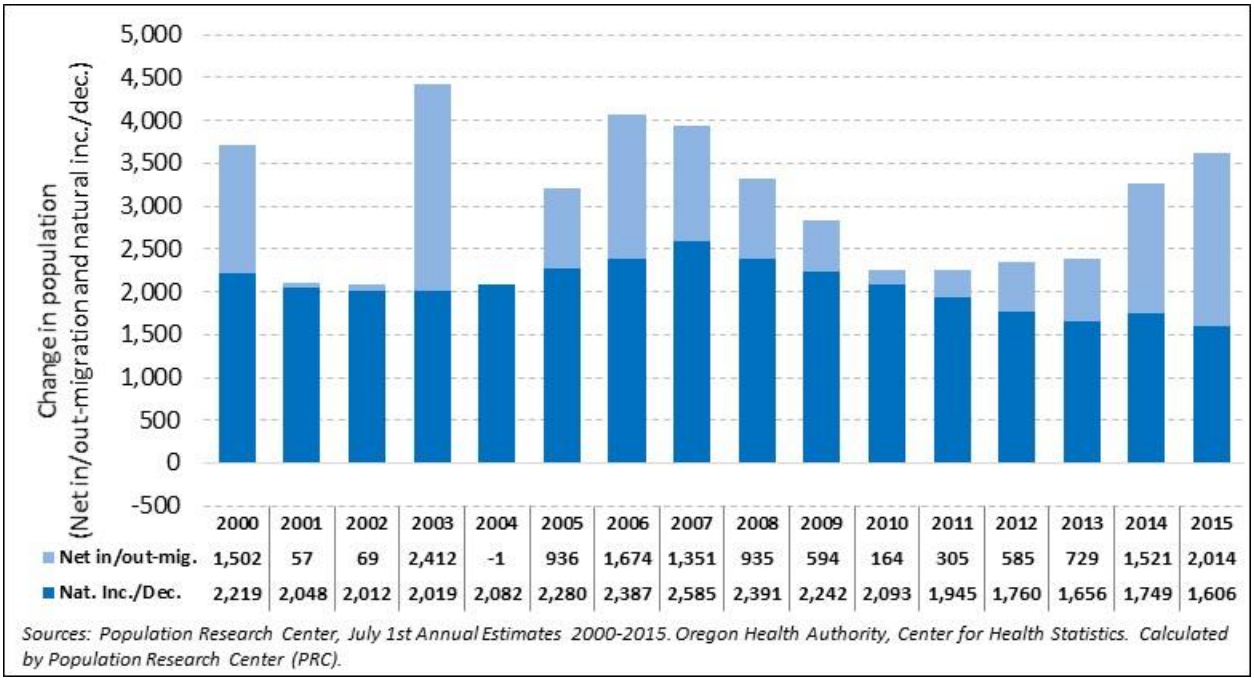
Figure 11. Marion County and Oregon—Age Specific Migration Rates (2000-2010)



Historical Trends in Components of Population Change

In summary, Marion County's positive population growth in the 2000s was the result of steady natural increase and years of substantial net in-migration (**Figure 12**). The larger number of births relative to deaths has led to natural increase (more births than deaths) in every year from 2000 to 2015. While net in-migration fluctuated dramatically during the early years of the last decade and slowed in the years following the recession, the number of in-migrants has increased during recent years, contributing to population increase. Even so, historical trends show that natural increase accounted for most of the population growth.

Figure 12. Marion County—Components of Population Change (2000-2015)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Net in/out-mig.	1,502	57	69	2,412	-1	936	1,674	1,351	935	594	164	305	585	729	1,521	2,014
Nat. Inc./Dec.	2,219	2,048	2,012	2,019	2,082	2,280	2,387	2,585	2,391	2,242	2,093	1,945	1,760	1,656	1,749	1,606

Sources: Population Research Center, July 1st Annual Estimates 2000-2015. Oregon Health Authority, Center for Health Statistics. Calculated by Population Research Center (PRC).

Housing and Households

The total number of housing units in Marion County increased rapidly during the middle years of this last decade (2000 to 2010), but this growth slowed with the onset of Great Recession in 2008. Over the entire 2000 to 2010 period, the total number of housing units increased by about twelve percent countywide; this was more than 12,000 new housing units (**Figure 13**). The Marion portion of the Salem-Keizer UGB captured the largest share of growth in total housing units, with Woodburn, areas outside the UGB, Silverton, and Sublimity also seeing large shares of the countywide housing growth. In terms of relative housing growth, Sublimity grew the most during the 2000s; its total housing stock increased by 61 percent (432 housing units) by 2010.

The rates of increase in the number of total housing units in the county, UGBs, and area outside UGBs are similar to the growth rates of their corresponding populations. Housing growth rates may differ slightly from population growth rates because (1) the number of total housing units are smaller than the numbers of people; (2) the UGB has experienced changes in the average number of persons per household; or (3) occupancy rates have changed (typically most pronounced in coastal locations with vacation-oriented housing). However, the patterns of population and housing change in the Marion County are relatively similar.

Figure 13. Marion County and Sub-Areas—Total Housing Units (2000 and 2010)

	2000	2010	AAGR (2000-2010)	Share of County 2000	Share of County 2010
Marion County	*108,174*	*120,948*	*1.1%*	*100.0%*	*100.0%*
Aumsville	1,059	1,263	1.8%	1.0%	1.0%
Aurora	287	373	2.7%	0.3%	0.3%
Detroit	383	368	-0.4%	0.4%	0.3%
Donald	236	372	4.7%	0.2%	0.3%
Gates (Marion)	237	227	-0.4%	0.2%	0.2%
Gervais	496	631	2.4%	0.5%	0.5%
Hubbard	809	1,040	2.5%	0.7%	0.9%
Idanha (Marion)	66	47	-3.3%	0.1%	0.0%
Jefferson	909	1,149	2.4%	0.8%	0.9%
Lyons (Marion)	49	26	-6.1%	0.0%	0.0%
Mill City (Marion)	135	144	0.6%	0.1%	0.1%
Mount Angel	1,149	1,334	1.5%	1.1%	1.1%
Salem/Keizer (Marion)	71,863	79,281	1.0%	66.4%	65.5%
Scotts Mills	110	139	2.4%	0.1%	0.1%
Silverton	3,075	3,824	2.2%	2.8%	3.2%
St. Paul	128	142	1.0%	0.1%	0.1%
Stayton	2,722	3,151	1.5%	2.5%	2.6%
Sublimity	710	1,142	4.9%	0.7%	0.9%
Turner	522	768	3.9%	0.5%	0.6%
Woodburn	7,102	8,529	1.8%	6.6%	7.1%
Outside UGBs	16,127	16,998	0.5%	14.9%	14.1%

Sources: U.S. Census Bureau, 2000 and 2010 Censuses.

Note: For simplicity each UGB is referred to by its primary city's name.

Occupancy rates tend to fluctuate more than PPH. This is particularly true in smaller UGBs where fewer housing units allow for larger changes (in relative terms) in occupancy rates. From 2000 to 2010, the occupancy rate in Marion County declined slightly; this was most likely due to slack in demand for housing as individuals experienced the effects of the Great Recession (Figure 14). Multiple sub-areas experienced similar declines in occupancy rates, with the Marion portion of Idanha (-10.4 percent) as well as Detroit (-5 percent) experiencing more extreme declines in the occupancy rate. Conversely, three UGBs, the Marion portions of Mill City and Gates in addition to Donald, recorded increases in occupancy rates of more than five percentage points.

Average household size, or PPH, in Marion County was 2.7 in 2010, the same as in 2000 (**Figure 14**). Marion County's PPH in 2010 was slightly higher than for Oregon as a whole, which had a PPH of 2.5. Average household size varied across the UGBs, ranging from 2.1 (Marion portion of Gates) to 4.3 (Gervais).

Figure 14. Marion County and Sub-Areas—Persons per Household (PPH) and Occupancy Rate

	Persons Per Household (PPH)			Occupancy Rate		
	2000	2010	Change 2000-2010	2000	2010	Change 2000-2010
Marion County	*2.7*	*2.7*	*0.0*	*94.0%*	*93.4%*	*-0.6%*
Aumsville	3.1	3.0	-0.1	93.9%	95.6%	1.8%
Aurora	2.7	2.7	0.1	95.1%	96.2%	1.1%
Detroit	2.2	2.1	-0.1	31.1%	26.1%	-5.0%
Donald	3.0	2.8	-0.2	85.6%	93.3%	7.7%
Gates (Marion)	2.3	2.1	-0.2	79.3%	89.9%	10.5%
Gervais	4.3	4.3	-0.1	94.6%	92.2%	-2.3%
Hubbard	3.3	3.3	0.0	94.2%	95.5%	1.3%
Idanha (Marion)	2.6	2.2	-0.4	84.8%	74.5%	-10.4%
Jefferson	3.0	2.9	-0.1	92.4%	94.6%	2.2%
Lyons (Marion)	2.4	2.4	0.0	83.7%	84.6%	0.9%
Mill City (Marion)	2.9	2.7	-0.3	80.0%	85.4%	5.4%
Mount Angel	2.8	2.6	-0.2	94.3%	94.0%	-0.3%
Salem/Keizer (Marion)	2.6	2.6	0.0	94.4%	93.8%	-0.6%
Scotts Mills	2.9	2.7	-0.2	99.1%	95.0%	-4.1%
Silverton	2.7	2.7	-0.1	94.6%	93.8%	-0.7%
St. Paul	2.9	2.9	0.0	96.1%	98.6%	2.5%
Stayton	2.7	2.6	-0.1	95.0%	94.4%	-0.5%
Sublimity	2.7	2.3	-0.3	96.5%	93.1%	-3.4%
Turner	2.4	2.6	0.2	94.1%	92.4%	-1.6%
Woodburn	3.1	3.2	0.1	92.0%	91.1%	-0.8%
Outside UGBs	2.9	2.8	-0.1	94.3%	93.4%	-0.9%

Sources: U.S. Census Bureau, 2000 and 2010 Censuses.

Note: For simplicity each UGB is referred to by its primary city's name.

Assumptions for Future Population Change

Evaluating past demographic trends provides clues about what the future will look like and helps determine the most likely scenarios for population change. Past trends also explain the dynamics of population growth specific to local areas. Relating recent and historical population change to events that influence population change serves as a gauge for what might realistically occur in a given area over the long-term. Our forecast period is 2017-2067.

Assumptions about fertility, mortality, and migration were developed for Marion County's overall population forecast and for each of its larger sub-areas.[4] The assumptions are derived from observations based on life events, as well as trends unique to Marion County and its larger sub-areas. Marion County sub-areas falling into this category include: the Marion portion of the Salem-Keizer UGB, Silverton, Stayton, and Woodburn**.**

Population change for smaller sub-areas is determined by the change in the number of total housing units, occupancy rates, and PPH. Assumptions around housing unit growth as well as occupancy rates are derived from observations of historical building patterns and current plans for future housing development. In addition, assumptions for PPH are based on observed historical patterns of household demographics—for example the average age of householder. Marion County sub-areas falling into this category include: Aumsville, Aurora, Detroit, Donald, Gervais, Hubbard, Jefferson, Mount Angel, Scotts Mills, St. Paul, Sublimity, Turner, and the Marion portions of Gates, Idanha, and Mill City**.**

Assumptions for the County and Larger Sub-Areas

During the forecast period the population of Marion County is expected to age more quickly during the first half of the forecast period and then remain relatively stable over the forecast horizon. Fertility rates are expected to slightly decline throughout the forecast period. Total fertility in Marion County is forecast to decrease from 2.09 children per woman in the 2010-15 period to 2.04 children per woman by 2065. Similar patterns of declining total fertility are expected within the county's larger sub-areas.

Changes in mortality rates and life expectancy are more stable compared to fertility and migration. Marion County and its larger sub-areas are projected to follow the statewide trend of increasing life expectancy throughout the forecast period—progressing from a life expectancy of 79 years in 2010 to 86 in 2060. However, in spite of increasing life expectancy and the corresponding increase in survival rates, Marion County's aging population will increase the overall number of deaths throughout the forecast period. Larger sub-areas within the county will experience a similar increase in deaths as their population ages.

Migration is the most volatile and challenging demographic component to forecast due to the many factors influencing migration patterns. Economic, social, and environmental factors—such as employment, educational opportunities, housing availability, family ties, cultural affinity, climate

[4] County sub-areas with populations greater than 7,000 in the forecast launch year were forecast using the *cohort-component method*. County sub-areas with populations less than 7,000 in forecast launch year were forecast using the *housing-unit method*. See Glossary of Key Terms at the end of this report for a brief description of these methods or refer to the *Methods* document for a more detailed description of these forecasting techniques.

change, and natural amenities—occurring both inside and outside the study area can affect both the direction and the volume of migration.

We assume net migration rates will change in line with historical trends unique to Marion County. A net in-migration of middle-aged individuals and retirees will persist throughout the forecast period. Countywide average annual net in-migration is expected to increase from 1,100 net in-migrants in 2015 to 2,529 net in-migrants in 2035. Over the last 30 years of the forecast period average annual net in-migration is expected to be more steady, remaining at about 2,499 net in-migrants through 2065.

Assumptions for Smaller Sub-Areas

Rates of population growth for the smaller UGBs are determined by corresponding growth in the number of housing units, as well as changes in housing occupancy rates and PPH. The change in housing unit growth is much more variable than change in housing occupancy rates or PPH.

Occupancy rates and PPH are assumed to stay relatively stable over the forecast period. Smaller household size is associated with an aging population in Marion County and its sub-areas.

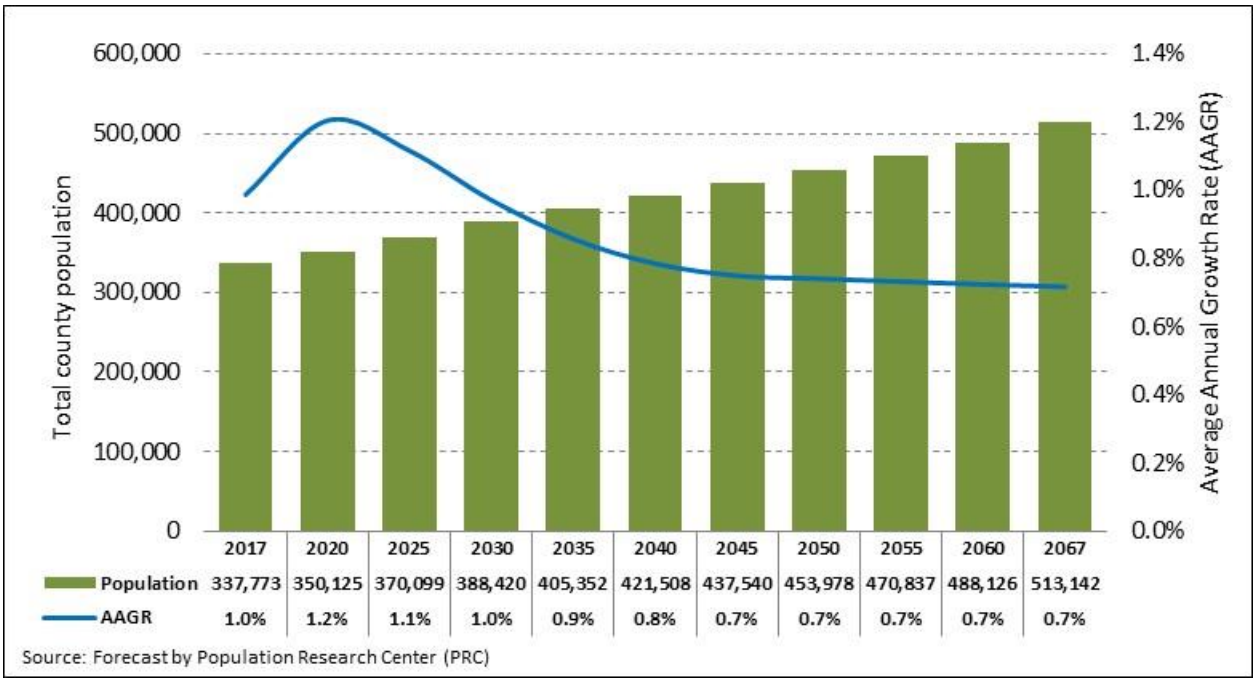
In addition, for sub-areas experiencing population growth we assume a higher growth rate in the near-term, with growth stabilizing over the remainder of the forecast period. If planned housing units were reported in the surveys, then we account for them being constructed over the next 5-15 years (or as specified by local officials). Finally, for county sub-areas where population growth has been flat or declining, and there is no planned housing construction, we hold population growth mostly stable with little to no change.

Forecast Trends

Under the most-likely population growth scenario for Marion County, countywide and sub-area populations are expected to increase over the forecast period. The countywide population growth rate is forecast to peak in 2020 and then slowly decline for the remainder of the forecast period. A reduction in population growth rates is driven by both (1) an aging population—contributing to steady increase in deaths — as well as (2) the expectation of relatively stable in-migration over the second half of the forecast period. The combination of these factors will likely result in population growth rates slowing as time progresses through the forecast period.

Marion County's total population is forecast to grow by 175,369 persons (52 percent) from 2017 to 2067, which translates into a total countywide population of 513,142 in 2067 (**Figure 15**). The population is forecast to grow at the highest rate—just above one percent per year—in the near-term (2017-2025). This anticipated population growth in the near-term is based on three core assumptions: (1) Marion County's economy will continue to strengthen in the next 10 years; and (2) middle-aged persons bringing their families or having more children, and (3) empty nesters and retirees will continue to migrate into the county, thus increasing deaths. The largest component of growth in this initial period is net in-migration. Over 14,000 more births than deaths are forecast for the 2017 to 2025 period. At the same time more than 22,000 in-migrants are also forecast, combining with natural increase for continued population growth.

Figure 15. Marion County—Total Forecast Population by Five-year Intervals (2017-2067)



Marion County's four largest UGBs — the Marion portion of Salem-Keizer, Woodburn, Silverton, and Stayton—are forecast to experience a combined population growth of more than 60,000 from 2017 to 2035 and roughly 105,000 from 2035 to 2067 (Figure 16). The Marion portion of the Salem-Keizer UGB is

expected to increase by roughly 48,000 persons from 2017 to 2035 (1.1% AAGR), growing from a total population of 218,689 in 2017 to 266,626 in 2035. The Woodburn UGB is forecast to increase at a faster rate (1.5% AAGR), growing from 26,211 persons in 2017 to a population of 34,187 in 2035. The Silverton UGB is forecast to grow at a slightly slower rate than Woodburn (1.4% AAGR), but still faster than Salem-Keizer, growing from 10,214 in 2017 to 13,076 in 2035. Stayton is expected to experience more modest population growth (0.8% AAGR) over the next 18 years. Growth is expected to occur more slowly for the Marion portion of Salem-Keizer, Woodburn, Silverton, and Stayton during the second part of the forecast period. The Marion portion of the Salem-Keizer UGB and Woodburn UGB are expected to grow as a share of the total county population, while the population share for Silverton and Stayton are expected to remain stable.

Population outside UGBs is expected to grow by 270 people from 2017 to 2035 but is expected to decline thereafter, losing roughly 4,800 people from 2035 to 2067. The population of the area outside UGBs is forecast to decline as a share of total countywide population as well, composing 14 percent of the countywide population in 2017 but 9 percent in 2067.

Figure 16. Marion County and Larger Sub-Areas—Forecast Population and AAGR

	2017	2035	2067	AAGR (2017-2035)	AAGR (2035-2067)	Share of County 2017	Share of County 2035	Share of County 2067
Marion County	*337,773*	*405,352*	*513,142*	*1.0%*	*0.7%*	*100.0%*	*100.0%*	*100.0%*
Salem/Keizer UGB (Marion)	218,689	266,626	353,218	1.1%	0.9%	64.7%	65.8%	68.8%
Silverton UGB	10,214	13,076	16,889	1.4%	0.8%	3.0%	3.2%	3.3%
Stayton UGB	8,138	9,432	11,841	0.8%	0.7%	2.4%	2.3%	2.3%
Woodburn UGB	26,211	34,187	46,262	1.5%	0.9%	7.8%	8.4%	9.0%
Smaller UGBs	25,934	33,175	40,912	1.4%	0.7%	7.7%	8.2%	8.0%
Outside UGBs	48,587	48,857	44,020	0.0%	-0.3%	14.4%	12.1%	8.6%

Source: Forecast by Population Research Center (PRC)

Note: Smaller UGBs are those with populations less than 7,000 in forecast launch year.

The Marion portion of the Salem-Keizer UGB, Marion County's largest, and Woodburn are expected to capture the largest share of total countywide population growth during the initial 18 years of the forecast period from 2017 to 2035 (**Figure 17**). However, the former is expected to capture a larger share of countywide population growth during the final 32 years of the forecast period from 2035 to 2067, while the latter's share is expected to decline slightly. Silverton is expected to capture a smaller share of the county's growth in the second half of the forecast period while Stayton's share is expected to increase slightly over the forecast period.

Figure 17. Marion County and Larger Sub-Areas—Share of Countywide Population Growth

	2017-2035	2035-2067
Marion County	*100.0%*	*100.0%*
Salem/Keizer UGB (Marion)	70.9%	74.8%
Silverton UGB	4.2%	3.7%
Stayton UGB	1.9%	2.1%
Woodburn UGB	11.8%	11.1%
Smaller UGBs	10.7%	8.3%
Outside UGBs	0.4%	0.0%

Source: Forecast by Population Research Center (PRC)

Note: Smaller UGBs are those with populations less than 7,000 in forecast launch year.

The smaller UGBs are expected to grow by a combined number of 7,241 persons from 2017 to 2035, with a combined average annual growth rate of 1.4 percent (Figure 16). This growth rate is due to stable growth expected in many of the smaller UGBs (Figure 18). Average annual growth rates for Aumsville, Aurora, Donald, Gervais, Hubbard, Jefferson, Scotts Mills, and Turner are expected be over one percent for the first half of the forecast period. Similar to the larger UGBs and the county as a whole, population growth rates are forecast to decline during the second half of the forecast period (2035 to 2067). The smaller UGBs are expected to collectively add 7,737 people from 2035 to 2067.

Figure 18. Marion County and Smaller Sub-Areas—Forecast Population and AAGR

	2017	2035	2067	AAGR (2017-2035)	AAGR (2035-2067)	Share of County 2017	Share of County 2035	Share of County 2067
Marion County	*337,773*	*405,352*	*513,142*	*1.0%*	*0.7%*	*100.0%*	*100.0%*	*100.0%*
Aumsville UGB	4,209	6,141	7,658	2.1%	0.7%	1.2%	1.5%	1.5%
Aurora UGB	1,028	1,321	1,622	1.4%	0.6%	0.3%	0.3%	0.3%
Detroit UGB	216	227	237	0.3%	0.1%	0.1%	0.1%	0.0%
Donald UGB	994	1,555	2,150	2.5%	1.0%	0.3%	0.4%	0.4%
Gates UGB (Marion)	435	462	489	0.3%	0.2%	0.1%	0.1%	0.1%
Gervais UGB	2,657	3,346	3,850	1.3%	0.4%	0.8%	0.8%	0.8%
Hubbard UGB	3,375	4,074	5,195	1.1%	0.8%	1.0%	1.0%	1.0%
Idanha UGB (Marion)	80	85	96	0.3%	0.4%	0.0%	0.0%	0.0%
Jefferson UGB	3,318	4,071	5,237	1.1%	0.8%	1.0%	1.0%	1.0%
Lyons UGB (Marion)	53	53	53	0.0%	0.0%	0.0%	0.0%	0.0%
Mill City UGB (Marion)	309	333	371	0.4%	0.3%	0.1%	0.1%	0.1%
Mount Angel UGB	3,551	3,847	4,403	0.4%	0.4%	1.1%	0.9%	0.9%
Scotts Mills UGB	384	465	554	1.1%	0.5%	0.1%	0.1%	0.1%
St. Paul UGB	401	441	517	0.5%	0.5%	0.1%	0.1%	0.1%
Sublimity UGB	2,857	3,316	3,876	0.8%	0.5%	0.8%	0.8%	0.8%
Turner UGB	2,066	3,439	4,605	2.9%	0.9%	0.6%	0.8%	0.9%
Larger UGBs	263,252	323,320	428,209	1.1%	0.9%	77.9%	79.8%	83.4%
Outside UGBs	48,587	48,857	44,020	0.0%	-0.3%	14.4%	12.1%	8.6%

Source: Forecast by Population Research Center (PRC)

Note: Larger UGBs are those with populations equal to or greater than 7,000 in forecast launch year.

Marion County's smaller sub-areas are expected to compose roughly 11 percent of countywide population growth in the first 18 years of the forecast period and about 8 percent in the final 32 years (Figure 17). Individually, all of the smaller UGBs are expected to capture a stable or decreasing share of total growth throughout the forecast period (Figure 19).

Figure 19. Marion County and Smaller Sub-Areas—Share of Countywide Population Growth

	2017-2035	2035-2067
Marion County	*100.0%*	*100.0%*
Aumsville UGB	2.9%	1.9%
Aurora UGB	0.4%	0.3%
Detroit UGB	0.0%	0.0%
Donald UGB	0.8%	0.6%
Gates UGB (Marion)	0.0%	0.0%
Gervais UGB	1.0%	0.7%
Hubbard UGB	1.0%	1.0%
Idanha UGB (Marion)	0.0%	0.1%
Jefferson UGB	1.1%	1.1%
Lyons UGB (Marion)	0.0%	0.0%
Mill City UGB (Marion)	0.0%	0.0%
Mount Angel UGB	0.4%	0.5%
Scotts Mills UGB	0.1%	0.1%
St. Paul UGB	0.1%	0.1%
Sublimity UGB	0.7%	0.6%
Turner UGB	2.0%	1.4%
Larger UGBs	88.9%	91.6%
Outside UGBs	0.4%	0.0%

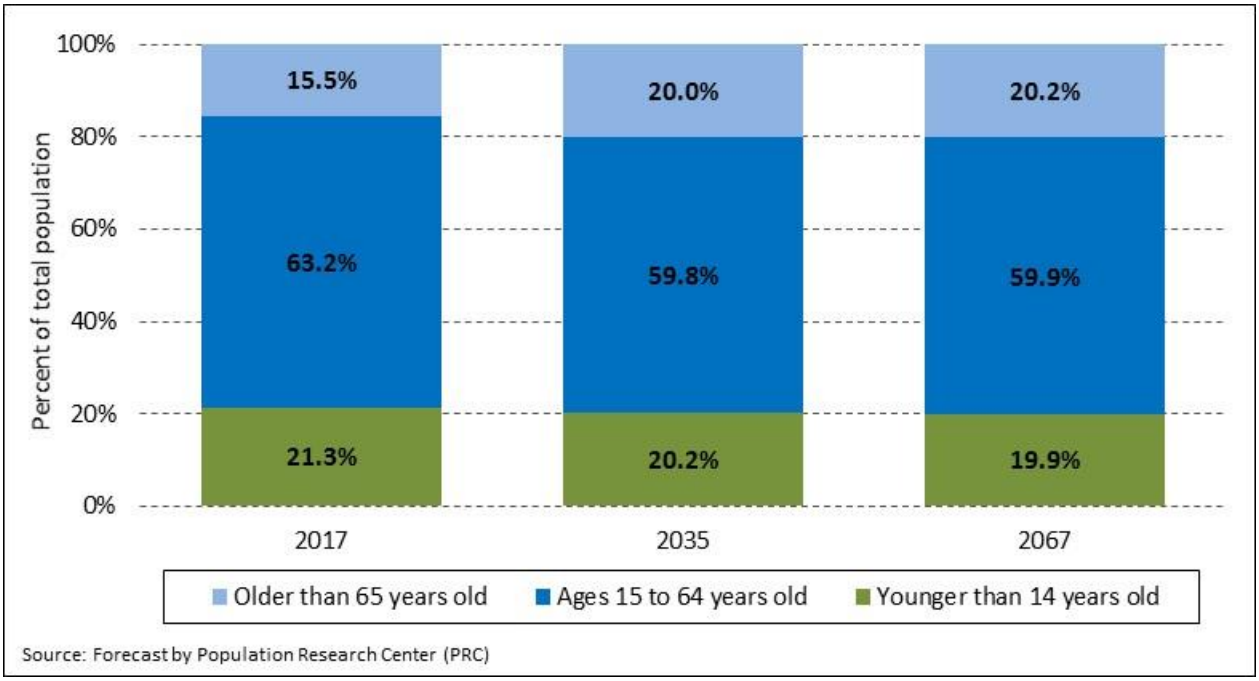
Source: Forecast by Population Research Center (PRC)

Note: Larger UGBs are those with populations equal to or greater than 7,000 in forecast launch year.

Forecast Trends in Components of Population Change

As previously discussed, a key factor in increasing deaths is an aging population. From 2017 to 2035 the proportion of the county population 65 or older is forecast to grow from roughly 15 percent to 20 percent; however the proportion of the population 65 or older is expected to stabilize from 2035 to 2067 (**Figure 20**). For a more detailed look at the age structure of Marion County's population see the final forecast table published to the forecast program website (http://www.pdx.edu/prc/opfp).

Figure 20. Marion County—Age Structure of the Population (2017, 2035, and 2067)

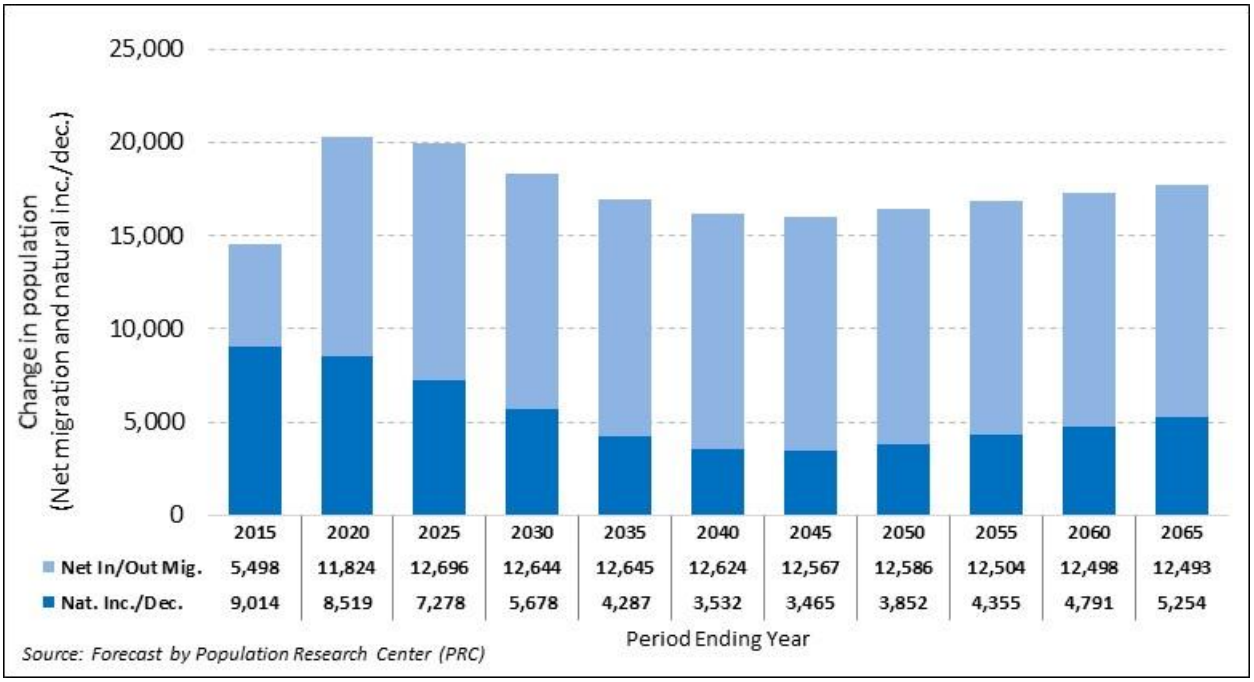


As the countywide population ages in the near-term—contributing to a slow-growing population of women in their years of peak fertility—and more women choose to have fewer children and have them at an older age, the increase in average annual births is expected to slow. This, combined with the rise in number of deaths, is expected to cause natural increase to drop in magnitude (**Figure 21**).

Net in-migration is forecast to increase rapidly in the near-term and then stabilize over the remainder of the forecast period. The majority of these net in-migrants are expected to be middle-aged individuals and young children under the age of 5.

In summary, a decline in the magnitude of natural increase and steady net in-migration are expected to lead to population growth reaching its peak in 2020 and then slightly tapering through the remainder of the forecast period (**Figure 21**). An aging population is expected to lead to an increase in deaths and a smaller proportion of women in their childbearing years that will likely result in a long-term decline in birth rates. Net in-migration is expected to remain relatively steady throughout the forecast period, and therefore will complement a diminishing natural increase.

Figure 21. Marion County—Components of Population Change, 2015-2065



Glossary of Key Terms

Cohort-Component Method: A method used to forecast future populations based on changes in births, deaths, and migration over time.

Coordinated population forecast: A population forecast prepared for the county along with population forecasts for its urban growth boundaries (UGB) and non-UGB area.

Housing unit: A house, apartment, mobile home or trailer, group of rooms, or single room that is occupied or intended for occupancy.

Housing-Unit Method: A method used to forecast future populations based on changes in housing unit counts, occupancy rates, the average numbers of persons per household (PPH), and group quarter population counts.

Occupancy rate: The proportion of total housing units that are occupied by an individual or group of persons.

Persons per household (PPH): The average household size (i.e. the average number of persons per occupied housing unit).

Replacement Level Fertility: The average number of children each woman needs to bear in order to replace the population (to replace each male and female) under current mortality conditions in the U.S. This is commonly estimated to be 2.1 children per woman.

Appendix A: Surveys and Supporting Information

Supporting information is based on planning documents and reports, and from submissions to PRC from city officials and staff, and other stakeholders. The information pertains to characteristics of each city area, and to changes thought to occur in the future. The cities of Aumsville, Aurora, Hubbard, Idanha, Keizer, Mount Angel, St. Paul and Woodburn did not submit survey responses.

Aumsville — Marion County—NO SURVEY RESPONSE						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
						Promos: **Hinders:**

Aumsville — Marion County—NO SURVEY RESPONSE	
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and the stage in the expansion process)	N/A
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Aurora — Marion County—NO SURVEY RESPONSE						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
						Promos: **Hinders:**
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and	N/A					

Aurora — Marion County—NO SURVEY RESPONSE	
the stage in the expansion process)	
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Detroit — Marion County—2/14/2017						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
There has been a decline of children in the last ten years due schools being closed and also due to population shift to second home owners.	Occupancy rates are stable. More than half of our home owners are second home owners	A 31 lot single-family residential sub-division is planned on the former high school grounds. No official plans have been submitted to the city.	None	Development of a storage facility has been applied for and expected to be completed in 2017	The water supply of the water system was updated in 2009 and the city plans to upgrade the water distribution system in 2017	**Promos:** **Hinders:** Not having a sewer system hinders growth for both residential and commercial use. A Wastewater facility would add potential for commercial and residential growth. A North Santiam Wastewater feasibility and Lands Inventory Study, sponsored by Marion County and Business Oregon Infrastructure Finance Authority (IFA) was completed in January 2017.

Detroit — Marion County—2/14/2017	
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and the stage in the expansion process)	A study was done in winter of 2013 that was not adopted by the city and was done for commercial and Industrial land only. There is no plan for expansion of the UGB.
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Donald — Marion County—11/17/2016						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
Working families and retirees. Majority white, some Latino	Nearly every house in Donald is occupied. We can monitor through utility bills. We are asked nearly daily for rentals. House sales flip quickly	We had a Housing Needs Analysis and an Economic Opportunities Analysis preformed. We learned that to meet the 2034 population projection of 2085 we need 856 dwelling units to accommodate the projected growth - 465 additional housing units (more than double current)		A 240,000 sq ft building that will house Wilco distribution center + Hazelnut Growers of OR processing + in future 3 more employers with 75 expected employees	Need a list of water projects completed, including new well site and sewer improvements. Nearly at capacity for both	**Promos:** **Hinders:** The UGB and Annexation lines are almost matched. We need either a developer to pick-up the cost for annexation of land or a grant to explore the possibilities**.**

Donald — Marion County—11/17/2016	
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and the stage in the expansion process)	N/A
Other information (e.g. planning documents, email correspondence, housing development survey)	**According to PRC background research:** - Donald has a surplus of residential land zoned for SF and a deficit of land for multifamily and mobile homes use. - According to 2015 Comp Plan, there are limited employment opportunities which are not sufficient to fully support the working people of the city. - However, there is sufficient commercial and industrial land available within the Donald urban are to meet the forecast demand.

Gates — Marion County—NO SURVEY RESPONSE						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
						Promos: **Hinders:**
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and	N/A					

Gates — Marion County—NO SURVEY RESPONSE	
the stage in the expansion process)	
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Gervais — Marion County—10/27/2016						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development /Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
Majority of population is hispanic with migrant fluctuation in the summer months. Some russian. Otherwise stable mix of elderly, and families with children.	Occupancy rates are stable. We have seen an increase in residential building permits. They have mostly been older homes that were demolished and replaced with two to four single family homes. In 2014, Gervais had 665 dwelling units and 98% of those were single-family dwellings.	No known development is planned though the pipeline survey says there are 299 units planned for the city of Gervais. No other information was provided.		Dollar General Store - will add approximately 12 jobs in the Spring of 2017	Our infrastructure capacity adequately serves current population. As the city grows, eventually the infrastructure will need to be expanded on.	**Promos:** The city has approximately 22.5 net residential buildable acres in its urban area (city limits & UGB). Gervais is a bedroom community to Woodburn, and the metro area is close and easily accessible for people who move here wanting a slower pace but still commute to work in the bigger, surrounding cities. There has been talk of adding an interchange off of I-5 that would lead directly into Gervais. **Hinders:** Gervais currently has a shortage of 74 acres of residential land to meet the estimated population and housing mix in 2034.

Gervais — Marion County—10/27/2016	
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and the stage in the expansion process)	We just had the EOA, BLI and HNA analysis updated in 2015. Gervais currently has a shortage (as mentioned above) of residential land and a surplus of employment lands. Total employment growth in the urban area is projected to be 95 by the year 2034. Gervais is primarily residential, single-family dwelling with very little economy. Bedroom community to Salem and Woodburn.
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Hubbard — Marion County—NO SURVEY RESPONSE						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
						Promos: **Hinders:**
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and	N/A					

Hubbard — Marion County—NO SURVEY RESPONSE	
the stage in the expansion process)	
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Idanha — Marion County—NO SURVEY RESPONSE						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
						Promos: **Hinders:**
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and	N/A					

Idanha — Marion County—NO SURVEY RESPONSE	
the stage in the expansion process)	
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Jefferson — Marion County—10/6/2016						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
No changes observed	Appears to be a lack of market value houses and rentals properties	Recently annexed 14.79 acres of R1 (Residential Low Density) but owner has no plans to develop. Local manufactured home subdivision only has two lots left to place homes on		Possible national retail chain	Sewer plant is only 5 years old. City is saving for a new water plant; construction expected to begin in 3 - 5 years	**Promos:** **Hinders:** Lack of housing
Highlights or summary from planning documents of influences on or anticipation of population and housing growth	N/A					

Jefferson — Marion County—10/6/2016	
(including any plans for UGB expansion and the stage in the expansion process)	
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Lyons — Marion County—1/20/2017						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
Population composition hasn't changed.	Residential construction has increased with seven new homes in 2016. Real estate sales have also picked up.	Construction 5 SFR units are underway. Square footage ranges from 2200 sq ft to 3900 sq ft. Prices range from $99,000 to $347,000.	None	One business is adding a new plant which isn't within the city limits. It may encourage housing development in Lyons.	Limited infrastructure.	**Promos:** **Hinders:** Lack of a sewer system hinders our growth.
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and	The planning commission recently approved a partition application which divides one parcel into three separate parcels. Currently, we have a development parcel that is for sale with the potential of being subdivided into 12 lots.					

Lyons — Marion County—1/20/2017	
the stage in the expansion process)	
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Mill City — Marion County—11/1/2016						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
Large section of retirees. More families with school age children moving to area. High percentage of Hispanic population.	Large portion of housing is old. Home sales have increased in last 12 months.	Potential for 50+ housing development within 5 years, property currently located outside UGB so annexation must first be done.	N/A	Recently Oregon Connections Academy (ORCA) moved to Mill City, Subway opened, Dollar General looking to open in 2017, 9 room hotel, restaurant, shopping complex coming in 2018.	Infrastructure capacity should be able to accommodate up to half (+/-) of the anticipated housing. However, large development or high use (restaurant) development would cause concern with sewer. Water and sewer both had upgrades within 10 years. Repairs needed on both and streets.	**Promos:** **Hinders:** Lack of industrial lands within city limits hinders growth. Rural location with little to no public transportation to needs (hospital, colleges, groceries, etc) hinders growth.

Mill City — Marion County—11/1/2016	
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and the stage in the expansion process)	N/A
Other information (e.g. planning documents, email correspondence, housing development survey)	**According to PRC background research:** - The Comp Plan and BLI report in 2015 concluded that Mill City has adequate supply of buildable land inside the Mill City Urban Growth Boundary to serve the needs of the community during the 20-year planning period from 2014 to 2035.

