PLANNING REPORT

WATER MASTER PLAN UPDATE

City of Manzanita
9155 Nehalem Road
Nehalem, Oregon 97131

August 2021

PACE
An Engineering Services Company

WATER MASTER PLAN UPDATE

City of Manzanita
P.O. Box 129
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PACE Engineers, Inc.
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PACE Project No. 19891

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PROJECT CERTIFICATION

The technical material and data contained in this report was prepared by PACE Engineers, Inc., under the supervision of the below listed individuals. Those responsible staff members who are registered professional engineers are licensed in the State of Oregon.

RENEWS: 12/31/2022

William M. Pavlich, PE, CWRE

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PACE Project No. 19891

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PUBLIC HEALTH DIVISION
Drinking Water Services
Kate Brown, Governor

Oregon Health Authority

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February 18, 2022

William Pavlich, PE
billp@paceengrs.com
PACE Engineers, Inc.
4500 Kruse Way, Suite 250
Lake Oswego, OR 97035

Re: **August 2021 Water Master Plan Update PACE Project #19891 (PR#13-2022)**
Manzanita Water Department (PWS ID#00505)
Concurrence with Master Plan

Dear Mr. Pavlich:

This letter is regarding the *August 2021 Water System Master Plan Update* ("Master Plan") for the Manzanita Water Department (PWS ID #4100505) that Dan Weitzel provided as a link via an e-mail sent on January 27, 2022. A plan review fee of $4,125 was also received on January 27, 2022. We have assigned plan review number 13-2022 (PR #13-2022) for this review.

The Master Plan represents a 20-year planning horizon out to the year 2040 for most elements, however, a 50-year planning horizon was used for the seismic component of the plan. Included is a system description, future demand estimates and CIP project lists with cost estimates. A summary of the Master Plan and key findings & recommendations is included with this letter beginning on page 3.

Upon review of the Master Plan, it appears the criteria listed in Oregon Administrative Rules (OAR) 333-061-0060(5) have been met – this concludes my review of the Master Plan. In general, I found the Master Plan to be comprehensive and well written with the only issue being a reference to the Neah-Kah-Nie water system at the bottom of page ii (shown below) where I believe the reference should have been to Manzanita.

> **ES-6 General and Projected Water System Demands**
>
> Projected water demands for the Neah-Kah-Nie Water system are show in Table ES.1.

Thank you for your efforts in developing the Master Plan and if you have any questions, please feel free to call me at (971) 200-0288 or e-mail me at evan.e.hofeld@dhsoha.state.or.us.

Sincerely,

Evan Hofeld, PE
Regional Engineer
Drinking Water Services

cc: Dan Weitzel, Public Works Director, Manzanita Water Department, dweitzel@ci.manzanita.or.us
Jaime Craig, Environmental Health Program Manager, Tillamook County
Jcraig@co.tillamook.or.us

EXECUTIVE SUMMARY

ES-1 Background and Need

The City of Manzanita is a coastal community located in Tillamook County approximately 26 highway miles north of the City of Tillamook. Manzanita owns and operates a municipal water system that provides water to the community. The City is also part of the Joint Water System (JWS) with the City of Wheeler; the JWS includes the well supply, carbon dioxide (CO_2) stripper, well water treatment and pumping, and part of the transmission main from the well supply system. There are several other communities (RT 53 Water, Inc.; Tideland Services Coop; and Nehalem Bay State Park) connected to the JWS via master meters. Currently there are 1,673 active residential service connections in the City of Manzanita.

The City's last State-approved Water Master Plan received Oregon Health Authority (OHA) approval on May 30, 2006. Currently the City is in compliance with OAR 33-061-0060(5), which requires community water systems with 300 or more service connections to maintain a current State approved Water Master Plan.

Since completion of the 2006 Master Plan, the City has experienced several issues that suggest an update to the current plan is warranted. These include:

- A proposed large development that may have significant impacts on the water system which has raised City concerns regarding potential water supply impacts and infrastructure needs to accommodate the development.
- Ongoing development and increased tourism.
- Water supply infrastructure that collects and conveys surface water (from Anderson Creek) to the City's water treatment plant has largely failed. The City now relies exclusively on water from the wells.
- Potential limitations on water production associated with the ongoing effort to obtain a permit extension for the well water right.
- An increased awareness, on a statewide level, in recent years of the importance of system reliability and resiliency – especially along the Oregon Coast.
- An interest in developing a backup water source such as a well near the City's water treatment plant. This would also facilitate routine operation of the treatment facility to maintain its functionality.
- A need to replace the City's largest reservoir based on risks of failure during a moderate earthquake and the potential consequences of such a failure.

The Master Plan update needs to meet Oregon Health Authority (OHA) requirements for a current Master Plan as well as provide a current evaluation of the City's needs. OHA requirements include a new provision that requires the City to include an element addressing seismic reliability.

ES-2 Planning Period

This Plan uses a 20-year planning period (through the year 2040) for most plan elements; a 50-year planning period is used for elements related to seismic reliability.

ES-3 Growth Projections

Projected growth for Manzanita is based on official population forecasts by Portland State University Population Research Center (March 31, 2020) plus additional growth associated with the Village at Manzanita development. The projected average annual growth rate (AAGR) is 1.34% (year 2020 – 2040) and 0.60% (year 2040 – 2070).

ES-4 Level of Service Goals

"Level of Service" ultimately refers to the quality of the water service provided to the customer, but the phrase also has implications for the City staff who are responsible for operating, maintaining, and administering the utility, and for City officials who are ultimately responsible for the support and political will to champion the mission and needs of the utility. The provision of clean, healthy drinking water is one of the most important services provided in a community and, consistent with this importance, the City of Manzanita should endeavor to provide a relatively high level of service.

One of the primary objectives for a water system is the protection of public health and welfare. For utilizing and expanding a water system, it is also important to minimize adverse environmental impacts. Various agencies have promulgated rules that ultimately support these objectives, and, at a minimum, every water system must comply with these rules and requirements.

ES-5 General Goals and Requirements

General level of service goals and requirements applicable to the water system include:

- Conveyance and delivery (goal): Adequate, consistent, and reliable delivery of water under all anticipated service conditions; capacity for system to deliver maximum day demand (MDD) plus fire flow (FF)
- Pressurization (requirement): A minimum of 20 psi system pressure must always be maintained (OAR 333-061-0025). The 20-psi minimum system pressure requirement extends to the customer water meter.
- Water quality (requirements): Comply with all Oregon Health Authority (OHA) requirements. Water quality also includes aesthetic considerations that may or may not be related to specific regulatory concerns. Efforts to maintain or improve the aesthetic quality of the water provided is a goal consistent with the provision of a high level of service.
- Reliability (goal and requirements): Reliability as a goal is the ability of the water system and City staff to avoid or circumvent problems that adversely impact system performance. Reliability is enhanced by routine and timely maintenance and replacement, good design and construction, providing adequate water supply, providing alternate or backup facilities or equipment, and having a contingency plan for efficiently handling specific problems. OHA recently added a new master planning provision (OAR 333-061-0060(5)(J)) that requires the City to include an element addressing seismic reliability.

ES-6 General and Projected Water System Demands

Projected water demands for the Manzanita Water system are show in Table ES.1.

Table ES-1: Projected Water System Demands[1]						
	2020	2025	2030	2035	2040	2070
EDUs	3,039	3,248	3,472	3,711	3,966	4,733
ADD[2] (mgd)[3]	0.33	0.35	0.38	0.40	0.43	0.51
MDD[4] (mgd)	0.73	0.78	0.83	0.89	0.95	1.14
MDD (gpm)[5]	507	543	583	625	670	718
MDD (cfs)[6]	1.13	1.21	1.29	1.38	1.47	1.76

1. All figures are rounded
2. ADD = average day demand
3. mgd = million gallons per day
4. MDD = maximum day demand
5. gpm = gallons per minute
6. cfs = cubic feet per second

ES-7 Water Conservation

For general planning purposes, no additional reductions in water demand or non-revenue water are incorporated into the projections for future water demand. Continued reductions, however, will reduce the City's impact on the long-term water supply capacity associated with the well sources. Manzanita and Wheeler will likely need to develop a Water Management and Conservation Plan (WMCP) after the well water right permit has been extended by Oregon Water Resources Department. There has been no indication of when the permit extension will be completed; the requirement to complete a WMCP is a typical permit condition for communities without an approved WMCP.

ES-8 Water Quality and Treatment

In general, both source and distribution water quality in Manzanita is excellent. Recent improvements at the well facility include construction of a carbon dioxide stripping tower and conversion to hypochlorite disinfection. The surface water treatment plant is no longer utilized because the raw water transmission main from the Anderson creek source is in disrepair and no longer functional. There are no specific treatment related recommendations other than diligence in meeting all applicable regulatory requirements.

ES-9 Water Source and Water Rights

The City currently relies on water from the wells. Water rights for the well supply is owned by Wheeler; the rights are in permit status. The permitted rate is 3.6 cfs – considerably more than needed to meet projected demands. Actual availability will be determined as part of the ongoing permit extension (see "Water Conservation" section above). The City has 4.03 cfs in certificated surface water rights associated with Anderson Creek, Neahkahnie Creek, and Alder Creek; however, these sources are not currently utilized. Actual water availability from these sources during parts of summer and early fall is likely to be very limited and insufficient to meet water system demands. There is a plan, associated with construction of an emergency well near the water treatment plant, to transfer A Neahkahnie Creek water right downstream to the proposed well site, also near the creek.

ES-10 Reservoir Storage

Total above ground reservoir storage is 2.35 million gallons (MG). The City's largest reservoir is 1.6 MG and was recently discovered to be next to a slope with a high potential for landslide or slope failure. The City is currently in preliminary design to replace the three above ground reservoirs with two reservoirs of approximately 1 MG each at the current site of the 0.25 MG and 0.5 MG reservoirs. The project addresses the issues with the 1.6 MG reservoir and also addresses complexities and potential problems associated with the current reservoir field piping and operational configurations.

ES-11 Distribution

As assessment of Manzanita's distribution system and the resulting improvement recommendations were based on map review, review of previous plan recommendations and implemented projects, fire flow needs, and information from staff on problem areas. Recommendations are included in the capital improvement plan. Current recommendations are extensive and shown in Figure 7.1 and noted in Table 7.1, both of which are included at the end of this Executive Summary.

ES-12 Resiliency Recommendations

The City completed a Water System Resiliency Study in 2018 that, in addition to supply and reservoir recommendations, included improvements to the transmission main to minimize damage to the City's "backbone" supply line from the wells to the City. These improvements consist primarily of projects to prevent water loss due to failure of vulnerable facilities (large service connections, bridge crossings, etc.) or to provide an emergency connection (the Fire and Rescue facility). The resiliency recommendations are noted individually in Table 7.1 (at the end of this Executive Summary).

ES-13 Water Rates

Manzanita's current water rate schedule was implemented on October 1, 2014. For residential customers inside the City, rates are based on a base monthly service charge of $39.50 that includes an allowance of up to 4,000 gallons per month. To the base charge is added the water usage rate of $2.50 per 1,000 gallons for usage beyond the 4,000 gallons included in the base charge (zero to 20,000 gallons) and $0.0035 per gallon for usage beyond 20,000 gallons. Meter reading and billings are quarterly.

Funding agencies often evaluate a community's rates based on a monthly single-family residential billing associated with 7,500 gallons of usage; for Manzanita, this billing would be $48.25 ($39.50 for base rate plus usage (overage) of $8.75 for 3,500 gallons).

For the fiscal year ending June 30, 2020, major sources of revenue included $1,003,327 in rates and $96,600 in System Development Charges.

The water fund budgets appear healthy with substantial reserves and significant allocations for capital improvements. There does not appear to be an immediate need to raise rates, even though rates have not been adjusted in the last 7 years. Nevertheless, the City should consider retaining a consultant to complete a Rate Study once decisions have been made on implementation of the recommended capital improvements. The rate study can be used to evaluate the benefit and feasibility of any changes in the rate structure in addition to determining rate increases needed for debt service on loan components of the funding package.

ES-14 Current System Development Charge (SDC)

The City's current Water SDC is $6,900 for a new service. SDCs were last updated on September 10, 2015. SDCs utilize an approved capital improvements plan as the basis for the SDC cost computation. As SDCs are based in part on anticipated project costs, the City should consider revising the SDC after the Water Master Plan has been adopted.

ES-15 Operations and Maintenance

The recommended capital improvements should not result in increased O&M costs; however, O&M costs are subject to market changes and inflationary pressures, so annual increases are typically required. Budgets and water rates are typically adjusted to take recent or anticipated changes into account; however, system deficiencies that have not been addressed can increase O&M costs in ways and to an extent not easily foreseen. This may take the form of emergency (overtime) callouts and extra costs, interim measures that may be needed until the problem can be addressed correctly, and unbudgeted emergency projects of potentially significant expense. Over time, such costs can add significantly to the overall utility budget.

ES-16 Capital Improvement Finance and Rate Impacts

Capital improvements can be implemented over the planning period according to the nature of the projects, the relative prioritization of the project, and other financial and practical considerations that the City may have. Because of the relatively high costs, funding agency participation may be needed or desired. If the City decides to pursue agency assistance, then once the City has determined which projects to include, the City should contact IFA to set up a One-Stop Meeting in Salem to discuss potential project funding. Representatives of potential funding agencies attend the meeting and can assist in developing an optimal funding approach. The Water Master Plan does include a discussion of funding alternatives and sources as well as a means of estimating rate impacts associated with loan financing.

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FIGURE ES-1: MANZANITA PROPOSED DISTRIBUTION IMPROVEMENTS

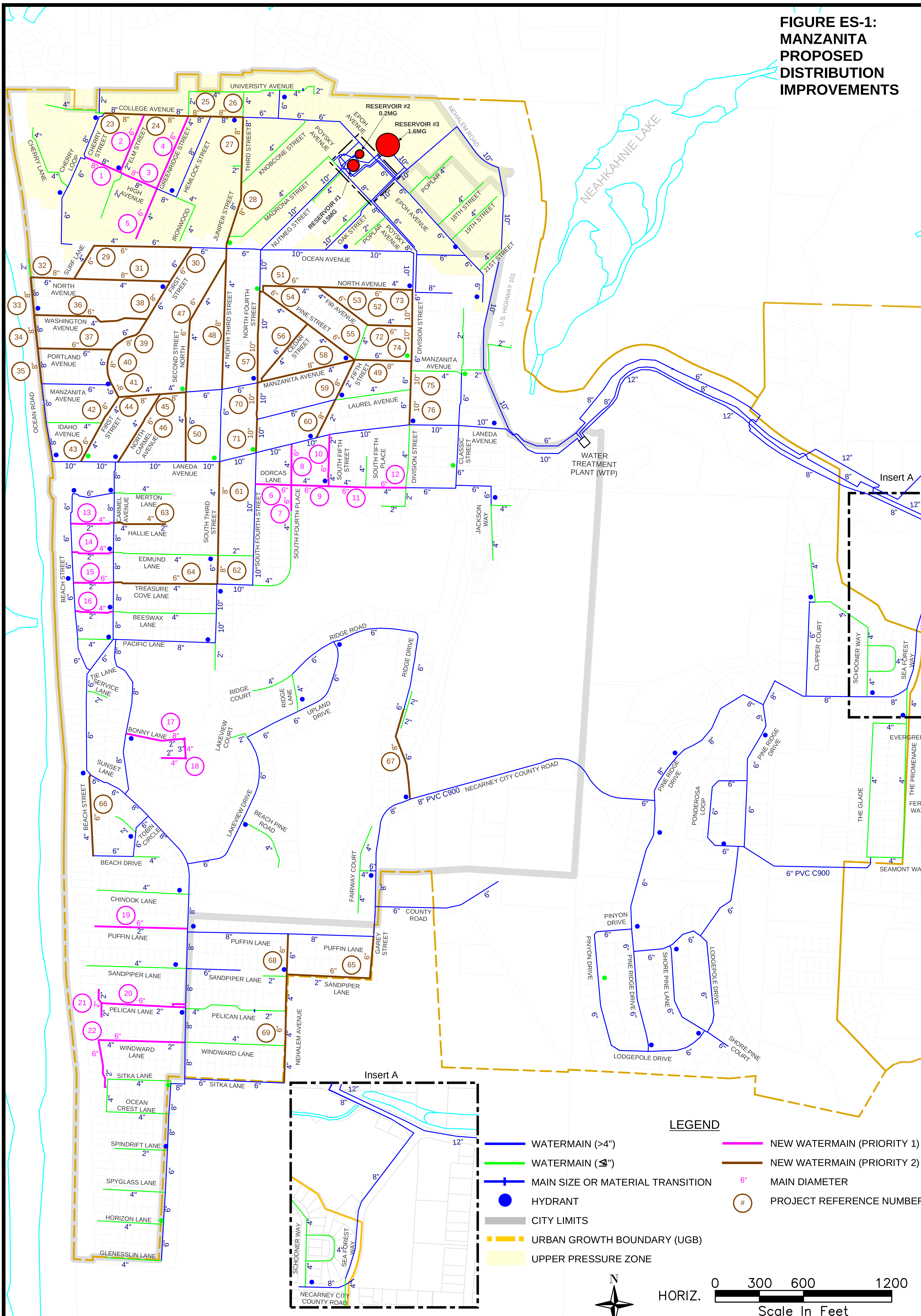

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Table ES-2: City of Manzanita CIP (All costs in current dollars) **Reference June 2021 ENR CCI:** 12112 **Current ENR CCI: (June 2021)** 12112

City of Manzanita Water Master Plan 2021
Distribution Improvements

Unit Costs June 2021 ($/LF)	Project Priority	Project Reference Number	Project Name (Description)	New Diameter (in.)	Length (LF)	Current Unit Cost ($/LF)	Construction Cost ($)	Total Cost ($)	Implementation (LF and Total Cost) 2021-2025 (LF)	2021-2025 ($)	2025-2030 (LF)	2025-2030 ($)	2031-2040 (LF)	2031-2040 ($)	CIP Totals Length (LF)	Cost ($)
$160	1	1	**High Avenue PR1**	8	250	$160	$40,000	$58,000	250	$58,000		$0		$0	250	$58,000
			Replace existing 8" AC. Elm Street to Cherry Street.													
$145	1	2	**Elm Street PR2**	6	390	$145	$56,550	$81,998	390	$81,998		$0		$0	390	$81,998
			Replace existing 2" ABS with 6". High Avenue to College Avenue.													
$160	1	3	**High Avenue PR3**	8	250	$160	$40,000	$58,000	250	$58,000		$0		$0	250	$58,000
			Replace existing 8". Greenridge Street to Elm Street.													
$145	1	4	**Greenridge Street PR4**	6	510	$145	$73,950	$107,228	510	$107,228		$0		$0	510	$107,228
			Replace existing 4" AC with 6".													
$145	1	5	**Greenridge Street PR4**	6	410	$145	$59,450	$86,203	410	$86,203		$0		$0	410	$86,203
			Replace existing 4"AC with 6".													
$160	1	6	**Dorcas Lane PR6**	8	230	$160	$36,800	$53,360	230	$53,360		$0		$0	230	$53,360
			New 8" main. South Fourth Street to South Fourth Place.													
$145	1	7	**South Fourth Place PR7**	6	230	$145	$33,350	$48,358	230	$48,358		$0		$0	230	$48,358
			Replace existing 4"PVC with 6". South from Dorcas Lane.													
$145	1	8	**South Fourth Place PR8**	6	280	$145	$40,600	$58,870	280	$58,870		$0		$0	280	$58,870
			Replace existing 4" AC with 6". Dorcas Lane to Laneda Avenue.													
$160	1	9	**Dorcas Lane PR9**	8	230	$160	$36,800	$53,360	230	$53,360		$0		$0	230	$53,360
			Replace existing 4" AC with 8". South Fifth Street to South Fourth Place.													
$145	1	10	**South Fifth Street PR10**	6	360	$145	$52,200	$75,690	360	$75,690		$0		$0	360	$75,690
			Replace existing 2" and 4"with 6". Dorcas Lane to Laneda Avenue.													
$160	1	11	**Dorcas Lane PR11**	8	265	$160	$42,400	$61,480	265	$61,480		$0		$0	265	$61,480
			Replace existing 4" AC with 8". South Fifth Street to South Fifth Place.													
$160	1	12	**Dorcas Lane PR12**	8	250	$160	$40,000	$58,000	250	$58,000		$0		$0	250	$58,000
			Replace existing 4" PVC with 8". Division Street to South Fifth Place.													
$135	1	13	**Hallie Lane PR13**	4	290	$135	$39,150	$56,768	290	$56,768		$0		$0	290	$56,768
			Replace existing 2"ABS with 4". Beach Street to Carmel Avenue.													
$135	1	14	**Edmund Lane PR14**	4	280	$135	$37,800	$54,810	280	$54,810		$0		$0	280	$54,810
			Replace existing 2"ABS with 4". Beach Street to Carmel Avenue.													
$145	1	15	**Treasure Cove Lane PR15**	6	260	$145	$37,700	$54,665	260	$54,665		$0		$0	260	$54,665
			Replace existing 2" PVC with 6". Beach Street to Carmel Avenue.													
$135	1	16	**Beeswax Lane PR16**	4	260	$135	$35,100	$50,895	260	$50,895		$0		$0	260	$50,895
			Replace existing 2" ABS with 4". Beach Street to Carmel Avenue.													
$160	1	17	**Bonny Lane PR17**	8	400	$160	$64,000	$92,800	400	$92,800		$0		$0	400	$92,800
			Replace existing 2" Glued Electrical Conduit with 8". East from connection with South Carmel Avenue.													
$135	1	18	**Bonny Lane PR18**	4	310	$135	$41,850	$60,683	310	$60,683		$0		$0	310	$60,683
			Replace existing 2" and 3" Glued Electrical Conduit with 4". Connects to project PR 17.													
$145	1	19	**Puffin Lane PR19**	6	620	$145	$89,900	$130,355	620	$130,355		$0		$0	620	$130,355
			Replace existing 2" PVC with 6". West from South Carmel Avenue.													
$145	1	20	**Pelican Lane PR20**	6	475	$145	$68,875	$99,869	475	$99,869		$0		$0	475	$99,869
			Replace existing 2" with 6". West from South Carmel Avenue.													
$115	1	21	**Pelican Lane PR21**	6	200	$115	$23,000	$33,350	200	$33,350		$0		$0	200	$33,350
			Replace existing 2". North and south from the west end of project PR20.													
$145	1	22	**Windward Lane PR22**	6	870	$145	$126,150	$182,918	870	$182,918		$0		$0	870	$182,918
			Replace existing 2" ABS and 4" PVC with 6". West from South Carmel Avenue and south to Sitka Lane.													
$160	2	23	**College Avenue PR23**	8	295	$160	$47,200	$68,440		$0	295	$68,440		$0	295	$68,440
			Replace existing 8" AC. Cherry Street to Elm Street.													
$160	2	24	**College Avenue PR24**	8	295	$160	$47,200	$68,440		$0	295	$68,440		$0	295	$68,440
			Replace existing 8" AC. Greenridge Street to Elm Street.													
$160	2	25	**College Avenue PR25**	8	160	$160	$25,600	$37,120		$0	160	$37,120		$0	160	$37,120
			Replace existing 8" AC. Greenridge Street to Hemlock Street.													
$160	2	26	**College Avenue PR26**	8	230	$160	$36,800	$53,360		$0	230	$53,360		$0	230	$53,360
			Replace existing 8" AC. Third Street to Hemlock Street.													

Unit Costs June 2021 ($/LF)	Project Priority	Project Reference Number	Project Name (Description)	New Diameter (in.)	Length (LF)	Current Unit Cost ($/LF)	Construction Cost ($)	Total Cost ($)	Implementation (LF and Total Cost) 2021-2025 (LF)	2021-2025 ($)	2025-2030 (LF)	2025-2030 ($)	2031-2040 (LF)	2031-2040 ($)	CIP Totals Length (LF)	Cost ($)
$160	2	27	**Third Street PR27**	8	230	$160	$36,800	$53,360		$0	230	$53,360		$0	230	$53,360
			Replace existing 8" AC. Knobcone Street to College Avenue.													
$160	2	28	**Juniper Street PR28**	8	430	$160	$68,800	$99,760		$0	430	$99,760		$0	430	$99,760
			Replace existing 8" AC. Knobcone Street to Ocean Avenue.													
$145	2	29	**Ocean Avenue/Surf Lane PR29**	6	940	$145	$136,300	$197,635		$0	940	$197,635		$0	940	$197,635
			Replace existing 4" and 6" AC with 6". From First Street to and southwest along Surf Lane to North Avenue.													
$160	2	30	**First Street PR30**	8	285	$160	$45,600	$66,120		$0	285	$66,120		$0	285	$66,120
			Replace existing 6" AC. Ocean Avenue to North Avenue.													
$160	2	31	**North Avenue PR31**	8	655	$160	$104,800	$151,960		$0	655	$151,960		$0	655	$151,960
			Replace existing 4" AC. First Street to Surf Lane.													
$160	2	32	**North Avenue PR32**	8	270	$160	$43,200	$62,640		$0	270	$62,640		$0	270	$62,640
			Replace existing 6" AC. Ocean Road to Surf Lane.													
$160	2	33	**Ocean Road PR33**	8	250	$160	$40,000	$58,000		$0	250	$58,000		$0	250	$58,000
			Replace existing 8" AC. North Avenue to Washington Avenue.													
$160	2	34	**Ocean Road PR34**	8	220	$160	$35,200	$51,040		$0	220	$51,040		$0	220	$51,040
			Replace existing 8" AC. Portland Avenue to Washington Avenue.													
$160	2	35	**Ocean Road PR35**	8	240	$160	$38,400	$55,680		$0	240	$55,680		$0	240	$55,680
			Replace existing 8" AC. Portland Avenue to Manzanita Avenue.													
$145	2	36	**Washington Avenue PR36**	6	760	$145	$110,200	$159,790		$0	760	$159,790		$0	760	$159,790
			Replace existing 4" AC with 6". From First Street to Ocean Road.													
$145	2	37	**Portland Avenue PR37**	6	500	$145	$72,500	$105,125		$0	500	$105,125		$0	500	$105,125
			Replace existing 6" AC. From First Street to Ocean Road.													
$160	2	38	**First Street PR38**	8	300	$160	$48,000	$69,600		$0	300	$69,600		$0	300	$69,600
			Replace existing 6" AC. Washington Avenue to North Avenue.													
$160	2	39	**First Street PR39**	8	320	$160	$51,200	$74,240		$0	320	$74,240		$0	320	$74,240
			Replace existing 6" AC. Washington Avenue to Portland Avenue.													
$160	2	40	**First Street PR40**	8	240	$160	$38,400	$55,680		$0	240	$55,680		$0	240	$55,680
			Replace existing 6" AC. Manzanita Avenue to Portland Avenue.													
$160	2	41	**First Street PR41**	8	80	$160	$12,800	$18,560		$0	80	$18,560		$0	80	$18,560
			Replace existing 6" AC with 8". From project PR40 south to Manzanita Avenue.													
$145	2	42	**First Street PR42**	6	225	$145	$32,625	$47,306		$0	225	$47,306		$0	225	$47,306
			Replace existing 6" AC. Idaho Avenue to Manzanita Avenue.													
$145	2	43	**First Street PR43**	6	270	$145	$39,150	$56,768		$0	270	$56,768		$0	270	$56,768
			Replace existing 4" AC. Idaho Avenue to Laneda Avenue.													
$160	2	44	**Manzanita Avenue PR44**	8	280	$160	$44,800	$64,960		$0	280	$64,960		$0	280	$64,960
			Replace existing 4" AC with 8". First Street to North Carmel Avenue.													
$160	2	45	**Manzanita Avenue PR45**	8	170	$160	$27,200	$39,440		$0	170	$39,440		$0	170	$39,440
			Replace existing 4" ACwith 8". Second Street North to North Carmel Avenue.													
$145	2	46	**North Carmel Avenue PR46**	6	515	$145	$74,675	$108,279		$0	515	$108,279		$0	515	$108,279
			Replace existing 4" AC. Manzanita Avenue to Laneda Avenue.													
$145	2	47	**Second Street North PR47**	6	935	$145	$135,575	$196,584		$0	935	$196,584		$0	935	$196,584
			Replace existing 4" AC with 6". Manzanita Avenue to North Third Street.													
$160	2	48	**North Third Street PR48**	8	1,000	$160	$160,000	$232,000		$0	1,000	$232,000		$0	1,000	$232,000
			Replace existing 4" AC with 8". Manzanita Avenue to Ocean Avenue.													
$160	2	49	**Manzanita Avenue PR49**	8	235	$160	$37,600	$54,520		$0	235	$54,520		$0	235	$54,520
			Replace existing 6" AC with 8". Fifth Street to Division Street.													
$145	2	50	**Second Street North PR50**	6	460	$145	$66,700	$96,715		$0	460	$96,715		$0	460	$96,715
			Replace existing 4" AC with 6". Manzanita Avenue to Laneda Avenue.													
$145	2	51	**North Avenue PR51**	6	370	$145	$53,650	$77,793		$0	370	$77,793		$0	370	$77,793
			Replace existing 4" AC with 6". Pine Street to Fir Avenue.													
$145	2	52	**North Avenue PR52**	6	625	$145	$90,625	$131,406		$0	625	$131,406		$0	625	$131,406
			Replace existing 4" AC with 6". Division Street to Fir Avenue.													
$145	2	53	**Fir Avenue PR53**	6	405	$145	$58,725	$85,151		$0	405	$85,151		$0	405	$85,151
			Replace existing 4" AC with 6". Fifth Street to North Avenue.													
$145	2	54	**Pine Street PR54**	6	365	$145	$52,925	$76,741		$0	365	$76,741		$0	365	$76,741
			Replace existing 4" AC with 6". Cedar Street to North Fourth Street.													

Unit Costs June 2021 ($/LF)	Project Priority	Project Reference Number	Project Name (Description)	New Diameter (in.)	Length (LF)	Current Unit Cost ($/LF)	Construction Cost ($)	Total Cost ($)	Implementation (LF and Total Cost) 2021-2025 (LF)	2021-2025 ($)	2025-2030 (LF)	2025-2030 ($)	2031-2040 (LF)	2031-2040 ($)	CIP Totals Length (LF)	Cost ($)
$145	2	55	**Pine Street PR55**	**6**	400	$145	$58,000	$84,100		$0	400	$84,100		$0	400	$84,100
			Replace existing 4" AC with 6". Cedar Street to Fifth Street.													
$145	2	56	**Cedar Street PR56**	**6**	500	$145	$72,500	$105,125		$0	500	$105,125		$0	500	$105,125
			Replace existing 4" AC with 6". Pine Street to Manzanita Avenue.													
$185	2	57	**North Fourth Street PR57**	**10**	610	$185	$112,850	$163,633		$0	610	$163,633		$0	610	$163,633
			Replace existing 10" AC. North Avenue to Manzanita Avenue.													
$160	2	58	**Manzanita Avenue PR58**	**8**	640	$160	$102,400	$148,480		$0	640	$148,480		$0	640	$148,480
			Replace existing 4" AC with 8". North Fourth Street to Fifth Street.													
$160	2	59	**Fifth Street PR59**	**8**	295	$160	$47,200	$68,440		$0	295	$68,440		$0	295	$68,440
			Replace existing 2" ABS with 8". Manzanita Avenue to Laurel Avenue.													
$160	2	60	**Fifth Street PR60**	**8**	310	$160	$49,600	$71,920		$0	310	$71,920		$0	310	$71,920
			Replace existing 2" ABS with 8". Laneda Avenue to Laurel Avenue.													
$160	2	61	**South Third Street PR61**	**8**	645	$160	$103,200	$149,640		$0	645	$149,640		$0	645	$149,640
			Replace existing 4" PVC with 8". Laneda Avenue to Edmund Lane.													
$160	3	62	**South Third Street PR62**	**8**	195	$160	$31,200	$45,240		$0		$0	195	$45,240	195	$45,240
			Replace existing 6" C900 with 8". Treasure Cove Lane to Edmund Lane.													
$135	2	63	**Hallie Lane PR63**	**4**	380	$135	$51,300	$74,385		$0	380	$74,385		$0	380	$74,385
			Replace existing 2" ABS and 4" with 4". East from Carmel Avenue.													
$145	2	64	**Treasure Cove Lane PR64**	**6**	690	$145	$100,050	$145,073		$0	690	$145,073		$0	690	$145,073
			Replace existing 4" AC with 6". South Third Street to Carmel Avenue.													
$145	2	65	**Sandpiper Lane PR65**	**6**	800	$145	$116,000	$168,200		$0	800	$168,200		$0	800	$168,200
			Replace existing 2" PVC with 6". Sandpiper Lane from Nehalem Avenue east to, and north along Garey Street to Puffin Lane.													
$145	2	66	**Beach Street PR66**	**6**	600	$145	$87,000	$126,150		$0	600	$126,150		$0	600	$126,150
			Replace existing 4" AC with 6". Beach Drive to Sunset Lane.													
$160	2	67	**Ridge Drive PR67**	**8**	605	$160	$96,800	$140,360		$0	605	$140,360		$0	605	$140,360
			Replace existing 6" AC with 8". From Necarney City Road north 605 feet .													
$145	2	68	**Nehalem Avenue PR68**	**6**	240	$145	$34,800	$50,460		$0	240	$50,460		$0	240	$50,460
			Replace existing 6". Puffin Lane to Sandpiper Lane.													
$145	2	69	**Nehalem Avenue PR69**	**6**	760	$145	$110,200	$159,790		$0	760	$159,790		$0	760	$159,790
			Replace existing 4" AC with 6". Sitka Lane to Sandpiper Lane.													
$185	2	70	**North Fourth Street PR70**	**10**	230	$185	$42,550	$61,698		$0	230	$61,698		$0	230	$61,698
			Replace existing 10" AC . Laurel Avenue to Manzanita Avenue.													
$185	2	71	**North Fourth Street PR71**	**10**	240	$185	$44,400	$64,380		$0	240	$64,380		$0	240	$64,380
			Replace existing 10" AC. Laurel Avenue to Laneda Avenue.													
$145	2	72	**Fir Avenue PR72**	**6**	300	$145	$43,500	$63,075		$0	300	$63,075		$0	300	$63,075
			Replace existing 4" AC with 6". Fifth Street to Division Street.													
$185	2	73	**Division Street PR73**	**10**	230	$185	$42,550	$61,698		$0	230	$61,698		$0	230	$61,698
			Replace existing 6" AC with 10". North Avenue to Fir Avenue.													
$185	2	74	**Division Street PR74**	**10**	230	$185	$42,550	$61,698		$0	230	$61,698		$0	230	$61,698
			Replace existing 6" with 10". Manzanita Avenue to Fir Avenue.													
$185	2	75	**Division Street PR75**	**10**	200	$185	$37,000	$53,650		$0	200	$53,650		$0	200	$53,650
			Replace existing 6" with 10". Manzanita Avenue to Laurel Avenue.													
$185	2	76	**Division Street PR76**	**10**	230	$185	$42,550	$61,698		$0	230	$61,698		$0	230	$61,698
			Replace existing 6" with 10". Laneda Avenue to Laurel Avenue.													
			Distribution CIP Total				**$4,497,075**	**$6,520,759**		**$1,617,656**		**$4,857,863**		**$45,240**		**$6,520,759**