Keizer — Marion County—NO SURVEY RESPONSE						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
						Promos: **Hinders:**
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and	N/A					

Keizer — Marion County—NO SURVEY RESPONSE	
the stage in the expansion process)	
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Mt. Angel — Marion County—NO SURVEY RESPONSE						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
						Promos: **Hinders:**
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and	N/A					

Mt. Angel — Marion County—NO SURVEY RESPONSE	
the stage in the expansion process)	
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Salem — Marion County—11/2/2016						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
Relatively young population (In 2010 the median age was 35, compared to 38 for Oregon). Salem is also growing older (24% 60 and older projected by 2035). Large share of single person households (29% in 2010, compared to 27% for Oregon). More families with children (34% in 2012, compared to 27% for Oregon). Hispanic/Latino population has grown (15% in 2000, 20% in 2010).	New single family residential subdivision and multi-family apartment development is generally picking up, as shown in housing development survey. Projected need for more multiple family units over the next 20 years. City has started a work plan to address the projected future need for addition multi-family units	738 SFR units in the pipeline of which 368 are under construction, 144 have been approved and 226 are under review. 868 MF units in the pipeline of which 279 units are under construction, 381 have been approved and 208 are under review.		- Henningsen Cold Storage: 5 employees (phase 1); additional 3 phases planned with an additional estimated 20 employees - Local brewery expansion: additional 5-10 employees - Open Source Dental (they are locating on Kuebler Boulevard) - they went through site plan review; don't know the	Many undeveloped areas lack adequate water and/or sewer infrastructure, but SDC funding is available for growth-related infrastructure. 5-year CIP includes "Pump station upgrades to serve new employment center" which is indirectly related to	**Promos:** Salem's industrial land base is unique within the Willamette Valley. Salem has about 900 acres of high value industrial land, in areas such as the Mill Creek Corporate Center. Salem also has a surplus of single family residential land. **Hinders:** Projected deficit of 271 acres of land designated for commercial uses over next 20-years. Adopted EOA includes recommendations to address this deficit. Projected deficit of approx.. 207 acres (2,900 units) of multiple family land over the next 20 years. The City has a work plan in place to address this projected

Salem — Marion County—11/2/2016						
	through exploring possibility of allowing accessory dwelling units and additional density (duplex and triplexes) in some single family residential areas.			employee estimates - Spec buildings at Mill Creek Corporate Center to accommodate new/expanding businesses (100,000 SF construction to start spring 2017) - estimate of 50 jobs for end of 2017 - early 2018? - Two local food processing companies - expansions planned in 2017 - estimate additional 25 jobs	population growth.	need for more multiple family dwelling units, as described above.

Salem — Marion County—11/2/2016	
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and the stage in the expansion process)	The Salem portion of the shared Salem-Keizer UGB is expected to grow area is projected to grow from 210,035 in 2015 to 269,274 in 2035 (Salem HNA, 2014). Our recent HNA and EOA conclude that no UGB expansion is needed. HNA identifies a projected deficit of 2,900 multifamily units (about 207 acres) over the next 20 years. The City is addressing this projected deficit with a work plan, as described above. Currently important industries in Salem are: Food and Beverage Manufacturing, Medical Services, and Government Services. Employment in medical services will grow with population growth to the extent that Salem continues to offer medical services not available in surrounding areas. Salem will continue to be a center for government jobs, especially for jobs in State Government. Salem's competitive advantages in attracting new employers include: location on I-5 and in close proximity to other cities and resources, presence of state government, access to highly skilled workers, and high quality of life. Salem is targeting the following industries for future growth, based on research about a wide range of potential target industries that might be appropriate for Salem, considering our competitive advantages: Technology manufacturing, Equipment manufacturing, Specialty metal manufacturing, Specialty food and beverage manufacturing, and Chemical manufacturing.
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Scotts Mills — Marion County—01/31/2017						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
Minimal population increase	There were 3 new single family homes built in 2016, 2 are completed and 1 is still in process	No Housing Development scheduled	None planned	None planned	There are plans to replace water lines with larger ones to help water flow	**Promos:** **Hinders:** Population growth is hindered by size of city limits
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and	N/A					

Scotts Mills — Marion County—01/31/2017	
the stage in the expansion process)	
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Silverton — Marion County—11/3/2016						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
Not a lot of variation over the years. 92% white with a median age of 35.	Vast majority of new housing is single family, 3-4 bedrooms.	93 unit apartments, est. comp. 2017/18. 20 unit farm worker housing est. comp 2017. 40 lot subdivision & 8 lot subdivision est. comp 2016. 76 & 10 lot subdivision est. comp 2018.		No large scale on the horizon. Industrial park has been filling up since 2012, which added about 250 jobs.	Sewer plant nearing capacity, have projects budgeted to increase capacity.	Silverton likes its small town feel and will never promote growth. Council passed a resolution to not consider annexations until Corvallis legal challenge to SB1573 has been concluded. **Promos:** **Hinders:**

Silverton — Marion County—11/3/2016	
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and the stage in the expansion process)	They have adequate land in UGB.
Other information (e.g. planning documents, email correspondence, housing development survey)	**According to PRC background research:** - The upper-end of the employment growth and land need scenario assumes 11 acres of net new industrial vacant land demand, which is below the estimated vacant industrial land supply of 84.7 acres. Hence, Silverton can easily accommodate the high industrial job growth scenario without expanding its Urban Growth Boundary. - Silverton Enterprise Zone is a rural zone sponsored by the city. It was designated in 2013 and terminates in 2023.

St. Paul — Marion County—NO SURVEY RESPONSE						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
						Promos: **Hinders:**
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and the stage in the expansion process)	N/A					

St. Paul — Marion County—NO SURVEY RESPONSE	
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Stayton — Marion County—1/22/2017						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
Stayton seems to have a high proportion of families; average household size has not decreased as much in Stayton as national or state averages; percentage of Hispanic families appears to be holding steady	Housing growth has been slow in recent decade; no multi-family development since 2002	Three housing developments: Wildlife Meadows with 40 single family units and 4 duplexes (8-units) currently under construction and should be done by 2020. Hayden Homes with 50 single family units, construction expected to start late summer 2017. Downtown Fourplex with 4-unit townhouse style apartments, approved and expected to start construction this summer.	None known	None known	Sewer and water have capacity for growth; City has constructed improvements to accommodate growth and has additional improvements planned	**Promos:** available utility capacity; location relative to Salem **Hinders**: lack of available land in city limits; perception of difficulty to annex land

Stayton — Marion County—1/22/2017	
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and the stage in the expansion process)	No UGB expansion needed for housing for several decades
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Sublimity — Marion County—11/1/2016						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
The City of Sublimity has many long-established families (> 100 years) who are residents here. There is, though, a measurable influx of younger couples and families.		We have a current development, the Hassler Farms Subdivision, with about 100 single family homes (a few duplexes) planned over the next couple of years in three phases. There is other buildable land, with about 40 acres presumably going to be eligible for development within the next 2-3 years.	Probably some expansion of our Marian Estates (senior health care and assisted living)	The City has just embarked on its first strategic planning, and as part of that effort the philosophy towards the City's 'stance' towards future employers will likely be determined.	Though there is considerable acreage available for growth within the City limits, the issue of water rights is paramount in all of our future planning.	**Promos:** **Hinders:** As noted, the availability of water is the key factor. The desire to remain "as is" among some residents and growth, though planned and executed deliberately and purposefully will be key to Sublimity's future.

Sublimity — Marion County—11/1/2016	
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and the stage in the expansion process)	No immediate plans for UGB expansion; The Comprehensive Plan, dated 1997, has never been approved by the state.
Other information (e.g. planning documents, email correspondence, housing development survey)	**According to PRC background research:** - Sublimity is primarily a residential commuter town that depends on employment for the most part in Salem or Stayton. This can be attributed to the lack of local employment opportunities and the city's desire to remain more of a residential town with a rural atmosphere.

Turner — Marion County—NO SURVEY RESPONSE						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
Less elderly population as community members die; more Hispanic population with younger and larger families	Vacancy rate is almost zero. Houses are in high demand, old foreclosures are gone, low supply of apartments make them very sought after	Crawford Crossing: 295 single family approved and underway and 130 multifamily units approved and underway. Construction starting 2018.	None	None	Excellent. 20 year capacity for water/sewer/streets. Schools will become pressure point for adding classrooms	**Promos:** Approved development with 70 acre lake and 40 acre park. 30 percent of Turner Elementary students are from Salem showing desire to 'get into' district. **Hinders:**

Turner — Marion County—NO SURVEY RESPONSE	
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and the stage in the expansion process)	No data generated from our UGB work yet.
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Woodburn — Marion County—NO SURVEY RESPONSE						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
						Promos: **Hinders:**
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and	N/A					

Woodburn — Marion County—NO SURVEY RESPONSE	
the stage in the expansion process)	
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Unincorporated Area — Marion County— 10/7/2016						
Observations about Population Composition (e.g. about children, the elderly, racial ethnic groups)	**Observations about Housing (including vacancy rates)**	**Planned Housing Development/ Est. Year Completion**	**Future Group quarters Facilities**	**Future Employers**	**Infrastructure**	**Promotions (Promos) and Hindrances (Hinders) to Population and Housing Growth; Other notes**
		Approximately 300 dwellings approved to be constructed in rural Marion County under Measure 49 waivers. Generally, occupancy of those homes is relatively love, around 2 pph. Total capacity: 600 persons.				**Promos:** **Hinders:**

Unincorporated Area — Marion County— 10/7/2016	
Highlights or summary from planning documents of influences on or anticipation of population and housing growth (including any plans for UGB expansion and the stage in the expansion process)	N/A
Other information (e.g. planning documents, email correspondence, housing development survey)	N/A

Appendix B: Specific Assumptions

Aumsville

The 5-year average annual housing unit growth rate is assumed to decline throughout the forecast period. The occupancy rate is assumed to be steady at 94.8 percent throughout the 50 year horizon. PPH is assumed to be stable at 3.06 over the forecast period. Group quarters population is assumed to remain at 5.

Aurora

The 5-year average annual housing unit growth rate is assumed to decline throughout the forecast period. The occupancy rate is assumed to be steady at 96.2 percent throughout the 50 year horizon. PPH is assumed to be stable at 2.73 over the forecast period. There is no group quarters population in Aurora.

Detroit

The 5-year average annual housing unit growth rate is assumed to slightly decline throughout the forecast period. The occupancy rate is assumed to be steady at 26.1 percent throughout the 50 year horizon. PPH is assumed to be stable at 2.15 over the forecast period. There is no group quarters population in Detroit.

Donald

The 5-year average annual housing unit growth rate is assumed to rapidly increase during the first 10 years and then decline thereafter. The occupancy rate is assumed to be steady at 93.3 percent throughout the 50 year horizon. PPH is assumed to be stable at 2.82 over the forecast period. There is no group quarters population in Donald.

Gates

The 5-year average annual housing unit growth rate is assumed to slightly decline throughout the forecast period. The occupancy rate is assumed to be steady at 84.6 percent throughout the 50 year horizon. PPH is assumed to be stable at 2.20 over the forecast period. There is no group quarters population in Gates.

Gervais

The 5-year average annual housing unit growth rate is assumed to decline throughout the forecast period. The occupancy rate is assumed to be steady at 92.2 percent throughout the 50 year horizon PPH is assumed to steadily decrease from 4.26 to 3.06 throughout the forecast period. Group quarters population is assumed to remain at 36.

Hubbard

The 5-year average annual housing unit growth rate is assumed to slightly decline throughout the forecast period. The occupancy rate is assumed to be steady at 95.5 percent throughout the 50 year horizon. PPH is assumed to be stable at 3.29 over the forecast period. There is no group quarters population in Hubbard.

Idanha

The 5-year average annual housing unit growth rate is assumed to remain stable at 0.20 percent throughout the forecast period. The occupancy rate is assumed to be steady at 79.7 percent throughout the 50 year horizon. PPH is assumed to be stable at 2.41 over the forecast period. There is no group quarters population in Idanha.

Jefferson

The 5-year average annual housing unit growth rate is assumed to decline throughout the forecast period. The occupancy rate is assumed to be steady at 94.6 percent throughout the 50 year horizon. PPH is assumed to be stable at 2.92 over the forecast period. Group quarters population is assumed to remain at 5.

Lyons

The 5-year average annual housing unit growth rate is assumed to decline from 8 percent to zero percent during the first 10 years and then remain at zero percent thereafter. The occupancy rate is assumed to be steady at 84.1 percent throughout the 50 year horizon. PPH is assumed to be stable at 2.42 over the forecast period. There is no group quarters population in Lyons.

Mill City

The 5-year average annual housing unit growth rate is assumed to slightly decline throughout the forecast period. The occupancy rate is assumed to be steady at 82.7 percent throughout the 50 year horizon. PPH is assumed to be stable at 2.79 over the forecast period. There is no group quarters population in Mill City.

Mount Angel

The 5-year average annual housing unit growth rate is assumed to increase during the first 10 years and then decline thereafter. The occupancy rate is assumed to be steady at 94.2 percent throughout the 50 year horizon. PPH is assumed to be stable at 2.59 over the forecast period. Group quarters population is assumed to remain at 305.

Salem-Keizer

Total fertility rates are assumed to follow a historical trend (observed from the 2000 to 2010 period) and gradually decline over the forecast period. Survival rates are assumed to be the same as those forecast

for the county as a whole; these rates are expected to gradually increase over the 50-year period. Age specific net migration rates are assumed to deviate from historical county patterns, with the sub-area experiencing a net in-migration of 20-29 year olds.

Scotts Mill

The 5-year average annual housing unit growth rate is assumed to decline throughout the forecast period. The occupancy rate is assumed to be steady at 95 percent throughout the 50 year horizon. PPH is assumed to be stable at 2.80 over the forecast period. There is no group quarters population in Scotts Mill.

Silverton

Total fertility rates are assumed to follow a historical trend (observed from the 2000 to 2010 period) and gradually decline over the forecast period. Survival rates are assumed to be the same as those forecast for the county as a whole; these rates are expected to gradually increase over the 50-year period. Age specific net migration rates are assumed to follow historical county patterns.

St. Paul

The 5-year average annual housing unit growth rate is assumed to slightly decline throughout the forecast period. The occupancy rate is assumed to be steady at 97.3 percent throughout the 50 year horizon. PPH is assumed to be stable at 2.86 over the forecast period. There is no group quarters population in St. Paul.

Stayton

Total fertility rates are assumed to follow a historical trend (observed from the 2000 to 2010 period) and gradually decline over the forecast period. Survival rates are assumed to be the same as those forecast for the county as a whole; these rates are expected to gradually increase over the 50-year period. Age specific net migration rates are assumed to deviate from historical county patterns, with the sub-area experiencing a net out-migration of 20-29 year olds and higher net in-migration rates for retirees.

Sublimity

The 5-year average annual housing unit growth rate is assumed to slightly decline throughout the forecast period. The occupancy rate is assumed to be steady at 93.1 percent throughout the 50 year horizon. PPH is assumed to be stable at 2.33 over the forecast period. Group quarters population is assumed to remain at 283.

Turner

The 5-year average annual housing unit growth rate is assumed to decline throughout the forecast period. The occupancy rate is assumed to be steady at 92.4 percent throughout the 50 year horizon. PPH is assumed to be stable at 2.61 over the forecast period. Group quarters population is assumed to remain at 31.

Woodburn

Total fertility rates are assumed to follow a historical trend (observed from the 2000 to 2010 period) and gradually decline over the forecast period. Survival rates are assumed to be the same as those forecast for the county as a whole; these rates are expected to gradually increase over the 50-year period. Age specific net migration rates are assumed to follow historical county patterns, but with higher rates for retirees.

Outside UGBs

The 5-year average annual housing unit growth rate is assumed to slightly decline throughout the forecast period. The occupancy rate is assumed to be steady at 93.8 percent throughout the 50 year horizon. PPH is assumed to be stable at 2.83 over the forecast period. Group quarters population is assumed to remain at 698.

Appendix C: Detailed Population Forecast Results

Figure 22. Marion County—Population by Five-Year Age Group

Population Forecasts by Age Group / Year	2017	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2067
00-04	24,691	25,352	26,197	26,969	27,816	28,816	29,909	31,003	32,054	33,109	34,228	34,704
05-09	23,891	24,434	25,568	26,399	27,186	28,059	29,082	30,197	31,303	32,373	33,452	33,907
10-14	23,384	23,915	24,862	25,996	26,850	27,669	28,573	29,627	30,764	31,900	33,005	33,447
15-19	24,007	24,271	25,231	26,211	27,415	28,337	29,217	30,184	31,300	32,512	33,727	34,197
20-24	22,550	23,062	23,521	24,435	25,395	26,584	27,495	28,365	29,308	30,405	31,599	32,075
25-29	22,780	23,029	23,943	24,404	25,363	26,382	27,635	28,597	29,506	30,500	31,658	32,158
30-34	22,140	22,839	23,290	24,200	24,675	25,666	26,714	27,998	28,977	29,911	30,935	31,408
35-39	21,200	21,626	22,818	23,254	24,175	24,671	25,679	26,747	28,038	29,033	29,987	30,402
40-44	20,767	21,541	22,308	23,530	23,994	24,970	25,503	26,563	27,678	29,032	30,083	30,485
45-49	20,489	21,097	22,468	23,267	24,568	25,082	26,128	26,708	27,833	29,026	30,473	30,922
50-54	20,268	20,250	21,293	22,655	23,469	24,800	25,324	26,384	26,962	28,097	29,307	29,886
55-59	20,094	20,175	20,174	21,201	22,565	23,395	24,739	25,272	26,331	26,916	28,062	28,546
60-64	19,054	19,778	19,943	19,939	20,973	22,349	23,197	24,553	25,093	26,164	26,768	27,228
65-69	16,306	17,739	18,919	19,078	19,111	20,154	21,518	22,379	23,729	24,287	25,366	25,616
70-74	13,300	15,253	17,442	18,438	18,448	18,344	19,200	20,338	20,978	22,064	22,398	22,716
75-79	9,613	11,445	14,313	16,258	17,078	16,985	16,789	17,466	18,377	18,834	19,682	19,748
80-84	6,698	7,546	10,033	12,448	14,041	14,641	14,451	14,175	14,626	15,261	15,509	15,731
85+	6,535	6,771	7,778	9,740	12,230	14,603	16,387	17,419	17,981	18,701	19,632	19,965
Total	**337,773**	**350,125**	**370,099**	**388,420**	**405,352**	**421,508**	**437,540**	**453,978**	**470,837**	**488,126**	**505,872**	**513,142**

Population Forecasts prepared by: Population Research Center, Portland State University, June 30, 2017.

Figure 23. Marion County's Sub-Areas—Total Population

Area / Year	2017	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2067
Marion County	337,773	350,125	370,099	388,420	405,352	421,508	437,540	453,978	470,837	488,126	505,872	513,142
Aumsville UGB	4,209	4,750	5,253	5,731	6,141	6,501	6,768	7,001	7,197	7,390	7,582	7,658
Aurora UGB	1,028	1,080	1,168	1,248	1,321	1,387	1,445	1,496	1,538	1,580	1,613	1,622
Detroit UGB	216	218	222	225	227	229	231	232	234	235	237	237
Donald UGB	994	1,011	1,172	1,355	1,555	1,705	1,820	1,922	2,007	2,072	2,128	2,150
Gates UGB (Marion)	435	441	449	456	462	467	472	476	481	484	488	489
Gervais UGB	2,657	2,781	2,996	3,175	3,346	3,494	3,618	3,716	3,789	3,834	3,853	3,850
Hubbard UGB	3,375	3,527	3,711	3,893	4,074	4,256	4,440	4,626	4,791	4,958	5,127	5,195
Idanha UGB (Marion)	80	81	83	84	85	87	88	90	92	93	95	96
Jefferson UGB	3,318	3,446	3,664	3,866	4,071	4,279	4,470	4,641	4,814	4,988	5,165	5,237
Lyons UGB (Marion)	53	53	53	53	53	53	53	53	53	53	53	53
Mill City UGB (Marion)	309	313	319	326	333	339	345	351	357	363	369	371
Mount Angel UGB	3,551	3,570	3,665	3,757	3,847	3,935	4,023	4,110	4,196	4,282	4,369	4,403
Salem/Keizer UGB (Marion)	218,689	226,495	239,794	253,349	266,626	279,724	292,908	306,297	319,963	333,816	347,730	353,218
Scotts Mills UGB	384	402	427	448	465	480	494	507	521	535	548	554
Silverton UGB	10,214	10,701	11,545	12,341	13,076	13,759	14,406	15,032	15,631	16,193	16,704	16,889
St. Paul UGB	401	409	420	431	441	452	463	475	487	499	512	517
Stayton UGB	8,138	8,330	8,696	9,065	9,432	9,798	10,174	10,552	10,936	11,318	11,695	11,841
Sublimity UGB	2,857	2,930	3,060	3,193	3,316	3,430	3,534	3,628	3,714	3,789	3,854	3,876
Turner UGB	2,066	2,355	2,925	3,214	3,439	3,655	3,859	4,050	4,225	4,382	4,541	4,605
Woodburn UGB	26,211	27,399	29,608	31,923	34,187	36,322	38,330	40,246	42,077	43,839	45,574	46,262
Outside UGB Area	48,587	49,833	50,870	50,289	48,857	47,158	45,599	44,476	43,737	43,422	43,638	44,020

Population Forecasts prepared by: Population Research Center, Portland State University, June 30, 2017.

City of Stayton
OREGON

KELLER ASSOCIATES

January 2006

WATER MANAGEMENT & CONSERVATION

P L A N

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CHAPTER 1.0 – Executive Summary

1.1 GENERAL SYSTEM DESCRIPTION

The City of Stayton is a community with a population of approximately 7,300 people (2003) located about 15 minutes southeast of Salem. Its city limits encompass about 1,770 acres including residential, industrial, commercial and public facilities. Although 86% of the accounts are residential and only 10% are business, residential water demand accounts for 32% and business water demands account for 48%. The business water demand is dominated by Norpac Foods Inc. which accounts for 42% of the total annual water demand. Other water consumers include the wastewater treatment plant (WWTP), schools, churches, multi-family facilities.

The City of Stayton has 46.59 cfs of surface water rights off the North Santiam River and 5.67 cfs of groundwater rights. Of these water rights, 23.27 cfs can be used year round; 3.99 cfs can be used from May through September, and 25 cfs can be used only from October through April.

1.2 PURPOSE

Oregon Administrative Rule 690-315 and 690-086 triggered the need to prepare a Water Management and Conservation Plan (WMCP). The WMCP has also been completed in conjunction with the update of the City's water master plan. This is the first WMCP Stayton has submitted to the Oregon Water Resources Department (WRD).

1.3 PROPOSED PROGRESS REPORT AND UPDATE SCHEDULE

In order to meet state rules, the City intends to submit a progress report on or before September of 2009 (five years) to discuss goals, benchmarks, and its water system and consumption. It is anticipated that existing City water rights, will satisfy 20-year demands. As a result, the City does not expect to submit an updated WMCP until 10 years have expired (in 2014).

1.4 SUMMARY OF DATA SOURCES

The data presented throughout the WMCP, which includes consumption and production data, billing records, and conservation and curtailment programs, were collected and developed in conjunction with City staff.

Historic populations were retrieved from US Census data. City population estimates from 2001 to 2004 were approximated using Stayton building permit information. Growth projections are based on a continued growth of 3.35%.

1.5 INPUT DURING PLAN DEVELOPMENT

Also key to the development and success of the WMCP were members of a Technical Review Committee comprised of Tom Etzel (water supervisor), Mike Faught (public works director), Ed Sigurdson (city engineer), Don Albert (wastewater supervisor), and Allan Drawson (city technician). A draft of the WMCP will be submitted to Marion County for review with a request for comments. A final version of the WMCP will be presented to City Council for their approval.

1.6 DOCUMENT ORGANIZATION

The document was developed in a sequence that is consistent with the Division 86 rules. Chapter 2 contains a municipal supplier description including existing demographics and service area, water right summary, water use summary, and water facilities inventory. Chapter 3 discusses current and planned conservation measures and goals. Chapter 4 outlines the City's water curtailment program. Chapter 5 discusses the City's ability to meet the 20-year projected water demands.

CHAPTER 2.0 – Municipal Supplier Description

2.1 SERVICE AREA

The City of Stayton currently serves about 7,300 (2003) residents located inside the service area illustrated in Figure 1. Existing water customers include single-residence homes, apartments, mobile home parks, assisted living centers, irrigation accounts, churches, schools, commercial users, and industrial water consumers. The industrial user, Norpac Foods Inc., is the largest water consumer and accounts for approximately 42 percent of the annual water consumption.

2.1.1 Historical Stayton Populations

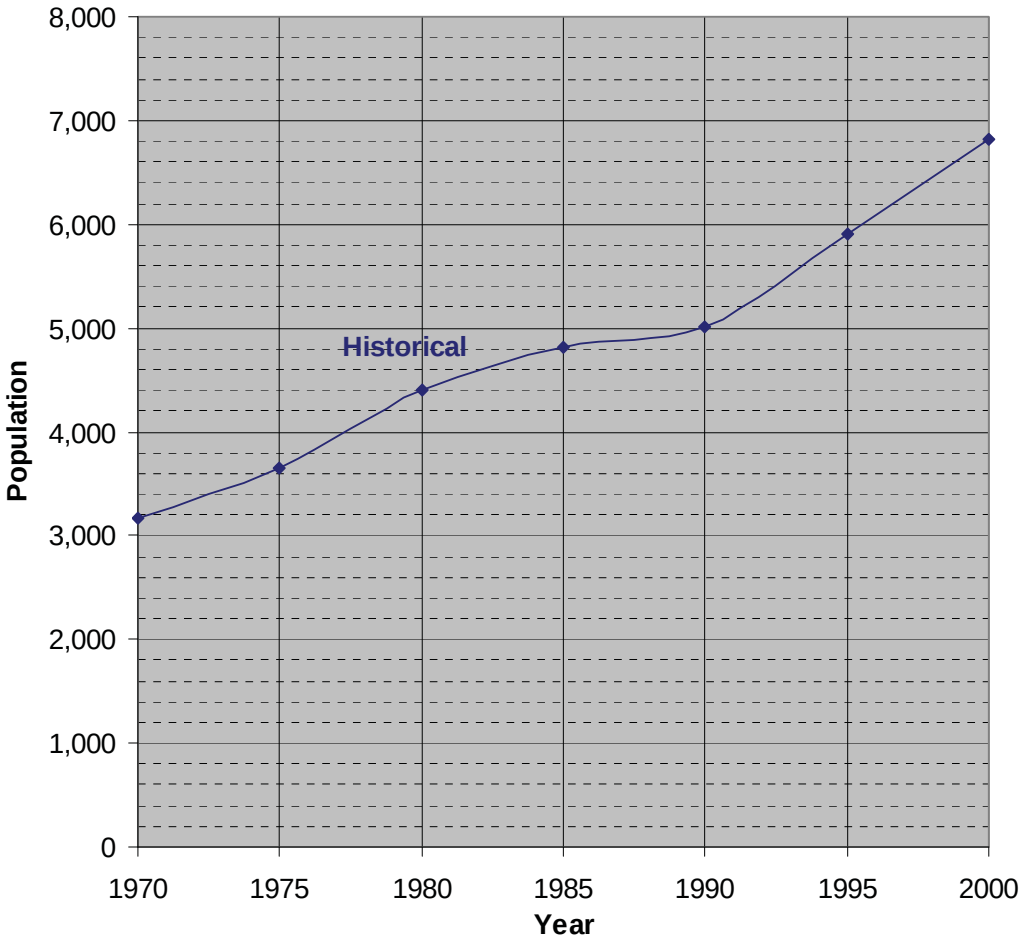
The estimated 2003 population for the City of Stayton is 7,300. Historical population in the City of Stayton and in Marion County retrieved from census data is shown in the following table.

Table 2.1
Stayton and Marion County Historical Population

Year	Office of Economic Analysis, State of Oregon and US Census—Marion Co.	Stayton Population Census Data	Marion County Growth Rate	Stayton % of Marion County	Stayton Annual Growth Rate
1970	151,309	3,170		2.10%	
1975	171,700	3,650	2.56%	2.13%	**2.86%**
1980	204,692	4,396	3.58%	2.15%	**3.79%**
1985	213,019	4,815	0.80%	2.26%	**1.84%**
1990	228,483	5,011	1.41%	2.19%	**0.80%**
1995	260,600	5,907	2.34%	2.27%	**3.34%**
2000	284,834	6,816	1.06%	2.39%	**2.90%**

As can be seen from the preceding table, the annual growth rate in Stayton declined between 1980 and 1990 and then rose sharply after 1990. The growth rate in Stayton has generally been higher than Marion County. Chart 2.1 illustrates historical population trends.

Chart 2.1
City of Stayton Historical Population



2.1.2 Existing Land Use

The City of Stayton includes lands designated as commercial, commercial retail, industrial, industrial agriculture, industrial commercial, light industrial, interchange development, low density residential, medium-high density residential, and public/semi-public zoning inside the city limits. Figure 2 in the Appendix graphically reflects the land use distribution adopted by the cities. The table below summarizes the breakdown in acreage for each land use type.

Table 2.2
Existing Land Use Inside Stayton City Limits Summary

Stayton		
Land Use	**Acres**	**% of Total**
Commercial	104	6%
Commercial Retail	47	3%
Industrial Agriculture	60	3%
Industrial Commercial	17	1%
Light Industrial	320	18%
Low Density Res.	709	40%
Medium-High Density Res.	273	15%
Public and Semi-Public	238	13%
Total Acreage	**1,768**	

2.2 SUMMARY OF EXISTING WATER SOURCES

The City currently holds 46.59 cfs of surface water rights from the North Santiam River and 5.67 cfs of groundwater rights. This includes 25 cfs under Permit 52447, which may only be exercised in the winter months (October thru April). Steven P. Applegate Consulting summarizes the City's year-round water right to be at least 23.27 cubic feet per second (cfs) which includes a recently acquired 10 cfs water right. This equates to 10,444 gpm or 15.04 MGD, which is 2.5 times greater than the current peak day demand of the City. A comprehensive review of the City's water rights and their current status is included in the Appendix.

Table 2.3
City of Stayton Water Rights Summary

Appl	Permit	Cert.	Source	Q (cfs)	POD	Prior.	Remarks
T-5883		80346	N. Santiam	2.78+	Power Canal	1909	779.5 AF annual limit
T-5884		80347	N. Santiam	0.82+	Salem Ditch *	1911	230.6 AF annual limit
T-5885		80348	N. Santiam	0.39+	Power Canal	1909	78.5 AF annual limit
T-8771		80349	N. Santiam	0.6~	Power Canal	1907	No annual limit
T-9192	12033		N. Santiam	10~	Salem Ditch	1923	Comp. Date – 10/2011
39297	29266	57094	N. Santiam	7~	Power Canal	1963	
71584	52447		N. Santiam	25#	Power Canal	1991	Extension pending to 2060
		Subtotal-Surface Water		46.59			
GR-145	Gr-139		Inf. Trench	2.67~	NWNE Sec 15	1930	Groundwater adjudication
G-270	G-173	24587	Well 2	3~	NENE Sec 15	1956	
		Subtotal-Groundwater		5.67			
		TOTAL WATER RIGHTS		52.26			

***** Salem Ditch and Stayton Power Canal assume in the record to be the same point of diversion-1800 feet South and 2830 feet East from the West ¼ Corner Section 11.
+ May through September only 3.99 cfs;
~ Year around use-23.27 cfs;
# October through April only-25 cfs;

All water rights have a designated municipal use. A comparison of the water right summarized in Table 2.3 and the seasonal water demand in Table 2.4 illustrates the estimated diversions under each water right. A majority of the wet weather water demands can be supplied by water from Certificate 57094 which is supplemented with groundwater from Certificate 24587 during periods when surface water is turbid and more difficult to treat at the water treatment plant. Dry weather water demands can be all supplied by water from Certificate 57094. Additional peak day water demands can be supplied by water from Certificate 80346. The projected 20 year peak day demand of 16.01 cfs summarized in Table 5.3 can all be supplied by water from developed water rights including water from Certificate 57094, 12033, 80349, 80348, 80347, 80346, Gr-139, and 24587.

The City's only undeveloped water right is for water granted under Permit 52447. Although this water right may not be necessary for demands in the next 20 years, the City will develop this water right sometime beyond the 20 year planning horizon to meet future water demands.

The main water source for the City is the N. Santiam River via the Power Canal. The Power Canal is fed from the North Channel of the Santiam River via a diversion structure that is situated approximately 1 mile east of the water treatment plant site. The City's use of the Power Canal is made possible through an interagency agreement with the Santiam Water Control District, which includes an annual use fee.

In addition to the Power Canal, the Water Treatment Plant (WTP) operates shallow infiltration wells that are located adjacent to and between the canal and the North Santiam River. The wells supply supplemental water during peak demand and high turbidity events. The water levels in the wells are reported to fluctuate with the levels of the river, as would be expected with a shallow well source that is significantly influenced by the river.

With the help of the Oregon Department of Fish and Wildlife, the Oregon Natural Heritage Information Center, and the Oregon Department of Agriculture, the Streamflow-dependent species listed by a state or federal agency in the North Santiam River were identified and are summarized below. The list below also includes those species identified by the City of Salem as part of their water management and conservation plan. The two cities' diversions are within a couple miles of each other. A list of those species identified as candidate species and species of concern is included in the Appendix.

<u>Fish</u>

- Spring Chinook Salmon
- Winter Steelhead

- Oregon Chub
- Pacific Lamprey

Wildlife

- Bald Eagles
- Western Pond Turtle
- Fender's Blue Butterfly
- Red-legged Frog

Plants

- Golden Indian Paintbrush
- Willamette Daisy
- Howellia
- Bradshaw's Lomatium
- Lincaid's Lupine
- Nelson's Checker-mallow
- White-topped Aster

It should be noted that the City has cooperated with the Santiam Water Control District in taking steps to minimize any negative impacts to sensitive, endangered, and threatened fish species by constructing a fish screen upstream of the water diversion and downstream from the water treatment plant on the Power Canal in order to isolate the plant from any fish species. The Oregon Department of Fish and Wildlife and NOAA Fisheries did review the construction plans and were involved in the construction methodology used for the fish screens. The US Fish and Wildlife also approved the biological opinion completed for the fish screen project.

The North Santiam River is listed as water quality limited with a water quality parameter of temperature. The details of the water quality listing have been included in the Appendix for reference. The City's water source is the North Santiam River and therefore is not in a critical groundwater area. The City does operate some shallow alluvial aquifer wells that are geographically located in limited groundwater areas, but are not from the aquifer of concern.

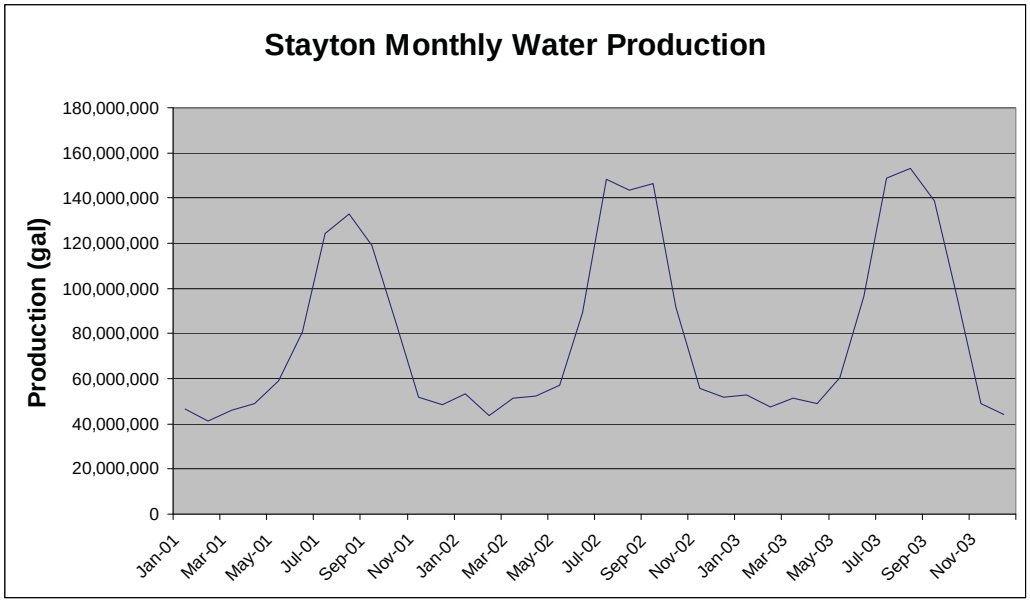
2.3 SUMMARY OF RECENT WATER USE

Water production data obtained from the WTP were used to summarize the current water production for the City. Historic water production from the Stayton WTP is summarized in Table 2.4.

Table 2.4
Stayton WTP Water Production

	Historical Water Production				
	2001 (MGD)	**2002 (MGD)**	**2003 (MGD)**	**2001-03 Average (MGD)**	**2001-03 Average (cfs)**
Average Day	2.42	2.70	2.71	2.61	4.04
Peak Day	5.19	6.08	6.65	5.97	9.24
Dry Weather (May-Oct)	3.26	3.68	3.77	3.57	5.53
Wet Weather (Nov-Apr)	1.56	1.70	1.63	1.63	2.52

Chart 2.2
Stayton Monthly Water Plant Production (2001-2003)

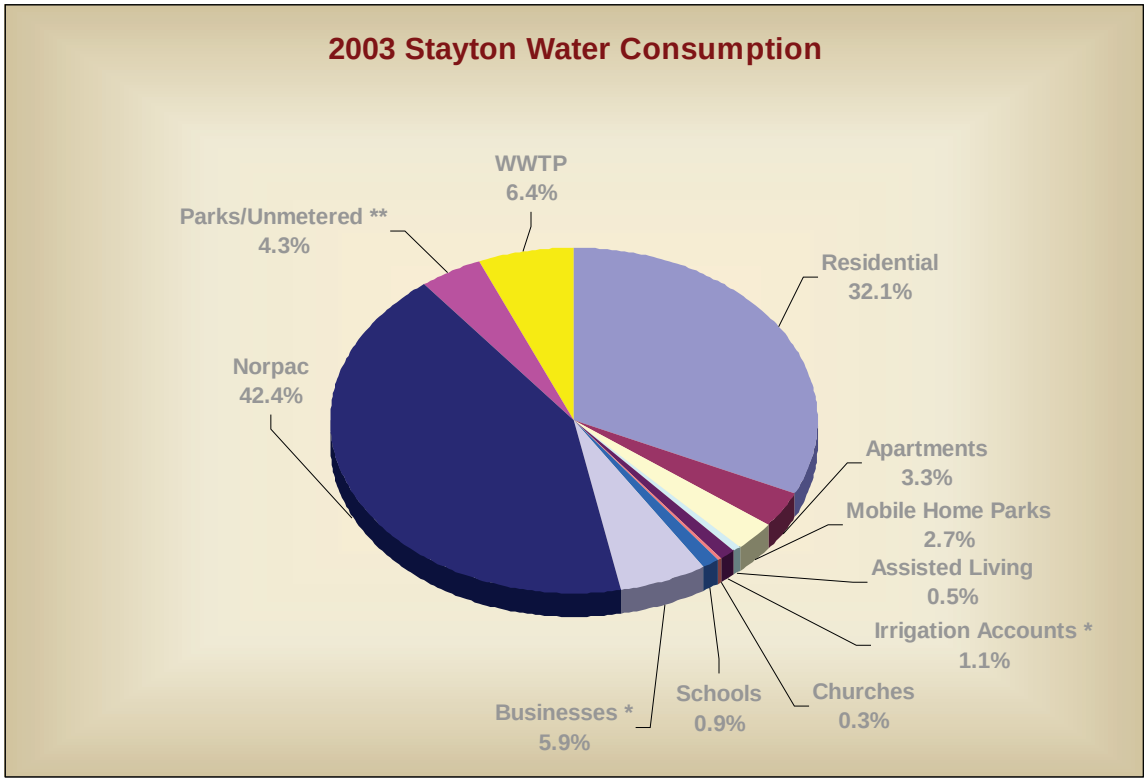


As illustrated in Chart 2.2, peak month flows correspond to the summer months of June through September during which time average flows more than double. This peak in production is generally a result of irrigation and a peak in summer use from the City's largest water consumer, Norpac Foods Inc. Industries. The processing of beans and corn creates a peak in Norpac Food's water demand during the months of July through October.

2.4 SUMMARY OF WATER CUSTOMERS

The City provides water to a variety of users. The general customer categories and their percentage of water use are illustrated in Chart 2.3.

Chart 2.3
Water Use Statistics for 2003



The "Residential" category includes both rental and owner occupied single-family residences and accounts for 32% of the water use for the City. Norpac Foods Inc. accounts for 42% of the total water consumption for the City. The "Parks/Unmetered" category includes the water used by the library, city hall, theatre, community center, cemetery, water plant, public works building, the pool, and the city parks. The Wastewater Treatment Plant (WWTP) uses approximately 6.4% of the total water provided.