Resiliency and Miscellaneous Improvements

Construction Costs June 2021 ($/LF)	Total Costs June 2021 ($)	Project Priority	Project Name (Description)	Plan Section Number	ENR Ratio	Construction Cost ($)	Total Cost ($)	Implementation (LF and Total Cost) 2021-2025 (%)	2021-2025 ($)	2025-2030 (%)	2025-2030 ($)	2031-2040 (%)	2031-2040 ($)	CIP Totals Length (%)	Cost ($)
	$400,000	H	**Emergency Well**	6.7.1	1	$0	$400,000	100	$400,000		$0		$0	100	$400,000
			See Appendix S for costs of project tasks.												
	$110,000	H	**Bleed Out Control**	6.7.1	1	$0	$110,000	100	$110,000		$0		$0	100	$110,000
			Bleed out control valve and vault at City limits near Fire and Rescue Station.												
	$170,000	H	**Bypass and Flow Control at WTP**	6.7.1	1	$0	$170,000	100	$170,000		$0		$0	100	$170,000
			Allows flow around WTP under seismic conditions leading to building failure.												
	$110,000	H	**Reservoir Bypass Connection and Water Main.**	6.7.1	1	$0	$110,000	100	$110,000		$0		$0	100	$110,000
			Allows flow directly to distribution system if reservoirs fail during a seismic event.												
	$55,000	H	**Emergency Connection**	6.7.1	1	$0	$55,000	100	$55,000		$0		$0	100	$55,000
			Emergency connection to Fire and Rescue facility.												
	$60,000	H	**Bleed Out Control**	6.7.1	1	$0	$60,000	100	$60,000		$0		$0	100	$60,000
			Bleed out control valve and vault at RT 53 Water, Inc. connection.												
	$110,000	H	**Bleed Out Control**	6.7.1	1	$0	$110,000	100	$110,000		$0		$0	100	$110,000
			Bleed out control valve and vault at Tidelands Services Coop connection.												
	$110,000	H	**City of Nehalem Intertie**	6.7.1	1	$0	$110,000	100	$110,000		$0		$0	100	$110,000
			Replace the intertie with the City of Nehalem.												
	$230,000	L	**Transmission Pedestrian Bridge Crossing**	6.7.1	1	$0	$230,000		$0		$0	100	$230,000	100	$230,000
			Remove the transmission main from the pedestrian bridge and replace it with a buried main.												
	$280,000	L	**Transmission Highway Crossing**	6.7.1	1	$0	$280,000		$0		$0	100	$280,000	100	$280,000
			Remove the transmission main from the bridge crossing at Hwy 101 and Hwy 53,and replace it with a buried main.												
	$4,000,000	H	**New Reservoirs**	6.7.2.2	1	$0	$4,000,000	100	$4,000,000		$0		$0	100	$4,000,000
			Construct two 1-million gallon reservoirs to replace existing reservoirs.												
	$1,000,000	H	**New Water Meters**	6.8.2	1	$0	$1,000,000	25	$250,000	25	$250,000	50	$500,000	100	$1,000,000
			Budget 100 water meter replacements per year at $500 per meter.												
	$40,000	H	**Leak Detection**	6.7.3.1	1	$0	$40,000	25	$10,000	25	$10,000	50	$20,000	100	$40,000
			Preliminary budget and frequency is $8,000 per detection survey and once every 5 years. Actual frequency should be based on need as determined by annual non-revenue water evaluations.												
	$50,000	H	**White Water Investigation**	6.5.2	1	$0	$50,000	100	$50,000		$0		$0	100	$50,000
			Study on the City's white water problem. Budget is preliminary and based on an order of magnitude estimate.												
	$100,000	M	**Water Master Plan Update**	6.8.1	1	$0	$100,000		$0	100	$100,000		$0	100	$100,000
			Periodic update of Plan. Actual budget should be adjusted as needed to reflect theanticipated level of effort required. Timing is uncertain but coordination with the preparation of the Water management and Conservation Plan may reduce costs for both.												
	$80,000	M	**Water Management and Conservation Plan**	6.8.1	1	$0	$80,000		$0	100	$80,000	100	$80,000	200	$160,000
			A new plan that will be required as part of the water right extension for the wells. Timing is uncertain but coordination with the preparation of the Water Master Plan may reduce costs for both. Updates are required every 5 years (budget $40,000 per update).												
	$15,000	M	**Water Right Partial Perfection**	6.8.1	1	$0	$15,000	100	$15,000		$0		$0	100	$15,000
			Partial perfection of well water rights. To be completed after complying with the conditions of the extended permit.												
	$25,000	H	**Water Rate Study**	8.2.3	1	$0	$25,000	100	$25,000		$0		$0	100	$25,000
			Complete new water rate study. Additional rate studies will likely be needed during the planning horizon - these should be added to the spreadsheet as needed.												
	$20,000	H	**Water SDC Study**	8.3	1	$0	$20,000	100	$20,000		$0		$0	100	$20,000
			Complete new water system system development charge study and methodology. Additional rate studies will likely be needed during the planning horizon - these should be added to the spreadsheet as needed.												
			Resiliency and Miscellaneous CIP Total			**$0**	**$6,965,000**	**$1,350**	**$5,495,000**	**$250**	**$440,000**	**$400**	**$1,110,000**	**$2,000**	**$7,045,000**
			CIP Total			**$4,497,075**	**$13,485,759**	**$1,350**	**$7,112,656**	**$250**	**$5,297,863**	**$400**	**$1,155,240**	**$2,000**	**$13,565,759**

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APPENDICES

TABLES

FIGURES

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SECTION 1 | INTRODUCTION

1.1 Background and Need

The City of Manzanita is a coastal community located in Tillamook County approximately 26 highway miles north of the City of Tillamook at latitude 45˚43'9" North and longitude 123˚56'9" West. Manzanita owns and operates a municipal water system that provides water to the community. The City is also part of the Joint Water System (JWS) with the City of Wheeler; the JWS includes the well supply, carbon dioxide (CO2) stripper, well water treatment and pumping, and part of the transmission main from the well supply system. There are several other communities (RT 53 Water, Inc.; Tideland Services Coop; and Nehalem Bay State Park) connected to the JWS via master meters. These are described in Section 2.3.3.1. Currently there are 1,673 active residential service connections in the City of Manzanita.

The City's last State-approved Water Master Plan received Oregon Health Authority (OHA) approval on May 30, 2006 (City of Manzanita Water System Master Plan, HGE, Inc., Architects, Engineers, Surveyors & Planners, May 2006). Currently the City is in compliance with OAR 33-061-0060(5), which requires community water systems with 300 or more service connections to maintain a current State approved Water Master Plan.

The oldest components of the water system date to the early 1960s but the City has had a water system since 1945 as evidenced by its earliest water right. A major improvement project was completed in 2003 with the construction of two wells and disinfection facility, transmission mains, and a surface water treatment plant. Improvements since that time have been primarily related to main and piping upgrades. The City recently added a CO2 stripper to treat well water prior to disinfection. The project included new pumps to deliver the finished water to the City.

Since completion of the 2006 Master Plan, the City has experienced several issues that suggest an update to the current plan is warranted. These include:

- A proposed large development that may have significant impacts on the water system which has raised City concerns regarding potential water supply impacts and infrastructure needs to accommodate the development. A new hydraulic model would be beneficial for the evaluation.
- Ongoing development and increased tourism.
- Water supply infrastructure that collects and conveys surface water (from Anderson Creek) to the City's water treatment plant has largely failed. The City now relies exclusively on water from the wells.
- Potential limitations on water production associated with the ongoing effort to obtain a permit extension for the well water right.
- An increased awareness, on a statewide level, in recent years of the importance of system reliability and resiliency – especially along the Oregon Coast.
- An interest in developing a backup water source such as a well near the City's water treatment plant. This would also facilitate routine operation of the treatment facility to maintain its functionality.
- A need to replace the City's largest reservoir based on risks of failure during a moderate earthquake and the potential consequences of such a failure.

The Master Plan update needs to meet Oregon Health Authority (OHA) requirements for a current Master Plan as well as provide a current evaluation of the City's needs. OHA requirements include a new provision (OAR 333-061-0060(5)(J) that requires the City to include an element addressing seismic reliability.

1.2 Purpose and Scope

This Water Master Plan is intended to provide the City of Manzanita with a comprehensive planning document consistent with State requirements (OAR 33-061-0060(5) Water Master Plans and the State's Guidelines for the Preparation of Planning Documents for Developing Community Water System Projects). A key objective is addressing issues noted in Section 1.1 (above) and the development of an updated CIP. The scope of work for this Plan includes all elements required for State approval.

1.3 Planning Period

This Plan uses a 20-year planning period (through the year 2040) for most plan elements; a 50-year planning period is used for elements related to seismic reliability.

1.4 Authorization and Funding

The City of Manzanita authorized PACE Engineers, Inc. to prepare this Water System Master Plan on December 10, 2019. This project has been funded entirely by the City of Manzanita.

SECTION 2 | AREA CHARACTERISTICS

2.1 Planning Area

The general planning area is shown in Figure 2-1 and includes all elements of the water system including water sources, transmission and distribution mains, and connections with the City of Wheeler and other master metered connections, and the area defined by Manzanita's urban growth boundary. Areas outside the City boundary are included or referenced for planning purposes insofar as they relate to the City's water supply and infrastructure needs.

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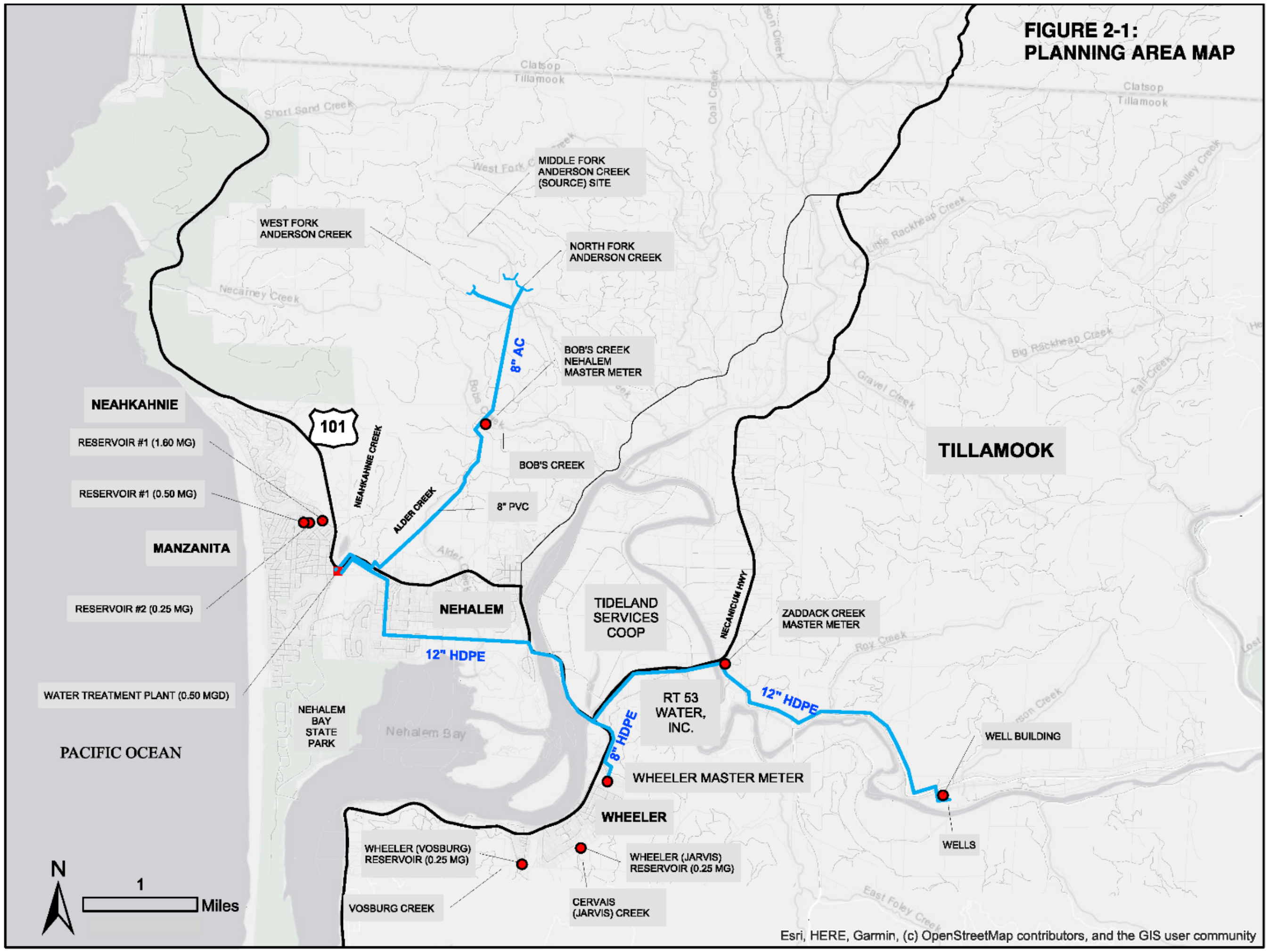

Figure 2-1	Planning Area Map	19891
		June 2021

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2.2 Physical Characteristics

2.2.1 Climate

Manzanita's climate is moist, marine, and temperate. Summers are cool and winters are mild, largely due to the moderating influence of the Pacific Ocean. Westerly winds from the ocean predominate over the coastal areas and inland into the Coast Range. Western Regional Climate Center data for Tillamook (Station: 358494 Tillamook 1 W), for the period 1948 – 2010, indicate an average annual precipitation total of 89.07 inches with 76 percent occurring in the six-month period November – April. Average daytime temperatures are 50.9°F in winter and 66.8°F in summer; average nighttime temperatures are 36.5°F in winter and 48.8°F in summer. Recorded temperature extremes range from 1°F (January 31, 1950) to 102°F (July 11, 1961, and August 9, 1981). Extreme daily precipitation is 5.22 inches (January 23, 1982). The area is subject to severe winter storms that can bring high precipitation totals and high winds, at times exceeding 100 miles per hour.

The following information on climate change that may be applicable to the Manzanita area is derived from *Climate Ready Communities, A Strategy for Adapting to Impacts of Climate Change on the Oregon Coast*, prepared by Department of Land Conservation and Development, January 2009. Projections indicate that winter precipitation will increase while summers will be drier with an increase in the duration of the summer "dry" period. Implications for coastal streams are more frequent winter flooding and reduced streamflow during the summer and early fall. By extension, for many spring water sources, we can assume a similar flow reduction in summer and early fall. The dry pattern has been noted in recent years with some of the smaller streams in northwest Tillamook County, that are typically perennial, being reported as dry or nearly dry towards the end of summer.

2.2.2 Land Resources

2.2.2.1 Landscape and Topography

Manzanita is situated along the Pacific Ocean and is generally hilly with elevations varying from sea level to approximately 200 feet. Nehalem Bay State Park is located south of the City on a long sand spit that separates the Pacific Ocean from Nehalem Bay. The City's older water rights are associated with streams in the mountainous and forested area to the northeast. Catchments for these streams range up to 1,860 feet in elevation (in the case of Anderson Creek).

2.2.2.2 Geology and Soil Characteristics

Most of Manzanita within its Urban Growth Boundary (UGB) consists of stable dunes above marine terraces. Surface water sources within the planning area originate near the boundary of Miocene volcanic rocks (basalt) and Oligocene-Miocene sedimentary rocks (sandstone, siltstone, claystone, or shale). Streams in the area typically flow through Oligocene-Miocene sedimentary deposits. The City's well sources are in gravel deposits along the north bank of the Nehalem River which flows through a mountainous area of undifferentiated Eocene volcanic rocks (primarily basalt).

Information on soil characteristics below is based on the United States Department of Agriculture, Natural Resources Conservation Service (NRCS) Soil Survey for Tillamook County, Oregon.

Most of the UGB uphill from the coast or bay is largely dominated by Netarts fine sandy loam soils which are characterized by excessive drainage, very rapid permeability, very slow runoff, very low water holding capacity, deep root penetration, severe wind erosion potential, generally low organic content, and are very strongly acidic.