Table 2.5 summarizes the demand for each category in gallons per capita per day. The severity of the system water loss is apparent by comparing the residential demand and the water loss. On an average day, the same amount of water used by the entire residential sector is lost from the system. The non-residential water demand stays fairly constant on a seasonal basis, averaging out to be about 46 gpcd. Norpac uses the largest percentage of water in comparison to the other categories.

Table 2.5
Water Use Statistics

Yearly Statistics	Existing Demands (MGD)	Existing Demands Per Capita				
		Total System [1] (gpcd)	Residential Only (gpcd)	Non-Residential (gpcd) [2]	Norpac (gpcd)	Water Loss (gpcd)
Average Day	2.71	371	106	46	114	106
Peak Day	6.50	890	N/A	N/A	N/A	N/A
Dry Weather (May-Oct)	3.75	514	147	56	197	113
Wet Weather (Nov-Apr)	1.65	226	64	35	29	97

Notes:

(1) Existing system includes residential and non-residential demands. Future demands from the existing system users are assumed to remain constant.

(2) Non-residential flow per capita per day excludes Norpac Demand.

2.5 FACILITIES DESCRIPTION

2.5.1 Source/Treatment

The City of Stayton operates a surface water treatment plant (WTP), which is currently rated for 6 million gallons per day (MGD). Treatment is accomplished through slow sand filtration and chemical addition to stabilize and disinfect the water. The City of Stayton currently draws their raw water from three sources: the N. Santiam River and two Ranney-type shallow ground water collectors.

The Power Canal is fed from the North Channel of the Santiam River via a diversion structure that is situated approximately 1 mile east of the WTP site. The ground water collectors include three shallow infilitration wells that are located between the Power Canal and the North Santiam River.

2.5.2 Transmission/Distribution

The City's water distribution system is composed of a network of pipes that total more than 44 miles and range from 1 to 24 inches in diameter. The water booster stations and transmission lines provide water service to pressure zones which are isolated by closed valves and pressure-reducing valves. Table 2.6 illustrates the length of pipe and percent of total for each pipe size.

Table 2.6
Water Distribution Pipe Size Summary

Pipe Size (in)	Total Length (ft)	% of Total
<= 2	28,537	12%
3	3,825	2%
4	28,227	12%
6	56,377	24%
8	39,524	17%
10	26,589	11%
12	26,664	11%
14	713	0.3%
16	9,213	4%
18	3,696	2%
20	8,977	4%
24	522	0.2%

The water distribution system is composed of various pipe materials as shown in Table 2.7.

Table 2.7
Water Distribution Pipe Material Summary

Pipe Type	Total Length (ft)	% of Total
Asbestos Cement	85,928	37%
Cast Iron	1,404	1%
Ductile Iron	72,146	31%
Galvanized Iron	10,320	4%
PVC	15,818	7%
Steel	47,076	20%

2.5.3 Finish Storage

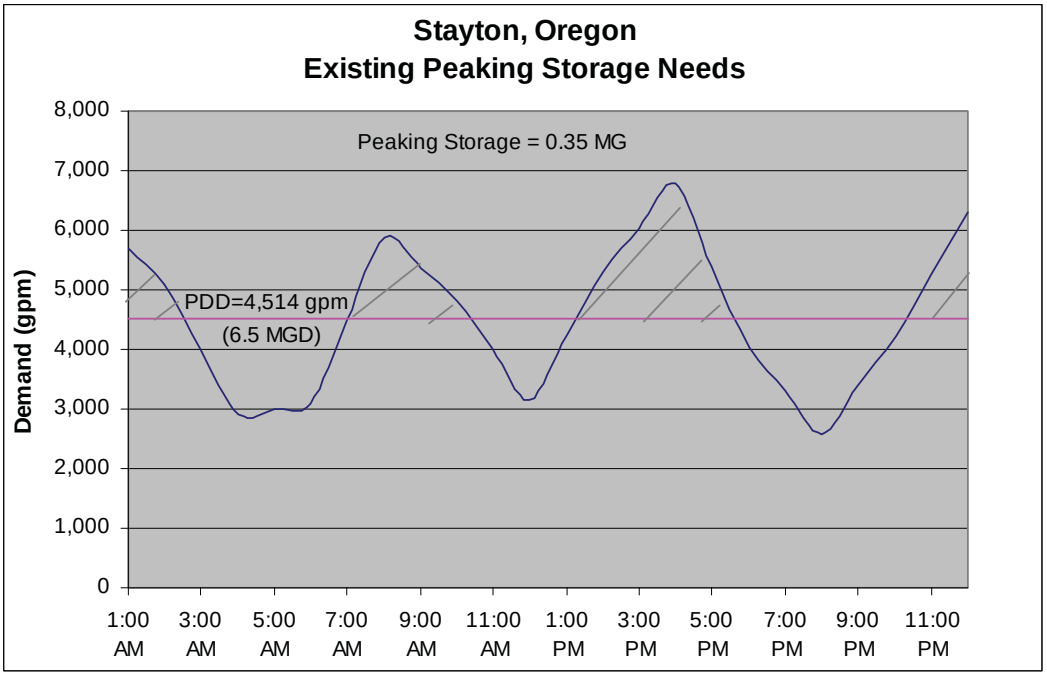
The City has a total of 6.9 million gallons of water storage in four storage facilities summarized in Table 2.8.

Table 2.8
Existing City Water Storage

Schedule M Reservoir	1.0	MG
Pine Street Reservoir	5.0	MG
WTP Reservoir	0.5	MG
Regis Reservoir	0.4	MG
Total Storage	**6.9**	**MG**

Storage is designed to provide both operational (daily peaking demand) and fire protection demand. The fire protection storage as stipulated by the International Fire Code was calculated by assuming a four-hour fire event with a demand of 4500 GPM. These assumptions correlate to fire storage of 1.08 MGD. The peaking storage is developed based on a local demand pattern which represents the variation in hourly demand. The demand pattern below was generated based on 24-hour monitoring data gathered on August 22, 2003. The peaks in the water demand occur at 8:00 am, 4:00 pm, and 12:00 am. The 8:00 am and 4:00 pm peak correspond to demands associated with preparation and returning from school and work. The 12:00 am peak likely corresponds to night time irrigation.

Chart 2.4
Existing Peaking Storage Needs



Based on the data and the assumptions outlined above, a comparison between the recommended and existing storage now, 2015, 2025, and at build-out is presented in Table 2.9.

Table 2.9
Estimated Water Storage (MG)

	2003 (MG)	2015 (MG)	2025 (MG)	Buildout (MG)
Peaking Storage [1]	0.35	0.44	0.56	0.67
Operational Storage	1.04	1.04	1.04	1.04
Fire Storage [3]	1.08	1.08	1.08	1.08
Minimum Recommended Storage	**2.47**	**2.56**	**2.68**	**2.79**
Emergency Storage (optional) [4]	2.70	3.45	4.33	5.21
Recommended Storage Volume	**5.17**	**6.01**	**7.01**	**8.00**
Less Existing Storage	*6.90*	*6.90*	6.90	6.90
Storage Need	**0.00**	**0.00**	**0.11**	**1.10**

Notes:

1. Assumed Peaking Storage using observed 24-hour demand pattern (8/22/2003) and assumes constant production equal to the peak day demand (PDD).
2. Assumed approximately 15% of existing storage to allow for volumn between "On" and "off" set points.
3. Assumed a 4-hr 4500 gpm fire event for the fire storage.
4. Assumed an average day demand for the emergency storage.

2.6 INTERCONNECTIONS

An 18-inch pipeline connects Stayton's Schedule "M" booster station and the 54-inch transmission line that feeds the City of Salem. Flow from Salem to Stayton must pass through a double check valve. Typical pressure in the Salem pipeline is approximately 23 psi. The check valves can be manually opened to allow flow from Stayton to Salem in the event of an emergency. Although the system was designed to provide emergency flow to Stayton, emergency flow has occurred in both directions in the past. Salem's SCADA system continuously monitors Chlorine and turbidity on the Salem's side of the intertie.

Salem has agreed to sell drinking water to Stayton at the rate of $0.35 per 100 cubic feet ($0.4679 per 1000 gallons), and Stayton has agreed to sell drinking water to Salem at the rate of $0.4346 per 100 cubic feet ($0.581 per 1000 gallons). The Mutual Water Agreement has been included as a reference.

2.7 SYSTEM EFFICIENCY

Table 2.8 compares reported water production data to consumption data. Water consumption for unmetered users such as the City Parks was approximated and included in the water consumption data reported below. The difference between water production and water consumption represents the amount of system water loss. Based on this data, water

losses account for 24 to 33% of all water leaving the water treatment plant. Factors that could contribute to system water loss include:

- Inaccurate water meters. Generally, water meters underestimate flows as they age. Based on discussions with water meter manufacturers, a residential water meter in a treated surface water system (generally soft, non-corrosive water) should accurately meter for 15-20 years. Based on housing records from census data, approximately 1,546 meters (58%) could be older than 25 years old and have likely been in operation beyond their period of accuracy.

- Leaky pipelines and services. The structural integrity of water pipelines and services naturally degrades over time. Root penetration, improper installation procedures, and other factors can also create leaks which result in system water loss. Pipes constructed with certain materials, including steel and asbestos cement, are generally more susceptible to leaks. Fifty-seven percent (57%) of the water lines in the Stayton water system are steel or asbestos cement. One extreme example of a leaky pipeline section is the two-block section of steel pipe located on Burnett Street near the public pool. Thirteen separate spot repairs have been made on this section of pipeline within the last several years. Another example of a leaky pipeline section is the 6-inch steel water line on Elwood Street.

- Unaccounted water use. Since water loss represents the difference between the water produced and the water consumed, water consumption that is not metered increases the water loss. Occasionally, cities use water for city purposes like street cleaning, public buildings, pools, fire protection, and line flushing that is not metered. Keller Associates has accounted for known unmetered water uses like the public pool, public buildings, parks, cemetery, WWTP, and WTP in the water balance calculations presented above. However, there are likely other unmetered water uses that add to the water loss, such as street cleaning, line flushing, and others. Keller Associates recommends that all water uses be metered where possible, regardless of whether or not they are invoiced.

Division 86 in the Oregon Administrative Rules requires any water supplier with water loss greater than 10% to establish a leak detection program. Division 86 further requires a leak repair or line replacement program for water suppliers with water loss greater than 15%. **Given the City's system loss, Stayton is required to establish both a leak detection and a leak repair program which is described in Chapter 3.**

Table 2.10
System Water Loss Summary

	2001	2002	2003
Water Consumption (gals)	616,612,508	685,393,053	774,859,053
Water Production (gals)	883,414,920	984,453,840	987,805,020
System Losses (%)	**30.2%**	**30.4%**	**21.6%**

CHAPTER 3.0 – Conservation Element

This chapter contains a proposed conservation plan that satisfies the requirements outlined in the new Division 86 rules and is practical for the City of Stayton. The new rules define "conservation as eliminating waste or otherwise improving efficiency in the use of water while satisfying beneficial uses by modifying the technology or method for diverting, transporting, applying or recovering the water; by changing management or water use; or by implementing other measures." Stayton's conservation plan focuses on "improving efficiency" by reducing water system losses. The sequence of the remainder of this chapter will mirror the sequence of the requirements outlined in Division 86 rules.

3.1 WATER USE AND MEASUREMENT PROGRAMS

A formal water management and conservation plan for the City of Stayton has not previously been submitted to the Oregon Water Resources Department (WRD). The City of Stayton water reporting program does conform to the measurement standards outlined in the OAR Chapter 690.

3.2 CONSERVATION MEASURES

Many water conservation measures exist, some of which include water reuse, retrofits on inefficient water devices, rate structures, public education, leak detection, and water system audits. The new requirements outlined by the Water Resources Department (WRD) identify the consideration of some conservation measures as mandatory for all water suppliers submitting a water management and conservation plan (WMCP). There is another set of conservation measures identified as "Additional Conservation Measures" which must be considered by only the large water suppliers and some medium-sized users. The section below will address all the conservation measures mandatory for the City of Stayton under Division 86 Rules.

3.2.1 Full Metering of Systems

Division 86 requires that water suppliers that are not fully metered implement a plan to become fully metered in the next five years. A full metered system meters all sources and consumers.

Sources

The sources that must be metered in Stayton include the intake for the WTP, the two infiltration wells, and the interconnection with the Salem water distribution. Currently, both infiltration wells include a meter that is read daily during operating hours. The 50-hp pump is

fitted with a water meter installed in 1995 and considered accurate by city staff. The 75-hp pump is fitted with a water meter that is old and has questionable accuracy. There is also a water meter on the interconnection with the City of Salem.

The discharge of the WTP is metered, but the intake is not currently metered. The City of Stayton has commissioned Keller Associates to complete a water master plan which is approximately 75% complete. Based on water measurement comparisons and a water balance, it has been determined that the meter from the WTP to the distribution system under-measures water production by an average of 8% every year. As a result, the City plans to replace or repair the existing water meter to improve metering accuracy. The City currently has plans to install a meter on the intake.

Consumers

All city water consumers, excluding those listed below, are metered and billed monthly. Most of the consumers are fitted with a ¾" meter. The authorized consumers that are not metered every month fall into two categories: consumers without meters and consumers with meters that are not read.

Consumers without meters:

- City parks
- WTP
- Cemetery
- City Shops
- Fire hydrant @ Fire Station

Consumers with meter that are not read:

- Public Works Building
- City Hall
- Theatre
- WWTP
- Library
- Police Department
- Pool
- Community Center

The City plans to install water meters on the consumers without meters within the next five years. The City intends to read all water connections including those listed above monthly regardless of whether they are invoiced. This information will be important in performing future water audits.

3.2.2 Meter Testing and Maintenance Program

The City currently has a program to replace 40 water meters per year. According to City staff this program has been in place for the last five years. Additionally, Norpac Food's water meters are

checked annually. A history of housing development in Stayton is presented in Table 3.1 which was developed from 2000 Census Data. A general correlation exists between the age of the homes and the water meters.

Table 3.1
History of Housing Development in Stayton

	1970	1980	1990	2000
Total Housing Units	938	1,546	1,867	2,668
Additional Housing Units / Meters	-	608	321	801
Estimated Additional Water Meters	35%	23%	12%	30%

Assuming that the housing units are served by the original water meters, 35% of the water meters are at least 35 years old, 23% are between 25 and 35 years old, 12% are between 15 and 25 years old, and 30% are less than 15 years old. Manufacturers recommend that residential water meters be replaced every 15-20 years. In order to replace the City's water meters every 20 years, the City of Stayton plans to replace approximately 160 water meters every year.

A water meter testing program can provide direction and priority for the meter replacement program. Old meters will be tested for accuracy. An alert meter reader should be able to spot an under-registering meter by a quick comparison with past readings. The accuracy versus location of the meters will be tracked in order to determine if a correlation between location and accuracy can be drawn. Those areas with meters that consistently test poorly should be targeted for meter replacement. A set of representative meters in an area can be tested every 5 years to track meter accuracy in an area.

3.2.3 Annual Water Audit

A comparison between the water produced and consumed over the past three years is illustrated in Table 2.7. The large water loss evident over the past couple years is likely due to meter inaccuracy, leakage in customer service lines and city lines, and authorized uses that are not billed, including main line flushing, fire fighting, fire flow tests, and others.

The City is currently planning to replace both the intake and finish water flow meters at the WTP. These improvements along with an active meter testing and replacement program, will ensure that future water audits will be accurate.

3.2.4 Leak Detection/Repair Program

The new state regulations require any water suppliers that have a system loss greater than 10% to implement a leak detection program. Regulations further stipulate that any water supplier with a system loss greater than 15% must implement a leak repair or line replacement program to reduce system loss. The City of Stayton falls into both these categories with an average system loss of 29% over the last three years.

The City has discussed performing leak detection on all ductile iron and steel pipes (see Figure 4 in the Appendix). The City intends to conduct a comprehensive leak detection study within the next five years. Those areas determined to contain the most leaks should be targeted first.

A water line replacement program should be implemented in order to maintain the integrity of the water distribution system. The asbestos cement and steel lines have historically been most problematic, and thus should be targeted first.

Based on a detailed analysis of the length of each pipe type and size, the City will work towards establishing an annual pipeline replacement budget. Over the next 20+ years, this will allows the City to replace all of the steel, cast iron, and galvanized iron pipes, and approximately 25% of the asbestos cement water lines. In order to minimize road repair inconvenience and expense, pipeline replacement should be coordinated with street improvements.

3.2.5 Rate Structure Based on Quantity of Water Metered

Current water rate structure for the City of Stayton satisfies state requirements. The City's water rate structure is composed of a base water rate plus a uniform consumption charge. The base water rate is dependent on both the size of the meter and the type of use. For example, the base water rate is typically more for consumers with larger meter sizes. The base water rate is also generally more for industrial and commercial consumers than for residential consumers. This system allows the City to charge those customers with a greater potential for water consumption.

In addition to the base water rate charge, the City has employed a consumption-based charge which encourages responsible water consumption. This type of rate structure also provides the City an economic tool to encourage water conservation by raising the consumption-based charge during periods of water shortage. The City's water rate structure is included in the Appendix for reference.

The City intends to review the rate structure and pursue a rate policy that will encourage water conservation.

3.2.6 Public Education Program

To increase public awareness of water conservation, the City plans to include conservation actions and City conservation programs in the Consumer Confidence Report which is distributed to all water customers. Additionally, the City has proposed distributing a water conservation flyer at the annual Summer Fest and Color Bridge Festivals in July and September respectively. Water conservation flyers are also available to the public at city buildings including City Hall and the Public Works Administration Building. The City also plans to include water conservation statements on the water bill distributed to customers every month.

3.3 SUMMARY OF 5-YEAR BENCHMARKS

Table 3.2
Summary of Conservation Goals

Planned Programs	Start Date	Frequency
Meter Installation	Jan. 2005	Meter all connections within 5 years
Meter testing	Jan. 2006	Test 200 ± annually
Meter replacement	Jan. 2006	Replace 160 meters every year (Compete replacement in 20 years)
Water audit	Jan. 2006	Annually
Leak detection	Jan. 2006	Every 5 to 10 years until water loss is below 15%
Leak repair	Jan. 2006	Annual Pipe Replacement Program
Public education	Jan. 2006	Annually

CHAPTER 4.0 – Water Curtailment Plan

New state regulations require water suppliers to prepare a water curtailment plan. A curtailment plan will enable suppliers to cope with short-term emergency water shortages by reducing water demands and locating alternative water sources. In addition, water suppliers should establish policies that will enable the supplier to initiate and enforce the water curtailment plan. Division 86 requires that a water curtailment plan, at a minimum, include the following four elements.

- A 10-year assessment of water supply deficiencies and capacity limitations
- Three stages of alert
- Situations which trigger each stage of alert
- A list of curtailment actions for each stage of alert

The City's primary source of water originates from the North Santiam River. Because this source is surface water, it is more susceptible to seasonal fluctuations, turbidity problems, and contamination. The water system is susceptible to mechanical and electrical failures at the WTP or in the distribution system. In addition, all water systems are at the mercy of natural disasters.

4.1 ASSESSMENT OF WATER SUPPLY

The City currently has some resources to alleviate impacts of water shortages. One resource is 6.9 million gallons of water storage in four reservoirs, which include the Schedule "M", Regis, Pine Street, and WTP reservoirs. Another resource is the interconnection to Salem's water system which, may provide water in emergency situations due to plant failure.

According to City staff, Stayton has not experienced water supply deficiencies in the last 10-15 years. The City was able to successfully cope with two situations that could have potentially limited the City's ability to satisfy water demands. The flood of 1996 created very high turbidity in the Power Canal which made the surface water unusable for a short period of time. However, during the high-turbidity period, demands were met with the shallow infiltration well system. Also, the Stayton WTP was shut down for a week during the summer because the filter beds were contaminated. However, the City was able to satisfy water demands during that week with the water intertie with Salem, Oregon.

The City of Stayton has adequate water rights and capacity at the WTP to meet present water demands. In order to meet future demands as growth occurs, additional improvements will be required at the WTP to insure adequate supply and redundancy. These improvements will be completed according to the City's Water Master Plan which is being updated concurrently with this document.

4.2 CURTAILMENT PLAN

The City's curtailment plan is composed of three stages: Mild, Moderate, and Critical. The trigger, goal, and implementation measures for each stage of the proposed curtailment plan are outlined in Table 4.1. Implementation of the City's curtailment plan will be coordinated through and under the direction of the public works director.

Table 4.1
City of Stayton's Proposed Water Curtailment Plan

Stage	Trigger	Goal	Implementation Measures
Mild	Determination made by the public works director that a potential for a water shortage exists	Public awareness and 5% reduction in consumption	• Activate Curtailment Plan • Public Education (via flyer distribution, media, city water bill, city website) • Voluntary irrigation schedule based on house numbers
Moderate	Determination made by the public works director that water shortage exists	10% reduction in consumption	• Continue with "Mild" stage measures except where noted below • Transition of irrigation schedule from *voluntary* to **mandatory** • Eliminate line flushing and City parks irrigation • Request businesses reduce consumption by 10%
Critical	Determination made by the public works director that there is a critical water supply shortage that threatens the City's ability to deliver water supplies	15% reduction in consumption	• Continue with "Moderate" stage measures except where noted below • Restrict use of water in pools • Restrict outdoor irrigation with city water • Ban washing vehicles with city water • Encourage a reduction in industrial water usage
Emergency	Water plant failure resulting in loss of production capacity	50% reduction in consumption	• Prohibit all irrigation • Impose industrial restrictions

CHAPTER 5.0 – Municipal Supply Element

5.1 SERVICE AREA

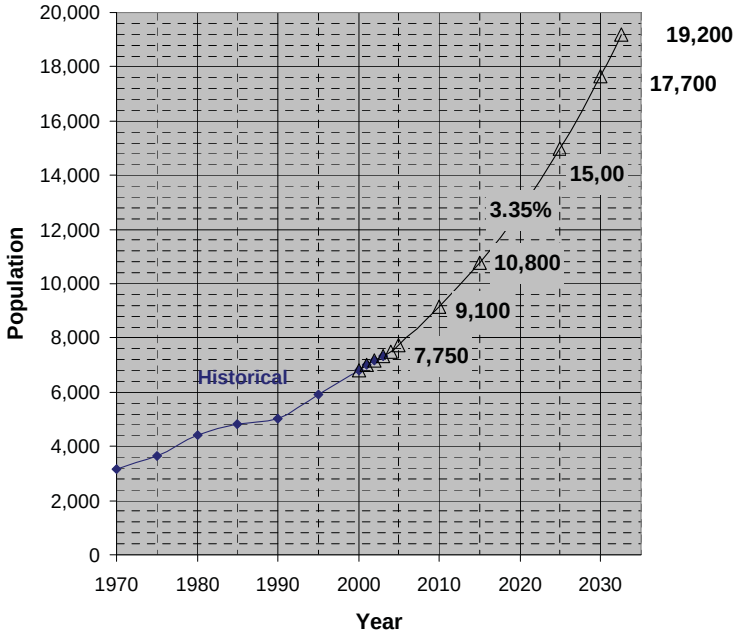
The City of Stayton currently serves about 7,300 (2003) people located inside the service area illustrated by the city limits in Figure 2. Water users include single-residence homes, apartments, mobile home parks, assisted living centers, irrigation accounts, churches, schools, commercial users, and industrial water consumers. The industrial user, Norpac Foods Inc., is the largest water consumer and accounts for approximately 42 percent of the annual water consumption.

5.1.1 Stayton Population Projection

The estimated 2003 population for the City of Stayton is 7,300. City population estimates from 2001 to 2004 were approximated using Stayton building permit information. Growth projections are based on a continued growth of 3.35%.

Build-out of the study area (UGB) using a growth rate of 3.35% will occur sometime around 2032.These estimates are represented in Chart 5.1 below.

Chart 5.1
City of Stayton Population Projections



5.1.2 Future Land Use

The assumed future land use map and the urban growth boundary (UGB) for the City of Stayton are illustrated in Figure 3 in the Appendix. This land use map was developed with input from the City Staff. A corridor of light industrial use is expected in the vicinity of the west urban growth boundary of Stayton. Most of the remaining growth area is designated as low density residential with medium-high density residential areas scattered throughout.

The development densities for residential areas illustrated in Table 5.1 were developed as targets for future residential development based on consultation with City planners.

Table 5.1
Household and Residential Densities

Low Density Residential (EDUs/ac)	Med-High Density Residential (EDUs/ac)	Household Size (people/EDU)
3.5	6	2.7

5.2 DEMAND FORECAST

Division 86 regulations require that a water demand forecast be conducted for 10 and 20-year needs. Water demands were calculated by adding the existing water usage recorded at the WTP and future demands projected for currently undeveloped land inside the Stayton study area.

In an effort to project future water demands, the existing water usage was categorized into residential, non-residential, Norpac Foods Inc., and water loss. The non-residential category includes commercial, industry excluding Norpac Foods Inc., WWTP consumption, and public water demand. For comparative purposes, the demand for each of these categories was averaged over the Stayton population so demands could be compared and projected on a per capita basis. Table 5.2 summarizes the demand for each category in gallons per capita per day. The severity of the system water loss is apparent by comparing the residential demand and the water loss. On an average day, the same amount of water used by the entire residential sector is lost from the system. The non-residential water demand stays fairly constant on a seasonal basis, averaging out to be about 46 gpcd. Norpac Foods Inc. uses the largest percentage of water.

Table 5.2
Existing Flow Summary

Yearly Statistics	Existing Demands (MGD)	Existing Demands Per Capita				
		Existing System [1] (gpcd)	Residential (gpcd)	Non-Residential (gpcd) [2]	Norpac Foods (gpcd)	Water Loss (gpcd)
Average Day	2.71	371	106	46	114	106
Peak Day	6.50	890	N/A	N/A	N/A	N/A
Dry Weather (May-Oct)	3.75	514	147	56	197	113
Wet Weather (Nov-Apr)	1.65	226	64	35	29	97

Notes:

(1) Existing system includes residential and non-residential demands. Future demands from the existing system users are assumed to remain constant.

(2) Non-residential flow per capita per day excludes Norpac Foods Inc. Demand.

Future demands were generated by adding the existing demands to the additional water demand created by development. The demands assumed for new development (presented in Table 5.3) were calculated by adding the existing demand, 45 gpcd for new non-residential demand, 50 gpcd for industrial water use, and 5% assumed water loss. The average day demand for new development is based on 210 gpcd (106 gpcd residential + 45 commercial/public + 50 industrial + 5% water loss).

It is assumed that the City will pursue leak detection, pipe replacement, and meter replacement and testing programs to reduce the current water loss. Future projections assume existing demands remain constant for existing development. This provides for some conservatism in future projections if the City is successful in detecting and removing mainline leaks. The projected demands for 2015, 2025, and build-out, summarized in Table 5.3, reflect 3.35% growth rate estimates.

Table 5.3
Water Demand Projections

Yearly Statistics	Evaluation Flows in MGD				
	New Development (gpcd) [3]	Existing Demands (MGD) [2]	2015 Flow (MGD)	2025 Flow (MGD)	Build-out Flow (MGD)
Stayton Population [1]	N/A	7,300	10,800	15,000	19,200
Average Day	210	2.71	3.45	4.33	5.20
Peak Day [4]	500	6.50	8.25	10.35	12.44
Dry Weather (May-Oct)	270	3.75	4.70	5.83	6.96
Wet Weather (Nov-Apr)	160	1.65	2.21	2.88	3.55

Notes:

(1) Population projections assume a 3.35% growth rate.

(2) Existing system includes residential and non-residential demands. Future demands from the existing system users are assumed to remain constant.

(3) New development includes residential and non-residential flows plus 5% water loss (which is substantially less than observed in the existing system). Some additional industrial demand (50 gpcd) but not to the magnitude of Norpac Foods Inc., was also assumed. Actual future demands will be a function of the type of future industry that locates within Stayton.

(4) In determining peak day demand for new development, a peak day factor (peak day divided by average day) of 2.4 was used. This is consistent with the existing peak day factor (890/371 = 2.4).

The projected 2025 peak day demand of 10.35 MGD is 93% of the existing summer water right of 11.16 MGD. When the Stayton urban growth boundary is at build-out, peak day demands are projected to be about 12.44 MGD, which exceeds the existing 11.16 MGD summer water right. However, Stayton is in the process of acquiring an additional 10 cfs (6.5 MGD) of year-round water rights which will satisfy build-out peak day demands.

The existing treatment capacity is the limiting factor for growth. Additional treatment capacity will be required to meet projected 2015 and 2025 demands.

5.3 ADDITIONAL REQUIREMENTS

A copy of this document was sent to those entities listed below that could be impacted by actions and policies proposed herein. Comments received from these entities in response to this document are included in the Appendix.

- City of Salem
- Santiam Water Control District

In order to meet state rules, the City intends to submit a progress report on or before September of 2009 (five years) to discuss goals, benchmarks, and its water system and consumption. It is anticipated that

existing City water rights, will satisfy 20-year demands. As a result, the City does not expect to submit an updated WMCP until 10 years have expired (in 2014). The update will include a status report on benchmarks proposed in this report. The update will also reestablish both existing and future supply and demand requirements and population trends.

WATER MANAGEMENT & CONSERVATION

Appendix A

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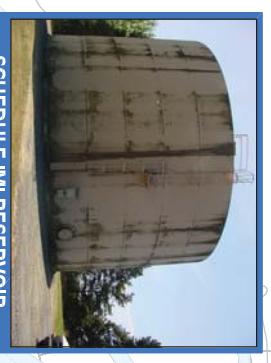
WASTE WATER TREATMENT PLANT

SCHEDULE 'M' RESERVOIR and BOOSTER STATION
150 HP DIESEL MOTOR BACK-UP



WATER TREATMENT PLANT

REGIS RESERVOIR and BOOSTER STATION
50 HP GAS MOTOR BACK-UP

PINE STREET RESERVOIR and BOOSTER STATION
2 - 15 HP SUBMERSIBLE PUMPS

SOUTHERN PACIFIC RR.
GOLF CLUB ROAD
WILCO RD.
WASHINGTON ST.
IDA ST.
GARDNER RD.
LOCUST ST.
REGIS ST.
NORTH SANTIAM HIGHWAY
SHAFF RD.
CASCADE HIGHWAY
HIGHWAY 22
1ST AVE
NORTH SANTIAM RIVER
FERN RIDGE RD.
SANTIAM ST.
STAYTON MEHAMA RD
BOEDIGH
UNION HIGH SCHOOL
REGIS HIGH SCHOOL
LIBRARY
PO
CH
SAINT MARY'S SCHOOL
HOSPITAL
PARALLEL PIPELINES 8" HIGH PRESSURE 12" LOW PRESSURE
2" OPEN VALVE
CHECK VALVE
NC VALVE
UPPER SERVICE AREA
12" (DRY LINE)
FP 100
FP 108

LEGEND
4 INCH AND SMALLER
06 INCH
08 INCH
10 INCH
12 INCH
14-30 INCH

FIGURE 1
Existing Distribution System
Water Management and Conservation Plan
CITY OF STAYTON
KELLER ASSOCIATES
KA:103002
002-fig04_01.dwg

LEGEND

- CITY LIMITS
- UGB — URBAN GROWTH BOUNDARY

EXISTING ZONING

- COMMERCIAL GENERAL ZONING
- COMMERCIAL RETAIL ZONING
- INDUSTRIAL AGRICULTURE ZONING
- INDUSTRIAL COMMERCIAL ZONING
- LIGHT INDUSTRIAL ZONING
- INTERCHANGE DEVELOPMENT ZONING
- LOW DENSITY RESIDENTIAL ZONING
- MEDIUM & HIGH DENSITY RESIDENTIAL
- PUBLIC AND SEMI-PUBLIC ZONING

EXISTING CHEMEKETA COLLEGE
EXISTING GOLF COURSE
SCHOOL
SALEM'S WATER TREATMENT PLANT
CITY OF STAYTON
NORTH SANTIAM RIVER
STARR ST.
MAIN ST.
CHURCH ST.
DIVISION ST.
COON HOLLOW RD.
CENTER ST.
NORTH SANTIAM HIGHWAY
HIGHWAY 22
GOLF CLUB ROAD
CASCADE HIGHWAY
BOEDIGHEIMER RD.
SHAEF RD.
FERN RIDGE RD.
WILCO RD.
REGIS ST.
GARDNER RD.
LOCUST ST.
SANTIAM ST.
ST. LYTON MEHAMA RD
SOUTHERN PACIFIC RR.
WASHINGTON ST.
IDA ST.
1ST AVE
UGB
FP 100

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KA:103002
002-fig02_03.dwg

KELLER ASSOCIATES

CITY OF STAYTON

Water Management and Conservation Plan

Existing Land Use

FIGURE 2

LEGEND

- CITY LIMITS
- UGB — URBAN GROWTH BOUNDARY

EXISTING ZONING

- EXISTING ZONING (SEE FIGURE 1 FOR LAND USE)

FUTURE ZONING

- COMMERCIAL ZONING
- COMMERCIAL RETAIL ZONING
- INDUSTRIAL AGRICULTURE ZONING
- INDUSTRIAL COMMERCIAL ZONING
- LIGHT INDUSTRIAL ZONING
- INTERCHANGE DEVELOPMENT ZONING
- LOW DENSITY RESIDENTIAL ZONING
- MEDIUM TO HIGH DENSITY RESIDENTIAL
- PUBLIC AND SEMI-PUBLIC ZONING

EXISTING CHEMEKETA COLLEGE
EXISTING GOLF COURSE
SCHOOL
SALEM'S WATER TREATMENT PLANT
CITY OF STAYTON
STARR ST.
MAIN ST.
CHURCH ST.
DIVISION ST.
COON HOLLOW RD.
CENTER ST.
NORTH SANTIAM HIGHWAY
HIGHWAY 22
GOLF CLUB ROAD
CASCADE HIGHWAY
BOEDIGHEIMER RD.
SHAFER RD.
FERN RIDGE RD.
REGIS ST.
WILCO RD.
GARDNER RD
SOUTHERN PACIFIC RR.
LOCUST ST.
SANTIAM ST.
ST. LYTTON HERMAN RD
WASHINGTON ST.
IDA ST.
1ST AVE
NORTH SANTIAM RIVER
UGB
FP 100

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KA:103002
002-fig02_04.dwg

KELLER ASSOCIATES

Water Management and Conservation Plan

Future Land Use

FIGURE 3

Water Quality Limited Streams Database

The following records match your search criteria. Select a **Record ID** to view details of the waterbody:

Record ID	Waterbody Name	Sub-Basin	River Mile	Parameter	Season	List Date	Listing Status
8854	North Santiam River	NORTH SANTIAM	0 to 10	Temperature	Summer	2002	303(d) List
8856	North Santiam River	NORTH SANTIAM	0 to 10	Temperature	September 1 - June 30	2002	303(d) List
8857	North Santiam River	NORTH SANTIAM	10 to 26.5	Temperature	September 15 - June 30	2002	303(d) List

There are 3 records in the table.

Download CSV file: Client630.csv

For additional information, please contact Karla Urbanowicz at (503) 229-6099.

Table 4. Listed, Candidate, and Species of Concern and the Determination of Effect from the Biological Assessment for Expansion, Operation and Maintenance of the Geren Island WTF

Common name	Scientific name	Federal status[1]	Jurisdiction
Oregon chub	*Oregonichthys crameri*	Endangered	USFWS
Winter steelhead	*Oncorhynchus mykiss*	Threatened	NOAA[2]
Spring chinook salmon	*Oncorhynchus tshawytscha*	Threatened	NOAA[2]
Bald eagle	*Haliaeetus leucocephalus*	Threatened	USFWS
Fender's blue butterfly	*Icaricia icarioides fenderi*	Endangered	USFWS[3]
Golden Indian paintbrush	*Castilleja laevisecta*	Threatened	USFWS[2]
Willamette daisy	*Erigeron decumbens* var. *decumbens*	Endangered	USFWS[2]
Howellia	*Howellia aquatilis*	Threatened	USFWS
Bradshaw's lomatium	*Lomatium bradshawii*	Endangered	USFWS
Kincaid's lupine	*Lupinus sulphureus* var. *kincaidii*	Threatened	USFWS[2]
Nelson's checker-mallow	*Sidalcea nelsoniana*	Threatened	USFWS
Candidate Species			
Yellow-billed cuckoo	*Coccyzus americanus*	Candidate	USFWS[3]
Oregon spotted frog	*Rana pretiosa*	Candidate	USFWS[2]
Taylor's checkerspot	*Euphydras editha taylori*	Candidate	USFWS[3]
Streaked horned lark	*Eremophila alpestris strigata*	Candidate	USFWS[3]
Pacific lamprey	*Lampetra tridentata*	Sp. of Concern	USFWS
Northern red-legged frog	*Rana aurora aurora*	Sp. of Concern	USFWS
Foothill yellow-legged frog	*Rana boylii*	Sp. of Concern	USFWS
Northwestern pond turtle	*Clemmys marmorata marmorata*	Sp. of Concern	USFWS
Little willow flycatcher	*Empidonax traillii brewsteri*	Sp. of Concern	USFWS
Band-tailed pigeon	*Columba fasciata*	Sp. of Concern	USFWS[3]
Olive-sided flycatcher	*Contopus cooperi (=borealis)*	Sp. of Concern	USFWS[3]
Yellow-breasted chat	*Icteria virens*	Sp. of Concern	USFWS[3]
Acorn woodpecker	*Melanerpes formicivarus*	Sp. of Concern	USFWS[3]
Oregon vesper sparrow	*Pooecetes gramineus affinis*	Sp. of Concern	USFWS[3]
Purple martin	*Progne subis*	Sp. of Concern	USFWS[3]
Silver-haired bat	*Lasionycteris noctivagans*	Sp. of Concern	USFWS[3]
Long-eared myotis	*Myotis evotis*	Sp. Of Concern	USFWS
Fringed myotis	*Myotis thysanodes*	Sp. Of Concern	USFWS
Long-legged myotis	*Myotis volans*	Sp. Of Concern	USFWS
Yuma myotis	*Myotis yumanensis*	Sp. Of Concern	USFWS
Pacific western big-eared bat	*Plecotus townsendii townsendii*	Sp. Of Concern	USFWS
Camas pocket gopher	*Thomomys bulbivorus*	Sp. of Concern	USFWS[3]
Oregon giant earthworm	*Megascolides macelfreshi*	Sp. of Concern	USFWS
White top aster	*Aster curtus*	Sp. of Concern	USFWS
Peacock larkspur	*Delphinium pavonaceum*	Sp. of Concern	USFWS

[1] Federal Status

Endangered: Species that are in danger of becoming extinct within the foreseeable future throughout all or a significant portion of their range.

Threatened: Species that are likely to become endangered within the foreseeable future.

Candidate: Species considered for threatened or endangered listing, but not yet the subject of a proposed rule

Species of Concern: Species that are currently under review for listing.

Shaggy horkelia	*Horkelia congesta* spp. *Congesta*	Sp. of Concern	USFWS
Thin-leaved peavine	*Lathyrus holochlorus*	Sp. of Concern	USFWS[3]

[1] Federal Status

Endangered: Species that are in danger of becoming extinct within the foreseeable future throughout all or a significant portion of their range.

Threatened: Species that are likely to become endangered within the foreseeable future.

Candidate: Species considered for threatened or endangered listing, but not yet the subject of a proposed rule

Species of Concern: Species that are currently under review for listing.

[2] Status changed since preparation of the Biological Assessment
Source: AAI and SPCA 1996

[3] Status change since 1996 Source: USFWS, October 2003

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES, CANDIDATE SPECIES AND SPECIES OF CONCERN THAT MAY OCCUR WITHIN THE AREA OF THE CITY OF SALEM WATER MANAGEMENT PLAN PROJECT
1-7-03-SP-0684

LISTED SPECIES[1/]

Birds		
Bald eagle[2/]	*Haliaeetus leucocephalus*	T
Fish		
Steelhead (Upper Willamette River)[3/]	*Oncorhynchus mykiss*	**T
Chinook salmon (Upper Willamette River)[4/]	*Oncorhynchus tshawytscha*	**T
Oregon chub	*Oregonichthys crameri*	E
Invertebrates		
Fender's blue butterfly[5/]	*Icaricia icarioides fenderi*	E
Plants		
Golden Indian paintbrush[6/]	*Castilleja levisecta*	T
Willamette daisy[7/]	*Erigeron decumbens* var. *decumbens*	E
Howellia	*Howellia aquatilis*	T
Bradshaw's lomatium	*Lomatium bradshawii*	E
Kincaid's lupine[8/]	*Lupinus sulphureus* var. *kincaidii*	T
Nelson's checker-mallow	*Sidalcea nelsoniana*	T

PROPOSED SPECIES

None

CANDIDATE SPECIES[9/]

Birds	
Yellow-billed cuckoo[10/]	*Coccyzus americanus*
Streaked horned lark	*Eremophila alpestris strigata*
Amphibians and Reptiles	
Oregon spotted frog	*Rana pretiosa*
Invertebrates	
Taylor's checkerspot	*Euphydryas editha taylori*

SPECIES OF CONCERN

Mammals	
Pacific western big-eared bat	*Corynorhinus (=Plecotus) townsendii townsendii*
Silver-haired bat	*Lasionycteris noctivagans*
Long-eared myotis (bat)	*Myotis evotis*
Fringed myotis (bat)	*Myotis thysanodes*

Long-legged myotis (bat)	*Myotis volans*
Yuma myotis (bat)	*Myotis yumanensis*
Camas pocket gopher	*Thomomys bulbivorus*
Birds	
Band-tailed pigeon	*Columba fasciata*
Olive-sided flycatcher	*Contopus cooperi (=borealis)*
Yellow-breasted chat	*Icteria virens*
Acorn woodpecker	*Melanerpes formicivorus*
Oregon vesper sparrow	*Pooecetes gramineus affinis*
Purple martin	*Progne subis*
Amphibians and Reptiles	
Northwestern pond turtle	*Emus (=Clemmys) marmorata marmorata*
Northern red-legged frog	*Rana aurora aurora*
Foothill yellow-legged frog	*Rana boylii*
Fish	
Pacific lamprey	*Lampetra tridentata*
Coastal cutthroat trout (Upper Willamette)	*Oncorhynchus clarki clarki*
Invertebrates	
Oregon giant earthworm	*Driloleirus (=Megascolides) macelfreshi*
Plants	
White top aster	*Aster curtus*
Peacock larkspur	*Delphinium pavonaceum*
Shaggy horkelia	*Horkelia congesta* ssp. *congesta*
Thin-leaved peavine	*Lathyrus holochlorus*

(E) - Listed Endangered *(T) - Listed Threatened* *(CH) - Critical Habitat has been designated for this species*
(PE) - Proposed Endangered *(PT) - Proposed Threatened* *(PCH) - Critical Habitat has been proposed for this species*
(S) - Suspected *(D) - Documented*

Species of Concern - Taxa whose conservation status is of concern to the Service (many previously known as Category 2 candidates), but for which further information is still needed.

(CF) - Candidate; National Marine Fisheries Service designation for any species being considered by the Secretary for listing for endangered or threatened species, but not yet the subject of a proposed rule.

[oo] *Consultation with National Marine Fisheries Service may be required.*

[1] *U. S. Department of Interior, Fish and Wildlife Service. October 31, 2000, Endangered and Threatened Wildlife and Plants, 50 CFR 17.11 and 17.12*
[2] *Federal Register Vol. 60, No. 133, July 12, 1995 - Final Rule - Bald Eagle*
[3] *Federal Register Vol. 64, No. 57, March 25, 1999, Final Rule - Middle Columbia and Upper Willamette River Steelhead*
[4] *Federal Register Vol. 64, No. 56, March 24, 1999, Final Rule - West Coast Chinook Salmon*
[5] *Federal Register Vol. 65, No. 16, January 25, 2000, Final Rule-Erigeron decumbens var. decumbens, Lupinus sulphureus ssp. kincaidii and Fender's blue butterfly*
[6] *Federal Register Vol. 62, No. 112, June 11, 1997, Final Rule-Castilleja levisecta*
[7] *Federal Register Vol. 67, No. 114, June 13, 2002, Notice of Review - Candidate or Proposed Animals and Plants*
[8] *Federal Register Vol. 66, No. 143, July 25, 2001, 12-Month Finding for a Petition To List the Yellow-billed Cuckoo*

OREGON NATURAL HERITAGE INFORMATION CENTER

Institute for Natural Resources

OREGON STATE UNIVERSITY
1322 SE Morrison Street
Portland, Oregon 97214-2423

August 25, 2004

Justin R. Walker
Keller Associates, Inc.
131 SW 5th Avenue, Suite A
Meridian, ID 83642

Dear Mr. Walker:

Thank you for requesting information from the Oregon Natural Heritage Information Center (ORNHIC). We have conducted a data system search for rare, threatened and endangered plant and animal records for your Stayton Water Management and Conservation Plan Project in Township 9 South, Range 1 West, Sections 11 and 13, W.M.

Twenty-five (25) records were noted within a two-mile radius of your project and are included on the enclosed computer printout. A key to the fields is also included.

Please remember that the lack of rare element information from a given area does not mean that there are no significant elements there, only that there is no information known to us from the site. To assure that there are no important elements present, you should inventory the site, at the appropriate season.

This data is confidential and for the specific purposes of your project and is **not to be distributed**.

If you need additional information or have any questions, please do not hesitate to contact me.

Sincerely,

Cliff Alton
Conservation Information Assistant

encl.: invoice (H-082404-CWA4)
computer printout and data key

OREGON NATURAL HERITAGE INFORMATION CENTER

Institute for Natural Resources

OREGON STATE UNIVERSITY
1322 SE Morrison Street
Portland, Oregon 97214-2423

Invoice Number: H-082404-CWA4
Index: RNR105

INVOICE

TO: Keller Associates, Inc.
131 SW 5th Avenue, Suite A
Meridian, ID 83642

ATTN: Accounts Payable

DATE: August 25, 2004

RE: Data system search for rare, threatened and endangered plants and animals in the vicinity of Township 9 South, Range 1 West, Sections 11 and 13, W.M. Requested by Justin R. Walker for the Stayton Water Management and Conservation Plan Project.

For services and products:

Computer records (25 @ $0.50/record)	$ 12.50
Computer fee (flat rate)	$ 20.00
Staff time (0.75 hours @ $50.00/hour)	$ 37.50
TOTAL DUE:	**$ 70.00**

Please make checks payable to: **Oregon Natural Heritage Information Center**

Please include invoice number at top of page with payment.

Terms: **Net 30**

Scientific Name: ***Rana aurora aurora***
Common Name: **Northern red-legged frog**
Federal Status: SOC GRANK: G4T4 NHP List: 4 Category: Vertebrate Animal
State Status: SV/SU SRANK: S3S4 HP Track: N ELCODE: AAABH01021
EO ID: 19241 First Obs: 1996-04-07 Last Obs: 1996-04-07 Confirmed:
Directions: GEREN ISLAND (STAYTON ISLAND). POND EXCAVATED IN 1979 TO OBSERVE GROUND WATER LEVELS. EAST OF SLOW SAND FILTERS IN AREA TO BE EXCAVATED FOR MORE SAND FILTERS. ALSO SMALL FORESTED WETLAND JUST EAST OF THE SLOW SAND FILTER COMPLEX.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion	WV	Polygon [Areal - Delimited (8 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	13		44122-G7	Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type: CITY; COUNTY
Owner Comments: CITY OF SALEM, MARION COUNTY
Managed Area Name:
EO Type: Minimum Elev.(m): 143 Annual Observations
EO Data: 1996: POND - 2 EGG MASSES HATCHING WITH SEVERAL ADULTS. FORESTED WETLAND SITE - 1 ADULT ONLY, NO EGGS.
EO Comments: ARTIFICIAL POND AND SMALL FORESTED WETLAND. ROUGH SKINNED NEWT, NORTHWESTERN SALAMANDER EGGS AND GARTER SNAKE IN POND.
Protection:
Management: LOTS OF BULLFROGS AT POND AND WETLAND.
General: OBSERVER: PRISCILLA STANFORD

Scientific Name: ***Rana pretiosa***
Common Name: **Oregon spotted frog**
Federal Status: C GRANK: G2 NHP List: 1 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: AAABH01180
EO ID: 5019 First Obs: 1937-10-13 Last Obs: 1937-10-13 Confirmed:
Directions: AUMSVILLE, ALONG MILL CREEK

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion	WV	Point [Areal - Estimated (8050 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
008S002W	36		44122-G7	Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER 1709000701 - MILL CREEK 1709000907 - SILVER CREEK

Owner Name/Type:
Owner Comments:
Managed Area Name:
EO Type: Minimum Elev.(m): 107 Annual Observations
EO Data: 1937: ONE ADULT FEMALE COLLECTED
EO Comments: LOW, EMERGENT MARSH
Protection:
Management:
General: COLLECTOR: H.S. FITCH MVZ#25288

Scientific Name: ***Haliaeetus leucocephalus***
Common Name: **Bald eagle**
Federal Status: LT GRANK: G4 NHP List: 4 Category: Vertebrate Animal
State Status: LT SRANK: S4B,S4N HP Track: Y ELCODE: ABNKC10010
EO ID: 26095 First Obs: 2003 Last Obs: 2003 Confirmed:
Directions: S. of Stayton, along the North Santiam River.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	16		44122-G7	Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type:
Owner Comments:
Managed Area Name:
EO Type: Minimum Elev.(m): Annual Observations
EO Data: See annual observations.
* 2003 - 1 downy nestling

EO Comments:
Protection:
Management:
General: Isaacs and Anthony nest 1128.

Scientific Name: ***Eremophila alpestris strigata***
Common Name: **Streaked horned lark**
Federal Status: C GRANK: G5T2 NHP List: 1 Category: Vertebrate Animal
State Status: SC SRANK: S2B HP Track: Y ELCODE: ABPAT0201L

EO ID: 1181 First Obs: 1999-05-19 Last Obs: 1999-05-19 Confirmed:
Directions: APPROX. 1.5 MI SE OF KINGSTON.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Point [Areal - Estimated (200 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	26		44122-G7	Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE		

EO Type: Minimum Elev.(m): 183 Annual Observations
EO Data: 1999: 1 BIRD OBSERVED.
EO Comments:
Protection:
Management:
General:

Scientific Name: ***Progne subis***
Common Name: **Purple martin**
Federal Status: SOC GRANK: G5 NHP List: 2 Category: Vertebrate Animal
State Status: SC SRANK: S2B HP Track: Y ELCODE: ABPAU01010

EO ID: 20254 First Obs: 1998-07-23 Last Obs: 1998-07-23 Confirmed:
Directions: FROM STAYTON TAKE KINGSTON-JORDAN RD. CROSS THE RIVER AND RAILROAD TRACKS. TURN LEFT ON KINGSTON-LYONS RD, AND GO 1.5 MI. TURN LEFT AT THE SIGN "BIRDHAVEN", GO UP THE GREAVEL LANE. THE NESTBOXES ARE NEAR THE GARDENS AND DOWN BELOW THE HOUSE IN THE MOWN F

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001E	18		44122-G6	Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE	FARM	

EO Type: Minimum Elev.(m): 226 Annual Observations
EO Data: 1998: 15 PAIRS NESTING IN BOXES.
EO Comments:
Protection:
Management:
General:

Scientific Name: ***Pooecetes gramineus affinis***
Common Name: **Oregon vesper sparrow**
Federal Status: SOC GRANK: G5T3 NHP List: 2 Category: Vertebrate Animal
State Status: SC SRANK: S2B,S2N HP Track: Y ELCODE: ABPBX95011

EO ID: 13494 First Obs: 1999-05-26 Last Obs: 1999-05-26 Confirmed:
Directions: SW of Wisner Cemetery.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	26		44122-G7	Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE		

EO Type: Minimum Elev.(m): 168 Annual Observations
EO Data: 1999: 1 bird observed.

EO Comments:
Protection:
Management:
General:

Scientific Name: ***Pooecetes gramineus affinis***
Common Name: **Oregon vesper sparrow**
Federal Status: SOC GRANK: G5T3 NHP List: 2 Category: Vertebrate Animal
State Status: SC SRANK: S2B,S2N HP Track: Y ELCODE: ABPBX95011
EO ID: 26250 First Obs: 1999-07-02 Last Obs: 1999-07-02 Confirmed:
Directions: Approx. 1mi SE of Kingston.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	24		44122-G7	Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type: Private
Owner Comments:
Managed Area Name:

EO Type:
Minimum Elev.(m): 198
Annual Observations:
EO Data: 1999: 1 male singing.
EO Comments:
Protection:
Management:
General:

Scientific Name: ***Ammodramus savannarum***
Common Name: **Grasshopper sparrow**
Federal Status: GRANK: G5 NHP List: 2 Category: Vertebrate Animal
State Status: SV/SP SRANK: S2B HP Track: Y ELCODE: ABPBXA0020
EO ID: 12542 First Obs: 1999-06-09 Last Obs: 1999-06-23 Confirmed:
Directions: APPROX. 1 MI SE OF STAYTON ISLAND.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	24		44122-G6	Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type: PRIVATE
Owner Comments:
Managed Area Name:

EO Type:
Minimum Elev.(m): 213
Annual Observations:
EO Data: 1999: 1 MALE SINGING.
EO Comments:
Protection:
Management:
General:

Scientific Name: ***Oncorhynchus tshawytscha pop. 23***
Common Name: **Chinook salmon (Upper Willamette River ESU, spring run)**
Federal Status: LT GRANK: G5T2Q NHP List: 1 Category: Vertebrate Animal
State Status: SRANK: S2 HP Track: Y ELCODE: AFCHA02052
EO ID: 94 First Obs: Last Obs: 1999-PRE Confirmed:
Directions: MILL CREEK & TRIBUTARIES

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion		Data currently not available.

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
			44122-G7	Stayton	17090007 - Middle Willamette
			44122-G8	Turner	
			44122-H8	Salem East	
			44123-H1	Salem West	

Owner Name/Type
Owner Comments:
Managed Area Name:

EO Type: REARING & MIGRATION - fish Minimum Elev.(m): Annual Observations
EO Data: SPRING RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE.
EO Comments:
Protection:
Management:
General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFW'S DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF CHINOOK IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus tshawytscha pop. 23***
Common Name: **Chinook salmon (Upper Willamette River ESU, spring run)**
Federal Status: LT GRANK: G5T2Q NHP List: 1 Category: Vertebrate Animal
State Status: SRANK: S2 HP Track: Y ELCODE: AFCHA02052
EO ID: 5008 First Obs: Last Obs: 1999-PRE Confirmed:
Directions: VALENTINE CREEK

County Name: Marion
Ecoregion:
Source Feature [Uncertainty Type (Distance)]: Data currently not available.
Town-Range Sec Note:
QuadCode QuadName: 44122-G6 Stout Mountain
Watershed: 1709000506 - NORTH SANTIAM RIVER, LOWER
Owner Name/Type:
Owner Comments:
Managed Area Name:

EO Type: REARING & MIGRATION - fish Minimum Elev.(m): Annual Observations
EO Data: SPRING RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE.
EO Comments:
Protection:
Management:
General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFW'S DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF CHINOOK IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus tshawytscha pop. 23***
Common Name: **Chinook salmon (Upper Willamette River ESU, spring run)**
Federal Status: LT GRANK: G5T2Q NHP List: 1 Category: Vertebrate Animal
State Status: SRANK: S2 HP Track: Y ELCODE: AFCHA02052
EO ID: 18370 First Obs: Last Obs: 1999-PRE Confirmed:
Directions: SANTIAM RIVER & TRIBUTARIES

County Name: Linn, Marion
Ecoregion:
Source Feature [Uncertainty Type (Distance)]: Data currently not available.
Town-Range Sec Note:
QuadCode QuadName:
44122-F3 Lawhead Creek
44122-F4 Mill City South
44122-F8 Crabtree
44122-G3 Elkhorn
44122-G4 Mill City North
44122-G5 Lyons
44122-G6 Stout Mountain
44122-G7 Stayton
44122-G8 Turner
44123-F1 Albany
Watershed: 17090005 - North Santiam
Owner Name/Type:
Owner Comments:
Managed Area Name:

EO Type: SPAWNING & REARING - fish Minimum Elev.(m): Annual Observations
EO Data: SPRING RUN. ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE. ODFW SALMONID DISTRIBUTION DOCUMENTATION 1998: NORTH SANTIAM RIVER, LITTLE NORTH SANTIAM RIVER. 1997: NORTH SANTIAM RIVER. 1952: NORTH SANTIAM RIVER.
EO Comments:
Protection:
Management:
General: DOCUMENTATION INFORMATION USED IN THIS EOR WAS DERIVED FROM THE ODFW SALMONID DISTRIBUTION DOCUMENTATION DIGITAL DATABASE DISTRIBUTED IN 2001. DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFW'S DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF CHINOOK IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus mykiss pop. 33***
Common Name: **Steelhead (Upper Willamette River ESU, winter run)**
Federal Status: LT GRANK: G5T2Q NHP List: 1 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: AFCHA02138
EO ID: 1134 First Obs: Last Obs: 1999-PRE Confirmed:
Directions: NORTH SANTIAM RIVER & TRIBUTARIES

County Name: Linn, Marion
Ecoregion:
Source Feature [Uncertainty Type (Distance)]: Data currently not available.

Town-Range Sec Note

QuadCode	QuadName
44122-F3	Lawhead Creek
44122-F4	Mill City South
44122-F8	Crabtree
44122-G2	Battle Ax
44122-G3	Elkhorn
44122-G4	Mill City North
44122-G5	Lyons
44122-G6	Stout Mountain
44122-G7	Stayton
44122-G8	Turner
44123-F1	Albany

Watershed: 17090005 - North Santiam
Owner Name/Type
Owner Comments
Managed Area Name

EO Type: SPAWNING & REARING - fish Minimum Elev.(m): Annual Observations
EO Data: WINTER RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE.
EO Comments:
Protection:
Management:
General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFW'S DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF STEELHEAD IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus mykiss pop. 33***
Common Name: **Steelhead (Upper Willamette River ESU, winter run)**
Federal Status: LT GRANK: G5T2Q NHP List: 1 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: AFCHA02138
EO ID: 4118 First Obs: Last Obs: 1999-PRE Confirmed:
Directions: ALDER CREEK

County Name: Marion
Ecoregion:
Source Feature [Uncertainty Type (Distance)]: Data currently not available.

Town-Range Sec Note

QuadCode	QuadName
44122-G6	Stout Mountain

Watershed: 1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type | Owner Comments | Managed Area Name

EO Type: MIGRATION - fish Minimum Elev.(m): Annual Observations
EO Data: WINTER RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE.
EO Comments:
Protection:
Management:
General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFWS DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF STEELHEAD IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus mykiss pop. 33***
Common Name: **Steelhead (Upper Willamette River ESU, winter run)**
Federal Status: LT GRANK: G5T2Q NHP List: 1 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: AFCHA02138
EO ID: 9461 First Obs: Last Obs: 1999-PRE Confirmed:
Directions: ALDER CREEK

County Name | Ecoregion | Source Feature [Uncertainty Type (Distance)]
Marion — Data currently not available.

Town-Range Sec Note | QuadCode QuadName | Watershed
44122-G6 Stout Mountain — 1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type | Owner Comments | Managed Area Name

EO Type: REARING & MIGRATION - fish Minimum Elev.(m): Annual Observations
EO Data: WINTER RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE.
EO Comments:
Protection:
Management:
General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFWS DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF STEELHEAD IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus mykiss pop. 33***
Common Name: **Steelhead (Upper Willamette River ESU, winter run)**
Federal Status: LT GRANK: G5T2Q NHP List: 1 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: AFCHA02138
EO ID: 16605 First Obs: Last Obs: 1999-PRE Confirmed:
Directions: VALENTINE CREEK

County Name | Ecoregion | Source Feature [Uncertainty Type (Distance)]
Marion — Data currently not available.

Town-Range Sec Note | QuadCode QuadName | Watershed
44122-G6 Stout Mountain — 1709000506 - NORTH SANTIAM RIVER, LOWER
44122-G7 Stayton

Owner Name/Type | Owner Comments | Managed Area Name

EO Type: REARING & MIGRATION - fish Minimum Elev.(m): Annual Observations
EO Data: WINTER RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE.
EO Comments:
Protection:
Management:

General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFWS DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF STEELHEAD IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus mykiss pop. 33***
Common Name: **Steelhead (Upper Willamette River ESU, winter run)**
Federal Status: LT GRANK: G5T2Q NHP List: 1 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: AFCHA02138
EO ID: 19279 First Obs: Last Obs: 1999-PRE Confirmed:
Directions: MILL CREEK & TRIBUTARIES

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion		Data currently not available.

Town-Range	Sec	Note	QuadCode	QuadName
			44122-G7	Stayton
			44122-G8	Turner
			44122-H8	Salem East
			44123-H1	Salem West

Watershed: 17090007 - Middle Willamette

Owner Name/Type | Owner Comments | Managed Area Name

EO Type: SPAWNING & REARING - fish Minimum Elev.(m): Annual Observations
EO Data: WINTER RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE.
EO Comments:
Protection:
Management:
General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFWS DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF STEELHEAD IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oregonichthys crameri***
Common Name: **Oregon chub**
Federal Status: LE GRANK: G2 NHP List: 1 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: AFCJB56010
EO ID: 18585 First Obs: 1996-05-20 Last Obs: 2003-07-31 Confirmed:
Directions: Sensitive Data - contact ORNHIC for more information

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion	WV	Point [Areal - Estimated (100 m)] Point [Areal - Estimated (100 m)] Polygon [Negligible (8 m)]

Town-Range	Sec	Note	QuadCode	QuadName
009S001W	15		44122-G6	Stout Mountain
009S001W	10		44122-G7	Stayton
009S001W	11			
009S001W	13			

Watershed: 1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name
CITY	CITY OF SALEM OWNS MOST OF THE ISLAND ALTHOUGH A FEW PRIVATE INHOLDINGS EXIST.	

EO Type: YEAR-ROUND - fish Minimum Elev.(m):
EO Data: See annual observations.

Annual Observations
- 2003 - 1845 chub captured/estimated
- 2002 - 747 chub captured/estimated
- 2001 - 782 chub captured/estimated
- 2000 - 359 chub captured/estimated
- 1999 - 894 chub captured/estimated
- 1998 - 1836 chub captured/estimated
- 1997 - 9737 chub captured/estimated
- 1996 - 12792 chub captured/estimated

EO Comments: Red-legged frog adults and eggs observed at site. Also tadpole, juvenile and adult bullfrogs and largemouth bass found.
Protection:
Management:
General: GEREN ISLAND IS THE SITE OF SALEM'S WATER SUPPLY AND FILTRATION PLANT. CHUBS WERE COLLECTED FROM A NUMBER OF SITES WITHIN A NETWORK OF CANALS, SLOUGHS AND PONDS CONNECTED WITH THE WATER TREATMENT PLANT. THE CITY HAS REQUESTED AN EXPANSION OF THE PLANT AND THE PROJECT IS CURRENTLY GOING THROUGH A BIOLOGICAL ASSESSMENT TO DETERMINE POTENTIAL IMPACTS TO CHUBS AND WETLANDS. PRELIMINARY DISCUSSIONS INDICATE THAT AN EASEMENT WILL BE GRANTED AND A RESERVE SET UP FOR THE LARGEST POND ON THE ISLAND (NORTH POND). Scheerer site #441, 442, 443, 444, 446, 447, 449, 574 and 612.

Scientific Name: ***Emys marmorata marmorata***
Common Name: **Northwestern pond turtle**
Federal Status: SOC GRANK: G3G4T3T4 NHP List: 2 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: ARAAD02031

EO ID: 2418 First Obs: 1997-06-09 Last Obs: 1999 Confirmed:
Directions: PIONEER PARK SLOUGH; OFF OF THE NORTH SANTIAM RIVER SOUTH OF STAYTON, NEAR THE STAYTON PARK TRAIL.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion	WV	Polygon [Negligible (8 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	11		44122-G7	Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER
009S001W	10				

Owner Name/Type | Owner Comments | Managed Area Name

EO Type: Minimum Elev.(m): 140 Annual Observations
EO Data: 1999: 6 adults observed basking. 1997: 1 turtle.
EO Comments:
Protection:
Management:
General: REPORTED BY PAUL SCHEERER, ODFW.

Scientific Name: ***Emys marmorata marmorata***
Common Name: **Northwestern pond turtle**
Federal Status: SOC GRANK: G3G4T3T4 NHP List: 2 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: ARAAD02031

EO ID: 25544 First Obs: Last Obs: 1999 Confirmed:
Directions: Valentine Cr. @ 16253 Old Mehama Road SE; E. of Stayton

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001E	08		44122-G6	Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type | Owner Comments | Managed Area Name

EO Type: Minimum Elev.(m): 162 Annual Observations
EO Data: 1999: exact date not specified, 1 adult turtle observed basking.
EO Comments:
Protection:
Management:
General:

Scientific Name: ***Lomatium bradshawii***
Common Name: **Bradshaw's lomatium**
Federal Status: LE GRANK: G2 NHP List: 1 Category: Vascular Plant
State Status: LE SRANK: S2 HP Track: Y ELCODE: PDAPI1B030

EO ID: 22909 First Obs: 1988 Last Obs: 1988-07-26 Confirmed:
Directions: BETWEEN KINGSTON & LYONS. TAKE KINGSTON-LYONS RD. TOWARDS LYONS, FOR 1.6 MI. TO SHARP RIGHT TURN. SIGHT IS STRAIGHT AHEAD. PLANTS ARE IN SEASONAL CREEK BED.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Polygon [Areal - Delimited (8 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001E	19		44122-G6	Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE		KINGSTON PRAIRIE PRESERVE

EO Type: Minimum Elev.(m): 229 Annual Observations
EO Data: ABOUT 1000 PLANTS CONCENTRATED IN A 3-4 ACRE PATCH ALONG THE SEASONAL CREEK DRAINAGE. POPULATION FRUITING & FLOWERING WELL, IN SPITE OF VERY LIMITED HABITAT. * 1988 - 1000
EO Comments: SHALLOW SOILED, BASALT CREEK BED & VERNAL POOLS. DOMINATED BY MIMGUT, DESCAE, ALOGEN, CAREX, JUNCUS & ELEOCHARIS, ALLIUM SP., POASCR & DANCAL. SURROUNDED BY FESRUB PRAIRIE.
Protection: NEEDS TNC PROTECTION ASAP!
Management:
General: GRAZING IS AN IMMEDIATE THREAT, AS IS FARMING. AREA WILL BE DEVELOPED SHORTLY (RECENTLY SUBDIVIDED)

Scientific Name: ***Erigeron decumbens var. decumbens***
Common Name: **Willamette Valley daisy**

Federal Status: LE	GRANK: G4T1	NHP List: 1	Category: Vascular Plant
State Status: LE	SRANK: S1	HP Track: Y	ELCODE: PDAST3M133

EO ID: 11171 First Obs: 1988 Last Obs: 1988-07-26 Confirmed:
Directions: BETWEEN KINGSTON & LYONS. TAKE KINGSTON-LYONS ROAD TOWARDS LYONS FOR 1.6 MILES TO SHARP RIGHT HAND TURN. SITE IS STRAIGHT AHEAD. PLANTS ARE ALSO ON E SIDE OF RD, 0.1 MI. FURTHER.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Polygon [Areal - Delimited (8 m)] Polygon [Areal - Delimited (8 m)] Polygon [Areal - Delimited (8 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001E	19		44122-G6	Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER
009S001E	24				

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE		KINGSTON PRAIRIE PRESERVE

EO Type: Minimum Elev.(m): 229 Annual Observations
EO Data: ABOUT 200 PLANTS, 150 ON E. SIDE OF ROAD AND 50 ON W. SIDE OF RD. (AT THE SOUTH END OF SITE). PLANTS SCATTERED IN DRIER AREAS OF SITE. LARGE & ROBUST. * 1988 - 200 PLANTS
EO Comments: RED FESCUE PRAIRIE DOMINATED BY FESRUB, AGREXA, AGRTEN & PANCAL WITH AGRDAS, FESIDA, FESARU, ANTODA AND MANY NATIVE FORBS. ALLUVIAL SILTY SOIL, SHALLOW IN SPOTS.
Protection: NEEDS TNC ACQUISITION TO PREVENT DEVELOPMENT.
Management:
General: ALVERSON COLLECTION, OSC. 1988.

Scientific Name: ***Aster curtus***
Common Name: **White-topped aster**

Federal Status: SOC	GRANK: G3	NHP List: 1	Category: Vascular Plant
State Status: LT	SRANK: S2	HP Track: Y	ELCODE: PDASTEF010

EO ID: 7265 First Obs: 1990 Last Obs: 1990-07-22 Confirmed:
Directions: KINGSTON PRAIRIE, ALONG N. FENCELINE OF FRICHTL PROPERTY DUE EAST OF 90 DEGREE CURVE, 4 PATCHES SCATTERED AT EDGE OF PARCEL AND IN THE RIGHT-OF-WAY ACROSS THE FENCE

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001E	19		44122-G6	Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE	RUBY FRICHTL	KINGSTON PRAIRIE PRESERVE

EO Type: Minimum Elev.(m): 229 Annual Observations
EO Data: AN ESTIMATED 75 RAMETS WERE OBSERVED IN 4 DIFFERENT PATCHES; ADDITIONAL COLONIES MAY OCCUR IN THE AREA. IN <1 ACRE
* 1990 - 75 RAMETS
EO Comments: REMNANT OF FESTUCA RUBRA/IDAHOENSIS PRAIRIE, WITH POTENTILLA GRACILIS, SIDALCEA CAMPESTRIS, ASTER HALLII, SOLIDAGO CANADENSIS. FENCE ROW AND R.O.W. MAY HAVE PROVIDED PROTECTION FROM GRAZING.
Protection:
Management: CYTISUS SCOPARIUS IS COLONIZING THE SITE
General:

Scientific Name: ***Lathyrus holochlorus***
Common Name: **Thin-leaved peavine**
Federal Status: SOC GRANK: G2 NHP List: 1 Category: Vascular Plant
State Status: SRANK: S2 HP Track: Y ELCODE: PDFAB250B0
EO ID: 5269 First Obs: 1988-05-15 Last Obs: 1988-05-15 Confirmed:
Directions: WISNER CEMETERY. I MI S OF KINGSTON. POP ACROSS RD FROM CEMETARY.

County Name: Linn
Ecoregion: WV
Source Feature [Uncertainty Type (Distance)]: Point [Areal - Estimated (50 m)]
Town-Range: 009S001W Sec: 23 Note:
QuadCode: 44122-G7 QuadName: Stayton
Watershed: 1709000506 - NORTH SANTIAM RIVER, LOWER
Owner Name/Type:
Owner Comments:
Managed Area Name:

EO Type: Minimum Elev.(m): 177 Annual Observations
EO Data: [NO EODATA GIVEN]
EO Comments: NEKIA SILTY CLAY LOAM (CLASS III).
Protection:
Management:
General: 1990 REPORT FOR LOCATING NATIVE GRASSLAND REMNANTS IN THE MID-WILLAMETTE VALLEY BY EDWARD ALVERSON.

Scientific Name: ***Cimicifuga elata***
Common Name: **Tall bugbane**
Federal Status: GRANK: G3 NHP List: 1 Category: Vascular Plant
State Status: C SRANK: S3 HP Track: Y ELCODE: PDRAN07030
EO ID: 2751 First Obs: 1998-06-30 Last Obs: 1998-06-30 Confirmed:
Directions: S OF BEAR BRANCH.

County Name: Linn
Ecoregion: WV
Source Feature [Uncertainty Type (Distance)]: Point [Areal - Estimated (50 m)]
Town-Range: 009S001W Sec: 25 Note:
QuadCode: 44122-G7 QuadName: Stayton
Watershed: 1709000506 - NORTH SANTIAM RIVER, LOWER
Owner Name/Type: COUNTY
Owner Comments: LINN COUNTY RIGHT OF WAY
Managed Area Name:

EO Type: Minimum Elev.(m): 244 Annual Observations
EO Data: ONE PLANT; IN BUD.
* 1998 - 1 PLANT
EO Comments: PLANT GROWING IN A BRUSHY R/W AREA ALONG COUNTY RD, KINGSTON JORDAN RD; PSME OVERSTORY; MID SLOPE; FILTERED LIGHT; MOIST; ASSOC SPECIES: PSME, POMU.
Protection:
Management:
General: 1998 BLM PLANT SIGHTING REPORT; TERRY FENNELL REPORTER.

Scientific Name: ***Delphinium oreganum***
Common Name: **Willamette Valley larkspur**
Federal Status: SOC GRANK: G1Q NHP List: 1 Category: Vascular Plant
State Status: C SRANK: S1 HP Track: Y ELCODE: PDRAN0B220
EO ID: 16633 First Obs: 1989 Last Obs: 2000-06-28 Confirmed:
Directions: KINGSTON PRAIRIE. FROM STAYTON DRIVE S ON FIRST STREET WHICH CROSSES THE N SANTIAM RIVER AND BECOMES STAYTON-SCIO ROAD. ~1/4 MI AFTER CROSSING THE RIVER, TURN LEFT (E) ON KINGSTON-JORDAN DR. GO ~1 MI, JUST PAST A RAILROAD CROSSING, TURN LEFT ON LINGSTON-

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Polygon [Areal - Delimited (8 m)]
Town-Range Sec Note	**QuadCode QuadName**	**Watershed**
009S001E 19	44122-G6 Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER
Owner Name/Type	**Owner Comments**	**Managed Area Name**
PRIVATE	THE NATURE CONSERVANCY, OREGON FIELD OFFICE. THIS TRACT HAS BEEN IN TNC OWNERSHIP SINCE 1996.	KINGSTON PRAIRIE PRESERVE

EO Type: Minimum Elev.(m): 229 Annual Observations

EO Data: ~1280 FLOWERING PLANTS, IN 12 SEPARATE PATCHES OVER AN AREA OF ~20 ACRES.

EO Comments: MODERATE QUALITY UPLAND PRAIRIE THAT ALSO SUPPORTS A GOOD POP OF ERDED. ASSOC WITH: FESTUCA ROEMERI, FESTUCA RUBRA, AGROSTIS CAPILLARIS, FESTUCA ARUNDINACEA, ERIOPHYLLUM LANATUM, SIDALCEA CAMPESTRIS, BRODIAEA HYACINTHINA, ACHILLEA MILLEFOLIUM, ASTER HALLII, PRUNELLA VULGARIS VAR LANCEOLATA.

Protection: POP EXTENDS TO THE N OFF NATURE CONSERVANCY LAND ONTO THE ROW OF A PRIVATE DRIVE.

Management: SCOTS BROOM PATCHES WERE REMOVED IN 1997/1998 WITH ANNUAL FOLLOW-UP SINCE THEN.

General: 2000 PLANT SIGHTING REPORT, ED ALVERSON REPORTER. MAY BE ONE OF THE BEST PROTECTED SITES FOR THIS SPECIES. TENDS TO OCCUR IN AREAS OF DEEPER SOILS. NEED TO SURVEY OTHER TNC TRACTS FOR THIS SPECIES.

25 records total

Key to Oregon Natural Heritage Information Center Data

Field Name	Description
Scientific Name	The scientific name of the species.
Common Name	The common name of the species.
Category	Value that indicates the broad biological category for each species.
ELCODE	Unique Heritage Program code for identifying this element. 1st and 2nd byte (PD=Plant dict, PM=Plant monocot, PG=Plant gymnosperm, PP=Plant pteridophyte, AA=amphibian, AB=bird, AF=fish, AM=mammal, AR=reptile, I=invertebrate. 3rd-5th byte (family abbreviation). 6th-7th (genus code). 8th-9th (species). 10th (tie breaker).
Federal Status	US Fish and Wildlife Service or National Marine Fisheries Service status. **LE**=listed endangered, **LT**=listed threatened, **PE** or **PT**=proposed endangered or threatened, **C**=candidate for listing with enough information available for listing, **SOC**=species of concern, **-PD**=proposed delisting, **-NL**=not listed (in part of the range).
State Status	For animals, Oregon Department of Fish and Wildlife status; **LE**=listed endangered, **PE**=proposed endangered, **PT**=proposed threatened, **SC** or **C**=sensitive-critical, **SV** or **V**=sensitive-vulnerable, **SP** or **P**=sensitive-peripheral, **SU** or **U**=sensitive-undetermined status. For plants, Oregon Department of Agriculture status; **LE**=listed endangered, **LT**=listed threatened, **C**=candidate.
GRANK/SRANK	ORNHIC participates in an international system for ranking rare, threatened and endangered species throughout the world. The system was developed by The Nature Conservancy and is now maintained by NatureServe in cooperation with Heritage Programs or Conservation Data Centers (CDCs) in all 50 states, in 4 Canadian provinces, and in 13 Latin American countries. The ranking is a 1-5 scale, primarily based on the number of known occurrences, but also including threats, sensitivity, area occupied, and other biological factors. In this book, the ranks occupy two lines. The top line is the Global Rank and begins with a "G". If the taxon has a trinomial (a subspecies, variety or recognized race), this is followed by a "T" rank indicator. A "Q" at the end of this line indicates the taxon has taxonomic questions. The second line is the State Rank and begins with the letter "S". The ranks are summarized as follows: **1** = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences; **2** = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction (extirpation), typically with 6-20 occurrences; **3** = Rare, uncommon or threatened, but not immediately imperiled, typically with 21-100 occurrences; **4** = Not rare and apparently secure, but with cause for long-term concern, usually with more than 100 occurrences; **5** = Demonstrably widespread, abundant, and secure; **H** = Historical Occurrence, formerly part of the native biota with the implied expectation that it may be rediscovered; **X** = Presumed extirpated or extinct; **U** = Unknown rank; **?** = Not yet ranked, or assigned rank is uncertain.
NHP list	All rare species in Oregon are assigned a list number of 1, 2, 3 or 4, where **1**=threatened or endangered throughout range, **2**=threatened or endangered in Oregon but more common elsewhere, **3**=Review List (more information is needed), **4**=Watch List (currently stable). A null value indicates the species is not currently on our rare species list.
HP Track	We currently obtain and computerize locational information for only those elements marked with **Y**(es). Those species marked with **N**(o) or **W**(atch) have incomplete data because we do not actively track them at this time.
EO ID	Unique identifier for the Element Occurrence (EO).
First_obs	First reported sighting date for this occurrence in the form YYYY-MM-DD.
Last_obs	Last reported sighting date, usually in the form YYYY-MM-DD.
Confirmed	Indication of whether taxonomic identification of the Element represented by this occurrence has been confirmed by a reliable individual. Blank=unknown, assumed to be correctly identified. Y=Yes, confident identification. ?=identification questions.
Directions	Site name and/or directions to site.
County	County name(s) in which EO is mapped.
Ecoregion	Physiographic Province in which EO is mapped: **CR**=Coast Range, **WV**=Willamette Valley, **KM**=Klamath Mountains, **WC**=West slope and crest of the Cascades, **EC**=East slope of the Cascades, **BM**=Ochoco, Blue and Wallowa Mts., **BR**=Basin and Range, **CB**=Columbia Basin, **SP**=Snake River Plains.

Key to Oregon Natural Heritage Information Center Data

Field Name	Description
Source Feature	A Source Feature is the initial translation of a discrete unit of observation data as a spatial feature. Creation of a Source Feature requires an interpretive process. The likely location and extent of an observation is determined through consideration of the amount and direction of any variability between the recorded and actual locations of the observation data. In most cases, the Source Feature is delineated to encompass locational uncertainty. A Source Feature can be a point, line, or polygon. The type of Source Feature developed depends on both the preceding conceptual feature type and the locational uncertainty associated with the feature.
Uncertainty Type (Distance)	The recorded location of an observation of an Element may vary from its true location due to many factors, including the level of expertise of the data collector, differences in survey techniques and equipment used, and the amount and type of information obtained. This inaccuracy is characterized as locational uncertainty, and is assessed for Source Feature(s) based on the uncertainty associated with the underlying information on the location of the observation. Four categories of locational uncertainty have been identified, as follows: Negligible uncertainty is less than or equal to 6.25 meters in any dimension. Source Features with negligible uncertainty are based on a comprehensive field survey with high quality mapping and a high degree of certainty. Linear uncertainty is greater than 6.25 meters, and varies along an axis (e.g., a path, stream, ridgeline). The true location of an observation with linear uncertainty may be visualized as effectively sliding along a line that delineates the uncertainty. Areal delimited uncertainty is greater than 6.25 meters, and varies in more than one dimension. The true location of an observation can be visualized as floating within an area with a boundary that can be specifically delimited. Boundaries can be defined using roads, bodies of water, etc. Areal estimated uncertainty is greater than 6.25 meters, and varies in more than one dimension. A boundary cannot be specifically delimited based on the observation information, i.e., the actual extent is unknown. The true location of the observation can be visualized as floating within an area for which boundaries cannot be specifically delimited. Source Features with areal estimated uncertainty require that the user specify an estimated uncertainty distance to be used for buffering the feature to incorporate the locational uncertainty.
Town-Range, Sec, and Note	United States rectangular land survey (also known as the Public Land Survey System) legal township, range, and section descriptions that best define the location of the Element Occurrence. Township first (4 bytes), range second (4 bytes). For example: 004S029E = Township 4S, Range 29E. All locations are with reference to the Willamette Meridian. Fractional ranges or townships are indicated in the Note field.
Quadcode	USGS code for the USGS topographic quadrangle map(s) where the record is mapped.
Quadname	Name of the USGS topographic quadrangle map(s) where the record is mapped.
Watershed	Watershed(s), identified according to the U.S. Geological Survey (USGS) Hydrologic Unit Map 10-digit code, within which the Element Occurrence is located.
Owner Name/Type and Comments	Federal, State, Private, etc.
Managed Area Name	BLM District, USFS Forest, Private Preserve
EO Type	For animals, type of occurrence, eg. roost, nest, spawning, etc.
EO Data	Species and population biology - numbers, age, nesting success, vigor, phenology, disease, pollinators, etc.
EO Comments	Habitat information, e.g. aspect, slope, soils, associated species, community type, etc.
Minimum Elevation	Minimum elevation of the area covered by the range of the taxon, in meters. -339 or blank=not determined.
Annual Observation	Summary of yearly observation.
Protection	Comments on protectibility and threats.
Management	Comments on how the site is managed.
General	Miscellaneous comments.