Areas near the coast are predominantly Waldport fine sand that has physical characteristics similar to those noted above for Netarts fine sandy loam; pH of the Waldport soil is 5.1–6.0. There is an area north of Nehalem Bay (vicinity of Ocean Way) that has Yaquina loamy fine sand with some notable characteristics: pH of 4.5-6.0, depth to water table of 0.0-7.0 inches, and frequent ponding.

2.2.3 Water Resources

From a regional standpoint, the largest and most significant surface water is the Nehalem River and Nehalem Bay. The mountains north of Manzanita and Nehalem include Neahkahnie Creek (and Lake), Alder Creek, Bob's Creek, and Anderson Creek. There are numerous smaller creeks tributary to the Nehalem River. The City has water rights on Neahkahnie Creek, Alder Creek, and Anderson Creek. Anderson Creek was a major water source for several years after the 2006 Water Master Plan was completed. The source is no longer utilized because of significant infrastructure deficiencies that have not been corrected. The City of Nehalem has water rights on Bob's Creek. The named streams above are perennial but may have very limited water availability during the latter-summer to early-fall period.

Groundwater in the area is limited in production capabilities with the notable exception of the City's current supply wells located near the Nehalem River and Peterson Creek. Dunal sources within the UGB are limited and may have water quality issues. As an example, Nehalem Bay State Park's water supply (prior to connecting to Manzanita's water system) was a dunal well with limited supply capacity and high iron content.

Floodplains are generally limited to the lower sections of various streams. Floodplains along the Nehalem River and Bay are notable; both the City of Nehalem and the City of Wheeler have experienced flooding. Manzanita has not experienced flooding but does have areas that are within the tsunami inundation zone.

Wetlands are common in the area and generally associated with riparian areas adjacent to the many creeks and drainways, and in low lying areas near surface waters.

2.2.4 Natural Hazards

Natural hazards in the area notably include earthquakes, tsunamis, coastal erosion, and landslides. Manzanita is located near the Cascadia Subduction Zone and could potentially sustain a magnitude 9 earthquake. Recurrence interval on very large quakes along the Oregon coast is approximately 300 – 800 years. The City prepared a Water System Resiliency Study in 2018[1]. A copy of the study is included in Appendix A. Exhibits in the study include earthquake and other hazard maps for the City.

Much of the City lies on hillsides above the Pacific Ocean and the higher areas are largely protected from tsunami impacts; however, a relatively large proportion of the developed lots and commercial core are within the tsunami zone.

[1] "Water System Resiliency Study", BergerABAM, January 2018.

Oregon Department of Geology and Mineral Industries (DOGAMI) recently updated tsunami maps for the area. Appendix A shows potential tsunami impacts to the area.

Landslides (including slumps and slow-moving landslides) are relatively uncommon in most of the City but not uncommon in the larger, hillier and more mountainous, area to the north of the City. These may be triggered by seismic events, and periods of high rainfall or storm conditions. The risk in most areas is low but significant landslide potential exists in the northwest edge and the northeast edge of the City. Appendix A shows potential landslide impacts to the area.

2.3 Socio-Economic Characteristics

2.3.1 Land Use

2.3.1.1 Current Land Use

Land use within most of the City is existing, and potential single-family residential development of varying densities. Most of the housing stock are second homes owned by non-residents. There is a commercial core that caters primarily to residents and visitors. Recreational use is focused on the beach, which is readily accessible by locals and visitors.

The City's Comprehensive Plan notes a desire to remain primarily residential with commercial services geared toward supporting people who live in or visit Manzanita. Forest and recreational uses predominate in other areas nearby.

2.3.1.2 Current Zoning

Manzanita Zoning Ordinance #95-4 was last amended on August 8, 2018. The ordinance and associated zoning map are available on the City's website. Zoning is summarized below:

Commercial (C1) is intended to provide a range of retail and service uses.

Limited Commercial (LC) is intended to control the scenic character of the ocean front. Commercial activities are limited to tourist accommodations, dining, and related activities.

Medium Density Residential (R-2) is intended for single family dwellings and duplexes on 5,000 square foot (minimum) lots.

High Density Residential (R-3) is intended for high density residential development. Allowed densities are 5,000 square foot (minimum) lots for single family residences or duplexes, plus 2,500 square feet for each additional unit. Development is limited to three units per lot (maximum).

High Density Residential/ Limited Commercial (R-4) is intended for high density residential development (as in R-3 above). Allowed densities are 5,000 square foot (minimum) lots for single family residences or duplexes, plus 2,500 square feet for each additional unit. Development is limited to four units per lot (maximum). Limited commercial use that serves the local population and provides a transition between the C1 and R3 zones is also allowed.

Residential Manufactured dwellings (RMD) is intended to provide for manufactured dwellings and for one family or two-family dwellings. The minimum lot size is 5,000 square feet, and not less than 2,500 square feet per dwelling unit.

Special Residential/ Recreational Area (SR-R) is intended for major un-platted land where dwellings are appropriate. Allowed uses include single family, multifamily, and commercial uses that serve the development. Residential development shall not exceed 6.5 units per gross acre.

2.3.1.3 Future Development

Single family residential development has increased at 1.18% average annual growth rate (AAGR) since 2005. The relatively low growth rate reflects the effects of the recession (2007-2009) and the slow recovery. Recent growth and anticipated near-term growth are more pronounced – even with the ongoing COVID 19 pandemic.

The City recently completed a buildable lands inventory (BLI)[2]. The BLI identifies 96.05 acres of buildable residential land zoned: Medium Density Residential (5.40 acres), High Density Residential (90.16 acres), and Commercial/Mixed (0.49 acres). Based on zoned density allowances, this translates to a potential of 748 – 1,305 new residences within the Manzanita Urban Growth Boundary (UGB).

The Village at Manzanita is a large 70-acre development currently in the initial stages of development. The property is located north of Necarney City Road and east of Classic Street. According to the developer's Pre-Application Meeting Submittal (April 2017), the proposed development will include: 280-320 detached single family residences, a small commercial center, a golf clubhouse, a private recreational facility, and a fitness center and spa. 15,000 square feet of commercial space is anticipated with half of that associated with growth in the City's commercial areas – primarily along Laneda Avenue. An updated conceptual site plan dated, October 2, 2017, was obtained from a representative of the developer (on November 12, 2020) which shows a revised layout with approximately 240 residential lots and eight phases of development implementation. A copy of the layout is included in Appendix B. Implementation is anticipated over a period of 8-10 years. If residential growth over the next 10 years was due solely to the Village, the AAGR for that period would increase to 1.38 percent.

Property and home costs are high relative to the local economy; consequently, future development will likely continue to appeal primarily to retirees and second-home buyers from outside the area.

2.3.2 Population and Selected Demographic Characteristics

Resident population and demographic characteristics for the City of Manzanita are included in Table 2.1. Population was 564 persons in 2000, 598 persons in 2010, and 647 persons in 2019.

[2] "Manzanita UGB: Buildable Lands Inventory", Cascadia Partners and FCS Group, October 10, 2019.

The Oregon Gazetteer (oregon.hometownlocator.com) includes basic demographic data from various sources. A copy of the Gazetteer is included in Appendix C. Selected data (as of July 1, 2019) is included in Table 2.1 along with Census 2000 and 2010 population data. Population growth has been nominal since 2000. Population statistics are based on full time residents; since 72.3 percent of the housing stock is associated with either vacancy or vacation use, part time residents comprise a significant fraction of the overall service population. Full time residents average 1.9 persons per household (pph). Service population, including part time as well as full time residents, typically peaks on major holidays in the summer and again around Christmas. The Oregon Health Authority (OHA Drinking Water Data Online) notes a service population of 3,200 persons which, presumably, reflects the estimated peak occupancy during the summer holidays.

Table 2-1: Demographic Characteristics (City of Manzanita)

Characteristic	Census 2000	Gazetteer 2019
Population		
Population	564	647
Housing		
Housing Units (total)	1078	1381 (100 percent)
Owner Occupied	307	256 (18.5 percent)
Renter Occupied	81	83 (6.6 percent)
Vacation or Vacant	771	1,042 (75.5 percent)
Households	307	339
Persons per household (pph)	1.84	1.91
Median Household Income (MHI)	$38,750	$52,615
Median Home Cost	$234,700	$435,246

2.3.3 Connections and Equivalent Dwelling Units (EDUs)

Because of the high proportion of non-resident housing units, growth projections in this master plan are developed based on service connections and EDUs rather than population alone. Growth based on resident population alone would likely underestimate the potential system growth.

2.3.3.1 Current Connections and Accounts

Current connections and accounts that are part of the Joint Water System *and billed by the City of Manzanita* are summarized in Table 2.2. A more detailed breakdown of accounts and usage is included in Section 5.

Table 2-2: Recent (Year 2020)[1] Service Connections and Equivalent Dwelling Units (EDUs)

Rate Code	Customer Category	Supplemental Description	No. of Accounts	EDUs
Inside City				
101	Residential	Single-Family Residential	1,285	1,285.0
104	Residential	Multi-Family Residential	37	57.3
Outside City				
103	Residential	Single-Family Residential	350	350.0
105	Residential	Multi-Family Residential	1	1.0
Residential Subtotal			1,673	1,693.3
Commercial Subtotal			66	336.8
Miscellaneous			22	439.0
Total			**1,761**	**2,469.1**

1. Based on June - December 2020 data for Joint Water System *minus* City of Wheeler.

The Joint Water System provides water to the City of Wheeler in addition to the City of Manzanita and other communities included in the Table 2.2 totals. The other communities are served by master meters and have their own distribution systems. These communities include:

- RT 53 Water, Inc. (formerly known as Zaddack Creek) is served via a 3" bulk meter and consists of 25 residential connections plus two high-hazard connections. (A high hazard connection is one requiring back flow prevention).
- Tideland Services Coop is served by two 2" bulk meters. Tideland provides service to 17 residential connections and nine high-hazard connections.
- Nehalem Bay State Park is served by a 2"-meter (which is billed as 2" commercial, outside City and therefore included in the City's commercial total). The park is large and includes: 265 sites with water and electricity, 18 yurts, hot showers, flush toilets, a horse camp with 17 sites, a hiker/biker camp, an airport camp, and a meeting hall.

As noted above, the City of Wheeler is not included in Table 2.2; the City completed a water master plan in 2015 that noted 241 service connections in 2013. Growth since that time has been nominal.

2.3.3.2 Current EDUs

EDU calculations are a method used to determine average metered consumption per dwelling unit for residential customers and per equivalent dwelling unit (EDU) for non-residential customers. "EDU" is typically employed collectively to both residential and non-residential customers. For residential customers, the number of EDUs is equal to the number of dwelling units (single family house, manufactured home, or a single unit of a multi-family building or complex). Average water consumption per EDU is determined by dividing the total metered residential consumption by the number of residential units for a defined period. For non-residential customers, the number of EDUs can be determined by dividing the non-residential customer's water usage by the average water consumption per residential EDU for the same period. Average water consumption per EDU is typically expressed in gallons per day (gpd) per EDU. EDUs can also be estimated or determined by other methods depending on the intended purpose. "Equivalent residential unit" (ERU) is a commonly used synonym for EDU.

EDUs in Table 2.2 are based on the average single family residential usage of 107 gpd per residence for the period June -December 2020. Prior data was obtained and reviewed but was highly problematic and ultimately not usable. The City has upgraded its billing software and was able to provide the data that was used to obtain a more realistic indication of actual usage and EDUs; nevertheless, the EDU determination is provisional since it is based on limited data. As previously noted, Manzanita has a high proportion of vacation and second homes, so average water usage is lower on a per residence basis than for communities where most of the homes are locally owned and occupied. Conversely, water usage can be very high during periods of high occupancy such as the 4th of July holiday.

Population in Wheeler in 2013 was 415 persons; population in 2019 was 400 persons. The computed EDUs (for 2013) was 313 based on an average day demand of 195 gpd/EDU. (As previously noted, Wheeler is not included in Table 2.2.) Unlike Manzanita, most homes in Wheeler are owner-occupied. Population and growth in Wheeler is relevant insofar as it affects the Joint Water System water supply evaluation.

2.3.3.3 Projected Growth and EDUs

Projected growth for Manzanita is based on official population forecasts by Portland State University Population Research Center (March 31, 2020) plus additional growth associated with the Village at Manzanita development. The computations are summarized in Table 2.3. Additional discussion regarding the table and methodology follows the table. Note that PSU forecast figures are for the urban growth boundary (UGB) while census data is typically for the area bounded by the City limits.

Manzanita residential accounts for year 2020 are based on customer data. The forecasted increase in residential accounts is based on the average annual (population) growth rates (AAGRs) for Manzanita. To this is added the residential growth associated with the Village at Manzanita development. The AAGR for the combination is used to compute the increase in total EDUs for the Manzanita water system. This includes an assumption that non-residential use will grow at the same rate as growth in residential accounts. The methodology also assumes that the ratio of approximately 70% vacation/vacant residences to 30% occupied by residents living in Manzanita, continues as it has over the previous 20-year period. Averaging the growth over the 20-year period (2020-2040) yields an AAGR of 1.34%.

Table 2-3: Water System Growth Forecast Computation						
	Year 2020	Year 2025	Year 2030	Year 2035	Year 2040	Year 2070
PSU Population Forecast[1]						
Manzanita UGB	798	813	857	894	924	1,126
Wheeler UGB	423	434	451	470	487	602
Joint System[2]	1,221	1,247	1,308	1,364	1,411	1,728
PSU Average Annual Population Growth Rate over Previous Year Noted (percentage)						
Manzanita UGB		0.37	1.06	0.85	0.66	0.66
Wheeler UGB		0.51	0.77	0.83	0.71	0.71
Joint System[2]		0.42	0.96	0.84	0.68	0.68
Manzanita Residential Accounts						
Residential[3]	1,673	1,705	1,797	1,875	1,938	2,364
Village at Manzanita		120	240	240	240	240
Total Residential	1,673	1,825	2,037	2,115	2,178	2,604
Total Residential AAGR (%)		1.75	2.23	0.75	0.59	0.60
Manzanita Total EDUs[4]	2,469	2,695	3,013	3,128	3,222	3,853
Manzanita Average Annual System Growth:						
20-year AAGR (2020-2040)						1.34 percent
30-year AAGR (2040-2070)						0.60 percent
50-year AAGR (2020-2070)						0.89 percent

1. Source: Population Research Center, Portland State University, March 31, 2020.
2. Combined Manzanita-Wheeler system.
3. Forecasted residential connections based on percent increases in population growth.
4. Assume non-residential growth is proportional to residential growth.

2.3.3.4 Ultimate Buildout

As noted in Section 2.3.1.3, current zoning and buildable lands includes potential for 748-1,305 new residences. This represents a total of approximately 2,420- 2,970 residences in Manzanita using 2019 total of 1668 residences to be consistent with the buildable lands inventory. Based on the AAGR of 0.597% continuing to buildout, buildout is forecasted for year 2058-2092. This is too far into the future to be considered reliable; however, the primary purpose of establishing buildout is to ensure that capital improvements are not over-designed to provide for more growth than can be accommodated by the community.

SECTION 3 | EXISTING WATER SYSTEM

3.1 Introduction and History

The City of Manzanita owns and operates a municipal water system that currently provides service to areas within the City's urban growth boundary (UGB). The City of Manzanita is also part of the Joint Water System that includes the City of Wheeler (see Section 4.5 for details). In early 2020, there were 1,761 metered water connections of which 1,673 were residential. The City currently relies on water supplied by two wells, constructed in 2003, that also provide water for the City of Wheeler. Historically, the City relied on surface water sources. Treatment is currently limited to carbon dioxide removal, disinfection, and corrosion control. The City also has a membrane filtration treatment plant that was constructed in 2003 for use with the City's surface water sources. Since the surface water source transmission mains have largely failed, the primary use of the treatment facility is to provide booster pumping to deliver the well water to the City's reservoirs. The treatment plant is maintained, and the City intends to use it for emergency purposes using water from a future well.

The City's most recent State approved Water Master plan was completed in 2006 (Water System Master Plan, HGE Inc., Architects, Engineers, Surveyors, & Planners, May 2006). Oregon requires community water systems with 300 or more service connections to have a current state-approved water master plan per OAR 33-061-0060(5).

Section 3 inventories and describes elements of the existing water system. Figure 3.1 shows the water system in Manzanita. Figure 3.2 shows piping and connections at the reservoir site. Figure 3.3 is a schematic of the Joint Water System with an emphasis on features of the Manzanita water system. See also Figure 2.1 for facility locations outside of Manzanita proper.