Mutual Water Agreement

This Agreement is made and entered into this 9th day of April, 2001, by and between the City of Salem, Oregon, an Oregon municipal corporation ("City of Salem"), and the City of Stayton, Oregon, an Oregon municipal corporation ("City of Stayton").

WHEREAS, City of Salem is the owner and operator of a community water system that supplies safe drinking water to customers in the Salem area, whose primary water source is from surface water withdrawn from the North Santiam River at Geren Island;

WHEREAS, City of Stayton is the owner and operator of a community water system that supplies safe drinking water to customers in the Stayton area, whose primary water source is from surface water withdrawn from the North Santiam River downstream from Geren Island;

WHEREAS, both Cities have community water systems that meet all current requirements of the Oregon Health Division for safe drinking water supplied to customers;

WHEREAS, both Cities have an adequate safe drinking water supply to serve their respective communities under normal conditions, peak season conditions, and most emergency situations;

WHEREAS, both Cities have a desire to further develop their emergency sources of safe drinking water supply with the capability to handle emergency conditions resulting from an unusual calamity such as a flood, storm, earthquake, drought, civil disorder, volcanic eruption, an accidental spill of hazardous material, or other occurrence which disrupts water service or can endanger the quality of the water produced by a water system;

WHEREAS, both Cities have a desire to occasionally provide surplus safe drinking water to one another and to occasionally use surplus safe drinking water from one another;

WHEREAS, both Cities have entered into previous water agreements with one another dated June 3, 1957, February 10, 1971, and August 27, 1999;

WHEREAS, both Cities are currently in the process of negotiating a separate agreement for construction of a transmission water conduit.

NOW, THEREFORE, in consideration of the covenants and agreements hereinafter set forth to be kept and performed by the parties hereto, it is mutually agreed as follows:

City of Salem Agrees:

1) To sell safe drinking water to the City of Stayton during emergency conditions (See Section 9);

2) To sell surplus safe drinking water to the City of Stayton (See Section 10);

3) To sell safe drinking water to the City of Stayton at the rate of $0.35 per 100 cubic feet ($0.4679 per 1,000 gallons). This includes emergency safe drinking water or surplus safe drinking water;

4) To limit future annual rate increases in the sale of safe drinking water to Stayton by an amount not to exceed the year end percentage change for the month ending in June in the Consumer Price Index for the West, as published by the Department of Labor, Bureau of Labor Statistics, for all urban consumers;

City of Stayton Agrees:

5) To sell safe drinking water to the City of Salem during emergency conditions (See Section 9);

6) To sell surplus safe drinking water to the City of Salem (See Section 10);

7) To sell safe drinking water under either emergency conditions or surplus safe drinking water to the City of Salem at the commodity rate charged other Stayton customers, which is $0.581 per 1000 gallons ($0.4346 per 100 cubic feet);

8) To limit future annual rate increases in the sale of safe drinking water to Salem by an amount not to exceed the year end percentage change for the month ending in June in the Consumer Price Index for the West, as published by the Department of Labor, Bureau of Labor Statistics, for all urban consumers;

Both Cities Agree:

9) To provide safe drinking water to one another for emergency conditions. When emergency safe drinking water is required by either City, the requesting City shall contact the other City to ensure safe drinking water is available. Only Stayton's City Administrator or Salem's Public Works Director, or their designee, of the City receiving the request is authorized to determine whether safe drinking water is available for the emergency condition. Once the availability of safe drinking water has been determined, representatives of each City shall coordinate the operations of appropriate valves, measuring devices, and auxiliary systems;

10) To provide surplus safe drinking water to one another. When surplus safe drinking water is required by either City, the requesting City shall contact the other City to ensure surplus safe drinking water is available. Only Stayton's City Administrator or Salem's Public Works Director, or their designee, of the City receiving the request is authorized to determine whether surplus safe drinking water is available. Once the availability of surplus safe drinking water has been determined, representatives of each City shall coordinate the operations of appropriate valves, measuring devices, and auxiliary systems;

11) To acknowledge and understand that the supply of emergency safe drinking water or surplus safe drinking water may be limited at times and seasons to specific locations if required to meet Safe Drinking Water Act standards of the Oregon Health Division. Additional treatment such as corrosion control and additional chlorine contact time may be required;

12) To jointly conserve safe drinking water during a regional water shortage, that may be caused by either a drought, a flood, or other regional emergency condition by following each Cities' individual water curtailment program. Conserving safe drinking water will maximize its availability to both communities, and subject to Section 9, water will be provided to each community during a water shortage on a per capita basis;

13) To support the other City's legal purchase, sale, lease, or maintenance of water rights by not contesting these actions; including, but not limited to, water right transfers, changing or modifying a water right permit, processing a water right time extension, filing proof of completions, and perfecting water rights;

14) To maintain an active water system backflow prevention program in their own respective water systems in accordance with Oregon Statutes for the life of this agreement;

15) For purposes of this Agreement "Safe Drinking Water" shall have the same definition as found in OAR 333-061-0020 (122).

16) This Agreement supercedes the Emergency Water Agreement between the parties dated August 27, 1999; the Agreement between the parties dated February 10, 1971; and paragraph 11 of the Agreement between the parties dated June 3, 1957. All other provisions of the 1957 Agreement shall remain in full force and effect.

17) This Agreement shall be effective simultaneously upon execution of the "Agreement for Construction of a Transmission Water Conduit," in substantially the same form as Exhibit A hereto.

18) This Water Agreement can be terminated with or without cause by either City by giving the other 180 calendar days' written notice.

19) Should a dispute arise over any of the items contained in this agreement, both Cities agree to participate in non binding mediation or non binding arbitration proceedings endeavoring to resolve the issue in dispute. The mediator or arbitrator shall be mutually agreed upon by both Cities.

City of Salem, Oregon

By: Roberta Wells
City Manager, Pro Tem

City of Stayton, Oregon

By: Gene Aldrich 3/20/01
Mayor

ATTEST: C M Childs
City Administrator

Approved as to form:

David A. Rhoten
City Attorney

Exhibit A—Agreement for Construction of a Transmission Water Conduit

Steven P. Applegate Consulting
5528 Murray Street SE
Salem, OR 97306
Voice/Fax (503)362-4040

March 28, 2005

Mr. Mike Faught
Public Works Director
City of Stayton
362 North 3rd Avenue
Stayton, OR 97383

REFERENCE: City of Stayton Water Rights

Dear Mr. Faught :

This is an update to my May 30, 2002, June 18, 2003 and August 23, 2004 reports. This report is to update the status of all water rights now held by the City of Stayton (City). It reflects all of the changes and clarifications we have been able to develop to date.

The table below lists all of the rights the City currently holds, their significant data and current status. Copies of the relevant documents that define these rights in the official record at the WRD were sent to you with my last report, and you recently received a copy of the final order approving Transfer 9192.

City of Stayton Water Rights

Appl'	Permit	Cert.	Source	Use	Q(cfs)	POD	Priority	Remarks
T-5883		80346	N. Santiam	Mun	2.78+	Power Canal	1909	779.5 AF annual limit
T-5884		80347	N. Santiam	Mun	0.82+	Salem Ditch*	1911	230.6 AF annual limit
T-5885		80348	N. Santiam	Mun	0.39+	Power Canal	1909	78.5 AF annual limit
T-8871		80349	N. Santiam	Mun	0.6~	Power Canal	1907	No annual limit
T-9192	12033		N. Santiam	Mun	10~	Salem Ditch	1923	Comp. Date- Oct. 2011
39297	29266	57094	N. Santiam	Mun	7~	Power Canal	1963	
71584	52447		N. Santiam	Mun	25#	Power Canal	1991	Extension pending to 2060
Subtotal-Surface Wtr					46.59			
GR-145	Gr-139		Inf. Trench	Mun	2.67~	NWNE Sec15	1930	Groundwater adjudication
G-270	G-173	24587	Well 2	Mun	3~	NENE Sec 15	1956	
Subtotal-Groundwtr					5.67			
Total					52.26 cfs			

*- *Salem Ditch and Stayton Power Canal assumed in the record to be the same point- 1800 feet South and 2830 feet East from the West 1/4 Corner Section 11.*

+-May through September only-3.99cfs; ~Year around use-23.27cfs (includes 17.6 cfs from the

river & 5.67 cfs from groundwater); #- October through April only-25cfs.
The water rights allow for the total use of up to 46.59 cfs (about 30 MGD) from surface water and 5.67 cfs (3.6 MGD) from groundwater. However, as noted on the table and further described below, many of the rights have season of use limitations. The individual rights are further described below.

Surface Water Rights-
The City holds seven surface water rights that allow for use of up to 46.59 cfs (16,429 GPM) from the North Santiam River. Priority dates range from 1907 to 1991. All but two of these are final rights evidenced by certificates that total 11.59 cfs..

Two of the rights from the river are "inchoate," or incomplete. Proof has not been made by the City to allow a final water right to be issued. These rights are the 10 cfs under Transfer 9192 and the 25 cfs under Permit 52447. See below for further discussion of these two rights.

Certificates 80346, 80347 & 80348- Transfers 5883, 5884 5885 were obtained by the City in 1986 through changes in character of use of irrigation rights previously held by the Santiam Water Control District and its patrons to municipal use by the City. The three certificates combined allow up to 3.99 cfs. These are some of the City's oldest rights. Because these water rights were initially for irrigation purposes, their exercise is limited to within the legal irrigation season, from May 1 to September 30. In addition, the three rights carry an annual aggregate volume limit of 1088.6 acre-feet, which was the original limit on the irrigation rights prior to the transfers.

Certificate 80349 -Transfer 8871 provided for a change of a 1907 right for 0.6 cfs for manufacturing use to municipal use by the City. It is the oldest right held by the City. Exercise of the right is allowed year around and there is no annual volume limit.

Certificate 57094 - This is a 1963 right from the river for 7.0 cfs (4.4 MGD). The use is allowed year around and there are no special conditions or volume limits.

Transfer 9291 - The most recent addition, as you know, is Transfer 9192, which was approved by the Oregon Water Resources Department (WRD) on November 1, 2004, conferring to the City a right for 10 cfs from the City of Salem's rights from the North Santiam River. The date of priority of this right is 1923. This is a year around use from the North Santiam River, and greatly improves Stayton's position from a water rights perspective. This addition raises the City's rights from the river to a total of 46.59 cfs, with 17.6 cfs being allowed year around. Under the terms of the transfer approval order, this right must be fully in use by October 1, 2010. Obviously, the City will need to apply for an extension of that time limit on or about the 2010 date.

Permit 52447- This is the most recent (1991), and the largest (25 cfs) of the City's rights. In 1999, the City applied for an extension of the October 1, 1999, completion date for the permit.

The request is to extend the required completion to the year 2060. That request is still pending. We recently submitted an updated extension request to conform with WRD's newly adopted rules for municipal extensions. Much of the justification for the extension is dependent upon information now being developed as part of the Master Plan/Management Plan process. We have asked WRD to hold further processing of the extension request until about July 2005, when we expect to have that detailed information available.

The most significant aspect of this permit is that use is allowed only from October through April. This was based upon a finding of limited water availability from natural flow when the permit was issued in 1996. Given that condition, this right may be of limited value to the City, especially given the quantities of water under the other rights that are available year around and during the summer months.

Permit 52447 also contains a condition that required the City to submit a Water Management & Conservation Plan (WMCP) within two years after the permit was issued, which would have been by July 8, 1998. As of this date, development of a Master Plan is under way. We will need to ensure that this plan is constructed to include all of the required elements of a WMCP to satisfy the requirements of WRD.

Groundwater Rights-

Groundwater Registration (GR) #139- This is simply a claim in the statewide groundwater adjudication for uses that began prior to the 1955 Groundwater Act. The City's claim is for 2.67 cfs (1199 GPM) from an "infiltration trench" for municipal use. The claim is for a 1930 priority date, the date the development was allegedly constructed. This will remain in claim status until such time as the State (WRD) conducts a full survey and analysis of the use under all of the claims and submits their findings to the courts. The State still has about ½ of the state to complete this process for surface water, so it does not seem likely it will occur in most of our lifetimes. It is possible they could choose to initiate this process in small geographic areas if significant disputes were to arise relative to the claims, but this is not likely. The only caution is that the claim, its validity to be determined when the adjudication does occur, must remain in relatively continuous use, without significant (five years?) lapses. I do not know the status of use from this well. If the City is not using this well, but is using another well which develops the same groundwater supply, it is advisable to notify WRD of that fact. The information will be placed in the file and the validity of the claim ultimately will be decided by the courts. There are no guarantees.

Permit G-173 is a certificated (C.24587) right for 3.0 cfs (1,347 GPM) from "Stayton Municipal Well #2." I did not attempt to retrieve specific information about this well, but presumably, if a well log exists, it would be readily available. Since this right is certificated, there is nothing the City need do to maintain it. The certificate protects the right from forfeiture. No further use is required.

Recommendations

As described above there are a few items needing attention from the City relative to their existing water rights.

1. Permit 52447- Once a Water Management & Conservation Plan is ultimately submitted to and approved by WRD and the pending extension application is approved, this permit will be in good status. As discussed above, the Master Plan currently in progress must be developed with the state's requirements for WMCP's firmly in mind.

2. GR-139 - If this source continues to be used, nothing is needed. If not, consideration should be given to protection of the claim. Further discussion is needed to determine how to proceed.

3. Undeveloped Water- Since the City holds rights to a significant amount of water that is not yet developed, options may exist for marketing some of it to other municipal entities in the area, or forming some type of water authority. Water marketing transactions are becoming more common around the state, and can be done either on a lease or permanent basis. The commodity has a significant monetary value. I have some data on this activity in Oregon if you care to see it.

4. The date of October 2010 under Transfer 9192 must be kept firmly in mind, knowing that an extension of that time limit will be necessary. It is also possible that legislative actions relative to municipal rights under permit or transfer orders may change the nature or need for future action.

I hope this provides the analysis you need. Please feel free to contact me if you have questions or if I can be of further assistance.

Respectfully Submitted,

Steven P. Applegate
Steven P. Applegate Consulting

cc: Justin Walker, Keller Associates

Stayton H2O Rate Structure

Water July 2002

Commodity Rate = .654 Per Thousand

Old Rates	Rates	Description	Base Rates	Details	
-101	1	3/4" Class 1	13.50	3/4" Resident	+ Bus. under 3000
-102	2	1" Class 1	19.40	1"-1 Resident	
-104	3	1 ½" Class 1	29.15	1 ½" Resident	
-105	4	2" Class 1	40.85	2" Resident	
-151	5	3/4" Class X	13.50	3/4" Resident	1-3 Units
-152	6	3/4" Class Y	22.45	3/4" Resident	4-15 Units
-162	7	1" Class Y	28.35	1" Resident	4-15 Units
-163	8	1" Class Z	93.30	1" Resident	16-34 Units
-172	9	1 ½" Class Y	38.10	1 ½" Resident	4-15 Units
-173	10	1 ½" Class Z	103.05	1 ½" Resident	16-34 Units
-183	11	2" Class Z	114.75	2" Resident	35 Plus Units
-201	12	3/4" Class 2	22.45	3/4" Business	3086-12345 Sq Ft
-202	13	1" Class 2	28.35	1" Business	3086-12345 Sq Ft
-204	14	1 ½" Class 2	38.10	1 ½" Business	3086-12345 Sq Ft
-205	15	2" Class 2	49.80	2" Business	3086-12345 Sq Ft
-301	16	3/4" Class3	87.40	3/4"	
-302	17	1" Class 3	93.30	1"	
-304	18	1 ½"Class 3	103.05	1 ½"	
-305	19	2" Class3	114.75	2"	
-306	20	3" Class 3	142.15	3"	
-308	21	6" Class 3	278.95	6'	
-309	22	2" Class 3	219.95	2"	
-350	23	3/4" No Fire	10.65	3/4" No Fire	Irrigation
-351	24	1" No Fire	16.55	1" No Fire	Irrigation
-352	25	1 1/4" No Fire	21.40	1 1/4" No Fire	Irrigation
-353	26	1 ½" No Fire	26.30	1 ½" No Fire	Irrigation
-354	27	2" No Fire	38.00	2" No Fire	Irrigation
-355	28	3" No Fire	65.40	3" No Fire	Irrigation
-358	29	8" No Fire	319.50	8" No Fire	Irrigation
-360	30	10" No Fire	456.35	10" No Fire	Irrigation
-401	31	3/4" Class 4	192.60	3/4" Industrial	
-402	32	1" Class 4	198.50	1" Industrial	
-404	33	1 ½" Class 4	208.25	1 ½" Industrial	
-405	34	2" Class 4	219.95	2" Industrial	
-406	35	3" Class 4	247.35	3" Industrial	
-453	36	Fire Line	8.10	3" Fire Line	
-454	37	Fire Line	9.15	4" Fire Line	
-460	38	Fire Line	17.75	6" Fire Line	
-468	39	8" Fire Line	28.95	8" Fire Line	
-475	40	Fire Line	0.00		
-497	41	Flat Rate	0.00	Flat Rate	
-499	42	No Water Service	0.00	No Water Service	
-501	43	3/4" Class 5	366.05	3/4"	
-502	44	1 ½" Class 5	381.70	1 ½"	
-505	45	2 " Class 5	393.40	2"	
-506	46	3 " Class 5	420.80	3"	
-508	47	6" Class 5	557.60	6"	
-510	48	10" Class 5	811.75	10"	
-598	49	Duplex on Same Meter	27.00		
-599	50	Reg. Use of fire	0.00		
-651	51	Residential 5 Units	0.00		
-999	52	City Facility	0.00	City Of Stayton	
	53	3/4" Theater/City Hall	0	Shared meter	

07/03/02
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DRAFT Technical Memorandum

City of Stayton Shallow Aquifer Evaluation, 2014

PREPARED FOR: Peter Olsen, PE – Keller Associates, Inc.
Dave Kinney – City of Stayton
Tom Etzel – City of Stayton

PREPARED BY: Christopher Augustine, RG – GSI Water Solutions, Inc. (GSI)
DeEtta Fosbury, RG – GSI
Walt Burt, RG – GSI

DATE: April 30, 2014

Introduction

This technical memorandum provides an evaluation of the feasibility for the City of Stayton to expand its groundwater system to meet a target capacity of 1,000 gallons per minute (gpm) or 1.4 million gallons per day (mgd) in the vicinity of the existing 75 Well. The purpose of the shallow aquifer evaluation was to assess the feasibility of constructing a new infiltration gallery near the 75 Well that would use the existing infrastructure and potentially the 75 Well to meet the City's target water supply demands. Currently, the City relies on two aging horizontal collector-type groundwater supply wells, including the 75 well, for use when turbidity events in the Santiam River during the winter months affect the City's ability to use its surface water supply. We understand that the City prefers not to rely on the 75 Well as its primary groundwater source in its existing configuration and condition.

Background

The City has been evaluating the feasibility of improving the capacity and reliability of its backup groundwater supply over the past four years. As part of the evaluation,, an exploratory drilling program was conducted in October 2012 to determine if the aquifer saturated thickness near the City's water treatment plant (WTP) could support a vertical supply well with a long-term capacity of 1,000 gpm. Observations made during the drilling program in 2010 indicated that the saturated thicknesses of the aquifer was relatively thin (less than 20 feet) near the 75 Well and 50 Well, and would not support a vertical water supply well to meet the City's target groundwater capacity (GSI, 2012).

Following the initial drilling exploration program, further investigations were conducted to identify and evaluate potentially favorable locations for a groundwater source of supply in the general vicinity of the City's WTP, including:

1. Review of historical aerial photographs and maps to identify target properties for further evaluation using surficial geophysical methods (GSI, 2013a)
2. Exploration of the target properties using surface geophysical techniques to delineate the most favorable locations over relatively large areas to complete exploration borings (GSI, 2013b)

The historical and geophysical investigations identified several potential areas of coarser-grained material, including an area near the 75 Well. Several of the potential locations were eliminated because of limitations of the City of Salem pipeline easements and other land use considerations. Previous test borings near the 75 Well indicated that the soils were coarse-grained, but that the saturated thickness was relatively thin. Given these limiting factors, GSI recommended that the City consider designing an infiltration gallery system in the vicinity of the 75 Well to improve the yield and performance of the 75 Well and/or a replacement well by infiltrating diverted surface water to increase the saturated thickness of the shallow aquifer, and continue using existing electrical and distribution infrastructure associated with the well.

While the previous geophysical interpretations near the 75 Well suggested that the coarse-grained materials observed at Test Boring 3 were present over a relatively large area east of the 75 Well, the City wanted to better characterize the lateral extent and hydraulic properties of the shallow aquifer near the 75 Well. Results of the shallow aquifer investigation and evaluation of the 75 Well are presented below.

Shallow Aquifer Investigation

The primary objective of the 2014 shallow aquifer investigation was to confirm the saturated thickness and hydraulic properties of the target coarse-grained alluvial aquifer near the 75 well. The aquifer was estimated to be 25 to 30 feet thick, based on interpretations from the geophysical survey and the Test Boring 3 location. Three of the proposed eight test borings were converted to temporary piezometers to evaluate the aquifer response to pumping of the 75 Well (Figure 1). The test was performed to estimate aquifer properties and the hydraulic connection of the 75 Well with the North Santiam River. The test boring program and the pumping test results are presented below.

Test Borings

Five test borings originally were proposed east of the 75 well. At the request of the City, three additional locations were added on the west side of the 75 well. The borings were advanced using a track-mounted sonic drilling rig operated by Cascade Drilling, Inc, Sherwood, Oregon. Figure 1 shows the approximate locations of the eight new test borings (Test Borings 4 through 11) and previously drilled Test Boring 3. The eight test borings were advanced approximately 25 to 30 feet below ground surface (bgs). GSI field staff members observed the recovered soil cores and classified the soils using American Society of Testing Materials (ASTM) Standard D2288- 09(a) *Standard Practice for the Description and Identification of Soils* (Visual/Manual Procedure). In general, the subsurface conditions observed at the eight borings were consistent with previous observations at Test Boring 3 and the interpretations of the geophysical survey conducted in 2013 (Zonge, 2013).

Groundwater was encountered between 5 and 10 feet bgs and was observed to be present to the maximum depth of exploration, approximately 25 feet bgs. The shallow aquifer appears to be unconfined (i.e., water applied at the surface will infiltrate to the saturated zone). The soil material

encountered in the saturated zone was predominately silty gravel (GM) to poorly graded gravel (GP). A stiff clayey gravel layer was encountered at a depth of 14 to 19 feet bgs. The layer graded to a more clayey gravel layer and was present to a depth of approximately 60 feet in Test Boring 3 (GSI, 2012). The clayey gravel layer below 20 feet bgs is not considered a target for water production. A summary of the encountered soils at the individual test borings is shown in Table 1 and soil boring logs are included as Attachment A.

Soil samples were collected for grain size analysis at four locations (Test Boring 4, 6, 7, and 10) for future design of infiltration gallery lateral depth, lateral screen length and slot size, and selection of a suitable gravel envelope. The soil samples were submitted to FEI Testing and Inspection in Corvallis, Oregon, for grain size analysis by ASTM Method C137/C117. The washed sieve method was selected to better evaluate the fine-grained portion (0.75 micrometer [µm] or less) of the selected soil samples based on the field classification of the soil. The grain size analyses are generally consistent with the field classification; however, they suggest that the sediments that were field-classified as clayey gravel are predominately silty gravel with less than 20 percent fines present. The individual laboratory results are included in Attachment B and summarized in Table 2.

Evaluation of the 75 Well

This section provides the pumping test methodology, test results, and interpretations of the aquifer response to pumping of the 75 Well; performance of the 75 Well; and groundwater quality results for the 75 Well. The aquifer test was performed to evaluate the hydraulic properties of the aquifer and to determine if there has been a substantial change in well performance since the last evaluation in 2010.

Water Level and Discharge Rate Monitoring

Periodically, water levels were measured manually using an electronic water level meter at the three piezometers, while the 75 Well water levels and the discharge rate of the 75 Well were monitored on the City's SCADA display. The 75 Well operational water levels and discharge rate are shown in Table 3. Piezometer water level data are summarized in Table 4.

Precipitation and River Stage Monitoring

Given that the aquifer is unconfined and is bounded to the south by the North Santiam River, precipitation and river stage also were monitored as part of the aquifer test. Precipitation observed at the National Weather Service, Salem, Oregon, weather station during the period of February 25 to March 5, 2014, was used to estimate local precipitation in the City because provisional data for local weather stations were not available. Based on observations at the Salem weather station, approximately 2.45 inches were recorded during the period of observation, 1.46 inches of which were observed on March 5, 2014 (the final day of the pumping test).

River stage fluctuations during the aquifer test were evaluated using the U.S. Geological Survey river gauge at Mehama, Oregon (No. 14183000), located approximately 11 miles upstream. A comparison of water levels observed at the 75 Well and the three temporary piezometers during the test and the river stage is shown in Figure 2.

75 Well Aquifer Test

The aquifer test was performed to evaluate the performance of the 75 Well and potential limitations for recovery of infiltrated water near the 75 Well. Temporary piezometers were installed in the

lower saturated zone at three boring locations (Test Borings 5, 7, and 8) to monitor the aquifer response to pumping of the 75 well. The 75 Well was operating from 12:37 on March 3, 2014, to 15:30 on March 4, 2014. The well discharge rate was observed to decrease from an initial pumping rate of 1,000 gpm to 460 gpm during pumping because of the variable frequency drive adjusting the rate; however, the pumping rate was relatively stable during the final few hours of pumping.

The specific capacity (a measure of aquifer and well performance, yield divided by drawdown) of the 75 Well previously had been observed to decrease substantially during testing in 2010. The specific capacity decreased from the 900 gpm/foot of drawdown in 1956 to approximately 70 gpm/foot of drawdown in 2010. The specific capacity observed during the current pumping test was approximately 66 gpm/foot of drawdown, which is slightly lower than the 2010 specific capacity.

Aquifer Response

A maximum drawdown of 7 feet bgs was observed at the 75 Well during pumping. The maximum drawdown was observed at Test Boring 7 (located 44 feet north from the 75 Well lateral) was 6.9 feet bgs, similar to that observed in the pumping well (Table 3). Test Borings 5 and 8 (approximately 92 feet and 84 feet northwest, respectively), located farther from the 75 Well lateral (Figure 1) also were observed to have substantial drawdown during pumping. Test Boring 5 had an observed maximum drawdown of 4.15 feet bgs while Test Boring 8 had 3.65 feet bgs (Table 4).

Qualitatively, the observed drawdown in the temporary piezometers suggests that pumping of the 75 Well results in a broad cone of depression and a large radius of influence in the aquifer. It also suggests that a substantial amount of the water infiltrated in the area of investigation to the east of the 75 Well would be recovered by the 75 Well. The similarity in magnitude of the 75 Well and Test Boring 7 drawdown suggests that the saturated thickness of the unconfined water-bearing zone is decreased up to 35 percent near the 75 Well lateral, and that the observed decrease in the discharge rate of the 75 Well during longer periods of operation likely results from this decrease in the saturated thickness near the well.

The water levels at the three piezometers and the pumping well were observed to respond rapidly to river level fluctuations during the pumping test, particularly in the late-time data (Figure 2). These observations suggest that the shallow aquifer (and the 75 Well) has a strong hydraulic connection to the river; however, as noted during the previous aerial photo review, it may not be as strong as it was when originally constructed because of riverbank migration farther from the laterals.

Aquifer Transmissivity Estimate

Transmissivity is the aquifer property that describes how rapidly water can be transmitted through the aquifer matrix and is a function of the hydraulic conductivity of the aquifer matrix and the saturated thickness of the material. In an unconfined aquifer, the saturated thickness decreases with continued pumping and can affect the well performance as the aquifer is dewatered. Given the relatively thin saturated thickness of the shallow aquifer, the temporary piezometers were installed at increasing distance from the 75 Well to evaluate dewatering of the shallow aquifer during pumping.

The late-time water levels likely were influenced by delayed drainage of the aquifer or the infiltration of precipitation. The dynamic nature of the test (i.e., changing pumping rate, changing river stage, and precipitation) preclude identifying and/or isolating the magnitude of the aquifer response relative to each of those potential influences. Early-time data were used for estimating properties because the river stage was relatively stable during this period of the test and likely did not substantially influence groundwater levels. However, the estimate of the effective transmissivity

of the aquifer using the early-time data should be considered only approximate and semi-quantitative.

Effective transmissivity from the early-time data was estimated using the analytical curve matching method of Daviau et al. (1985). The analytical curve matching solution is for a horizontal pumping well in a confined aquifer (AQTESOLV PRO, 2012). Based on the best fit curve match, the estimated effective transmissivity for the shallow aquifer is approximately 40,000 gallons per day per foot (gpd/ft). This estimate of transmissivity likely is affected by recharge from the nearby North Santiam River (increasing the estimated transmissivity) and does not account for the decrease in aquifer thickness resulting from pumping (decreasing transmissivity) or delayed drainage (increasing transmissivity in early-time data). Assuming a 20-foot aquifer thickness results in a hydraulic conductivity estimate of 2,000 gpd per square foot (gpd/ft^2) or 270 feet/day. The estimated hydraulic conductivity is in general agreement with the published hydraulic conductivity estimates for clean gravels (3,500 ft/day) to sand and gravel mixtures (35 ft/day), but should be considered an order of magnitude estimate.

The National Resources Conservation Service (NRCS) soil mapping survey for Linn County shows that the surficial soils near the City WTP and the 75 Well are classified as Alluvial Land (Ad) floodplain deposits. The drainage class is somewhat poorly drained; however, this is likely because of the shallow depth to water than the transmitting capacity of the soil. Estimates of the saturated hydraulic are from 19.98 to 99.98 inches per hour (approximately 40 to 200 feet/day) for the most limiting layer (NRCS, 2014). On the basis of the NRCS characterization and the estimate of hydraulic conductivity of the aquifer test at the 75 Well, the shallow aquifer and overlying soils appear to have a high infiltration capacity.

Water Quality Evaluation

Shallow aquifer water quality was evaluated to (1) observe water quality trends during sustained pumping and (2) to collect a bacterial assessment and water quality sample to identify any potential limitations on the operation and maintenance of the 75 Well. The 75 Well water quality and bacterial population previously were evaluated in 2010 (GSI, 2010). Those water quality results indicated that the bacterial clogging of the well screen and filter pack likely was occurring and was affecting well performance. The observed water quality trends and analytical results for the 2014 testing are presented in the following sections.

Water Quality Trends During Pumping

Water quality field parameters of pH, specific conductance, dissolved oxygen and temperature was recorded periodically during the 75 Well pumping test (Figures 3 through 6). Specific conductance was observed to be relatively low for groundwater. Additionally, decreasing trends for temperature, and specific conductance and increases in dissolved oxygen indicate that surface water contribution increased with increased pumping duration during the 75 Well aquifer test.

General Water Quality

General water quality parameters (major cations, anions, metals, and nutrients) also were evaluated. The overall water quality was relatively good and showed a strong surface water signature based on the total dissolved solids and dilute concentrations of major cations and anions.

Bacterial Assessment

A water quality sample was collected at the 75 Well overflow valve for a complete well profile and bacterial assessment analysis by Water Systems Engineering, Inc. (WSE) of Ottawa, Kansas. During sampling, two water quality samples were collected to evaluate bacterial population distribution near the 75 Well. The first water quality sample (i.e., the casing sample) was collected after approximately 1 minute of pumping to characterize the bacterial population within the 75 Well caisson. A second sample (i.e., the aquifer sample) was collected after approximately 3 hours of pumping to evaluate bacterial populations farther from the well. The 2010 and 2014 WSE analytical laboratory reports are included as Attachment C.

The bacterial assessment indicated that slime-forming bacteria, *Bacillus cereus* and *Bacillus thuringiensos,* were present in the casing sample and iron-related bacteria, *Gallionella* and *Leptothrix,* were present in the aquifer sample. Additionally, the adenosine triphosphate (ATP) results for the casing sample indicated significant bacterial populations were present in the casing, screen, and filter pack of the 75 Well. Consistent with the ATP results, concentrations of resuspended iron (an indicator of bacterial activity) were also extremely high in the 2014 samples. The ATP results for the 2014 casing sample were significantly higher, suggesting that the bacterial biological population has continued to develop since the previous evaluation in 2010.

Summary of Results

The results of the soil boring investigation and pumping test program to evaluate the feasibility of using an infiltration system as part of the City's water system can be summarized as follows:

- The aquifer appears to be capable of supporting a 1,000-gpm infiltration gallery system that uses the 75 Well and/or additional collection laterals installed as part of the infiltration gallery system. The design of a system will depend on the final design capacity of the system and other considerations discussed below.
- A clear hydraulic connection with the North Santiam River was apparent during the pumping test; however, based on the previous aerial photo review, it may not be as strong as it was when the 75 Well was originally constructed because of migration of the riverbank farther from the laterals.
- Water quality from the 75 Well is generally good and reflects the influence of the North Santiam River and, to a lesser extent, the infiltration of precipitation.
- The bacterial assessment and water quality evaluation indicated that a bacterial population continues to be present in the 75 Well and the surrounding aquifer. The City will need to maintain the 75 Well lateral, as well as any additional laterals or collector systems installed in the future using a comprehensive maintenance and redevelopment program for the 75 Well.

Based on water quality observations, the encountered soil horizons and hydraulic evaluation of the shallow aquifer near the 75 Well suggest that the subsurface is suitable for infiltration of diverted surface water for collection and withdrawal by the 75 Well and/or another collector facility. The only potential limitation identified as part of this study is biofouling of the 75 Well and any additional collector laterals installed as part of an infiltration gallery system.

Recommendations

This section describes considerations for the design for the infiltration gallery system and recommendations for operation and maintenance of the 75 Well, should the City choose to continue to use the well either as a primary groundwater supply source or as a supplement to a new groundwater source.

Infiltration Gallery Design Considerations

Based on discussions with City staff members, the City would rather have a secondary collector or lateral rather than rely on the 75 Well as the primary recovery system for the infiltration gallery. The potential locations for the second lateral include locations on the east side of the 75 Well and on the west side of the 75 Well, near the Frog Pond.

Location

Based on the nature of soils encountered in the exploratory borings and aquifer testing results, an infiltration gallery facility, including a new collection lateral, is feasible on east and west sides of the 75 Well, as well as in the vicinity of the Frog Pond. While location of the infiltration gallery system and a new lateral on the west side of the 75 Well appears feasible, City staff members have indicated that underground utilities/piping are located in this area and would need to be re-located to accommodate construction of a lateral in this area.

Design Capacity

The final design of the infiltration gallery and laterals will depend on the selected target capacity of the system to meet current and future City water supply demand. Evaluation of anticipated mounding from operation of the infiltration system should be completed as part of the design process to be used in conjunction with the target recovery rate of the 75 Well and/or new lateral to develop the final size and design of both the infiltration gallery and a new lateral.

The lateral screen slot size and gravel envelope should be designed to minimize screen intake velocities (less than 0.1 ft/second) to limit the entrainment of the finer-grained portion of the shallow aquifer, and also to facilitate operation and maintenance of the system given the potential for biofouling to occur. The lower portion of the saturated zone appears to have a generally consistent composition of predominately silty gravel. The length of the lateral screen interval will be dependent on the footprint of the infiltration structure designed to meet the City's capacity of 1000 gpm. On the basis of the of our understanding of subsurface conditions, it is our opinion that an engineered gravel envelope composed of pea gravel with 60 feet of 12-inch diameter 100-slot continuous wrap screen should be sufficient to meet the preliminary design target rate; however, if the final design target recovery rate is significantly higher than 1,000 gpm or the screen length is limited, the preliminary screen design would need to be reevaluated.

Lateral and Infiltration Basin Maintenance

The infiltration gallery system will be designed for use during periods of high turbidity in the North Santiam River. Given that consideration, the ability to perform periodic maintenance to remove accumulated fines from the base of the infiltration gallery will need to be incorporated into the system design. Likewise, maintenance on the lateral also will need to be incorporated into the design based on the aquifer bacterial populations present near the 75 Well and the shallow aquifer. GSI recommends that clean-outs be installed in the lateral system to allow the introduction of jetting and/or vacuum truck system tooling to maintain the laterals.

75 Well Operation and Maintenance

The persistence of a bacterial population of iron-related bacteria and slime-forming bacteria in the shallow aquifer and 75 Well will require periodic maintenance and redevelopment to maintain well performance. The City previously has performed maintenance on the 75 Well using fluid impulse generation (HydroPuls™) and pumping, with limited success. GSI contacted a drilling contractor and Ranney Collector Wells to evaluate alternative procedures for periodic maintenance to remove accumulated biofilm and sediment in the 75 Well lateral, including the use of a vacuum truck.

Based on conversations with the driller, the use of a vacuum truck is feasible; however, it does have several potential limitations including:

- Limited access because of the relatively small caisson diameter, lateral geometry, and ballast rock (observed in previous well videos) used to install the lateral.
- Because of the limited access, a diver likely would be needed to assist in the use of the vacuum truck.
- Limited entrance velocities to remove biofilm and fines accumulated in the screen and filterpack will result in poor improvements to well performance on a cost benefit basis.
- Less effective in removing sediment and biofilm debris because of inability to simultaneously agitate and extract accumulated clogging materials.
- Potential risk of damaging the approximately 60-year-old lateral in the 75 Well, further limiting the 75 Well performance.

Given the potential risks and complications with redevelopment of the 75 Well, it is likely that a drilling contractor would not recommend attempting redevelopment of the well using vacuum or standard well redevelopment methods. Additionally, previous redevelopment using impulse generation methods and/or mechanical methods to redevelop the well have not resulted in substantial long-term improvements of the specific capacity of the 75 Well.

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FIGURE 1

Test Borings Locations

Test Drilling and 75 Well Evaluation

LEGEND

- Well
- 2012 Test Boring
- 2014 Test Boring
- Well 75 Lateral

NOTE:
* Temporary piezometer installed.
Locations are approximate.

N

0 20 40 60
Feet

MAP NOTES:
Date: April 17, 2014
Data Sources: Aerial Photo taken July 2010 by Microsoft

GSI Water Solutions, Inc.

Document Path: P:\Portland\357 - City of Stayton\002 - Well Field Expansion\Project_GIS\Project_mxds\Test_Drill_75_Well_Eval\Figure1_Test_Boring_Locs_Lateral.mxd

Figure 2. River Stage and Water Levels During 75 Well Test

Test Drilling and 75 Well Evaluation

City of Stayton

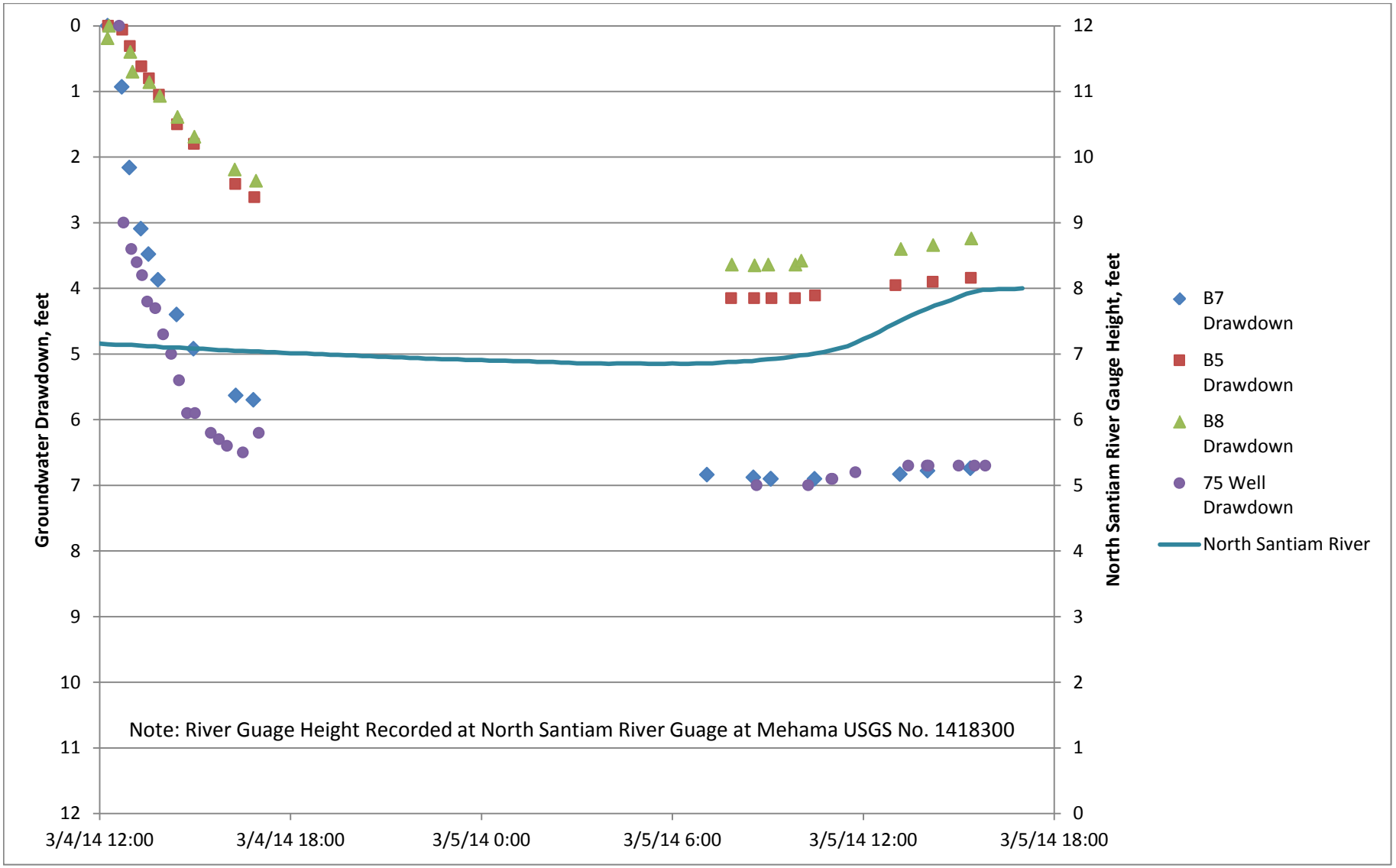
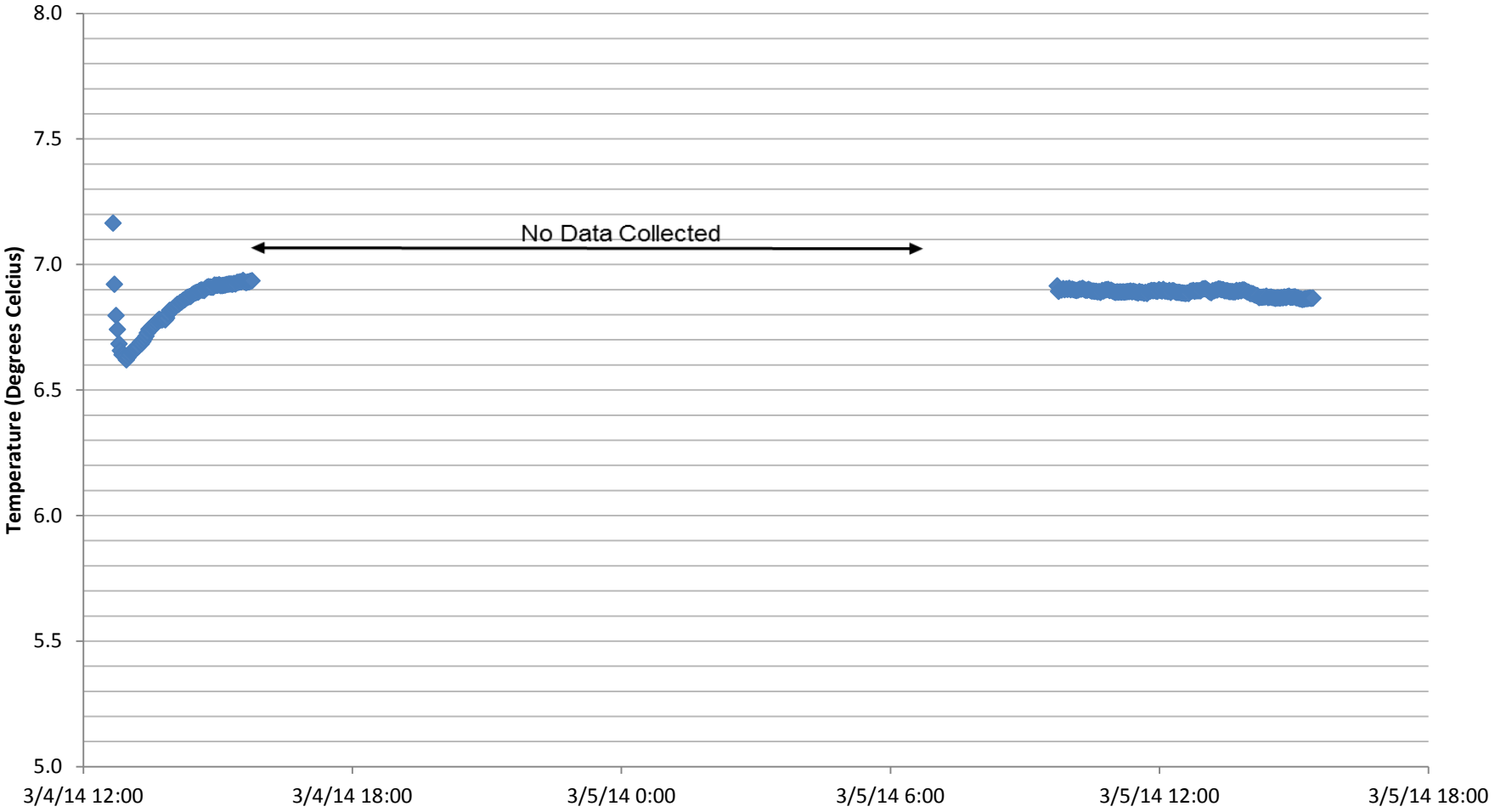


Figure 3: Groundwater Temeprature Observations During 75 Well Aquifer Test

Test Drilling and 75 Well Evaluation

City of Stayton

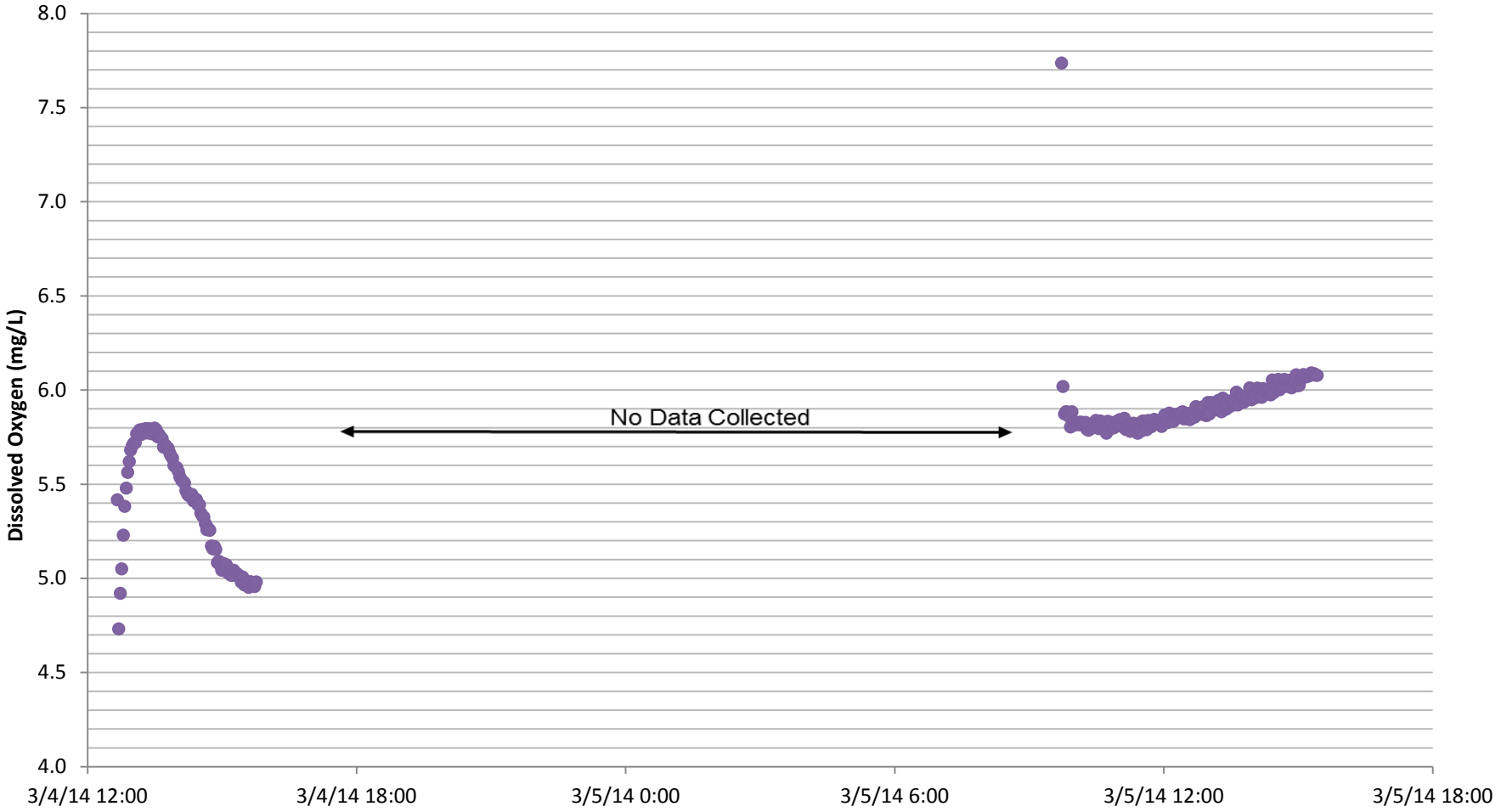


GSI Water Solutions, Inc.

Figure 4: Groundwater Dissolved Oxygen Observations During 75 Well Test

Test Drilling and 75 Well Evaluation

City of Stayton

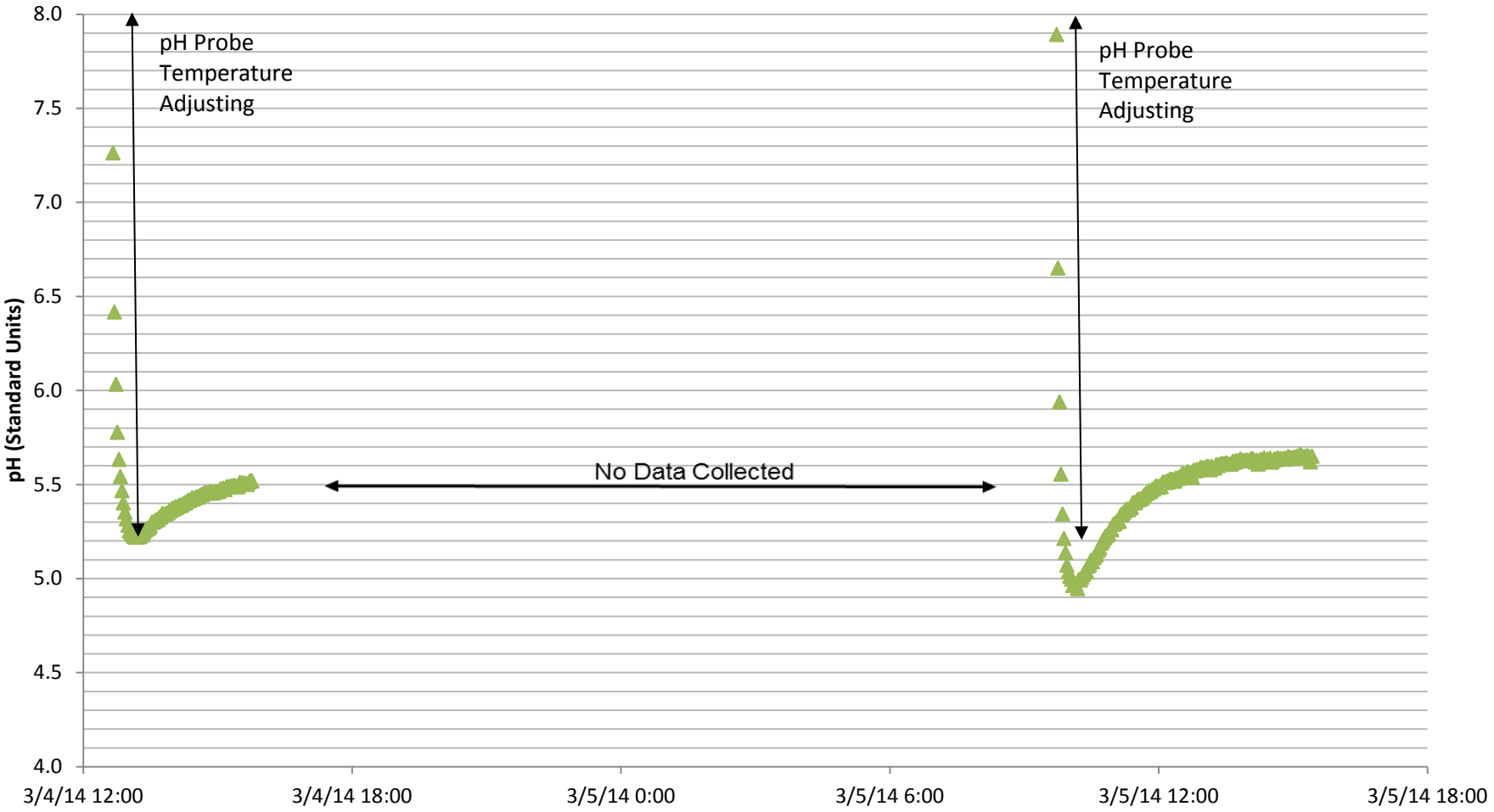


GSI Water Solutions, Inc.

Figure 5: Groundwater pH Observations During 75 Well Test

Test Drilling and 75 Well Evaluation

City of Stayton

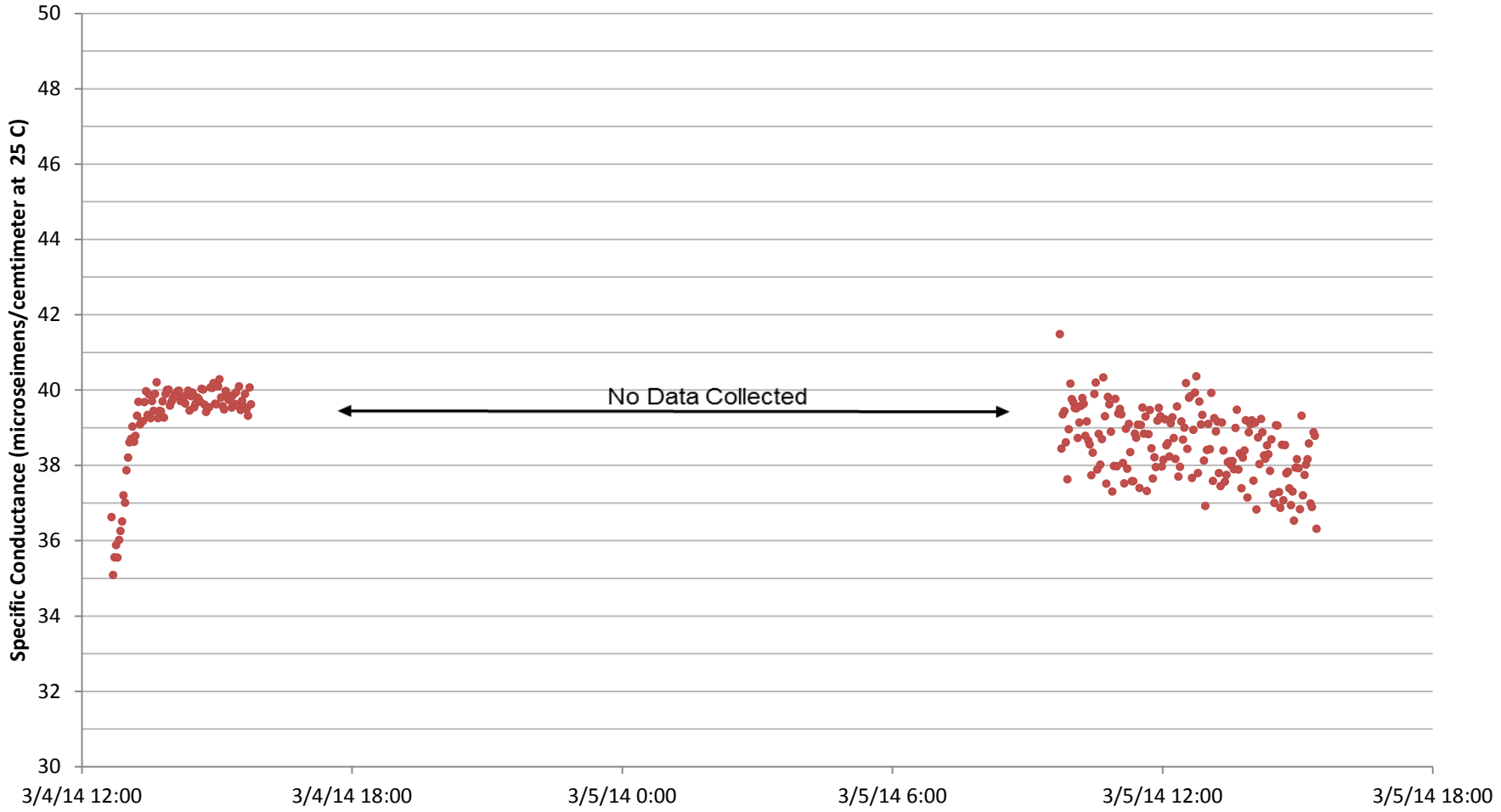


GSI Water Solutions, Inc.

Figure 6: Groundwater Specific Conductance Observations During 75 Well Test

Test Drilling and 75 Well Evaluation

City of Stayton



GSI Water Solutions, Inc.

Table 1: Summary of Test Borings

Test Drilling and 75 Well Evaluation

City of Stayton

Test Boring	**Depth Drilled** *feet*	**Depth to Water *** *feet*	**Depth to GC/GM Contact** *feet*
B4	30	7.5 - 10	19
B5	25	6	17
B6	30	6	17
B7	25	10	19
B8	30	10 - 15	18
B9	25	5 - 10	19
B10	25	4	18
B11	25	8 - 10	14

* Range given when value is unknown due to poor sample recovery from the sonic core barrel.

GC = Clayey Gravel

GM = Silty Gravel

Table 2: Summary of Soil Samples

Test Drilling and 75 Well Evaluation

City of Stayton

Sample Name	**Depth Interval** *feet*	**Cobbles** *%*	**Gravel** *%*	**Sand** *%*	**Fines** *%*	**Lab USCS Designation**
B4-10-15	10 - 15	39.9	33.1	21.6	5.4	GP-GM
B6-15-20	17 - 19.5	0	44.6	38	17.4	GM
B6-20-25	19.5 - 22.5	0	64.4	29.7	5.9	GP-GM
B7-0-5	1 - 5	0	65.8	25.2	9	GW-GM
B7-5-10	5 - 10	38	32.6	17.3	12.1	GM
B7-10-15	10 - 15	0	69	26.3	4.7	GW
B7-15-20*	23 - 24	0	71.4	22.8	5.8	GP-GM
B7-20-25	19.5 - 22.5 and 24 - 25	0	57.7	29.6	12.7	GM
B10-5-10	5 - 10	0	77.2	17.5	5.3	GP-GM
B10-10-15	13 - 15	0	81.8	15.6	2.6	GP

Notes:

* Sample was mislabeled.

USCS = unified soil classification system

Table 3: 75 Well Levels

Test Drilling and 75 Well Evaluation

City of Stayton

Date	Time	Elapsed Time *(minutes)*	Pump Speed *%*	Discharge *gallons per minute*	Sensor Pressure *feet of water*	75 Well Drawdown *feet*
3/4/2014	12:37	0.00	100	1000	13.4	0
3/4/2014	12:45	8.00	98	970	10.4	3
3/4/2014	13:00	23.00	97	930	10	3.4
3/4/2014	13:10	33.00	95	900	9.8	3.6
3/4/2014	13:20	43.00	93	870	9.6	3.8
3/4/2014	13:30	53.00	92	840	9.2	4.2
3/4/2014	13:45	68.00	90	830	9.1	4.3
3/4/2014	14:00	83.00	88	780	8.7	4.7
3/4/2014	14:15	98.00	87	760	8.4	5
3/4/2014	14:30	113.00	85	720	8	5.4
3/4/2014	14:45	128.00	83	700	7.5	5.9
3/4/2014	15:00	143.00	82	680	7.5	5.9
3/4/2014	15:30	173.00	82	670	7.2	6.2
3/4/2014	15:45	188.00	80	650	7.1	6.3
3/4/2014	16:00	203.00	80	620	7	6.4
3/4/2014	16:30	233.00	80	620	6.9	6.5
3/4/2014	17:00	263.00	75	550	7.2	6.2
3/5/2014	8:39	1202.00	73	460	6.4	7
3/5/2014	10:16	1299.00	73	470	6.4	7
3/5/2014	11:00	1343.00	73	470	6.5	6.9
3/5/2014	11:02	1345.00	73	460	6.5	6.9
3/5/2014	11:45	1388.00	73	460	6.6	6.8
3/5/2014	13:25	1488.00	73	470	6.7	6.7
3/5/2014	14:00	1523.00	73	460	6.7	6.7
3/5/2014	14:03	1526.00	73	490	6.7	6.7
3/5/2014	15:00	1583.00	73	480	6.7	6.7
3/5/2014	15:30	1613.00	75	500	6.7	6.7
3/5/2014	15:50	1633.00	75	500	6.7	6.7

Note:

Pumping began at 12:37 on 3/4/2014 and ended at 15:30 on 3/5/2014.

Estimate

Table 4: Piezometer Water Levels

Test Drilling and 75 Well Evaluation

City of Stayton

Date	Time	B7 Depth to Water *feet*	B7 Drawdown *feet*	Time	B5 Depth to Water *feet*	B5 Drawdown *feet*	Time	B8 Depth to Water *feet*	B8 Drawdown *feet*
3/4/2014	12:15	6.32	--	12:16	4.5	--	12:18	7.26	--
3/4/2014	12:42	7.25	0.93	12:43	4.56	0.06	12:15	7.45	0.19
3/4/2014	12:56	8.48	2.16	12:57	4.81	0.31	12:58	7.66	0.4
3/4/2014	13:18	9.41	3.09	13:19	5.12	0.62	13:02	7.96	0.7
3/4/2014	13:32	9.8	3.48	13:33	5.3	0.8	13:34	8.12	0.86
3/4/2014	13:50	10.19	3.87	13:52	5.55	1.05	13:54	8.33	1.07
3/4/2014	14:25	10.72	4.4	14:26	6	1.5	14:27	8.65	1.39
3/4/2014	14:57	11.24	4.92	14:58	6.3	1.8	14:59	8.95	1.69
3/4/2014	16:17	11.95	5.63	16:16	6.91	2.41	16:15	9.45	2.19
3/4/2014	16:50	12.02	5.7	16:52	7.11	2.61	16:55	9.62	2.36
3/5/2014	7:05	13.16	6.84	7:51	8.65	4.15	7:52	10.9	3.64
3/5/2014	8:33	13.2	6.88	8:34	8.65	4.15	8:35	10.91	3.65
3/5/2014	9:06	13.22	6.9	9:07	8.65	4.15	9:01	10.9	3.64
3/5/2014	9:05	13.22	6.9	9:51	8.65	4.15	9:52	10.9	3.64
3/5/2014	10:28	13.22	6.9	10:29	8.61	4.11	10:03	10.84	3.58
3/5/2014	13:09	13.15	6.83	13:01	8.45	3.95	13:11	10.66	3.4
3/5/2014	14:01	13.1	6.78	14:11	8.4	3.9	14:12	10.6	3.34
3/5/2014	15:22	13.06	6.74	15:23	8.34	3.84	15:24	10.5	3.24

Note:

Pumping began at 12:37 on 3/4/2014 and ended at 15:30 on 3/5/2014.

ATTACHMENT A

Test Boring Logs

GSI Water Solutions, Inc.

PROJECT NUMBER :	BORING NUMBER :	
357.002	B-1	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : City of Stayton Well Field Expansion LOCATION : Stayton, OR
DRILLING CONTRACTOR : Boart LOGGER : D. Fosbury
DRILLING METHOD AND EQUIPMENT USED : Sonic
WATER LEVEL : 11-16 ft START : 10/8/12 END : Abandoned on 10/9/12

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	LITHOLOGIC LOG	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
0-4	4	0 – piled on ground	ML	Soft brown SILT with ~10% fine sand, dry
4-6	2	2	SP	loose brown gravelly fine SAND with 5-10% silt, dry. Gravel is poorly graded, fine to coarse, subangular to subrounded, cobbles > 4" (mostly fine)
6-11	5	2		
11-16	5	2	GP	Gray-Brown poorly graded fine to coarse angular to rounded GRAVEL with 20% fine to medium sand and 5% silt, becomes wet between 11 and 16
16-26	10	10	SP	>50% fine-med sand with lumps of clay, gravel is <3", subrounded to rounded, red staining on faces
			GP-GC	Gray-Brown, fine to coarse angular to rounded GRAVEL with ~10% coarse sand and ~10% high plasticity fines, moist
26-36	10	10		6" cobble
36-46	10	10		36-43 color change to med Brown, matrix is softer, higher moisture
				43-66 color change to gray-brown, matrix is stiffer, lower moisture
46-56	10	10		

Graphic log.xlsx

GSI Water Solutions, Inc.

PROJECT NUMBER :	BORING NUMBER :	
357.002	B-1	SHEET 2 OF 2

SOIL BORING LOG

PROJECT : City of Stayton Well Field Expansion LOCATION : Stayton, OR
DRILLING CONTRACTOR : Boart LOGGER : DFosbury
DRILLING METHOD AND EQUIPMENT USED : Sonic
WATER LEVEL : 11-16 ft START : 10/8/12 END : Abandoned on 10/9/12

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	LITHOLOGIC LOG	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
46-56	10	10		
56-66	10	10		
66-76	10	10	CL	Blue-gray, sandy clay with 10% fine to med gravel high plasticity, moist
				8" cobble
				Boulder
				TD = 76 feet Abandoned hole
				Start Card # 1017999

Graphic log.xlsx

GSI Water Solutions, Inc.

PROJECT NUMBER :	BORING NUMBER :	
357.002	B-2	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : City of Stayton Wellfield Expansion LOCATION : Stayton, OR
DRILLING CONTRACTOR : Boart-Longyear LOGGER : DFosbury
DRILLING METHOD AND EQUIPMENT USED : Sonic
WATER LEVEL : 6-16 ft START : 10/9/2012 END : 10/9/2012

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	LITHOLOGIC LOG	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
0 D-3	3	0 - piled on Ground	GM	Gray-brown, poorly graded, fine to coarse, angular to subrounded GRAVEL with 20-30% silt, ~10% fine sand, loose, dry
3-6	3	3		
5 6-16	10	4		
10			contact approximate	
			SP	Gray brown, poorly graded fine to coarse, angular to subrounded GRAVEL with ~10% fine to med sand and ~5% med plasticity fines, occasional cobbles >4"; wet
15 16-26	10	11	SC	Increased fines >15%; moist
20				
25 26-36	10	10		
30				28-30 Color change to red-brown, wet
				30-36 Gray-brown, moist, red staining on rocks
35 36-46	10	10		36-42 red-brown, moist, occasional weathered pockets that appear blue-gray
40				42-44 wet
45				44-53 gray-brown, moist
46-56	10	10		
50				

GSI Water Solutions, Inc.

PROJECT NUMBER :	BORING NUMBER :	
357.002	B-2	SHEET 2 OF 2

SOIL BORING LOG

PROJECT : City of Stayton Wellfield Expansion LOCATION : Stayton, OR
DRILLING CONTRACTOR : Boart Longyear LOGGER : DFosbury
DRILLING METHOD AND EQUIPMENT USED : Sonic
WATER LEVEL : 6-16 ft START : 10/9/2012 END : 10/9/2012

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	LITHOLOGIC LOG	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
46-56	10	10		
			SP	53-54 DK brown, fine-med SAND with 5-10% fines, loose, wet
56-66	10	10	GP-GC	54-60 Gray-brown, poorly graded, fine to coarse angular to subrounded GRAVEL with ~10% fine to med sand and ~10% med to high plasticity fines, occasional cobbles >4", dense moist, stiff fines, red staining, no rocks
			CL	61-66 Blue-gray sandy CLAY with 10% fine to med gravel, stiff, moist
				TD=66 Abandoned Hole
				Start card # 1018000

GSI Water Solutions, Inc.

PROJECT NUMBER :	BORING NUMBER :	
357.002	B-3	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : City of Stayton Wellfield Expansion LOCATION : Stayton, OR
DRILLING CONTRACTOR : Boart Longyear LOGGER : D. Fosbury
DRILLING METHOD AND EQUIPMENT USED : Sonic
WATER LEVEL : 6-10 ft START : 10/10/2012 END : 10/10/2012

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	LITHOLOGIC LOG	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
0-3	3	0 - Piled on ground	GM	Gray-Brown ~~well graded~~, fine to coarse, angular to subrounded GRAVEL with ~20-30% silt, cobbles >4", dry, loose
3-6	3	3		
6-10	4	2 bottom ½' wet		
10-16	6	4		
			GP-GC	Gray Brown, ~~poorly graded~~ fine to coarse, angular to subrounded GRAVEL with ~10% fine to med sand and ~10% med to high plasticity fines, occasional cobbles >4", loose, wet
16-26	10	10		
				20-26 Stiff fines, lower moisture
26-36	10	10		26-27 Soft fines, 10-20% sand, wet 27-36 alternating stiff fines and low moisture with soft fines and high moisture
36-46	10	10		36-37 Color change to red brown, wet 37-57 Same as 27-36
46-56	10	10		

GSI Water Solutions, Inc.

PROJECT NUMBER :	BORING NUMBER :
357.002	B-3 SHEET 2 OF 2

SOIL BORING LOG

PROJECT : City of Stayton Wellfield Expansion LOCATION : Stayton, OR
DRILLING CONTRACTOR : Boart Longyear LOGGER : DFosbury
DRILLING METHOD AND EQUIPMENT USED : Sonic
WATER LEVEL : 6-10 ft START : 10/10/2012 END : 10/10/2012

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	LITHOLOGIC LOG	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
46-56	10	10		
56-66	10	10		57-61 Color change to med brown, wet
				61-64 Color change to gray-brown, moist
			CL	64-66 Blue-gray sandy CLAY with fine to coarse gravel + red staining on gravels
				TD = 66 ft Abandoned Hole Start Card ± 1018001

Graphic log.xlsx

GSI Water Solutions, Inc.

PROJECT NUMBER :	BORING NUMBER :
1357.002.005	B4 SHEET 1 OF 1

SOIL BORING LOG

PROJECT : City of Stayton Test Drilling LOCATION : Stayton, OR
DRILLING CONTRACTOR : Cascade LOGGER : D. Fosbury
DRILLING METHOD AND EQUIPMENT USED : Rotosonic
WATER LEVEL : START : 3/6/2014 END : 3/7/2014

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	LITHOLOGIC LOG	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
0	0-5	5		0-1 Grass/topsoil
			GP-GM	Medium dense, gray-brown, fine to coarse, sub rounded to subangular, poorly graded GRAVEL and cobbles <4 inches, with 15-30% fine to coarse sand and 5-15% silt
5	5-7.5	1		* Contact unknown because of poor recovery
	7.5-10	1.5		Becomes wet
10	10-15	3	GP	* Contact unknown because of poor recovery Loose, gray, fine to coarse, subrounded to subangular, poorly graded GRAVEL <2 inches, with 15-30% fine to coarse sand and <5% fines
15	15-20	2.5		* Contact unknown because of poor recovery Increasing medium plasticity fines
			GC	Dense, gray-brown clayey GRAVEL <2 inches with
20	20-22.5	2.5		15-30% fine to coarse sand, moist to wet
	22.5-25	2.5	GP-GC	Lower clay content, wet
			GC	Clayey gravel, same as 19-22.5 ft
25	25-30	5		Becomes dry
30				Total depth of boring: 30 feet

GSI Water Solutions, Inc.

PROJECT NUMBER :	BORING NUMBER :	
0357.002.005	B5	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : City of Stayton Test Drilling LOCATION : Stayton, OR
DRILLING CONTRACTOR : Cascade LOGGER : D. Fosbury
DRILLING METHOD AND EQUIPMENT USED : Rotosonic
WATER LEVEL : START : 3/3/14 END : 3/3/14

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	LITHOLOGIC LOG	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
0	0-5	5		0-0.5 Grass/topsoil
			GP-GM	Loose, gray-brown, fine to coarse, sub-rounded to angular, poorly graded, GRAVEL and cobbles <4 inches, with 15-30% sand and 5-15% silt, moist to dry
5	5-7.5	2.5		Becomes wet.
	7.5-10	2.5		
10	10-15	5	GP	Loose, gray, fine to coarse, rounded to subrounded poorly graded GRAVEL <3 inches with 15-30% fine to coarse sand and <5% silt, wet
			GP-GC	14.5: 5-15% medium plasticity fines.
15	15-20	5		
			GC	Dense, gray-brown, clayey GRAVEL with 15-30% fine to coarse sand, moist to wet
20	20-25	5	GP-GC	5-15% medium plasticity fines, wet
			GC	Greater clay content, same as 17-19.5 ft
25				Total depth of boring: 25 feet

GSI Water Solutions, Inc.

PROJECT NUMBER :	BORING NUMBER :	
0357.002.005	B6	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : City of Stayton Test Drilling LOCATION : Stayton, OR
DRILLING CONTRACTOR : Cascade LOGGER : DFosbury
DRILLING METHOD AND EQUIPMENT USED : Rotosonic
WATER LEVEL : START : 3/6/14 END : 3/6/14

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	LITHOLOGIC LOG	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
0	0-2.5	2.5		0-1 grass/topsoil
			GP-GM	loose, gray-brown, fine to coarse, sub-rounded to sub angular, poorly graded GRAVEL <3 inches, with 15-30% fine to coarse sand and 5-15% silt, moist to dry.
	2.5-5	2.5		
5	5-10	5		Becomes wet
10	10-15	5	GP	Loose, gray fine to coarse, rounded to subrounded, poorly graded GRAVEL <3 inches with 15-30% fine to coarse sand and <5% silt, wet
15	15-20	5		increasing fines
			GC	Dense, gray-brown, clayey GRAVEL with 15-30% fine to coarse sand, moist to wet.
20	20-25	5	GP-GC	lower clay content, loose and wet
			GC	Same as 17-19.5 ft 24.5-26 increased fines, dry
25	25-30	5		moist, same as 17-19.5 ft
30				Total Depth of Boring: 30 feet

GSI Water Solutions, Inc.

PROJECT NUMBER :	BORING NUMBER :	
0357.002.005	B7	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : City of Stayton Test Drilling LOCATION : Stayton, OR
DRILLING CONTRACTOR : Cascade LOGGER : DFosbury
DRILLING METHOD AND EQUIPMENT USED : Rotosonic
WATER LEVEL : START : 3/4/2014 END : 3/4/2014

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	LITHOLOGIC LOG	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
0	0-4	3	GW-GM	0-0.5 Grass / topsoil 0.5: Loose, gray-brown, fine to coarse sub-rounded to angular, well graded GRAVEL and cobbles <4 inches, with 15-30% fine to coarse sand and 5-15% silt, moist to dry
	4-5	1		
5	5-7.5	2.5		
	7.5-10	2.5		
10	10-15	3	GW	Loose, gray ~~brown~~, fine to coarse, rounded to subangular, well graded GRAVEL <2 inches with 15-30% fine to coarse sand and <5% silt, wet.
15	15-20	4		Larger gravels, <3 inches, increasing fines
			GC	Dense, gray-brown, clayey, fine to coarse
20	20-25	5		rounded to subangular, well graded GRAVEL <3 inches, with 15-30% fine to coarse sand, moist to wet.
			GW-GC	22.5-24: lower clay content, wet
			GC	24-25: greater clay content, same as 19-22.5 ft
25				Total Depth of boring: 25 feet

GSI Water Solutions, Inc.

PROJECT NUMBER :	BORING NUMBER :	
0357.002.005	B8	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : City of Stayton Test Drilling LOCATION : Stayton, OR
DRILLING CONTRACTOR : Cascade LOGGER : B Fosbury
DRILLING METHOD AND EQUIPMENT USED : Rotosonic
WATER LEVEL : START : 3/3/2014 END : 3/3/2014

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	LITHOLOGIC LOG	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
0	0-5	5		Grass/topsoil
			GW-GM	Loose, gray-brown, fine to coarse, sub-rounded to subangular, well graded GRAVEL and cobbles <5 inches, with 15-30% fine to coarse sand and 5-15% silt, moist to dry
5	5-10	1.5		Cobble stuck in bit → pushing sample *Exact contact unknown due to poor recovery
10	10-15	1.5	GW	Loose, gray ~~brown~~, fine to coarse, rounded to subrounded, well graded GRAVEL <4 inches, with 15-30% fine to coarse sand and <5% silt, wet.
15	15-20	4		
			GC	Dense, gray-brown, clayey, fine to coarse rounded to subangular, well graded GRAVEL
20	20-25	5		and cobbles <4 inches with 15-30% fine to coarse sand, moist to wet
			GW-GC	lower clay content, wet.
			GC	Same as 18-21 ft
			GW-GC	Lower clay content, wet.
			GC	Same as 18-21ft
25	25-30	5		
30				Total Depth of Boring: 30 feet

GSI Water Solutions, Inc.

PROJECT NUMBER :	BORING NUMBER :	
0357.002.005	B9	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : City of Stayton, Test Drilling — LOCATION : Stayton, OR
DRILLING CONTRACTOR : Cascade — LOGGER : DFoshury
DRILLING METHOD AND EQUIPMENT USED : Rotosonic
WATER LEVEL : — START : 3/5/2014 — END : 3/5/2014

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	LITHOLOGIC LOG	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
0	0-2.5	1	GP-GM	0-0.5 Grass / Topsoil Medium dense, med brown, fine to coarse rounded to subangular, poorly graded GRAVEL and cobbles <4 inches with 15-30% fine to coarse sand and 5-15% silt, dry
	2.5-5	1.5		
5	5-10	0.5		* Contact unknown because of poor recovery Becomes wet
10	10-15	2	GP	* Contact unknown because of poor recovery Loose, gray fine to coarse, rounded to subangular poorly sorted GRAVEL <3 inches, with 15-30% fine to coarse sand and <5% fines
15	15-20	5		
			GC	Increasing medium plasticity fines Dense, gray-brown clayey fine to coarse
20	20-25	5		rounded to subangular, poorly-graded GRAVEL <3 inches with 15-30% fine to coarse sand, moist
25				Total Depth of Boring: 25 feet

GSI Water Solutions, Inc.

PROJECT NUMBER :	BORING NUMBER :	
0357.002 005	B10	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : City of Stayton Test Drilling LOCATION : Stayton, OR
DRILLING CONTRACTOR : Cascade LOGGER : DFosbury
DRILLING METHOD AND EQUIPMENT USED : Rotosonic
WATER LEVEL : START : 3/4/14 END : 3/4/14

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	LITHOLOGIC LOG	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
0	0-4	4	GP-GM	0-1 Grass/topsoil Loose, med brown, fine to coarse, rounded to subangular, poorly graded GRAVEL <3 inches with 15-30% fine to coarse sand and 5-15% silt, dry.
	4-5	1		
5	5-10	3		→ Becomes wet at 4 feet Cobbles <4 or 5 inches
10	10-15	3	GP	Loose, gray, fine to coarse, rounded to subangular, poorly sorted GRAVEL <3 in with 15-20% fine to coarse sand and <5% fines
15	15-20	5	GP-GC	Increasing medium plasticity fines
			GC	Dense, gray-brown clayey, fine to coarse, rounded to subangular, poorly graded GRAVEL <3 inches
20	20-25	5		with 15-30% fine to coarse sand, moist.
25				Total Depth of Boring: 25 feet

GSI Water Solutions, Inc.

PROJECT NUMBER :	BORING NUMBER :	
0357.002.005	B11	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : City of Stayton Test Drilling LOCATION : Stayton, OR
DRILLING CONTRACTOR : Cascade LOGGER : D Rosbury
DRILLING METHOD AND EQUIPMENT USED : Rotosonic
WATER LEVEL : START : 3/4/14 END : 3/5/14

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	LITHOLOGIC LOG	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY
0	0-5	5	GP-GM	0-0.5 grass/topsoil Medium dense, medium brown, fine to coarse rounded to subangular, poorly graded GRAVEL, >3 inches, with 15-30% fine to coarse sand and 5-15% silt, dry
5	5-8	3		
	8-10	0.5		*Contact unknown because of poor recovery Loose, gray, fine to coarse, rounded to subangular, poorly sorted gravel and cobbles <5 inches
10	10-15	1		with 15-30% fine to coarse sand and <5% fines, wet
			GC	Dense, gray-brown slightly fine to coarse rounded to subangular, poorly graded GRAVEL <3 inches, with 15-30% fine to coarse sand, moist.
15	15-20	5	GP-GC	increasing med plasticity fines, wet
			GC	Same as 14-18 ft
20	20-25	5	GP-GC	increasing med plasticity fines, wet
			GC	Same as 14-18 ft
25				Total Depth of Boring: 25 feet

ATTACHMENT B

Grain Size Distribution Curves

FEI
TESTING & INSPECTION, INC.
Geotechnical & Construction Services

LETTER OF TRANSMITTAL

Date: March 27, 2014

Project No.: 2146064
Report No.: C-29121

Re: Stayton Test Borings

To: GSI Water Solutions, Inc.
55 SW Yamhill Street,
Suite 300
Portland, Oregon 97204

Attn: DeEtta Fosbury

Enclosed are:

- ☐ Report
- ☐ Copy of Letter
- ☐ Other
- ☐ Drawings
- ☐ Specifications
- ☑ Test Results (11 Pages Total Incl. Cover)

These are transmitted as checked below:

- ☑ For your use
- ☑ As requested
- ☐ For your review/approval
- ☐ For your files

Remarks: Requested laboratory testing results attached. Please call if you have any questions.