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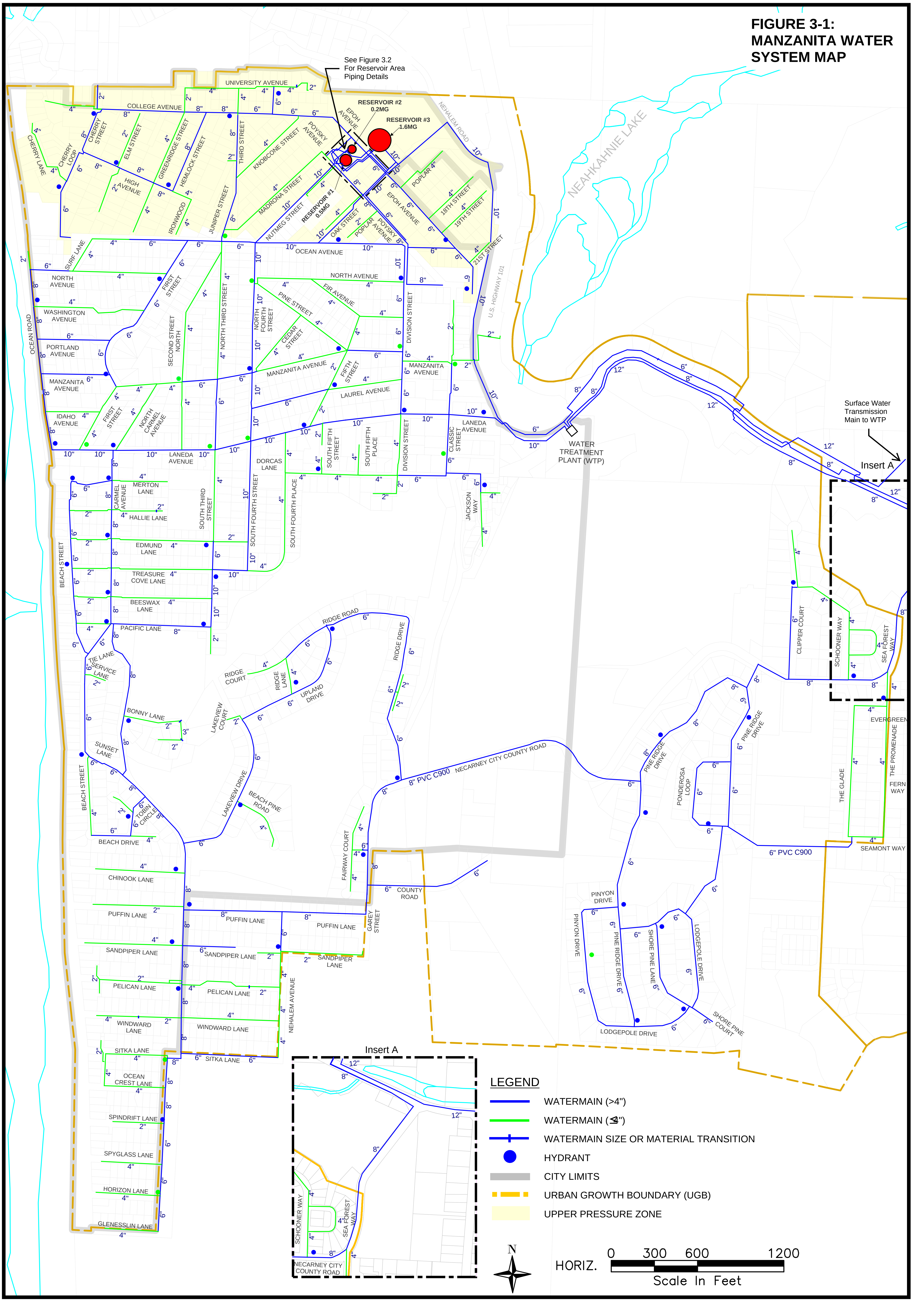

FIGURE 3-1:
MANZANITA WATER
SYSTEM MAP
See Figure 3.2
For Reservoir Area
Piping Details
RESERVOIR #2
0.2MG
RESERVOIR #3
1.6MG
RESERVOIR #1
0.5MG
NEAHKAHNIE LAKE
WATER
TREATMENT
PLANT (WTP)
Surface Water
Transmission
Main to WTP
Insert A
LEGEND
WATERMAIN (>4")
WATERMAIN (≤4")
WATERMAIN SIZE OR MATERIAL TRANSITION
HYDRANT
CITY LIMITS
URBAN GROWTH BOUNDARY (UGB)
UPPER PRESSURE ZONE
N
HORIZ.
0 300 600 1200
Scale In Feet

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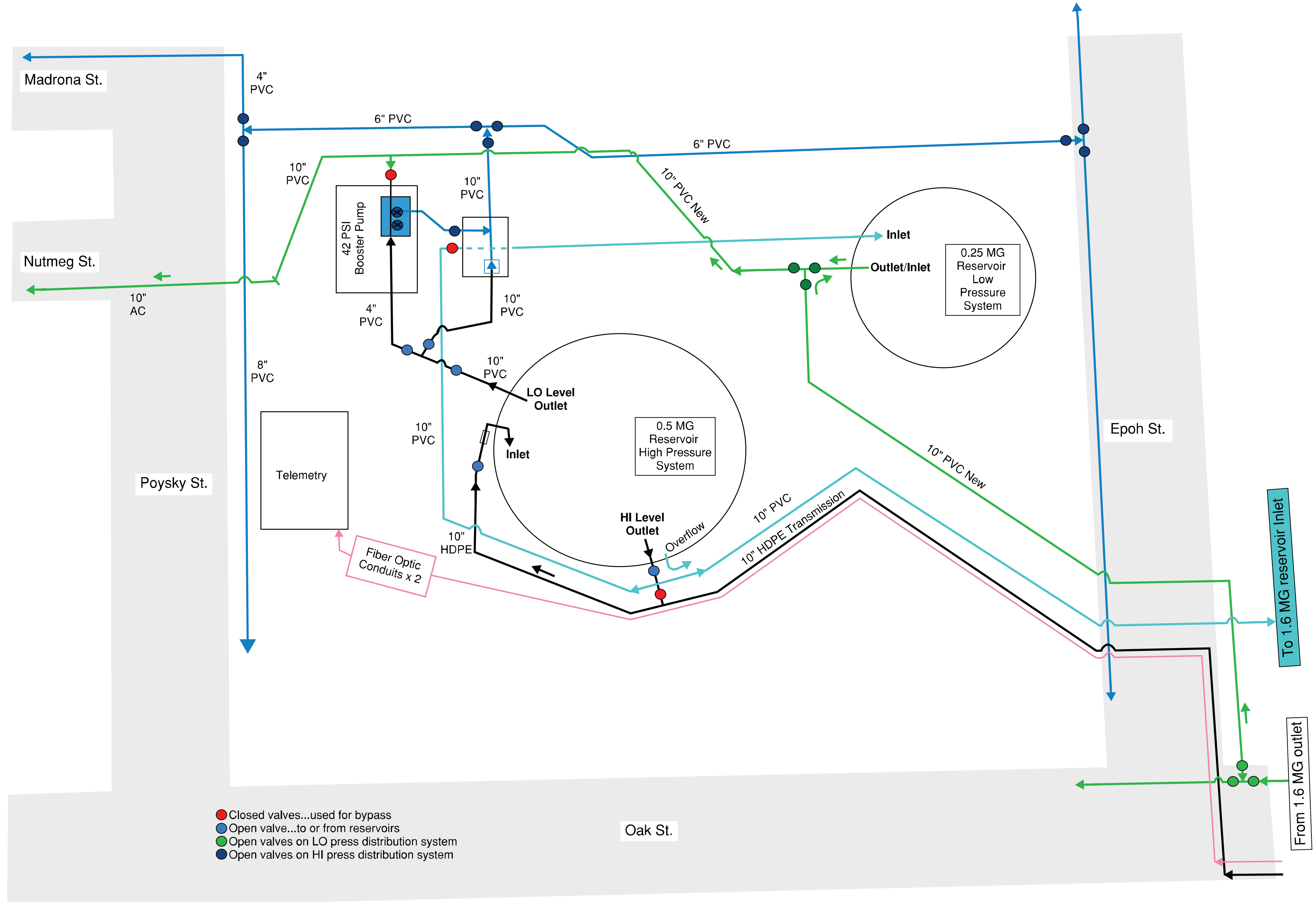

FIGURE 3-2:
RESERVOIR AREA DETAIL

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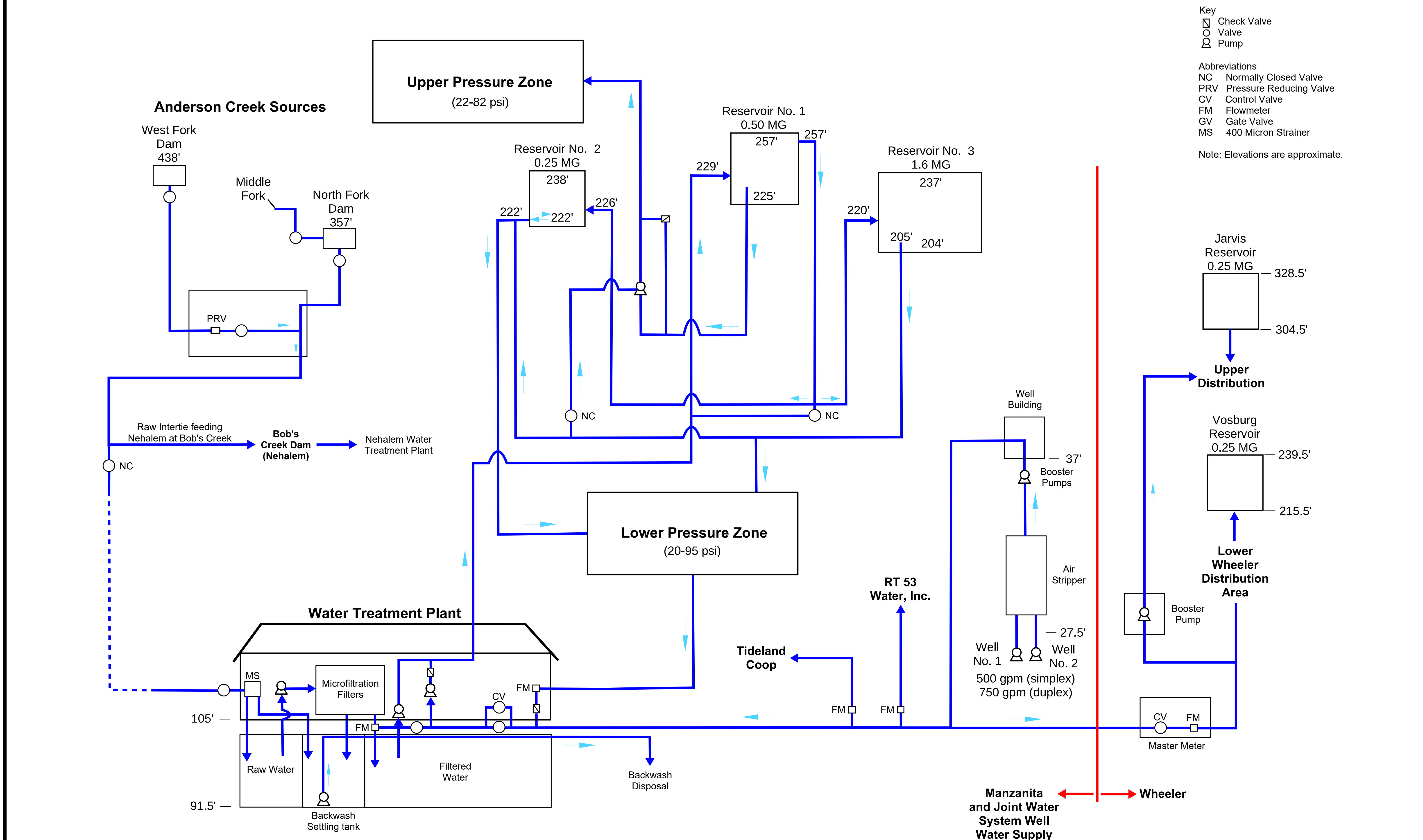
FIGURE 3-3:
EXISTING MANZANITA/WHEELER
WATER SYSTEM SCHEMATIC



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3.2 Mapping and Documentation

Mapping and system documentation for this plan were obtained primarily from the prior water master plan, City provided maps and documents, supplemented with staff interviews and limited site visits. Elevation data is from a variety of sources and may not be on the same datum. A review of City documents and survey information yields a range of elevations for key facilities. These were reviewed and elevations were selected based on general consistency and an understanding of the system. The selected elevations were rounded and added to Figure 3-3. Accuracy of the mapping and elevation data is assumed to be sufficient for general planning purposes; however, critical elements and elevations should be verified prior to, or as part of any design work.

3.3 Source

3.3.1 Water Rights

Water rights are regulated by the Oregon Water Resources Department (OWRD). OWRD maintains extensive records; copies of permits and certificates are readily available through their website (http://www.oregon.gov/owrd/). For convenience, copies are included in Appendix D.

3.3.1.1 Municipal Water Rights

Water rights related to the Manzanita system are summarized in Table 3.1. Copies of certificates, permits, and applications are included in Appendix 3.1. All Manzanita water rights have been certificated and are for surface sources and municipal uses.

Sources listed in Table 3.1 are current place names. The associated water rights reflect historic names as follows:

Alder Creek = Lange Creek

Anderson Creek = Beniteau Creek

Neahkahnie Creek = Classic Lake Creek = Ettenberger Creek

Table 3-1: Water Rights Summary						
Application No.	Permit No.	Certificate No.	Priority Date	Source	Rate	Use
City of Wheeler (for Joint Water System)						
G-13479	G-12196	–	07/29/1993	Wells	3.6 cfs	Municipal
City of Manzanita						
S-21322	S17073	44775	12/10/1945	Anderson Creek		
				Middle Fork	0.25 cfs	Municipal
				North Fork	0.25 cfs	Municipal
S-23417	S-18634	21684	09/14/1948	Alder Creek	0.5 cfs	Municipal
S-25124	S-21913	21707	08/14/1950	Alder Creek	0.433 cfs	Municipal
				Neahkahnie Creek	0.867 cfs	Municipal
R-26028	R-1455	21708	06/12/1951	Neahkahnie Creek and Alder Creek.	1.23 Ac-ft	Municipal
S-57745	S-43756	82159	12/15/1978	Anderson Creek		
				West Fork	0.5 cfs	Municipal
Oregon Water Resources Department						
MF 36		59752	05/09/1973	Nehalem River	(See note 1)	Instream
IS-70958		72503	11/30/1990	Peterson Creek.	(See note 2)	Instream

1. Instream flow rates vary according to specific time periods:

Oct 1 - Oct 15	200	cfs
Oct 16 - Apr 30	270	cfs
May 1 - May 31	200	cfs
Jun 1 - Jun 30	150	cfs
Jul 1 - Sep 30	100	cfs

2. Instream flow rates vary according to monthly time periods:

Jan	12.2	cfs
Feb	10.8	cfs
Mar	8.51	cfs
Apr	4.05	cfs
May	1.45	cfs
Jun	1.13	cfs
Jul	0.52	cfs
Aug	0.23	cfs
Sep	0.18	cfs
Oct	0.45	cfs
Nov	5.98	cfs
Dec	10.9	cfs

The City of Manzanita and the City of Wheeler have been seeking a water rights extension for the Joint Water System wells (Permit No. G-12196 owned by the City of Wheeler). The cities have also been pursuing changes to the permit that would provide more certainty regarding permitted use – specifically, minimizing the impact of potential water curtailment requirements.

An application for extension of time for the permit was submitted to OWRD in 2004. A Water Management and Conservation Plan (WMCP) was prepared and submitted to OWRD in 2005 consistent with conditions and requirements included in the original permit. The WMCP was placed on temporary hold in 2006; since the permit extension had not yet been issued, placing the WMCP on hold would prevent the Cities from having to resubmit the plan and review fees. The primary delay in the extension was associated with a requirement, from new legislation, that the Oregon Department of Fish and Wildlife (ODFW) participate in the review process. Part of the problem was a lack of concurrence on what exactly that meant and how to implement the requirement.

There have been numerous discussions between the Cities and the agencies regarding the status of the extension as well as possible modifications of the permit conditions.

In 2014, the process appeared to be approaching a tentative solution. ODFW had prepared draft calculations for their Fish Persistence review that include water curtailment requirements associated with Nehalem River levels. The calculations were based in part on stream and aquifer modelling by OWRD hydrologists. The model showed a time lag and associated diminution of the well withdrawal impact on Nehalem River flows. The effect diminishes with sustained pumping of the well; consequently, the effect has a practical application primarily in averaging out the effects of very high withdrawals (occurring over say a holiday weekend) on the Nehalem River. Averaging withdrawals over several days as a basis for permit compliance could reduce the impact of potential curtailment on water usage by the Cities.

Additional delays in processing the extension occurred in 2016-2017 with the anticipation of legislation that could significantly affect how permit extensions are handled; consequently, OWRD staff were instructed to not process permit extensions that had an "ODFW component" until after the 2017 legislative session. The Cities were informed in 2017 that fish persistence would be re-evaluated according to new criteria. Since that time, OWRD has been waiting for a response from ODFW. ODFW has had numerous staff changes resulting in continued delays. There have been several times when it appeared that a resolution was near, but never came to pass. Currently, the Cities are still waiting for the final ODFW review to be completed.

A copy of a 2018 memorandum sent to Jeffrey Pierceall, an extension specialist at OWRD, is included in Appendix E. The document describes concerns and issues associated with the initial ODFW fish persistence determination and proposed curtailment criteria and recommendations for agency consideration in developing their analysis and resulting permit terms.

3.3.1.2 Local Instream Water Rights

Instream water rights that affect the Wheeler Wells are included in Table 3.1. The wells are hydraulically connected to Peterson Creek and the Nehalem River but separated by a distance of 300 feet, and 450 feet respectively. The instream water rights are senior rights, and therefore have priority over the Cities' water rights. This bears on ODFW's and OWRD's evaluation of the ongoing permit extension.

3.3.2 Historic Sources

The Alder Creek and Neahkahnie Creek Sources are historic sources that are no longer utilized. The City is considering an effort to relocate the Neahkahnie source point of diversion downstream to a well to be located near the Water Treatment Plant and Neahkahnie Creek.

Anderson Creek (see Figure 2-1) was the City's primary water source and the one for which the water treatment plant was constructed. The source is currently not used directly by Manzanita; however, the City of Nehalem has used the source by agreement with Manzanita. Anderson Creek includes three forks, each of which had its own point of diversion and allowed withdrawals.

The North Fork (Anderson Creek) was the City's primary year-round water source. An impoundment structure (the "Lower Dam") consisting of concrete and removable wood planks is used to control water levels above the intake located in the stream bed upstream. GPS coordinates for the intake are 45.75396 north latitude, -123.89597 west longitude. Approximately 1,060 lineal feet of main separate the intake from the junction with the transmission main from the Upper Dam (West Fork).

The West Fork (Anderson Creek) source was utilized primarily to supplement flow from the North Fork. The concrete dam structure (the "Upper Dam") is 45 feet wide and 8 feet high with water levels upstream controlled by removeable wood planks. GPS coordinates for the intake are 45.75219 north latitude, -123.895858 west longitude. Approximately 1,320 lineal feet of main separate the intake from the junction with the transmission main to the water treatment plant. Prior to the junction, the flow is pressure reduced to adjust for the approximate 80-foot head differential between the North Fork and West Fork impoundments.

The Middle Fork (Anderson Creek) was infrequently used. The dam washed out in the 1990s and the channel moved further east. A pipe was installed as an emergency repair that diverted flow to the North Fork above the dam and intake. GPS coordinates for the original (historic) intake are 45.75394 north latitude, -123.89650 west longitude.

The dams are reported to be marginally functional but have deteriorated further since the last master plan was completed. The dams have not been upgraded since then and still do not meet standards for fish passage. Flows from the Anderson Creek sources were sufficient to reliably supply the City year-round. Recent years have seen significantly reduced stream flows in the region during the Summer and early Fall, undoubtedly affecting availability of flows in Anderson Creek. City staff have noted the reductions as well, though specific measurements have not been made and recorded.

The Anderson Creek raw water transmission main consists of 15,200 lineal feet of 8-inch AC pipe and 5,000 lineal feet of 8-inch PVC pipe. The line is in poor condition and staff report that it is currently non-functional in its capability of delivering flow to the City's water treatment plant. The City of Nehalem has a tie-in high up on the transmission main and has diverted water to Nehalem when the transmission main was functional.

3.3.3 Current Sources (Wells)

The City's current water source consists of two wells located above the north bank of the Nehalem River approximately five miles by road north and east from the City of Wheeler. Well logs for the well field are included in Appendix F. The wells were drilled in July 1996, constructed in December 2002, and brought online in March 2003. A site map and key well elevations and settings are shown in Appendix G which includes selected record drawings of the recent air stripper, well, and booster pump project.

Well data is summarized in Table 3-2.

Table 3-2: Well Data Summary

	Well No. 1	Well No. 2
Drilled	May 24, 1996	May 25, 1996
Constructed	December 2002	December 2002
Online	March 2003	March 2003
Finished Depth	50 feet	60 feet.
Casing Diameter	12 inches	12 inches
Screen		
Diameter	12 inches	12 inches
Length	2.0 feet	15.5 Feet.
Well Pump		
Type	Submersible	Submersible
Drive	Variable Frequency	Variable Frequency
Manufacturer		
Model		
Horsepower		
Capacity (design)	525 gpm	525 gpm
at total dynamic head (TDH)	105 ft.	105 ft.
Capacity (installed)	500 gpm	500 gpm
Flowmeter		
Type	Magnetic	Magnetic
Manufacturer	Dan Foss	Dan Foss
Model	Mag 3100 Water	Mag 3100 Water
Serial Number	031129T172	18329T222

Simplex (one pump at a time) operation is typical, but the pumps are capable of duplex (both pumps on) operation. Duplex capacity is approximately 750 gpm. Originally, the pumps pumped directly to the system via the well building with treatment limited to injected disinfectant and corrosion control chemicals. This was modified in 2017 with the addition of a carbon dioxide (CO_2) scrubber. The CO_2 scrubber breaks the pressure thereby requiring the flow to be re-pumped via new booster pumps at the well building. The new pumps have been matched to provide approximately 500 gpm in simplex mode and 750 gpm in duplex mode. (Duplex mode was not available prior to the upgrade due to electrical supply limitations.)

3.3.4 Alternative Source (Manzanita-Neahkahnie Intertie)

Very low spring flows in the summer of 2014 prompted the Neahkahnie Water District to work with the City of Manzanita to construct an intertie between the two communities to provide water in the event of an emergency. Manzanita's reservoir is lower than Neah-Kah-Nie's; consequently, the City must activate the water treatment plant booster pumps in order to provide water to Neah-Kah-Nie's system. Neah-Kah-Nie's system is very small compared to Manzanita so it is unlikely that they could help the City in anything but a true emergency - and only to a very limited extent. In the event of water shortages due to lower stream flows, it is more likely that Neah-Kah-Nie will experience a greater need for supplemental water than Manzanita.

3.3.5 Alternative Source (Manzanita-Nehalem Intertie)

Manzanita has an emergency (unmetered) intertie with the City of Nehalem. The intertie is for finished water and is located along Highway 101 near the east edge of the Manzanita urban growth boundary.

3.4 Treatment

3.4.1 Manzanita Water Treatment Plant

The Manzanita Water Treatment Plant came online in March 2003. Selected plan sheets, including facility data, are included in Appendix H. The facility utilizes a microfiltration membrane process. The facility has an installed capacity of 350 gpm and was designed to be readily expandable to 690 gpm. Filtered water was disinfected, then pumped to the City's reservoirs. Currently, the facility is only used for booster pumping water (from the current well supply) up to the reservoirs. The 20 Hp booster pump and bypass piping are located in the treatment plant.

Prior to its construction, the citizens of Manzanita, in numerous public meetings, expressed a preference and support for continued utilization of the surface water sources (Anderson Creek) rather than reliance on the new wells (see Section 3.3 above). Because of citizen demands, and the regulatory requirement for compliance with the surface water treatment rules, the City constructed the treatment plant.

Initial operation provided treated surface water to the City while other parts of the Joint Water System utilized well water. Eventually, Manzanita also made use of the well water. Reservations about use of the well water diminished and was accompanied by a realization that costs associated with the well source were lower than treating the surface water. This, as well as dealing with the increasingly problematic Anderson Creek transmission main, led the City to stop using the surface water sources. Nevertheless, the facility is maintained, and the City is considering the construction of a nearby well to use Neahkahnie Creek influenced groundwater to provide water to the City under emergency conditions and to provide water for periodic operation to better maintain the facility.

3.4.2 Well Treatment

The well source has been classified as groundwater by OHA; consequently, filtration is not required. Treatment is currently limited to CO2 removal, disinfection, and corrosion control (pH adjustment with caustic soda). Disinfection is via a MIOX mixed oxidant onsite disinfection system that is in poor condition and well past its useful life. The City is currently in the process of replacing it with a sodium hypochlorite system. The new disinfection system includes a Prominent Dual Gamma X Feed Panel that includes two Prominent Gamma X (metering) pumps (GMXA1604NPTVOOOUDC1300EN) and chemical feed elements and piping that are skid mounted and ready for installation. Low salt sodium hypochlorite will be used because of the longer shelf life. The City recently acquired the equipment skid and is moving forward with installation.

The well building includes chemical storage and feed components, electrical panels, flowmeters, turbidimeter, chlorine analyzer, and standby power.

Excess carbon dioxide is removed prior to disinfection via the recently constructed air stripping tower. The tower has been very successful in reducing CO2 concentrations (95%+ removal) but the process results in pressure loss associated with water from the wells. Because of this, booster pumps are needed after the CO2 removal to re-pressurize and deliver water to the system. Data for the stripping tower and booster pumps are included in Table 3.3.

Table 3-3: Well Site Air Stripper and Booster Pump Data Summary

Air Stripper	
Type	Vertical Tower
Manufacturer	Delta Cooling Towers, Inc.
Model	ΔS6-180RF
Height	27.5 ft.
Inside Diameter	6.0 ft.
Packing Bed Depth	18.0 ft.
Air Flow Rate	2,500 cfm
Air to Water Ratio	24.93:1
Hydraulic Capacity	750 gpm
Carbon Dioxide Removal Efficiency	95+ %
Booster Pumps	
Number	2
Type	Vertical Turbine
Drive	Variable Frequency
Manufacturer	Gicon/Goulds
Model	9RCHC 5-stage
Horsepower	40 Hp
Capacity (design)	523 gpm (Simplex)
at Total Dynamic Head	221 feet.
Capacity (Duplex)	750 gpm

The facility is owned and operated by the City of Manzanita. Wheeler participates financially in accordance with provisions of the intergovernmental agreement with Manzanita.

3.5 Storage Reservoirs

Manzanita has three existing ground-level, treated water reservoirs, plus the clearwell located at the Water Treatment Plant. These are described individually in the following subsections. Capacity totals 2,420,000 gallons (or 2,350,000 gallons without clearwell capacity).

3.5.1 Reservoir No. 1

Location:	North of Oak Street between Poysky Street and Ephoh Street
Pressure Zone	Base/Upper
Volume	500,000 gallons
Construction Date	1979
Material	Welded Steel
Base Elevation	231.89 Feet
Height (to overflow)	30.5 Feet

3.5.2 Reservoir No. 2

Location	North of Oak Street between Poysky Street and Epoh Street
Pressure Zone:	Base
Volume:	250,000 gallons
Construction Date:	1960
Material:	Concrete
Base Elevation (Approximately)	224
Height (to overflow):	15 feet

3.5.3 Reservoir No. 3

Location	North Oak Street just east of Epoh Street
Pressure Zone:	Base
Volume:	1,600,000 gallons
Construction Date:	1997
Material:	Glass-Fused Bolted Steel
Base Elevation (Approximately)	206
Height (to overflow):	33 feet

3.5.4 Water Treatment Plant Clearwell

Location	South of Highway 101 and east of Laneda Avenue
Pressure Zone:	N/A
Volume:	70,000 gallons
Construction Date:	2003
Material:	Concrete
Base Elevation (Approximately)	94.41 Feet
Height (to overflow):	105.71 Feet

3.5.5 Reservoir Operation

- The above ground storage reservoirs are located in close proximity to each other at the north end of the City. The reservoirs are 24 to 61 years old and over that time there have been a number of piping modifications resulting in a complex operational scheme. Figure 3-2 shows piping related to the reservoirs in plan view; Figure 3-3 shows a schematic of the relationship. A basic description of the normal flow path is described below:
- Water (supplied by the wells) is booster pumped at the water treatment plant and delivered via a dedicated transmission main to Reservoir No. 1 (the highest reservoir).
- Water from Reservoir No. 1 fills the line that feeds Reservoir No. 3 (and Reservoir No. 2) via an outlet near the top of Reservoir No. 1. The line fills by overflowing Reservoir No. 1 at the connection. Reservoir No. 1 also routes flow to the booster pumps that pressurize the upper zone.

- Reservoir No. 3 feeds the lower pressure zone and Reservoir No. 2.
- Reservoir No. 3 can provide additional water to the upper zone under fire flow conditions (see Section 3.6).
- The system includes bypass provisions when normally closed valves are open.

A recent study (included as Appendix A) noted deficiencies related to seismic reliability. Concerns extend to all three reservoirs. The largest, Reservoir No. 3, has settled enough to require repairs to the bolted panels. It is also located near a slope that has high potential for slope failure. The study supports this in part with evidence of ground movement in the area. Currently, the City intends on replacing the reservoirs, most probably with two large reservoirs located on the existing site of Reservoir No. 1 and Reservoir No. 2.

3.6 Booster Pumping

Manzanita has three booster pumping facilities: at the well building (see Section 3.4.2), at the water treatment plant (see Section 3.4.1), and a booster pump station located at the reservoir field. Locations are indicated on Figure 3.2 and schematically in Figure 3.3. The booster pump station at the reservoir field consists of two 5 Hp Grundfos pumps with a capacity of 130 gpm, in simplex mode, which provide pressurization to the upper pressure zone. Pressures vary from 30 psi to 45 psi based on alternating operation of pumps which cycle on/off 16 to 18 times per hour. The pumps can operate in duplex mode if one pump cannot repressurize the system. According to staff, this would likely occur only during fire flow conditions. Under fire flow conditions, when system pressure drops sufficiently, additional water from Reservoir No. 1 can supplement flow from the pump station.

3.7 Transmission And Distribution

3.7.1 Transmission Mains

Raw water transmission mains from the historic Anderson Creek sources are discussed in Section 3.2.2.

Raw water transmission mains from the wells to the well building consist of parallel 8-inch mains.

Finished water transmission from the well building consists of 22,200 lineal feet of 12-inch HDPE main to the Wheeler Intertie, and 16,900 lineal feet of 12-inch HDPE main from the Intertie to the Manzanita Water Treatment Plant. From the treatment plant to the reservoir, mains include, in order: 39 lineal feet of 8-inch CL52 ductile iron (DI), 3,587 lineal feet of 8-inch IP-size DR-11 HDPE, and 85 lineal feet of 8-inch C-900 PVC. There is a 3,300 lineal foot, 8-inch main that connects the City of Wheeler (at 1st Street Master Meter) to the Wheeler Intertie.

3.7.2 Distribution Mains

Mains in the City range from 2-inch to 10-inch diameter. The larger mains include both finished water transmission and distribution functions. Materials are predominantly AC and PVC. Most of the system is looped but dead-end lines are common in the upper pressure zone and in the southwest lower zone along roads that dead-end near the beach. 10-inch mains extend along Laneda Avenue, the City's commercial core. The City has been active in replacing old AC lines whenever practicable, typically during street improvement projects.

In 2020 there were 1,761 active water meters, 1,673 of which were residential.

The distribution system is shown in Figure 3.1.

3.8 Service Areas and Pressure Zones

There are two pressure zones in Manzanita: an upper zone and a lower (or base) zone. The two are separated by normally closed valves; there are no pressure reducing valves allowing the upper system to feed into the lower system. Historically, the upper system was fed by gravity from Reservoir No. 1; currently, the upper zone is fed via a booster pump. The booster pump can be bypassed under fire flow conditions to allow for greater flow availability.

The general location of the service areas (pressure zones) is shown in Figure 3.2; key elements and connections are shown in Figure 3.3.

3.9 SCADA and Telemetry

The City currently uses a SCADA and telemetry system that was designed and implemented by Camtronics, Inc. All key facilities (treatment plant, well supply system, and reservoirs) are connected and the system provides full control of reservoir and chemical feed set points, pump speeds, alarm set points, time limits, and alarm on/off settings. Data related to reservoir, water treatment plant, and the well site operation are collected and saved.

3.10 Water Use

Water use and water demands are discussed in detail in Section 5.

3.11 Water Quality and Regulatory Status

3.11.1 Regulatory Overview

Drinking water quality is regulated at the federal level through the 1974 Safe Drinking Water Act and subsequent amendments. States have the flexibility to develop more stringent requirements in addition to the minimum established by the federal regulations. In Oregon, the Oregon Health Authority (OHA), Drinking Water Program is responsible for administering federal and state regulations of public water systems. Oregon Administrative Rules (OAR) Chapter 333 Division 61 includes the rules for public water systems. The complete rules and related data and materials are available directly through OHA's website: http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Pages/index.asx or through an internet search: "OHA drinking water program".

3.11.2 Current Water Quality

Water quality discussed in this section is based on recent data from the (Wheeler) well source or as sampled from appropriate locations in the Manzanita water system. Data is from OHA and the City of Manzanita records.

Water quality is generally excellent with all chemical concentrations well within regulated maximum contaminant limits (MCLs). Most of the tested-for chemical concentrations result in no detections. Detected constituents in recent years include the following:

Nitrates: For the wells, for the most recent period reviewed (April 19, 2005 – February 5, 2020), 16 samples averaged 1.186 mg/l with the highest concentration being 1.7 mg/l. MCL for Nitrate is 10 mg/l. Samples are from source water.

Disinfection Byproducts: For the most recent period reviewed (January 5, 2005 – October 28, 2019), 21 samples: averaged 6 positive results for Total Haloacetic acids (HAA5) with a range of

0.001 - .0206 mg/l with the highest concentration being 0.021 mg/l; and 20 positive results for Total Trihalomethane (TTHM) with a range of 0.001 – 0.0132 mg/l with the highest concentration being 0.013 mg/l. MCL for HAA5 is 0.060 mg/l. MCL for TTHM is 0.080 mg/l. Samples are from the distribution system.

Lead and Copper: Recent 90th percentile testing and results (September 24-25, 2020), based on 10 samples, were: 0.000 mg/l for Lead and 0.061 mg/l for copper. The action level for Lead is 0.015 mg/l; the action level for Copper is 1.3 mg/l. Samples are from the distribution system.

Carbon Dioxide: Carbon Dioxide (CO2) is present in the well water. Measurements of total CO2 in October 2011 ranged from 32-56 mg/l. Associated pH ranged from 6.20 – 7.45. A few years later, CO2 levels had increased, and raw water pH had dropped as low as 5.6. The City was using a high volume of caustic soda to address the low pH problem which also contributed to taste -related complaints by customers. The City studied the problem and responded with construction of a CO2 stripping tower adjacent to the well building. Naturally occurring CO2 is not a regulated contaminant.