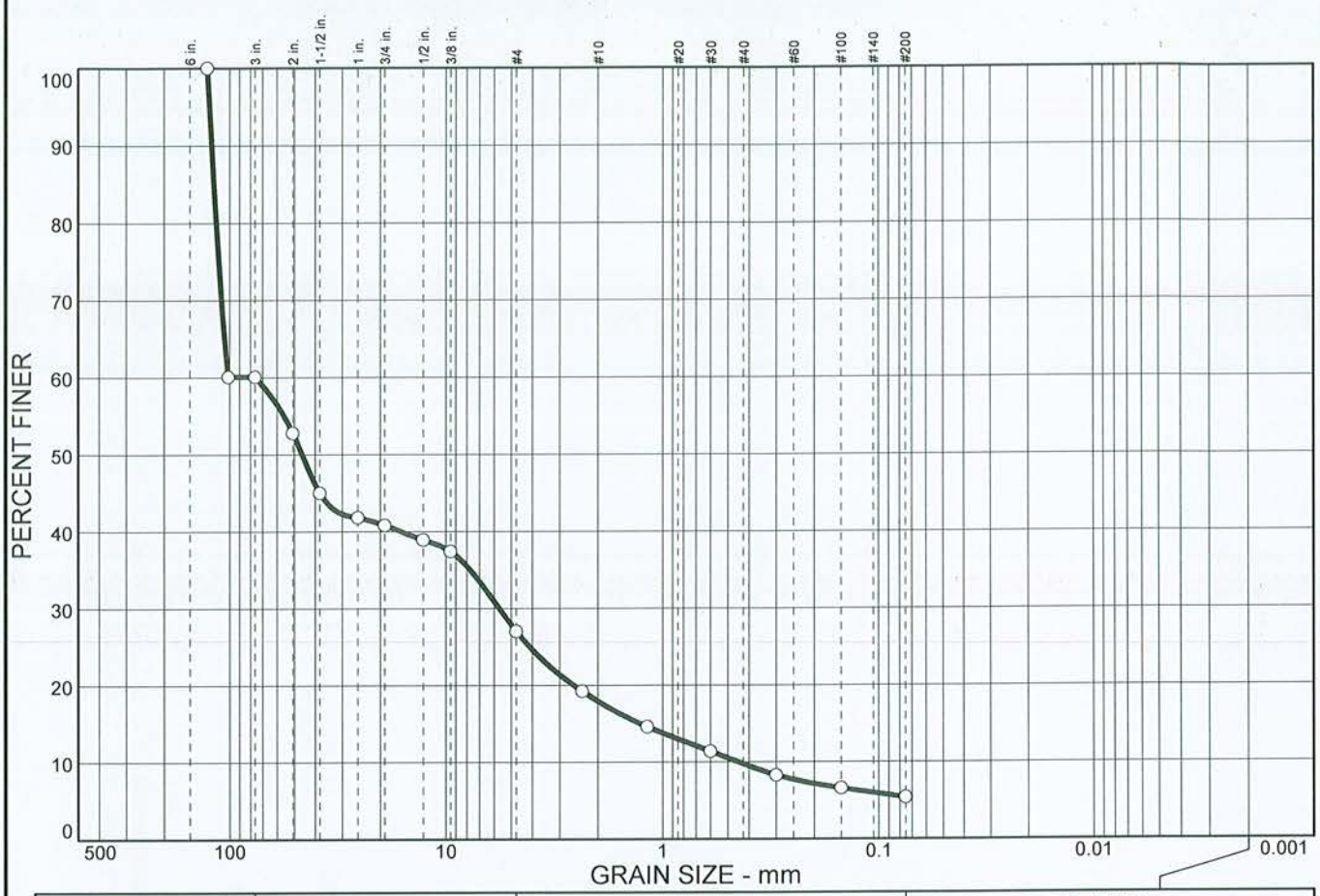
Copy to:

Signature:

Rachel Rucker

Rachel Rucker
President

Sieve Analysis ASTM C 136/ C 117



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
39.9	19.3	13.8	9.1	8.2	4.3	5.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
5 in.	100.0		
4 in.	60.1		
3 in.	60.1		
2 in.	52.8		
1.5 in.	45.0		
1 in.	41.8		
3/4 in.	40.8		
1/2 in.	38.9		
3/8 in.	37.4		
#4	27.0		
#8	19.2		
#16	14.6		
#30	11.4		
#50	8.3		
#100	6.6		
#200	5.4		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 118.5 D_{60}= 75.7 D_{50}= 46.0
D_{30}= 5.70 D_{15}= 1.27 D_{10}= 0.447
C_u= 169.19 C_c= 0.96

Classification

USCS= GP-GM AASHTO= A-1-a

Remarks

Sample No.: B4-10-15 **Source of Sample:** 5397 **Date:** 03-27-14
Location: **Elev./Depth:**

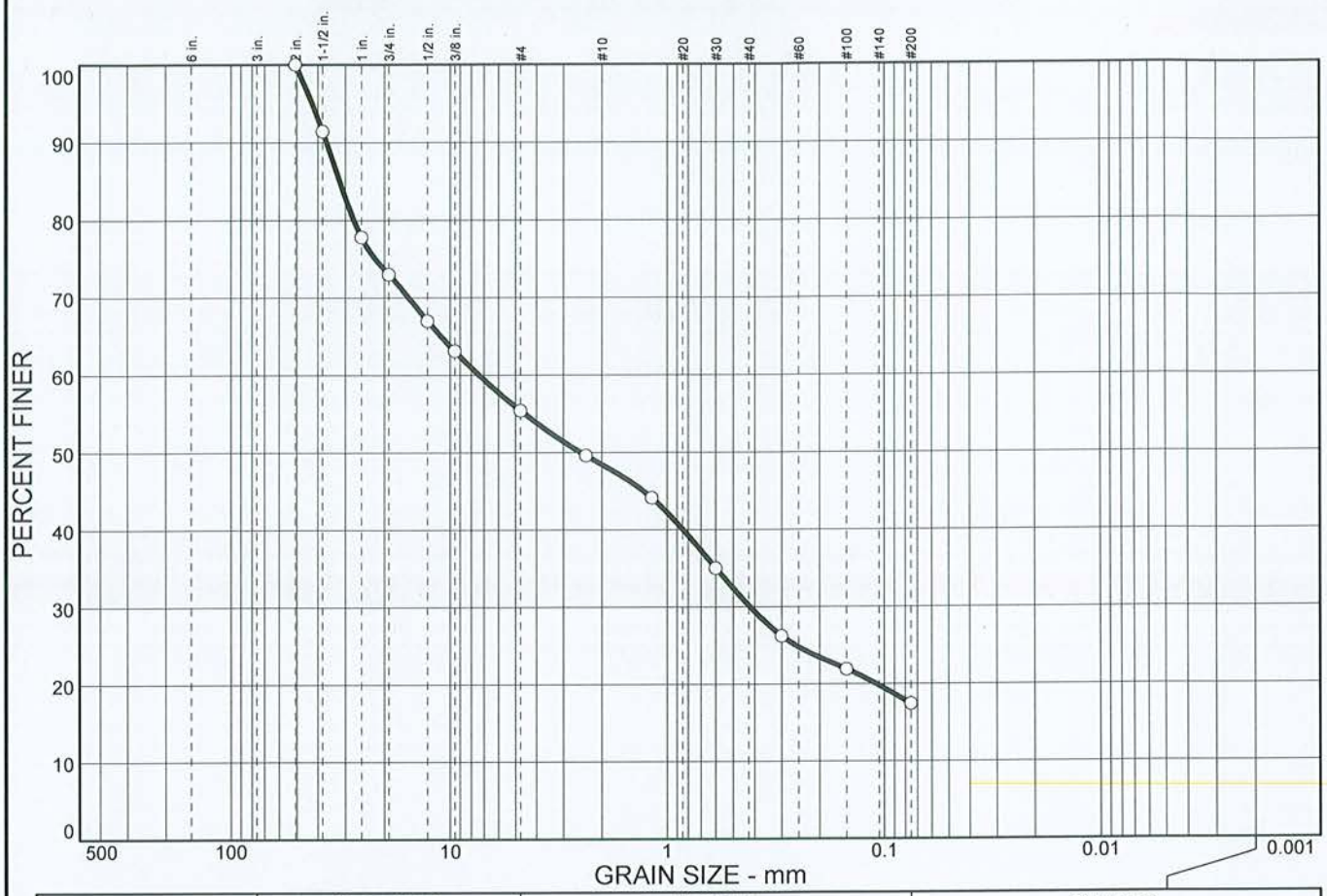
FEI Testing & Inspection, Inc.

Corvallis, OR

Client: GSI Water Solutions, Inc.
Project: Stayton Test Borings

Project No: 2146064 **Figure**

Sieve Analysis ASTM C 136/ C 117



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	27.0	17.6	7.0	18.3	12.7	17.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	91.4		
1 in.	77.8		
3/4 in.	73.0		
1/2 in.	67.0		
3/8 in.	63.1		
#4	55.4		
#8	49.6		
#16	44.1		
#30	35.0		
#50	26.2		
#100	21.9		
#200	17.4		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 31.9 D_{60}= 7.37 D_{50}= 2.49
D_{30}= 0.420 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= GM AASHTO= A-1-b

Remarks

Sample No.: B6-15-20 **Source of Sample:** 5397 **Date:** 03-27-14
Location: **Elev./Depth:**

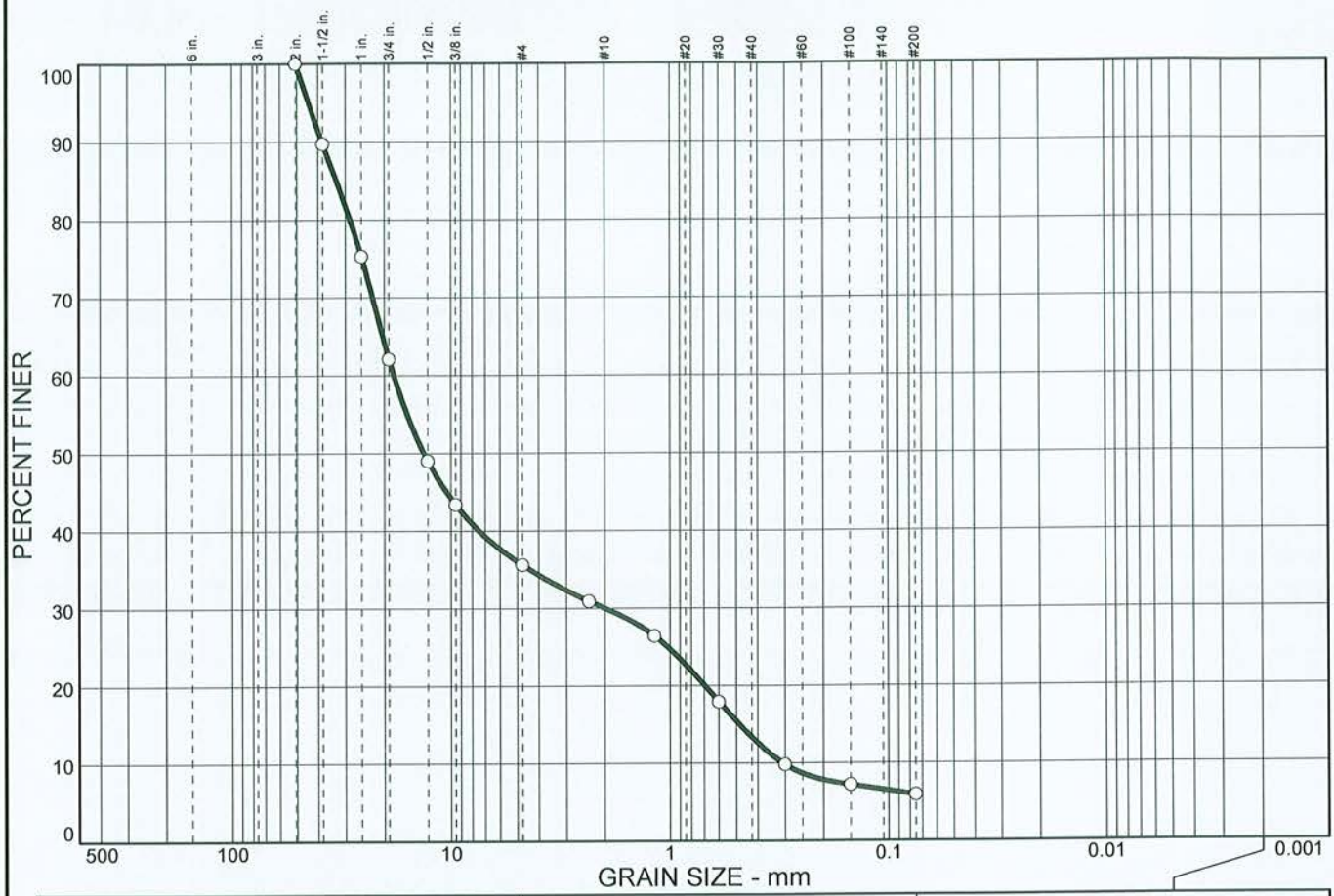
FEI Testing & Inspection, Inc.

Corvallis, OR

Client: GSI Water Solutions, Inc.
Project: Stayton Test Borings

Project No: 2146064 **Figure**

Sieve Analysis ASTM C 136/ C 117



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	37.9	26.5	5.6	16.7	7.4	5.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	89.7		
1 in.	75.3		
3/4 in.	62.1		
1/2 in.	49.0		
3/8 in.	43.4		
#4	35.6		
#8	30.9		
#16	26.4		
#30	17.9		
#50	9.8		
#100	7.2		
#200	5.9		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 33.1 D_{60}= 18.1 D_{50}= 13.2
D_{30}= 2.00 D_{15}= 0.485 D_{10}= 0.308
C_u= 58.84 C_c= 0.72

Classification

USCS= GP-GM AASHTO= A-1-a

Remarks

Sample No.: B6-20-25 **Source of Sample:** 5397 **Date:** 03-27-14
Location: **Elev./Depth:**

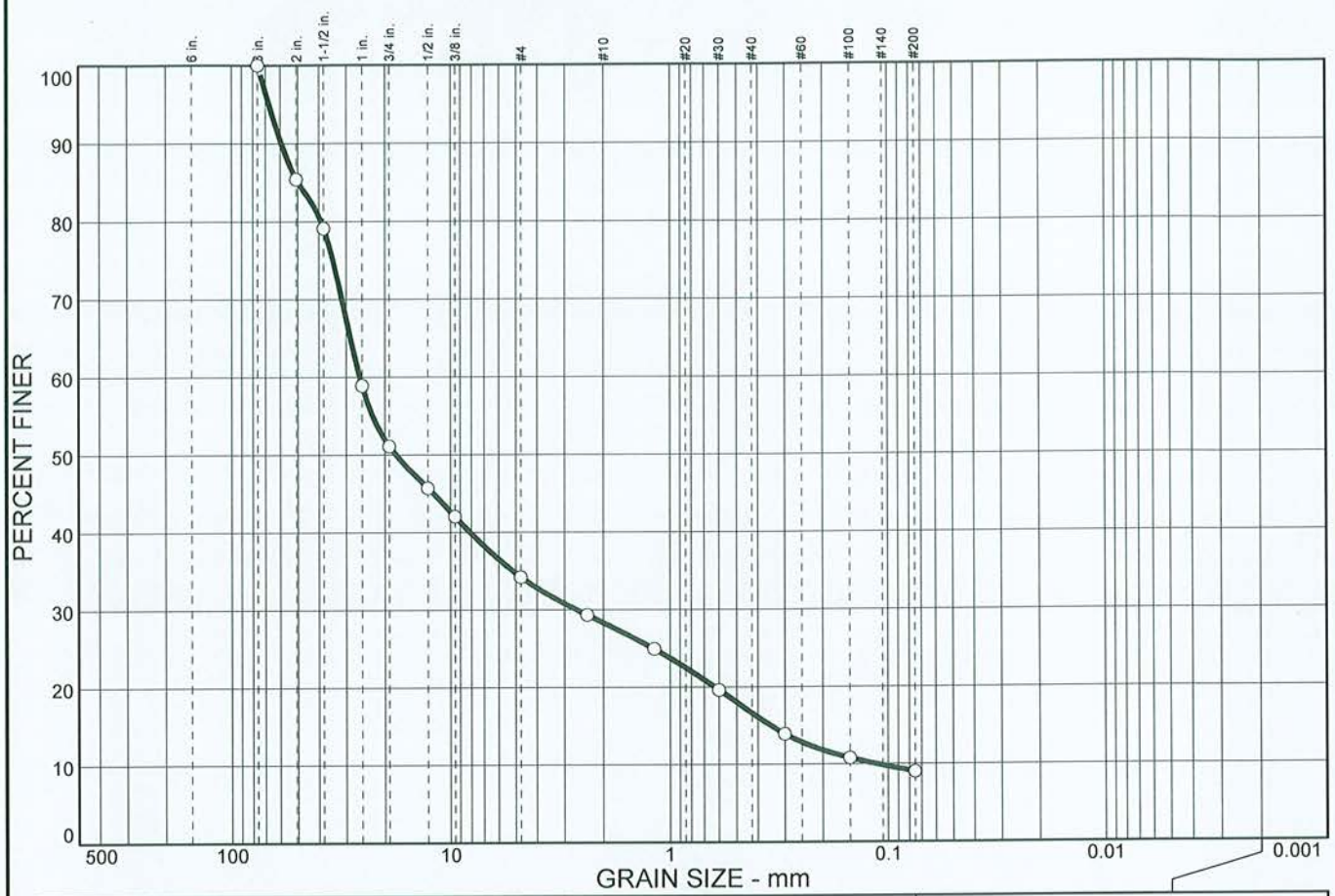
FEI Testing & Inspection, Inc.

Corvallis, OR

Client: GSI Water Solutions, Inc.
Project: Stayton Test Borings

Project No: 2146064 **Figure**

Sieve Analysis ASTM C 136/ C 117



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	48.9	16.9	5.9	11.7	7.6	9.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	85.4		
1.5 in.	79.1		
1 in.	58.9		
3/4 in.	51.1		
1/2 in.	45.7		
3/8 in.	42.0		
#4	34.2		
#8	29.3		
#16	24.9		
#30	19.6		
#50	13.9		
#100	10.8		
#200	9.0		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 49.9 D_{60}= 26.0 D_{50}= 17.8
D_{30}= 2.65 D_{15}= 0.350 D_{10}= 0.113
C_u= 230.64 C_c= 2.39

Classification

USCS= GW-GM AASHTO= A-1-a

Remarks

Sample No.: B7-0-5 **Source of Sample:** 5397 **Date:** 03-27-14
Location: **Elev./Depth:**

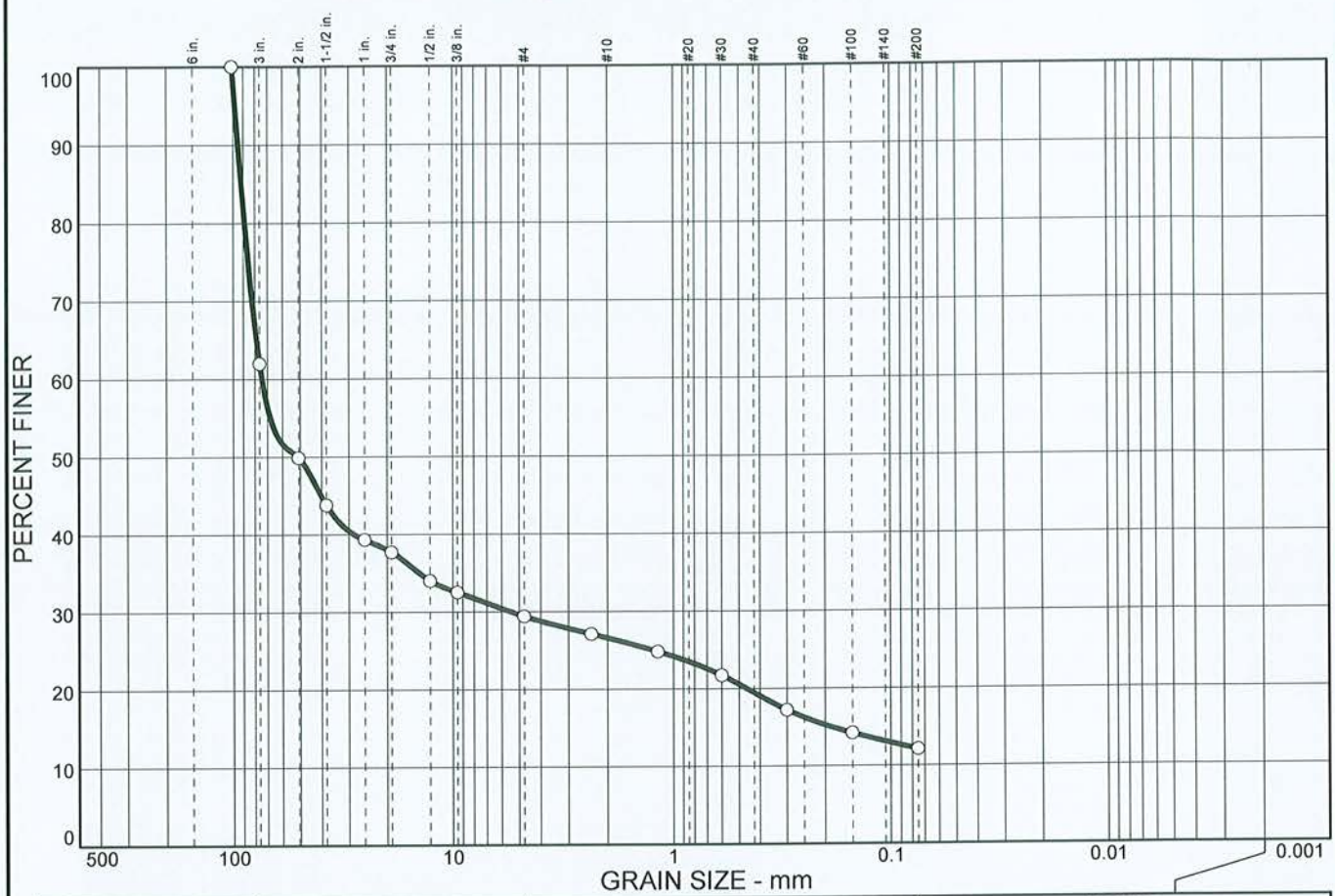
FEI Testing & Inspection, Inc.

Corvallis, OR

Client: GSI Water Solutions, Inc.
Project: Stayton Test Borings

Project No: 2146064 **Figure**

Sieve Analysis ASTM C 136/ C 117



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
38.0	24.3	8.3	2.8	7.1	7.4	12.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4 in.	100.0		
3 in.	62.0		
2 in.	49.9		
1.5 in.	43.8		
1 in.	39.3		
3/4 in.	37.7		
1/2 in.	34.0		
3/8 in.	32.5		
#4	29.4		
#8	27.1		
#16	24.8		
#30	21.7		
#50	17.2		
#100	14.2		
#200	12.1		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 92.1 D_{60}= 74.3 D_{50}= 51.2
D_{30}= 5.48 D_{15}= 0.188 D_{10}=
C_u= C_c=

Classification

USCS= GM AASHTO= A-1-b

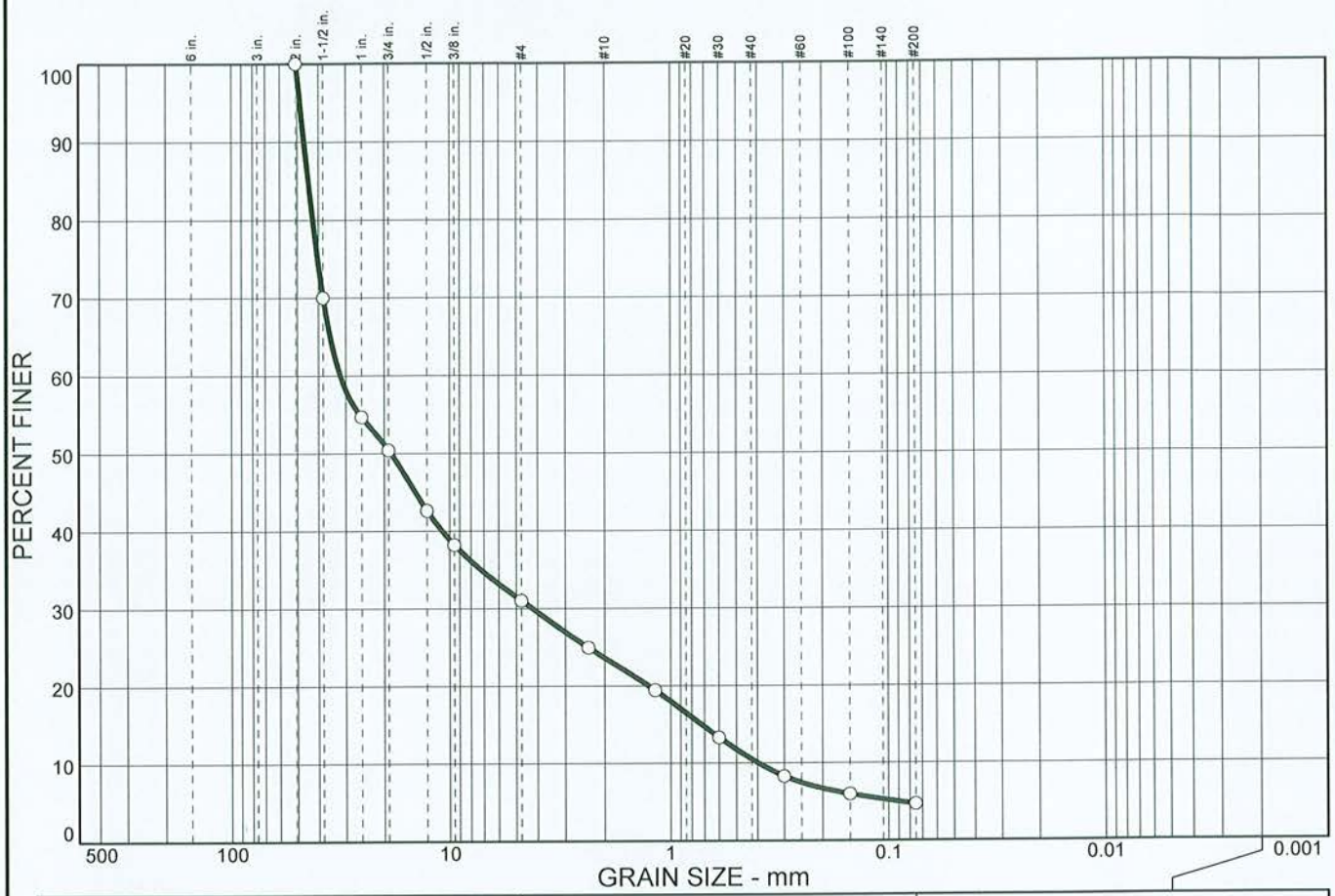
Remarks

Sample No.: B7-5-10 **Source of Sample:** 5397 **Date:** 03-27-14
Location: **Elev./Depth:**

FEI Testing & Inspection, Inc.
Corvallis, OR

Client: GSI Water Solutions, Inc.
Project: Stayton Test Borings
Project No: 2146064 **Figure**

Sieve Analysis ASTM C 136/ C 117



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	49.6	19.4	7.4	13.1	5.8	4.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	70.0		
1 in.	54.7		
3/4 in.	50.4		
1/2 in.	42.6		
3/8 in.	38.2		
#4	31.0		
#8	24.9		
#16	19.4		
#30	13.3		
#50	8.3		
#100	6.0		
#200	4.7		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 44.6 D_{60}= 31.8 D_{50}= 18.6
D_{30}= 4.25 D_{15}= 0.725 D_{10}= 0.396
C_u= 80.25 C_c= 1.43

Classification

USCS= GW AASHTO= A-1-a

Remarks

Sample No.: B7-10-15 **Source of Sample:** 5397 **Date:** 03-27-14
Location: **Elev./Depth:**

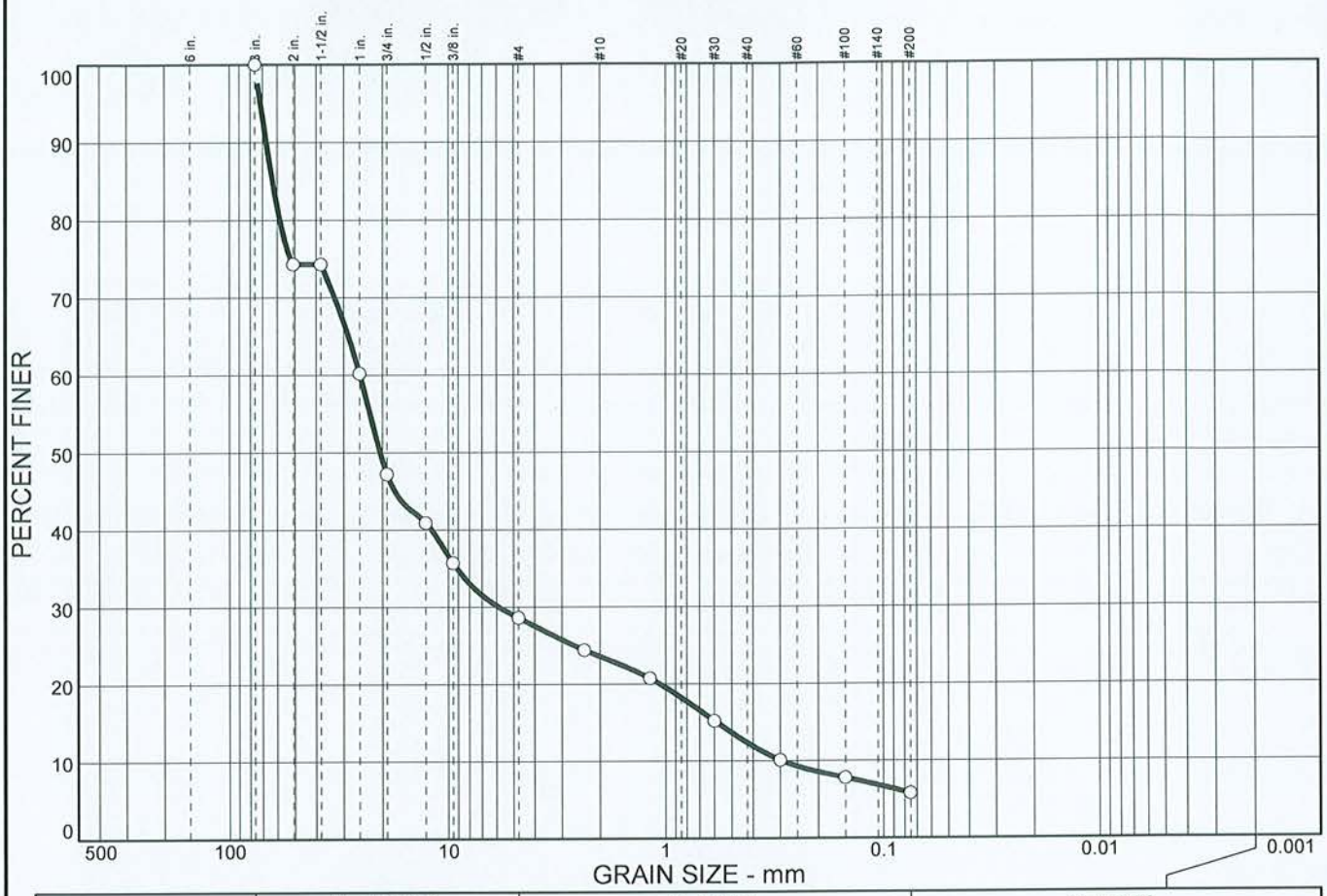
FEI Testing & Inspection, Inc.

Corvallis, OR

Client: GSI Water Solutions, Inc.
Project: Stayton Test Borings

Project No: 2146064 **Figure**

Sieve Analysis ASTM C 136/ C 117



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	52.8	18.6	5.0	11.2	6.6	5.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	74.3		
1.5 in.	74.3		
1 in.	60.2		
3/4 in.	47.2		
1/2 in.	40.9		
3/8 in.	35.7		
#4	28.6		
#8	24.4		
#16	20.7		
#30	15.2		
#50	10.1		
#100	7.8		
#200	5.8		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 63.2 D_{60}= 25.3 D_{50}= 20.5
D_{30}= 5.86 D_{15}= 0.586 D_{10}= 0.294
C_u= 85.96 C_c= 4.61

Classification

USCS= GP-GM AASHTO= A-1-a

Remarks

Sample No.: B7-15-20 **Source of Sample:** 5397 **Date:** 03-27-14
Location: **Elev./Depth:**

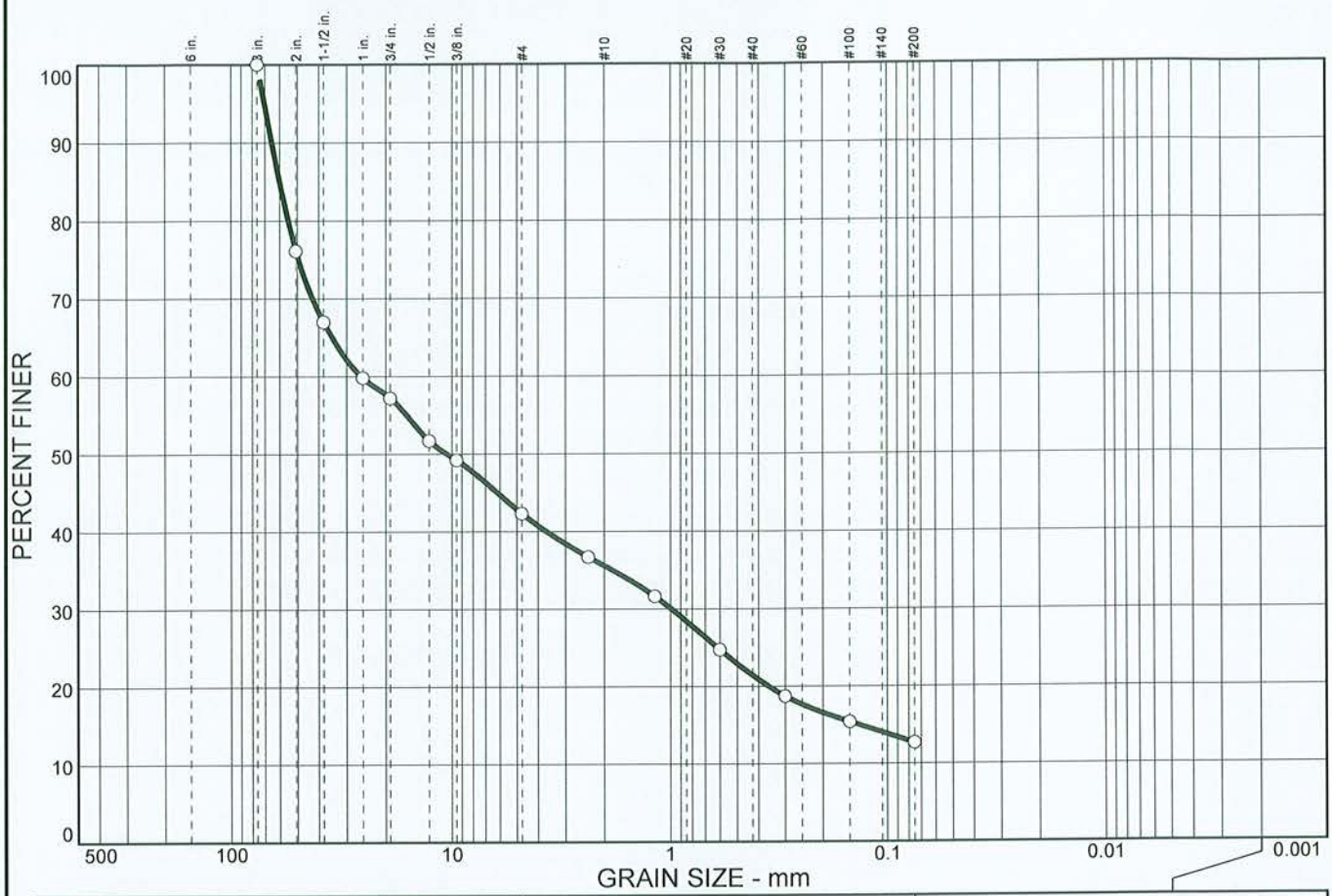
FEI Testing & Inspection, Inc.

Corvallis, OR

Client: GSI Water Solutions, Inc.
Project: Stayton Test Borings

Project No: 2146064 **Figure**

Sieve Analysis ASTM C 136/ C 117



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	42.8	14.9	6.7	14.2	8.7	12.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	76.1		
1.5 in.	67.0		
1 in.	59.8		
3/4 in.	57.2		
1/2 in.	51.7		
3/8 in.	49.2		
#4	42.3		
#8	36.7		
#16	31.6		
#30	24.7		
#50	18.7		
#100	15.4		
#200	12.7		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 60.3 D_{60}= 25.9 D_{50}= 10.6
D_{30}= 0.996 D_{15}= 0.135 D_{10}=
C_u= C_c=

Classification

USCS= GM AASHTO= A-1-a

Remarks

Sample No.: B7-20-25 **Source of Sample:** 5397 **Date:** 03-27-14
Location: **Elev./Depth:**

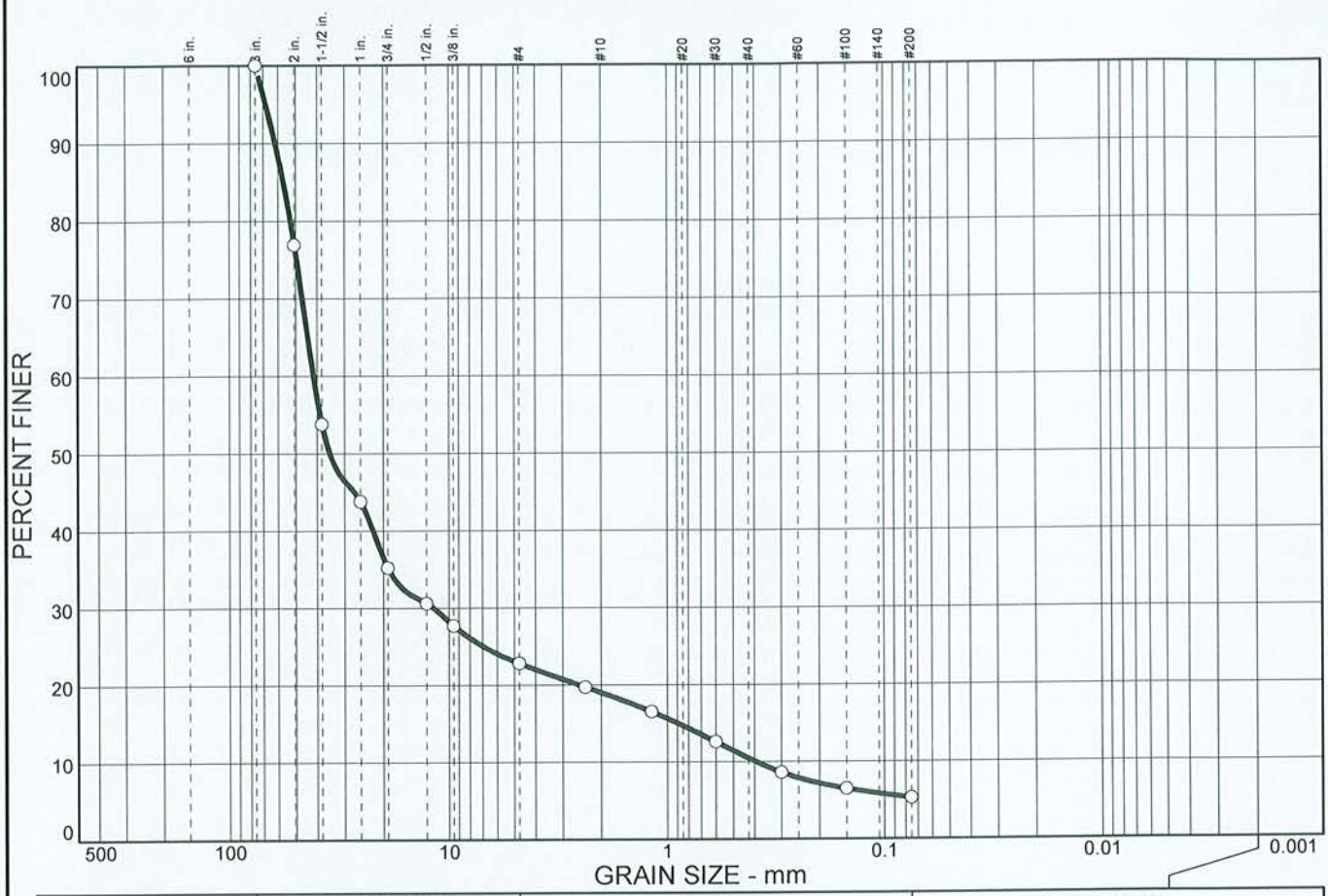
FEI Testing & Inspection, Inc.