“White Water”: White water refers to the visual appearance of the tap water due to the formation of small air bubbles in the water. The City has had a problem with this since early 2004. An initial evaluation was completed in 2005 (see Appendix I) and included some recommendations for improvements to address deficiencies that may have contributed to the problem (as well as to address the hydraulic and reliability issues that were discovered). Also included are recommendations for additional study that may be needed to fully address the issue. The improvements were constructed and did address the hydraulic and reliability issues noted (but were not effective in reducing occurrences of white water). Follow up recommendations, in the evaluation, to locate the source of the white water were not undertaken. Instead, the City issued a request for proposals and selected a firm that differed in their analysis of the problem. Their conclusion was that the actual problem was related to CO2 in the well water. The recommendations for the recently constructed CO2 stripper were based in part to address the white-water problem - though the primary reason for the project was to address the amount and cost of caustic soda being used. The project has been highly successful at reducing the CO2 levels and chemicals required but has not eliminated the white-water problem.

3.11.3 Historic Water Quality

A table showing water quality for the Anderson Creek source is included in Appendix J. Water quality was generally excellent except for manganese (0.08 mg/l reported) which exceeds the non-enforceable EPA secondary standard of 0.05 mg/l. Manganese can contribute to staining or a bitter metallic taste.

3.11.4 Regulatory Status

The District is currently in compliance with all water quality related regulatory requirements. OHA gave the City an “Outstanding Performer” award on July 18, 2019.

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SECTION 4 | LEVEL OF SERVICE GOALS

4.1 Introduction

"Level of Service" ultimately refers to the quality of the water service provided to the customer, but the phrase also has implications for the City staff who are responsible for operating, maintaining, and administering the utility, and for City officials who are ultimately responsible for the support and political will to champion the mission and needs of the utility. The provision of clean, healthy drinking water is one of the most important services provided in a community and, consistent with this importance, the City of Manzanita should endeavor to provide a relatively high level of service.

One of the primary objectives for a water system is the protection of public health and welfare. For utilizing and expanding a water system, it is also important to minimize adverse environmental impacts. Various agencies have promulgated rules that ultimately support these objectives, and, at a minimum, every water system must comply with these rules and requirements.

4.2 General Goals and Requirements

General level of service goals and requirements applicable to the water system include:

- Conveyance and delivery (goal): Adequate, consistent, and reliable delivery of water under all anticipated service conditions; capacity for system to deliver maximum day demand (MDD) plus fire flow (FF)
- Pressurization (requirement): A minimum of 20 psi system pressure must always be maintained (OAR 333-061-0025); customer services must have individual pressure reducing valves if system pressures exceed 80 psi. Generally, a goal of a minimum of 40 psi under normal (non-fire flow) conditions is preferable if practicably achievable. The 20-psi minimum system pressure requirement extends to the customer water meter.
- Water quality (requirements): Comply with all Oregon Health Authority (OHA) requirements (see Section 3.11.1 for discussion). Water quality also includes aesthetic considerations that may or may not be related to specific regulatory concerns. Efforts to maintain or improve the aesthetic quality of the water provided is a goal consistent with the provision of a high level of service.
- Fire protection (goal): Provide fire protection consistent with American Water Works Association (AWWA), Insurance Services Office (ISO), Oregon Fire Code, and local fire department requirements, recommendations, and standards.
- Reliability (goal and requirements): Reliability as a goal is the ability of the water system and City staff to avoid or circumvent problems that adversely impact system performance. Reliability is enhanced by routine and timely maintenance and replacement, good design and construction, providing adequate water supply, providing alternate or backup facilities or equipment, and having a contingency plan for efficiently handling specific problems. OHA recently added a new master planning provision (OAR 333-061-0060(5)(J)) that requires the City to include an element addressing seismic risk assessment and mitigation.

4.3 Specific Goals

4.3.1 Water Supply

The water supply components (source, treatment, and transmission) should be sized to provide the maximum daily demand (MDD) within a 24-hour period at a minimum and, preferably, within a 20-hour period. Sizing should also incorporate consideration of the planning period, design life, economics, and plans for future utilization and demands.

4.3.2 Treatment

In addition to meeting current regulatory requirements, treatment recommendations should consider and potentially incorporate, or facilitate incorporation in the future, measures to address anticipated regulatory changes (if applicable).

4.3.3 Fire Protection

Fire protection capabilities are typically based on the ability to deliver a minimum specified flow for a minimum specified duration. Recommended fire flows and durations based on the Oregon Fire Code (Appendix K) for the City of Manzanita are provided in Table 4-1.

Table 4-1: Fire Flow Goals

Land Use	Fire FlowRate (gpm)	Fire Flow Duration (min.)	Equivalent Volume (gal)
Residential Single-Family/Duplex	1,000	60	60,000
Commercial Core	2,000	120	240,000

Actual fire flow requirements are building-specific, and alternatives may be developed to provide some of the requisite protection. Examples might include an engineered building sprinkler system or an onsite fire pump drawing from a surface water source. In some areas, typically small peripheral service areas, fire protection may not be available via the water system. Fire protection to these areas is typically provided by a fire department equipped with tankers and other equipment for fighting rural fires. Appendix K includes current fire flow requirements for buildings.

From a fire protection perspective, more fire flow capability is always better; however, no specified capability can guarantee protection from all fire-related scenarios.

Fire hydrant spacing for new construction should comply with requirements of the 2019 Oregon Fire Code (Appendix K).

4.3.4 Storage Reservoirs

Oregon has no requirement for the provision of finished water storage (reservoirs), but the state does always require (per OAR 333-061-0025) the maintenance of a minimum system pressure of 20 psi. Reservoirs are one of the most practical and economical means of meeting the pressurization requirement. For purposes of this water master plan, reservoir sizing is based on the standard design provision of three times the average daily demand plus fire flow reserve (3xADD+FF). Provision of needed storage capacity is best provided with two or more reservoirs (per service area) to facilitate service when one reservoir is offline. Generally, more capacity is better from a reliability standpoint; however, too much capacity can result in lost chlorine residuals and formation of disinfection byproducts.

4.3.5 Pump Stations

Pump stations to service areas with reservoirs should be designed to provide MDD with the largest pump out of service. Pump stations to service areas without reservoirs should provide PHD with the largest pump out of service. High service (fire) pumps may be provided in cases where they are consistent with the fire protection goals and plans in the affected service area. Pump stations serving areas with no reservoirs or with inadequate reservoir capacity should be provided with emergency power generators or designed to facilitate connection to a portable generator. Compromises with the above standards are common in areas provided with domestic service and no fire protection.

This is often the case when only a few customers are served by the pump station.

4.3.6 Transmission and Distribution

Transmission and distribution mains should be sized according to anticipated hydraulic requirements that may include the provision of fire flow. Line velocities are generally five feet per second (fps) or less to reduce head loss. Reduction of head loss reduces pumping cost and pressure losses; consequently, proper sizing can reduce system operational costs and improve fire flow capabilities. Systems designed to provide fire protection typically utilize an 8-inch minimum main size except for parts of a grid with lengths of less than 600 feet where 6-inch mains may be acceptable. AWWA does not recognize lines of less than 6-inch-diameter as providing fire protection.

Hydraulics, reliability, and water quality are generally enhanced with a “looped” water main configuration that minimizes the occurrence of single-feed or dead-end lines. Nevertheless, single-feed lines are commonly used for reservoir transmission mains and supply transmission mains. Dead-end mains should be avoided but may be practicably unavoidable because of topography and existing development.

4.3.7 Telemetry

Telemetry should be provided for each key facility including intake pumps, treatment plant, pump stations, and reservoirs. Telemetry provides alarm notification at a minimum. Important additional functions may include data acquisition and operational control.

4.4 Design Life

Design life (or useful life) refers to the anticipated service life of an item or system component. Typical design life values are expressed in terms of “years of service” and reflect typical design, material, and construction standards associated with municipal water system infrastructure. Actual years of service may vary greatly according to the service demands and conditions – as well as the level of maintenance provided. Typical design lives, selected from “Asset Management: A Handbook for Small Water Systems,” September 2003 (EPA 816-R-03-016), are summarized below:

Wells and Springs	25 - 35 years
Intake Structures	35 - 45 years
Treatment and Chlorination Equipment	10 - 15 years
Storage Tanks (Reservoirs)	30 - 60 years
Pumps	10 - 15 years
Buildings	30 - 60 years

Electrical Systems	7 - 10 years
Computers	5 years
Transmission and Distribution Mains	35 - 40 years
Valves	35 - 40 years
Meters	10 - 15 years
Service Laterals	30 - 50 years
Hydrants	40 - 60 years

As a concept, “design life” is primarily used for planning and budgeting for replacement or significant rehabilitation. As such, it is an important consideration in asset management. The values are only a starting point and should be adjusted and refined to reflect local conditions and experience.

4.5 Intergovernmental Agreement (IGA)

An intergovernmental agreement between the City of Manzanita and the City of Wheeler, and related to the Joint Water System, was signed, and adopted by both parties on October 24, 2000. A second, and related, intergovernmental agreement related to the designation of a person in direct responsible charge (for operation of the water system) was signed on March 9, 2005. Both documents are included in Appendix L.

The “Joint System” is defined to include “the well field, wells, disinfection plant, the transmission line from the wells to the intersection of Highway 101, and two master meters”.

Wheeler owns the well field, the access easement to the wells, the wells, and a telemetry monitoring station. Manzanita owns the disinfection plant, telemetry system, the transmission line from the wells to the junction with Highway 101, and the two master meters. The transmission main along Highway 101 between Highway 53 and Hemlock Street (in Wheeler) is owned by Manzanita but maintained by Wheeler. Water rights for the wells are owned by Wheeler.

The intergovernmental agreements also provide for allocation of costs, operations and maintenance requirements, and administration of the Joint System.

Decisions on major changes to the Joint System are subject to approval of both City Councils. “Major changes” includes, among other definitions, the addition or discontinuation of a water treatment process, and an increase in the number or capacity of the existing wells.

The term of the initial IGA is 40 years from the date of the Rural Utilities Service (RUS) loan award and cannot be terminated without the written consent of RUS.

4.6 Conformance and Implementation

As a general guideline, water systems should be in conformance with the most current requirements and standards. However, as a practical matter many do not, simply because the requirements and guidelines have become more stringent over time. Many requirements, typically those associated with the Safe Drinking Water Act (SDWA) Amendments and Oregon Health Authority (OHA) rules, do require immediate action to correct identified deficiencies. Other deficiencies, such as system configuration, material condition, or hydraulic deficiencies, may not trigger a regulatory mandate, but still reflect a lower level of service because of compromised reliability or performance. The condition of mechanical, electrical, and telemetry components will also not typically trigger a regulatory mandate but could cause severe problems or hardship to the City if failure occurs.

The promptness with which a community addresses known deficiencies and implements needed improvements is itself a measure of the level of service provided.

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SECTION 5 | WATER DEMANDS ANALYSIS

5.1 Introduction

This section focuses on water demands and usage for the City of Manzanita and includes water demand projections for future growth during the planning period.

Water demand analysis uses certain terms and abbreviations with considerable frequency.These terms are summarized below for convenience.

Average Daily Demand (ADD): total usage or production for the year divided by the number of days in the year.

Maximum Month Demand (MMD): total usage or production for the month with the highest total demand during the year, divided by the number of days in the month.

Maximum Day Demand (MDD): total usage or production for the day with the highest demand during the year. This may also be known or referred to as peak day demand.

Peak Hour Demand (PHD): total usage or production for the one-hour period with thehighest demand during the year.

The demand parameters defined above are typically and variously expressed as:

gallons per day (gpd)
millions of gallons per day (mgd)
gallons per capita per day (gpcd)
gallons per minute (gpm)
cubic feet per second (cfs)

5.2 Recent (Customer) Metered Water Usage

City customer water meters are read and recorded quarterly. Detailed customer data was obtained for 2018 and 2019. The City had a long-standing problem with its billing software: meter readings were recorded with transposed numbers. The City could correct the bills, but the software would not allow staff to record and retain the changes to the data. Since it was the only data available, considerable effort was expended toward editing the data to obtain a summary that was at least suggestive of general usage patterns in the City. Delays in plan development and implementation by the City of a billing software replacement, resulted in two quarters of accurate customer usage data for July – December 2020. A summary of the data is included in Table 5-1.

Table 5-1: Manzanita Customer Usage (7/1/2020 - 12/31/2020)

Rate Code	Description	Number of Accounts	Metered Usage for Period July – December 2020			Percent of Total
			July-Sept	Oct-Dec	Jul-Dec	
1	Resident – City	1,285	16,895,000	8,049,000	24,944,000	51.79
3	Resident-Outside	350	4,586,000	2,389,000	6,975,000	14.48
4	Multi-Residential - City	37	603,000	516,000	1,119,000	2.32
5	Multi-Residential - Outside	1	4,000	0	4,000	0.01
6	Commercial City 5/8"	33	868,000	311,000	1,179,000	2.45
7	Commercial City 1"	20	980,000	608,000	1,588,000	3.30
8	Commercial City 1.5"	1	109,000	6,000	115,000	0.24
9	Commercial City 2"	2	476,000	264,000	740,000	1.54
11	Commercial Outside 5/8"	3	11,000	14,000	25,000	0.05
12	Commercial Outside 1"	3	49,000	59,000	108,000	0.22
14	Commercial[3] Outside 2"	1	1,764,000	830,000	2,594,000	5.39
15	Commercial City 3/4"	3	114,000	80,000	194,000	0.40
16	Active (No Charge)	13	1,460,000	81,000	1,541,000	3.20
17	Collections/ Payment off	1	0	0	0	0.00
18	Meter on vacant lot	5	14,000	0	14,000	0.03
19	Bulk[4] Coop 2"	2	3,389,000	2,640,000	6,029,000	12.52
21	Bulk[5] 3"	1	996,000	0	996,000	2.07
Total		1,761	32,318,000	15,847,000	48,165,000	100.00

1. "Outside" refers to outside the City limits. Numbers indicate meter size.
2. Average for the period reviewed.
3. Nehalem Bay State Park.
4. Tideland Services Coop
5. RT 53 Water, inc.

Single-family residential usage accounts for 51.79 percent of overall usage. Average residential usage is 107 gpd/ EDU. This is low compared to most communities but reasonable based on data in Table 2.1 that shows 75.5 percent of the housing stock is classified as vacant or vacation use. Overall, residential usage accounts for 68.6 percent of customer usage that is billed by Manzanita. If usage associated with RT 53 Water, Inc., Nehalem Bay State Park, and Tideland Services Coop are excluded, residential use accounts for 85.7 percent of overall usage. The three named customers are outside of Manzanita proper, but Manzanita bills them as part of the Joint Water System.

5.3 Recent Production Water Demand

In recent years, all water used by the City is from the wells associated with the Joint Water System. Recent water production data for the years 2017- 2019 is summarized in Table 5-2. Additional is provided in Appendix M.

Table 5-2: Recent Water Production (2017 - 2019)

Year	Well No. 1	Well No. 2	Production Total[1]	Manzanita	RT 53/ Tideland	Wheeler
Annual Total (Gal.)						
2017	120,708,721	9	120,708,730	77,431,555	7,216,272	36,060,903
2018	19,805,557	92,299,135	112,104,692	77,237,709	6,902,289	27,964,694
2019	0	110,093,817	110,093,817	69,625,795	9,807,360	30,660,662
Annual Average (mgd)						
2017	0.331	0.000	0.331	0.212	0.020	0.099
2018	0.054	0.253	0.307	0.212	0.019	0.077
2019	0.000	0.302	0.302	0.191	0.027	0.084
Maximum Month (mgd)						
2017	0.505 - Aug	0.000	0.505 - Aug	0.356- Aug	0.027 - Jan	0.135 Aug
2018	0.223 - Feb	0.480 - Jul	0.480 - Jul	0.363 - Jul	0.023 Feb	0.104 - Jul
2019	0.000	0.443 - Jul	0.443 - Jul	0.325 - Jul	0.032 Dec	0.099 - Jul
Maximum Day (mgd)[2]						
2017	0.696 Sep	0.000	0.696 Sep	0.642 Jul	0.047- Feb	0.232- Aug
2018	0.629 Jan	0.722 Aug	0.722 Aug	0.674 Jul	0.054- Aug	0.239- Aug
2019	0.000	0.718 Jul	0.718 Jul	0.649 Jul	0.059- Aug	0.230- Aug

1. Well No. 1 plus Well No. 2.
2. Note: the numbers in each column are independent and do not necessarily occur on the same day for the months indicated.

As noted in Section 5.2, Manzanita billings include water usage by RT 53 Water, Inc., and Tideland Services Coop. These are noted separately from the Manzanita total in Table 5-2.

5.4 Non-Revenue Water

Non-revenue water is represented as the difference between water produced and water used (metered and sold, metered but not-sold, contractor use, Fire Department use, and estimates of water use or losses associated with Public Works activities). A certain amount of loss is inevitable and depends on many factors such as total pipe length, water usage, and water pressure. OAR 690-086-0150 (4)(e) requires a regularly scheduled and systematic leak detection program if an annual water audit indicates that leakage exceeds 10 percent.