Corvallis, OR

Client: GSI Water Solutions, Inc.
Project: Stayton Test Borings

Project No: 2146064 **Figure**

Sieve Analysis ASTM C 136/ C 117



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	64.8	12.4	3.8	8.5	5.2	5.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	76.9		
1.5 in.	53.8		
1 in.	43.8		
3/4 in.	35.2		
1/2 in.	30.6		
3/8 in.	27.7		
#4	22.8		
#8	19.7		
#16	16.5		
#30	12.6		
#50	8.6		
#100	6.5		
#200	5.3		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 57.0 D_{60}= 41.6 D_{50}= 35.1
D_{30}= 11.8 D_{15}= 0.896 D_{10}= 0.393
C_u= 106.04 C_c= 8.58

Classification

USCS= GP-GM AASHTO= A-1-a

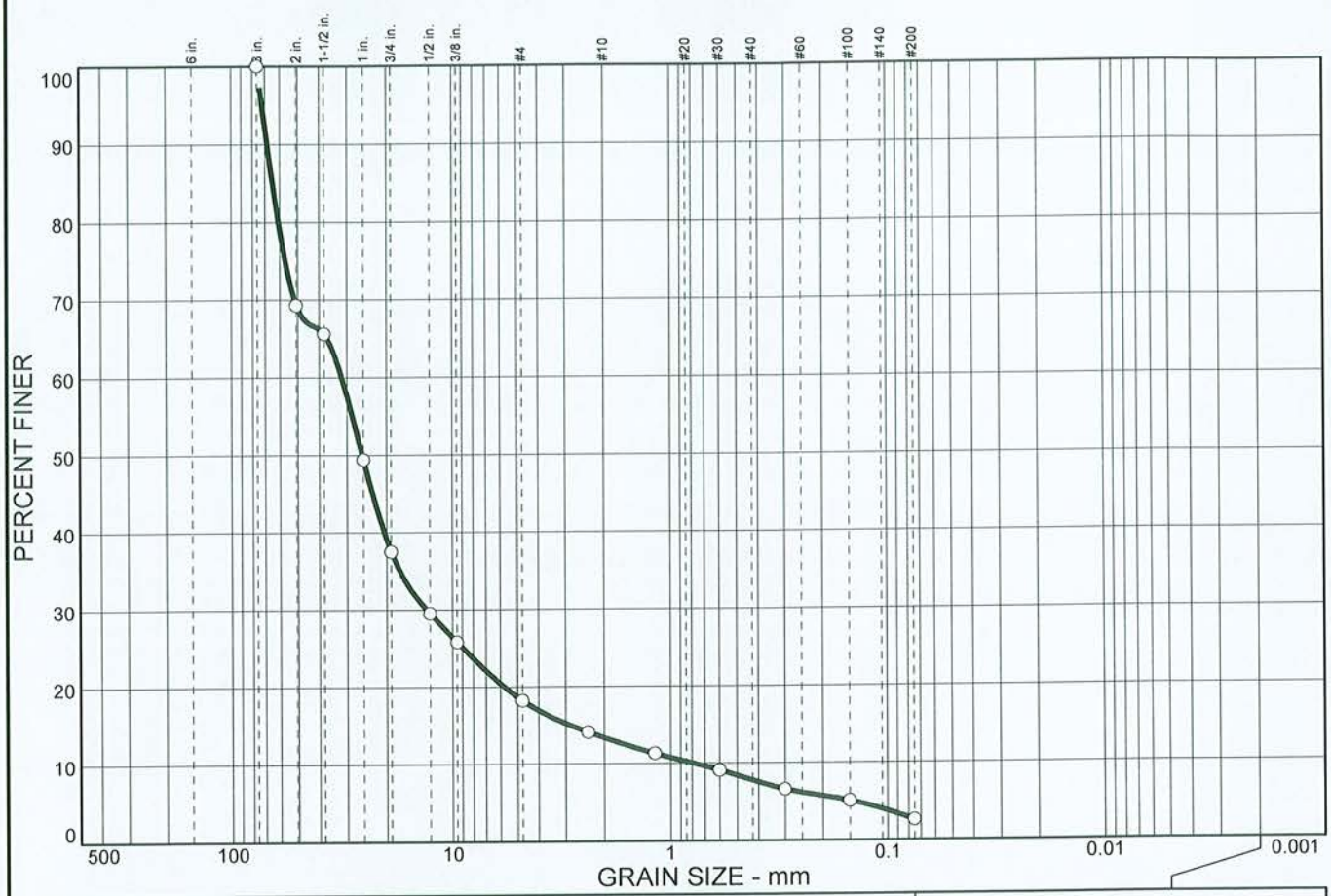
Remarks

Sample No.: B10-5-10 **Source of Sample:** 5397 **Date:** 03-27-14
Location: **Elev./Depth:**

FEI Testing & Inspection, Inc.
Corvallis, OR

Client: GSI Water Solutions, Inc.
Project: Stayton Test Borings
Project No: 2146064 **Figure**

Sieve Analysis ASTM C 136/ C 117



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	62.5	19.3	4.8	5.6	5.2	2.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	69.3		
1.5 in.	65.6		
1 in.	49.4		
3/4 in.	37.5		
1/2 in.	29.5		
3/8 in.	25.8		
#4	18.2		
#8	14.1		
#16	11.3		
#30	9.1		
#50	6.6		
#100	5.1		
#200	2.6		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 64.9 D_{60}= 31.7 D_{50}= 25.7
D_{30}= 13.2 D_{15}= 2.87 D_{10}= 0.787
C_u= 40.35 C_c= 6.96

Classification

USCS= GP AASHTO= A-1-a

Remarks

Sample No.: B10-10-15 **Source of Sample:** 5397 **Date:** 03-27-14
Location: **Elev./Depth:**

FEI Testing & Inspection, Inc.
Corvallis, OR

Client: GSI Water Solutions, Inc.
Project: Stayton Test Borings
Project No: 2146064 **Figure**

ATTACHMENT C

Water Systems Engineering Analytical Report

Water Systems Engineering Inc.
3201 Labette Terrace
P.O. Box 700
Ottawa, KS 66067-0700
Phone: 785-242-6166
Fax: 785-242-9411

WATER TREATMENT ANALYSIS AND CONTROL REPORT

Matt Kohlbecker
GSI Water Solutions
55 SW Yamhill St., Suite 400
Portland, OR 97204-3318

Date: January 14, 2010

Lab Report No. 18347

RE: City of Stayton, Well 75; casing and aquifer samples dated 12/28/09
Complete Profile (1); PO # 357:001:001

NA - Not Applicable
ND - Not Detected
*(as $CaCO_3$)

	Well 75		Detection Limits
	Casing 11:15 am mg/l	Aquifer 11:55 am mg/l	
pH Value	6.87	6.83	NA
Phenolphthalein Alkalinity*	ND	ND	4 mg/L
Total Alkalinity*	44	44	4 mg/L
Hydroxide Alkalinity	ND	ND	4 mg/L
Carbonate Alkalinity	ND	ND	4 mg/L
Bicarbonate Alkalinity	44	44	4 mg/L
Total Dissolved Solids	60	60	1.0 mg/l
Conductivity (µm or µS/cm)	84	83	NA
ORP (mV)	460	441	0.1 mV
Langelier Saturation Index	-2.23	-2.27	NA
Total Hardness*	36	36	4 mg/L
Carbonate Hardness	36	36	4 mg/L
Non Carbonate Hardness	0	0	4 mg/L
Calcium*	20	20	4 mg/L
Magnesium*	16	16	4 mg/L
Sodium (as Na)	1.48	1.52	5.0 mg/L
Potassium (as K)	0.5	0.3	0.1 mg/L
Chlorides (as Cl^-)	7.1	5.8	2 mg/L
Nitrate (Nitrogen)	ND	ND	0.3 mg/L
Chlorine (as Cl_{2+})	ND	ND	0.02 mg/L
Dissolved Iron (as Fe^{2+})	ND	ND	0.02 mg/L
Suspended Iron (as Fe^{3+})	1.69	0.43	0.02 mg/L
Iron Total (as Fe)	1.69	0.43	0.02 mg/l
Iron (resuspended)	3.12	0.62	0.02 mg/l
Copper (as Cu)	ND	ND	0.04 mg/L
Manganese (as Mn)	0.2	0.3	0.1 mg/L
Phosphate (as PO_4)	0.19	0.09	0.06 mg/L
Sulfate (as SO_4)	ND	ND	2 mg/L
Silica (as SiO_2)	32.6	28.2	1.0 mg/L
Tannin/Lignin	0.1	0.1	0.1 mg/L
Total Organic Carbon (C)	0.7	1.2	0.0 mg/l

Bacterial Analysis:

	WELL 75	
	Casing 11:15 am	**Aquifer 11:55 am**
Plate Count (colonies/ml)	4	2
Anaerobic Growth	25%	30%
Sulfate Reducing Bacteria	Positive	Negative
Fe / Mn Oxidizing Bacteria	Positive	Positive
ATP (cells per ml) Initial	251,000	114,000
ATP (cells per ml) 24 hour	228,000	107,000
Total Coliform	Negative	Negative
E.coli Coliform	Negative	Negative
Bacterial Identification	*Leptothrix, Gallionella, Cupriavidus pauculus, Serratia plymuthica*	*Leptothrix, Gallionella, Cupriavidus pauculus*

Microscopic Evaluation:

Casing: Heavy visible bacterial activity with minor number of small protozoa, heavy iron oxide with extremely large number of Leptothrix, minor number of Gallionella.

Aquifer: Moderate visible bacterial activity with trace of protozoa, moderate iron oxide with moderate to high levels of Leptothrix, minor number of Gallionella.

Observations And Interpretations:

When received in the lab the casing sample was light brown in color. The aquifer sample was clear and free of sediment.

Chemical analysis produced generally consistent results between the casing and aquifer samples. The analysis found low hardness and alkalinity with a near neutral pH. Total dissolved solids and conductivity were also very low. The oxidation-reduction potential indicates an oxidative condition existing within the well. The calculated Langelier Saturation Index was negative indicating an under saturated condition with respect to the calcium carbonate content and a moderately corrosive environment. Metals analysis (cations) found calcium, sodium, potassium, and magnesium at low levels in both samples. Anionic compounds (sulfates, phosphates, nitrates, and chlorides) were also present at very low levels.

Iron as total iron, suspended iron, and resuspended iron were at levels of concern primarily in the casing sample. Resuspended iron was particularly high in the casing sample. Resuspended iron is the result of chemically oxidized as well as biologically mobilized iron. Overall there appears to be a low level of mineralization in the natural groundwater at this location. The low level of alkalinity combined with the neutral pH and negative saturation

index indicates a relatively low potential for mineral scale formation both in the form of carbonate and sulfate precipitation.

Bacterial analysis identified limited plate growth with four colony forming cells per milliliter in the casing sample. The organisms were identified as *Cupriavidus pauculus,* and *Serratia plymuthica.* Each of these organisms are widely distributed in nature including in soils and decaying vegetation. They are generally non-pathogenic although are considered opportunistic pathogens capable of causing infection in individuals with compromised immune systems. Two colony forming cells per milliliter were identified in the aquifer sample. The organism was also identified as *Cupriavidus pauculus.*

Adenosine triphosphate (ATP) which is a measure of the total amount of cellular material present in the sample was excessive in both samples being particularly high in the casing sample. Any value over 100,000 is of concern for bacterial congestion. ATP concentrations in the aquifer sample were more representative of a properly functioning well system but still exceeded desirable levels. This indicates that bacterial growth is taking place both within the well screen and casing but also in the surrounding formation.

Anaerobic organisms were present at 25% and 30% in the casing and aquifer samples respectively. The presence of anaerobic organisms is generally associated with a stagnant zone or zones of low flow within the well.

Based on the design of the well, a five foot diameter “caisson” with a 24-inch perforated lateral extension, it is possible that the stagnant zone may be at the bottom of the caisson below the inlet of the lateral where little mixing of fresh water is taking place. The samples tested negative for total coliforms including E-coli. Sulfate reducing organisms were identified in the casing sample. Trace amounts of multi-celled organisms (protozoa) were observed in both samples. Protozoa are associated with near surface conditions and their presence in a well is usually the result of a faulty surface seal or perforated surface casing. In the case of this particular well design they may be finding their way into the well via natural migration downward to the shallow lateral. It may also be advisable to inspect the caisson for cracks or other leaks allowing surface water to enter.

The microscopic evaluation identified moderate to heavy levels of visible bacterial activity in the samples along with excessive levels of iron oxide based biofilm.

The dominant bacterial organisms identified in the microscopic evaluation were *Leptothrix* with light amounts of *Gallionella. Leptothrix* and *Gallionella* are larger, stalked bacterium that utilize iron as an energy source and secrete an iron-oxy-hydroxide byproduct. This secretion is often responsible for accumulations of iron oxide in wells and piping systems. Furthermore, the stalked nature of the bacteria rapidly clogs well screens and pump intakes, reducing flow into and out of wells. The secreted stalks are often shed during cycling of the well, resulting in surges of red water and spikes in total iron readings. These organisms are known to migrate beyond the well system and can foul transmission lines and filter systems. Both are a naturally occurring bacteria found in a variety of aquatic environments including aquifers. In addition to fouling concerns, they are a chief form of microbial induced corrosion. In its attachment to iron bearing surfaces, *Gallionella* pits the metal in an effort

to secure the iron necessary for energy. All iron bearing structures, including stainless steel, are susceptible to this form of pitting.

The *Gallionella* occurrence is of concern beyond biofouling capability. As accumulations of the iron-oxy-hydroxide stalks build within the well, the base layers tend to dehydrate, resulting in a harder, more dynamic iron oxide scale. These scale accumulations are very effective fouling mechanisms within the well and pump. High *Gallionella* populations typically result in a higher degree of required pump maintenance due to fouling of the intakes and iron oxide accumulations within the pump bowls. Moderate levels of visible bacterial activity were noted in the aquifer sample with *Gallionella* and biofilm present.

In summary, the chemistry of both water samples indicates a low level of mineralization with limited potential for mineral scale formation. The high biological load in the casing sample indicates significant bacterial congestion from slime forming organisms. Heavy populations of these types of organisms often result in plugging of the well openings and surrounding formation leading to lost well capacity. This is the likely cause of the reported lost capacity in Well 75.

The observations and interpretations presented are based on an evaluation of the water samples and submitted data. Further investigative efforts, such as a pump test, video survey, or other evaluation methods may offer additional insight into the well's condition and the degree and cause of fouling.

We appreciate the opportunity to be of service, and if you have any questions do not hesitate to contact this office or reach me directly on my cell at 913-707-5926,

Sincerely,
Water Systems Engineering, Inc.

Paul D. Buozis
Professional Geologist

Water Systems Engineering, Inc.

Date: April 2, 2014

Lab Report No. 19777

Chris Augustine
GSI Water Solutions
55 SW Yamhill, Suite 300
Portland, OR 97204

Project Description: City of Stayton, OH, 75 Well, Samples Dated 3/4/14
Complete Well Profile (1)

Test Description:

The Complete Well Profile analysis is designed for comparative analysis of two samples, typically one static and one pumping sample. The Complete Well Profile utilizes a series of inorganic chemical and microbiological tests to identify fouling and corrosion issues with potential impacts on the operation of the sampled well. The tests include a number of inorganic chemical parameters such as pH, total dissolved solids/conductivity, hardness, alkalinity, oxidation reduction potential (ORP), bicarbonate, carbonates, silica, sodium, potassium, chloride, iron, manganese, phosphate, nitrate, sulfate, and total organic carbon (TOC). Biological assessment is designed to quantify the total bacterial population, identify two dominant populations of bacteria, assess anaerobic conditions, and identify the presence of iron related bacteria and sulfate reducing organisms. Also included are tests for Adenosine triphosphate (ATP), heterotrophic plate count (HPC), total coliform and E. coli coliform, and a microscopic evaluation.

Testing Procedures:

All laboratory testing procedures are performed according to the guidelines set forth in *Standard Methods for the Examination of Water and Wastewater* as established by the American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF). Corrosion analyses are performed in accordance with the guidelines as set forth by the National Association of Corrosion Engineers (NACE). In general, these methods are approved by both the Environmental Protection Agency (EPA) and AWWA for the reporting of water and/or wastewater data.

Sample collection and shipment is the responsibility of the customer, performed according to protocol and procedures defined by the laboratory in advance of the sampling event with regards to the specific project and nature of the problem.

Disclaimer:

The data and interpretations presented are based on an evaluation of the samples and submitted data. Conclusions reached in this report are based upon the data available at the time of submittal and the accuracy of the report depends upon the validity of information submitted. Any recommendations presented are based on laboratory and field evaluations of similar fouling occurrences within potable water systems. Further investigative efforts, such as efficiency testing, site inspection, video survey, or other evaluation methods may offer additional insight into the system's condition and the degree of fouling present.

Client: GSI
Date: April 2, 2014
Lab Report No. 19777

Re: City of Stayton OH, 75 Well; Samples dated: 3/4/14
Complete Profile; Stayton

ND - Not Detected NA - Not Applicable * as $CaCO_3$	**75 Well Casing 12:38** mg/l	**75 Well Aquifer 15:45** mg/l	**Detection Limits**
pH Value	6.76	6.42	NA
Phenolphthalein Alkalinity *	ND	ND	4 mg/l
Total Alkalinity *	16	16	4 mg/l
Hydroxide Alkalinity	ND	ND	4 mg/l
Carbonate Alkalinity	ND	ND	4 mg/l
Bicarbonate Alkalinity	16	16	4 mg/l
Total Dissolved Solids	36	32	1.0 mg/l
Conductivity (µm or µS/cm)	50	45	NA
ORP (mV)	241.0	211.0	NA
Langelier Saturation Index	-3.2	-3.36	NA
Total Hardness *	24	20	4 mg/l
Carbonate Hardness	16	16	4 mg/l
Non Carbonate Hardness	8	4	4 mg/l
Calcium *	8	12	4 mg/l
Magnesium *	16	8	4 mg/l
Sodium (as Na)	ND	ND	0.02 mg/l
Potassium (as K)	ND	ND	0.1 mg/l
Phosphate (as PO_4)	0.10	ND	0.06 mg/l
Chlorides (as Cl)	6.4	6.4	2 mg/l
Nitrate (Nitrogen)	ND	ND	0.3 mg/l
Chlorine (as Cl)	ND	ND	0.02 mg/l
Dissolved Iron (as Fe^{2+})	ND	ND	0.02 mg/l
Suspended Iron (as Fe^{3+})	0.33	0.44	0.02 mg/l
Iron Total (as Fe)	0.33	0.44	0.02 mg/l
Iron (resuspended)	8.82	0.56	0.02 mg/l
Copper (as Cu)	ND	ND	0.04 mg/l
Manganese (as Mn)	ND	ND	0.1 mg/l
Sulfate (as SO_4)	ND	ND	2 mg/l
Silica (as SiO_2)	18.2	17.6	1.0 mg/l
Tannin/Lignin	0.1	0.1	0.1 mg/l
Total Organic Carbon (C)	0.7	0.9	0.0 mg/l

Biological Analysis:

	75 Well Casing 12:38	75 Well Aquifer 15:45	Detection Limit
Plate Count (colonies/ml)	>1,500	0	NA
Anaerobic Growth (%)	30	20	NA
Sulfate Reducing Bacteria	Negative	Positive	NA
SRB Occurrence	Negative	very low	NA
Fe/Mn Oxidizing Bacteria	Negative	Positive	NA
ATP (cells per ml) Initial	913,000	176,000	NA
ATP (cells per ml) Initial Filtered	523,000	--	NA
ATP (cells per ml) 24 Hour	2.1 Million	135,000	NA
ATP (cells per ml) 24 Hour Filtered	606,000	--	NA
Total Coliform	Negative	Negative	NA
E.coli Coliform	Negative	Negative	NA
Bacterial Identification	*Bacillus cereus/thuringiensis*	*Leptothrix*	NA
Bacterial Identification	-	*Gallionella*	NA

Microscopic Evaluation:

Casing: Heavy visible bacterial activity with minor number of protozoa, minor amount of plant particulate matter, heavy iron oxide, low to moderate iron oxide entrained biofilm.

Aquifer: Moderate visible bacterial activity, low to moderate number of protozoa, trace of iron oxide, moderate iron oxide entrained biofilm with moderate number of Leptothrix and minor number of Gallionella.

Observations and Interpretations:

The inorganic chemical analysis performed on the samples from Well no. 75 produced generally consistent results between the casing and aquifer samples. The analysis found low hardness and alkalinity with a slightly acidic but nearly neutral pH. Total dissolved solids and conductivity were also very low. The oxidation-reduction potential indicates an oxidative condition existing within the well which can lead to metal oxide deposition in the presence of metal ions. The calculated Langelier Saturation Index was negative indicating an under saturated condition with respect to the calcium carbonate content and implying a moderately corrosive environment. The chemical analysis found most chemicals to be present at concentrations below levels of concern for potable water supplies. Two exceptions include silica at a level slightly above the desirable level but not at a level of great concern, and resuspended iron at an exceedingly high level in the casing sample. Resuspended iron is iron that has been concentrated by biological activity and is an indication of the bacterial population present. Resuspended iron in the aquifer sample was at an acceptable level.

The chemistry of the groundwater at this location is generally very good with a low level of dissolved mineral content. The low level of alkalinity combined with the neutral pH and negative

saturation index indicates a relatively low potential for mineral scale formation both in the form of carbonate and sulfate precipitation.

Biological analysis identified an extreme level of plate growth in the casing sample with over 1,500 colony forming units (CFUs) per milliliter in the casing sample. The dominant organism was identified as *Bacillus thuringiensis*. *Bacillus thuringiensis* is a gram-positive, soil-dwelling bacterium, commonly found in the environment. As with most Bacilli, the bacteria are known to produce excessive slime or biofilm as a means of nutrient capture. The heterotrophic plate count for the aquifer sample was at a much more acceptable level of 4 CFUs per milliliter.

Adenosine triphosphate (ATP), a measure of the amount of cellular material present in a sample and is an indication of the total biological population present, was excessive in both samples being particularly high in the casing sample. ATP values for a properly functioning well system are in the range of 20,000 to 60,000 cells per milliliter (cpm). Any value over 100,000 cpm is of concern for bacterial congestion and biofouling. ATP concentrations in the aquifer sample were more representative of a properly functioning well system but still exceeded desirable levels. These values would suggest that while the bacterial growth is taking place within the well screen and casing it is also present in the surrounding formation.

Anaerobic organisms were present at 30% and 20% in the casing and aquifer samples respectively. The presence of anaerobic organisms is generally associated with a stagnant zone or zones of low flow within the well. The aquifer sample also contained a very low level of sulfate reducing bacteria.

Testing for total coliform bacteria presence, as well as E.coli specific coliforms, was negative for both of the well samples.

The microscopic evaluation identified moderate to heavy levels of visible bacterial activity in the samples along with excessive levels of iron oxide based biofilm. Each sample also contained a low to moderate number of protozoa. *Protozoa* are single-celled eukaryotic organisms present in water. *Protozoa* are most often associated with surface water bodies, indicating large, diverse, and mature microbiological communities. *Protozoa* occurrence is a concern as some are parasitic and some, like *Giardia* and *Cryptosporidium,* are pathogenic. The identification of *Protozoa* within a water sample is dependent on microscopic evaluation, with neither heterotrophic plate tests nor total coliform tests indicating their presence. It is likely that the shallow construction of the well is allowing near surface organisms to filter down into the well intake area.

While no iron and manganese oxidizing organisms were detected in the casing sample, the aquifer sample contained a low amount of *Gallionella* and a moderate amount of *Leptothrix. Leptothrix* and *Gallionella* are larger, stalked bacterium that utilize iron as an energy source and secrete an iron-oxy-hydroxide byproduct. This secretion is often responsible for accumulations of iron oxide in wells and piping systems. Furthermore, the stalked nature of the bacteria rapidly clogs well screens and pump intakes, reducing flow into and out of wells. The secreted stalks are often shed during cycling of the well, resulting in surges of red water and spikes in total iron readings. These organisms are known to migrate beyond the well system and can foul transmission lines and filter systems. Both are a naturally occurring bacteria found in a variety of aquatic environments including aquifers. In addition to fouling concerns, they are a chief form of microbial induced corrosion. In its attachment to iron bearing surfaces, *Gallionella* pits the metal in an effort to secure the iron necessary for energy. All iron bearing structures, including stainless steel, are susceptible to this form of pitting.

Based on the design of the well, a five foot diameter “caisson” with a 24-inch perforated lateral extension, it is possible that the stagnant zone may be at the bottom of the caisson below the inlet of the lateral where little mixing of fresh water is taking place.

In comparing the results of this analysis with those from a previous analysis reported in WSE Lab Report no. 18347 dated January 20, 2010, the chemistry remains essentially unchanged. The biological content has varied slightly with a much higher ATP level present in the casing sample in the current analysis as compared to previous testing. Additionally, the plate count in this analysis for the casing sample was much higher than previously. The remaining parameters measured were similar to the past analysis with similar concentrations of anaerobic growth, visible bacterial activity, and protozoa occurrence.

Considering the high level of biological growth present in Well no. 75, and the fact that all of the organisms present are capable of producing large amounts of biofilm and iron oxide deposits, it would be advisable to conduct a well cleaning involving both mechanical cleaning as well as a thorough disinfection. A review of the current operating capacity and efficiency of the well will aid in identifying the degree of cleaning efforts required, however, data does suggest a need to focus on the well column and directing additional energy towards the lowest extension of the well.

We appreciate the opportunity to be of service, and if you have any questions do not hesitate to contact our office.

Sincerely,
Water Systems Engineering, Inc.

Paul D. Buozis
Professional Geologist

APPENDIX C

Agreements

KELLER ASSOCIATES

SANTIAM WATER CONTROL DISTRICT MUNICIPAL WATER DELIVERY AGREEMENT

THIS AGREEMENT is made effective October ___, 2003 and becomes retroactive to January 1, 2003, by and between the Santiam Water Control District, herein referred to as "District," and the City of Stayton, herein referred to as "the City."

RECITALS:

A. District is a public body, corporate and politic, exercising public powers pursuant to Oregon Revised Statute Chapter 553.

B. City is a public body, corporate and politic, exercising public powers pursuant to Oregon Revised Statute Chapter 221.

C. District owns and operates a water control system, which delivers irrigation water to approximately 16,800 acres of land generally located between Stayton, Oregon and Salem, Oregon. In addition, District delivers water for municipal, hydroelectric, and commercial uses. District owns and operates the facilities that deliver water from the North Santiam River to the City's water treatment facilities. In addition, District owns and operates the Salem Canal and delivers water to the City of Salem through said canal under a perpetual contract.

D. City is the owner and operator of a community water system that supplies safe drinking water to customers in the Stayton area. The primary source of water for the City is surface water withdrawn from the North Santiam River, downstream of Geren Island, which water is delivered through the District's power canal.

E. The City is in the process of receiving an additional 10 cfs of water rights from the City of Salem under cert. # 12033. District is currently working with numerous state and federal agencies to obtain the approval and funding of the final design and permits required to install a fish screen and fish bypass facilities at the head of the power canal, which provides water to the City. Said fish screen and bypass facilities will be located at the point of diversion on the North Santiam River. The fish screen and bypass facilities are required by State law, and in order for the District to comply with the requirements of the Federal Endangered Species Act.

F. District's canal and the design of the fish screen and bypass facilities and head works provide limited capacity, and the additional delivery of ten cubic feet of water per second from the North Santiam River to the city's water treatment facility may require the District to limit future deliveries of water to other water users or to alter the design and operation of its facilities to accommodate this additional supply.

G. On or about February 4, 1971, the City and the District entered into a Water Delivery Contract for the delivery of municipal water from the North Santiam River through the District's power canal to the City's water treatment facility. Said Contract was amended by Amendment dated August 8, 1988, to reflect changes in the City's water usage. Following the execution of said Amendment to the Contract, the City acquired additional year-round rights and a right of 25 cfs for

delivery from October 1 to May 30. District was not aware of the City's acquisition of these rights until recently, and the Agreements between the parties do not provide for the delivery by the District of said additional water.

H. The parties, by this Agreement, desire to replace their existing Contract and Amendment for water delivery and to provide for the delivery by District to City of the additional water described above, including the said proposed transfer of ten cubic feet per second of water from the City of Salem to the City.

AGREEMENT

NOW, THEREFORE, the parties mutually and severally covenant and agree as follows:

1. City agrees to pay to District the sum of $100,000 upon execution of this Agreement as a contribution to the design and construction of the fish screen and bypass facilities for the District's power canal.

2. City agrees to pay to District, annually, an operation and maintenance charge. The charge payable by the City will be determined prior to November 15 of each calendar year from metered measurements made by the City. The charge will be based on the minimum usage of 21.59 cubic feet of water per second or actual use, whichever is greater, and the charge shall be effective on the first day of January of the next succeeding year. The City's "actual use" shall be based on the average used during the calendar month of the current year in which the greatest quantity of water was used by the City. The operation and maintenance charge payable by the City for 2003 is $24,180.80. Said charge was computed by multiplying 21.59 cfs by $1,120 per cfs = $24,180.80.

The base rate charged per cfs will be adjusted annually by the change in the consumer price index, using the CPI-W Index for the period of time between September 30 of the prior calendar year and September 30 of the current calendar year.

3. The City agrees to install, operate, and maintain a water-flow meter that keeps a continuous record at its point of diversion from the District's canal. The City shall cause said meter to be independently inspected and recalibrated, if necessary, annually. The City shall provide to the District a true copy of the record of usage during the preceding 12 months on November 1 of each year, commencing November 1, 2005. The parties agree and acknowledge, however, that the City will require a reasonable period of time to acquire, install, and calibrate the meter. Therefore, the record provided November 1, 2005 will not include a full 12 months. However, the City shall insure that the meter is fully operational on or before April 1, 2005.

4. Transportation: The District shall transport for the City and deliver to the City water intake through the District's power canal, all cubic feet per second of surface water rights currently owned or under permit including 10 cfs of water rights from the City of Salem under cert. # 12033. (See attached list of water rights.)

5. The District shall apply the payment provided under paragraph1., above, to the design and construction of the fish screen and bypass facilities. The District shall insure that the fish screen

and bypass facilities, as installed, shall be capable of providing not less than 46.59 cubic feet of water per second through the District's power canal to the City's water treatment plant on a continuous basis. Said amount of water is the maximum amount of water that the District is obligated to deliver to the City under the terms of this Agreement.

6. The District agrees that it shall use its best efforts to maintain and keep the canal, dams that provide the water to the District's diversion point, the trash racks, fish screens, bypass facilities, and all other facilities required for the delivery of water, free of debris and other impediments, and in a condition that will reasonably insure its ability to deliver such water to the City. The City shall have no obligation to operate and maintain any District-owned facilities. The City shall, however, be solely responsible for the operation and maintenance of its point of diversion from the District's canal and for the operation and maintenance of the flow meter required by this Agreement.

The District has no control over the quality of water in the North Santiam River, and it operates and maintains no water quality facilities, except its trash racks and the fish screens. Therefore, the District, except as to negligence on the part of the District, shall not be liable for defective quality of water delivered through the canal to the City. However, the District will at all times assist the City in maintaining water quality through the delivery system.

7. This Agreement and the rights and obligations of the parties hereto shall, at all times, be subject to the regulatory authority of the state of Oregon, as vested in any duly-constituted agency, the regulatory authority of the United States of America, as vested in any duly-constituted agency, the Water Control District Act, and to all rules and regulations adopted by the Board of Directors of the District in connection with its operation as a public entity.

8. Uncontrollable forces, which in the exercise of due diligence could not have reasonably been avoided, including but not limited to decrees and orders of any court having jurisdiction, lawful orders or directives of any governmental agency or authority, strikes, insurrection, acts of public enemy, fire, flood, earthquake, or other acts of God, negligent or deliberate acts of third parties, mechanical and structural breakdown or failure, shall excuse the affected party from its obligations under this Agreement.

9. Each of the parties hereto agrees to indemnify and hold the other party and its respective officers, employees, and agents, harmless against and from any and all liability and loss for injury to person or damage arising out of its own sole activities hereunder, except such injury or damage that may be caused by the sole or contributing negligence of the other. Each party's liability under this Agreement shall be limited by the "Tort Actions Against Public Bodies" law of the State of Oregon and such further statutory acts that limit liability of public bodies. Neither party, by executing this Agreement, shall be deemed to have waived any statutory limitation of liability.

10. Dispute Resolution

10.1 In the event a dispute arises between the parties as to the terms of this Agreement, the matter shall first be addressed through mandatory mediation.

If not settled by mediation, the parties shall resolve the matter by binding arbitration in accordance with Oregon laws.

10.2 In the event either party initiates arbitration to enforce the terms of this Agreement or to seek damages for its breach, or arising out of any dispute concerning the terms and conditions hereby created, the prevailing party shall be entitled to an award of its reasonable attorney fees in arbitration, or on appeal.

10.3 This Agreement shall be construed according to the laws of the State of Oregon.

11. Survival of Transfer: The parties agree that the City's rights under this Agreement shall survive any transfer of ownership of the diversion and/or canal by any means and whether voluntary or involuntary, from the District to any other person or entity.

12. Upon approval of this Agreement by final action of the City Council of City and its execution by the City's duly authorized officers, the District agrees to withdraw its protest to the transfer of said ten acre feet of water to the City from the City of Salem.

13. Term: The term of this Agreement is 20 years. This Agreement shall automatically be extended for five successive additional years unless the City or the District gives notice one year in advance that it does not intend to renew. All terms of this Agreement shall remain in effect during the five year successive extensions.

14. Claims: The parties agree that the District shall not file complaints, actions, or claims against the City related to evaporation or water loss related to the City's water usage under the Water Delivery Contract.

15. This Agreement supercedes all prior Agreements heretofore entered into between the parties for the delivery of water through the District's power canal to the City's water treatment facility. This Agreement is terminable only by mutual agreement of the City and the District.

16. No changes, modifications, or amendments to or waivers of any of the terms or conditions hereof shall be valid, except as the same are expressed in writing, approved by the City Council of the City and the Board of Directors of the District, and signed by the authorized representative of each of the parties.

SANTIAM WATER CONTROL DISTRICT, "DISTRICT"

By: Steven Kendell
Its President, Board of Directors

Steven Kendell
Print Name

By: Larry Trosi
Its Secretary, Board of Directors

Larry Trosi
Print Name

Date: 11-19-03

CITY OF STAYTON, "CITY"

By: Gerry Aboud
Mayor Gerry Aboud

By: Chris Childs
Chris Childs, City Administrator

Date: 12-2-2003

STATE OF OREGON, County of Marion) ss.

This instrument was acknowledged before me on Nov 19, 2003 by Steven Kendell, as President, and by Larry Trosi, as Secretary of the Board of Directors of the Santiam Water Control District.

OFFICIAL SEAL
LORI HUMPHREY
NOTARY PUBLIC - OREGON
COMMISSION NO. 354464
MY COMMISSION EXPIRES APRIL 16, 2006

Lori Humphrey
Notary Public for Oregon

My Commission Expires: 4/16/2006

Mutual Water Agreement

This Agreement is made and entered into this 9th day of April, 2001, by and between the City of Salem, Oregon, an Oregon municipal corporation ("City of Salem"), and the City of Stayton, Oregon, an Oregon municipal corporation ("City of Stayton").

WHEREAS, City of Salem is the owner and operator of a community water system that supplies safe drinking water to customers in the Salem area, whose primary water source is from surface water withdrawn from the North Santiam River at Geren Island;

WHEREAS, City of Stayton is the owner and operator of a community water system that supplies safe drinking water to customers in the Stayton area, whose primary water source is from surface water withdrawn from the North Santiam River downstream from Geren Island;

WHEREAS, both Cities have community water systems that meet all current requirements of the Oregon Health Division for safe drinking water supplied to customers;

WHEREAS, both Cities have an adequate safe drinking water supply to serve their respective communities under normal conditions, peak season conditions, and most emergency situations;

WHEREAS, both Cities have a desire to further develop their emergency sources of safe drinking water supply with the capability to handle emergency conditions resulting from an unusual calamity such as a flood, storm, earthquake, drought, civil disorder, volcanic eruption, an accidental spill of hazardous material, or other occurrence which disrupts water service or can endanger the quality of the water produced by a water system;

WHEREAS, both Cities have a desire to occasionally provide surplus safe drinking water to one another and to occasionally use surplus safe drinking water from one another;

WHEREAS, both Cities have entered into previous water agreements with one another dated June 3, 1957, February 10, 1971, and August 27, 1999;

WHEREAS, both Cities are currently in the process of negotiating a separate agreement for construction of a transmission water conduit.

NOW, THEREFORE, in consideration of the covenants and agreements hereinafter set forth to be kept and performed by the parties hereto, it is mutually agreed as follows:

City of Salem Agrees:

1) To sell safe drinking water to the City of Stayton during emergency conditions (See Section 9);

2) To sell surplus safe drinking water to the City of Stayton (See Section 10);

3) To sell safe drinking water to the City of Stayton at the rate of $0.35 per 100 cubic feet ($0.4679 per 1,000 gallons). This includes emergency safe drinking water or surplus safe drinking water;

4) To limit future annual rate increases in the sale of safe drinking water to Stayton by an amount not to exceed the year end percentage change for the month ending in June in the Consumer Price Index for the West, as published by the Department of Labor, Bureau of Labor Statistics, for all urban consumers;

City of Stayton Agrees:

5) To sell safe drinking water to the City of Salem during emergency conditions (See Section 9);

6) To sell surplus safe drinking water to the City of Salem (See Section 10);

7) To sell safe drinking water under either emergency conditions or surplus safe drinking water to the City of Salem at the commodity rate charged other Stayton customers, which is $0.581 per 1000 gallons ($0.4346 per 100 cubic feet);

8) To limit future annual rate increases in the sale of safe drinking water to Salem by an amount not to exceed the year end percentage change for the month ending in June in the Consumer Price Index for the West, as published by the Department of Labor, Bureau of Labor Statistics, for all urban consumers;

Both Cities Agree:

9) To provide safe drinking water to one another for emergency conditions. When emergency safe drinking water is required by either City, the requesting City shall contact the other City to ensure safe drinking water is available. Only Stayton's City Administrator or Salem's Public Works Director, or their designee, of the City receiving the request is authorized to determine whether safe drinking water is available for the emergency condition. Once the availability of safe drinking water has been determined, representatives of each City shall coordinate the operations of appropriate valves, measuring devices, and auxiliary systems;

10) To provide surplus safe drinking water to one another. When surplus safe drinking water is required by either City, the requesting City shall contact the other City to ensure surplus safe drinking water is available. Only Stayton's City Administrator or Salem's Public Works Director, or their designee, of the City receiving the request is authorized to determine whether surplus safe drinking water is available. Once the availability of surplus safe drinking water has been determined, representatives of each City shall coordinate the operations of appropriate valves, measuring devices, and auxiliary systems;

11) To acknowledge and understand that the supply of emergency safe drinking water or surplus safe drinking water may be limited at times and seasons to specific locations if required to meet Safe Drinking Water Act standards of the Oregon Health Division. Additional treatment such as corrosion control and additional chlorine contact time may be required;

12) To jointly conserve safe drinking water during a regional water shortage, that may be caused by either a drought, a flood, or other regional emergency condition by following each Cities' individual water curtailment program. Conserving safe drinking water will maximize its availability to both communities, and subject to Section 9, water will be provided to each community during a water shortage on a per capita basis;

13) To support the other City's legal purchase, sale, lease, or maintenance of water rights by not contesting these actions; including, but not limited to, water right transfers, changing or modifying a water right permit, processing a water right time extension, filing proof of completions, and perfecting water rights;

14) To maintain an active water system backflow prevention program in their own respective water systems in accordance with Oregon Statutes for the life of this agreement;

15) For purposes of this Agreement "Safe Drinking Water" shall have the same definition as found in OAR 333-061-0020 (122).

16) This Agreement supercedes the Emergency Water Agreement between the parties dated August 27, 1999; the Agreement between the parties dated February 10, 1971; and paragraph 11 of the Agreement between the parties dated June 3, 1957. All other provisions of the 1957 Agreement shall remain in full force and effect.

17) This Agreement shall be effective simultaneously upon execution of the "Agreement for Construction of a Transmission Water Conduit," in substantially the same form as Exhibit A hereto.

18) This Water Agreement can be terminated with or without cause by either City by giving the other 180 calendar days' written notice.

19) Should a dispute arise over any of the items contained in this agreement, both Cities agree to participate in non binding mediation or non binding arbitration proceedings endeavoring to resolve the issue in dispute. The mediator or arbitrator shall be mutually agreed upon by both Cities.

City of Salem, Oregon

By: Roberts Wells
City Manager, Pro Tem

City of Stayton, Oregon

By: Gene Aburd 3/20/01
Mayor

ATTEST: C M Childs
City Administrator

Approved as to form:

David A. Rhoten
City Attorney

Exhibit A—Agreement for Construction of a Transmission Water Conduit