Sufficient data was not available for the analysis of non-revenue water. The City is planning to undertake the calculations on an annual basis as it collects data from the new software (discussed in Section 5.2). Historically, the City has been very good at locating and correcting leaks in the system; nevertheless, for a one-year period (September 2004 to August 2005), the 2006 Water master plan estimated non-revenue water at 24.7 percent. The City's Updated Water Management and Conservation Plan (March 2010) noted 4.4 percent non-revenue water in the year 2009. Given the prevalence of sandy soils, the existence of old AC mains, and the relatively high system pressures in the lower parts of the City, losses may currently be higher.

5.5 Current (Joint) Water System Demands

Year 2021 water demands for the Joint Water System are conservatively estimated from recent production data primarily to establish a basis for projecting future water demands. Average day demand (ADD) is estimated to be 0.33 mgd. Maximum month demand (MMD) is estimated at 0.55 mgd.

Peak hourly demand (PHD) is estimated based on an empirical formula (source: Water System Design Manual, Washington State Department of Health, 2019):

- PHD = (MDD/1440)[(C)(N)+F]+18
- Where: PHD = Peak hourly demand (gpm)
- C = Coefficient associated with ranges of EDUs
- N = Number of EDUs
- F = Factor associated with ranges of EDUs
- MDD = Maximum day demand (gpd/EDU)
- Current EDUs (equivalent dwelling units): 3,039
- For a range of N (251 – 500): C = 1.8 and F = 125
- For a range of N (> 500): C = 1.6 and F = 225
- MDD = 730,000 gpd/3,039 EDUs = 240.2 gpd/EDU
- PHD = (240.2/1440) [(1.6)(3,039)+225]+18 = 866.6 gpm = 1.25 mgd.

Estimated (year 2020) water system demands and associated peaking factors are summarized in Table 5-3. The peaking factors are relatively high due to significant seasonal changes in occupancy of vacation and second homes moderated by relatively low summer irrigation use.

Table 5-3: Estimated Year 2020 Water System Demand

Parameter	Demand (mgd)	Demand (gpm)	Peaking Factor
ADD	0.33	229.2	1.0
MMD	0.55	381.9	1.7
MDD	0.73	506.9	2.2
PHD	1.25	866.6	3.8

5.6 Water Conservation

Section 3: Conservation Element and Section 4: Curtailment Plan Elements from the City's Water Conservation Management Plan (updated March 2010) is included in Appendix N. The document provides information on conservation policies. The Plan was submitted to OWRD but withdrawn while waiting for a requested permit extension. The permit extension for the Wheeler wells is still awaiting final processing. A new Water Management & Conservation Plan with updated information will be needed consistent with anticipated requirements associated with the permit extension.

For general planning purposes, no additional reductions in water demand or unaccounted- for water are incorporated into the projections for future water demand. Continued reductions, however, will reduce the City's impact on the available water supply capacity associated with the well sources.

The Joint Water System has seen a 19 percent increase in residential connections over that noted in the 2006 Water Master Plan, with almost all the growth occurring in Manzanita. Over the same period, average annual water demand has only increased 9 percent. This suggests that the City's efforts in reducing leaks and replacing deteriorated mains have had a beneficial impact on reducing overall water demand.

5.7 Projected Water System Growth

Projected water system growth is anticipated to approximately match that of projected system connection growth as measured in equivalent dwelling units (EDUs). Growth through 2040 is forecasted to increase an average of 1.34 percent per year; however, actual growth is likely to initially increase at a greater rate with the development the Village at Manzanita and the current real estate market. Wheeler is also seeing interest in potential large developments; consequently, Joint Water System projected production figures are based on a 1.34 percent average annual growth rate (AAGR). The 2070 figure is based on an overall increase of 0.89 percent AAGR from 2020 (see Table 2.3 for details).

5.8 Projected Water System Demand

Projected water system demands for the Joint Water System are shown in Table 5-4. All parameters noted, except PHD, increase by 1.34 percent per year for general planning purposes and represent an average over the planning period. The 2070 figures are based on a 0.89 percent increase consistent with the discussion in Section 5.7 above. Actual system growth may be much more rapid, or slower, at times and as such may impact timing of improvements. PHD is calculated according to the equation included in Section 5.5.

Table 5-4: Projected Water System Demands[1]

	2020	2025	2030	2035	2040	2070
EDUs	3,039	3,248	3,472	3,711	3,966	4,733
ADD (mgd)	0.33	0.35	0.38	0.40	0.43	0.51
MMD (mgd)	0.55	0.59	0.63	0.67	0.72	0.86
MDD (mgd)	0.73	0.78	0.83	0.89	0.95	1.14
PHD (mgd)	1.25	1.33	1.41	1.50	1.60	1.90
ADD (gpm)	229	245	263	282	302	324
MMD (gpm)	382	409	439	471	504	541
MDD (gpm)	507	543	583	625	670	718
PHD (gpm)	867	922	978	1,044	1,111	1,322
ADD (cfs)	0.51	0.55	0.58	0.62	0.67	0.80
MDD (cfs)	1.13	1.21	1.29	1.38	1.47	1.76

1. All figures are rounded.

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SECTION 6 | WATER SYSTEM ANALYSIS

6.1 Introduction

This section of the Water Master Plan assumes the reader is familiar with the previous sections. Focus of this section is on evaluations and analyses of the water utility with a goal of developing an understanding of current and future needs and developing strategies and improvements to address those needs and level of service goals. Costs, insofar as discussed, generally reflect considerations discussed in Section 7.2.

6.2 Water Demands

Water usage and demands are discussed in detail in Section 5. Current and projected water demands for design purposes are summarized in Table 5-4.

The resulting water demand projections are conservative based on the projected 1.34 percent average annual growth rate (AAGR) and the assumption, for planning purposes, that conservation considerations will not be used to reduce projected water demands. Metered customer demand is reasonable, but non-revenue water losses are unknown at this time but believed to be relatively low based on a comparison of the lower percentage increase in water production versus the higher percentage of customer growth since the 2006 Master Plan was completed. Water losses tend to increase over time; therefore, some level of effort will be required just to maintain the current levels.

6.3 Source and Water Rights – Recommendations

6.3.1 Well No. 1 and Well No. 2

Well No. 1 and Well No. 2 are currently the only source utilized for Manzanita's water supply and will likely be the primary source through the planning period. Recent upgrades to the wells, treatment, and supply capabilities included a 50 percent increase in capacity – are more than sufficient for the planning period. Current developed capacity is 750 gpm, approximately 46 percent of the 3.6 cfs water right permit (1,616 gpm). The availability of the remaining water right is currently being reviewed as part of the permit extension process. The expectation based on earlier conversations with the Oregon Water Resources Department (OWRD) and the Oregon Department of Fish and Wildlife (ODFW) is that curtailment will be required during periods of low stream flows in either Petersen Creek or the Nehalem River. The anticipated curtailment is proportional and shared with instream requirements that are to be identified by ODFW. Curtailment, in the form of reduced withdrawals will likely occur at times in late summer/early fall and prior to the fall rains that typically arrive in mid-October. The extent of the reductions has not been determined nor has the potential frequency of required curtailment actions. Likely impacts include reduced availability of water for industrial purposes, irrigation, and activities such as car washing. Water for human consumption (for both residents and visitors) are not anticipated to be restricted. Human consumption is defined as "the use of water for the purposes of drinking, cooking, and sanitation" per OAR 690-300-0010(24).

6.3.2 Anderson Creek

The 2006 Water Master Plan included recommendations for upgrading the Anderson Creek surface water sources that were Manzanita's primary water sources at the time (see Appendix O). In 2006, the well sources primarily supplied the City of Wheeler and parts of the Joint Water System other than Manzanita. Recommendations for improvements to the Anderson Creek supply system were not implemented, and the supply system has deteriorated further. The transmission main is no longer functional downstream of the connection with the City of Nehalem's raw water transmission main.

Construction of the City's surface water treatment plant was based on citizen preference to continue relying on surface water. The decision was also supported by a skeptical attitude, held by at least some, toward the proposed wells (Well No. 1 and Well No. 2) and their water quality. This latter concern has largely passed and there is an awareness that the well water is more economical to produce; consequently, there is diminished support and perceived need to restore the surface water supply from Anderson Creek.

In recent years, there has been a trend toward lower stream flows during the summer and early fall in coastal Tillamook County that call into question the viability of the source for restoration since water would likely not be available during the summer period of highest water usage and demand. The original dams were constructed at a time when the City could legally take all the water in the stream during low flow periods (provided the quantity did not exceed the City's water right). Changes in regulatory requirements are such that this is no longer legal, and a minimum quantity of water, as defined by the agencies involved, must be allowed to pass to support aquatic life. During low flow periods, this is likely to result in no water being available for the City. This concern has been exacerbated by the trend in lower summer stream flows.

A current, updated order of magnitude cost for the improvements included and described in Appendix O is $5,000,000. This is probably low since the environmental and permitting costs are likely to be more substantial than was the case in 2006. The high costs and limited reliability are the basis for not recommending improvements for the Anderson Creek sources during this planning period.

Limited future improvements may be possible in coordination with the City of Nehalem in order to preserve Nehalem's existing use. Under this scenario, where Nehalem is the primary beneficiary, costs should be borne by Nehalem. Another potential future use would be to locate a site downstream toward the mouth of Anderson Creek where wells could be constructed near the stream. This would require a water right transfer and proof that at least 50 percent of the water withdrawals are from the stream. Since Anderson Creek flows and discharges to the east, a new and much longer transmission main would also be required. Withdrawals would likely be conditioned by ODFW and OWRD in a manner similar to that anticipated for Well No. 1 and Well No. 2.

6.3.3 Proposed Emergency Well

The proposed project consists of constructing an emergency water supply well near the City's Water Treatment Plant, transferring one of the City's water rights (for Neahkahnie Creek) to the well, and connecting the well to the treatment plant. The intent is to develop a well of approximately 80 gpm (approximately 35 percent of the current average day demand) that could be relied upon in the event of an emergency (such as loss of the well supply transmission main due to seismic damage). Additional uses include opportunities to run the plant periodically to exercise the equipment and verify that the facility is operational, and to provide additional water to offset or mitigate potential curtailment requirements that may be implemented at times per the extended permit for Well No. 1 and Well No. 2 (as discussed in Section 6.3.1 above). A copy of the *Emergency Well Feasibility Study*, PACE Engineers, Inc., May 2017, is included in Appendix P. A follow up study was conducted that verified the feasibility of achieving 80 gpm and the likelihood of complying with the requirement that streamflow depletion be at least 50% of the well discharge rate within 10 days of continuous pumping. A copy of the study, *Streamflow Depletion Analysis*, GeoEngineers, Inc., October 8, 2018, is included in Appendix Q.

6.3.4 Other Sources

No other sources of water have been identified for development during the planning period. The City does have an intertie with the Neah-Kah-Nie Water District and one with the City of Nehalem. These have very limited utility for Manzanita except under emergency conditions that only affect Manzanita and not the surrounding communities. Available water under such circumstances is likely to be very limited and require severe curtailment of normal usage. Depending on the terms of the water right permit extension for Well No. 1 and Well No. 2, it may be desirable for the City to look for additional sources. Desalination of Nehalem Bay water is possible option. Technological innovation has reduced costs over the years, but current costs are still prohibitive for a small community. Future technological innovations and possible adverse climate impacts on water supply may make this a more attractive option for supplementing developed water supply.

6.3.5 Water Rights

Manzanita's water rights are all perfected municipal rights. As such, there are no additional requirements other than compliance with the provisions and terms of the certificates. The well water rights associated with the Joint Water System are owned by the City of Wheeler and are still in the permit stage of development. The permits are currently being extended to allow more time for development of the water use consistent with the permit and prior to certification. The process is discussed in detail in Section 3.3.1.1. It is unknown at this time as to when the permit extension process will be resolved. When it is, the City will be required to develop a water management and conservation plan consistent with an anticipated new permit condition to that effect. The City should also plan on proceeding with a partial perfection of the water right. Partial perfection allows part of the permit to be perfected (and a certificate issued) while the remainder is retained in the permit for future development and perfection.

6.4 Water Quality and Treatment

6.4.1 Water Quality

In terms of regulated contaminants, both source and distribution system water quality in Manzanita are excellent.(See Section 3.11 for discussion). There are no specific recommendations other than diligence in meeting all applicable regulatory requirements.

Water quality testing in the City indicates no problem with lead; therefore, no changes are recommended. The Reduction in Lead Drinking Water Act does not require changes to the existing system, but it does require that new pipe and appurtenances meet the new lead-free standard.

6.4.2 Well No. 1 and Well No. 2 Treatment

The City is currently installing a new hypochlorite disinfection system to replace the old MIOX onsite mixed oxidant disinfection system. The project improves the reliability of the disinfection system and allows more control of the disinfectant dose than the prior system. With the recent construction of the carbon dioxide stripper, there are no water quality issues or treatment needs anticipated during the planning period.

6.4.3 Water Treatment Plant

The Water Treatment Plant is currently offline. There are no plans to restore the surface water sources; however, development of the proposed emergency well, in close proximity to Neahkahnie Creek, will require the treatment facility to be operational. Well water quality has not been determined yet but dunal wells (such as the one proposed) can be relatively high in iron and manganese. While some dilution from stream water is anticipated, actual well water quality may require or benefit from some treatment process modifications.

6.5 Capacity

6.5.1 General

In general, the capacity of Manzanita's existing water system infrastructure is adequate for the planning period under typical operating conditions. Current limitations are primarily related to fire flow.

Manzanita does include some undeveloped land at elevations that cannot be served by the existing system. Most of this land is included in the Village at Manzanita development which is currently developing the lower elevation areas within the development boundaries. The development was considered in evaluating City water system growth (see Section 2) and water needs over the planning period; there are no concerns with providing for the volumetric water needs of the Village development (unless the City supply is reduced in order to comply with any future curtailment requirements). However, the existing system does not provide the flow (rate) and pressurization needed to serve the entire development. The developer is responsible for developing a plan/design for the provision of adequate water service, including fire flow capabilities, within the development. This may include mains of adequate diameter and hydraulic capacity, and booster pumping for pressurization and fire flow availability in the higher elevation areas. Additional, or desirable, improvements may include upsizing City mains outside of the development to improve hydraulic capacity in the development, and/or the addition of a reservoir to meet local demand – especially under fire flow conditions. Improvements that are coordinated with the City and provide some benefit to the City, such as reservoir capacity beyond the needs of the development or upsizing and replacing old and/or undersized mains, may be eligible for cost sharing with the City.

Capacity, as it pertains to specific elements (supply, distribution, pumping, and storage), is discussed in Section 6.7.

6.5.3 Hydraulic Model (and White-Water Discussion)

A hydraulic model of the water system was developed primarily to check general capacity and capabilities of the water system. The model was created using InfoWater software. The model includes 330 pipes and was created based on data provided by the City. Initial efforts were unsuccessful, with modelled flows significantly higher, in some cases fourfold or more, than recent hydrant test results indicated should be the case.

Extensive follow up work was conducted to look for potential errors in the model and in the data used in its development. This work included discussions and reviews with City staff, and additional discussions with the City's GIS consultant and Nehalem Bay Fire & Rescue staff involved with hydrant testing (see Appendix R for test data). Consideration was also given to possible obstructions in the system: closed valves, pipe corrosion and/or buildup, and trapped air. Discussions with City staff ruled out the valve and pipe concerns, and staff have not noted anything to suggest trapped air anywhere in the system. Nevertheless, the presence of white-water in the system suggested a possible link, so the system was reviewed for potential sources of excess air. (See Section 3.11.2 and Appendix I for a description of the white-water problem.)

There are several theories regarding the source of excess air - all based on limited information and speculation at this time. The issue has received very little follow up attention over the past 15 years, aside from the CO_2 removal analysis and air stripper project - which did not correct the problem. Follow up study is recommended and should be pursued with a qualified engineer on a time and materials basis rather than a fixed fee basis since the scope of work will likely evolve as the project develops. For budget purposes, $50,000 may be adequate. City staff assistance will be needed to assist with field work.

The City is planning to replace the three existing reservoirs and piping with two new reservoirs (see Section 6.7.2.2). It is possible that the project may result in a correction of both the white-water problem and the relatively low hydrant flows. A working hydraulic model may not be achievable until there is a resolution to the issues involved. Until the issues are resolved, any new water system construction should be based on current flow and pressurization availability as determined or documented by recent hydrant flow tests or, in the case of replacement mains, an understanding of current system performance, prevailing standards, and judgement of the City's engineer and Public Works Director.

Update *(August 11, 2021): Manzanita's Public Works Director has been working with the hydraulic model and as part of the effort has acquired hydrant flow testing equipment ("Hose Monster", the same equipment used by Nehalem Bay Fire & Rescue (NBFR)). A recent discussion with the manufacturer suggested that the problem (much higher model flows than flow test measured flows) could be due to NBFR not using the appropriate, proprietary software. The City has conducted several flow tests that suggest this is likely the case. City results indicate much higher flows than those obtained by NBHR, and so far, are similar to model predictions. City staff are planning to conduct more tests across the City; and, assuming the results are consistent and similar enough to pre-calibrated model results, staff will calibrate and complete development of the model. The model when complete, is not anticipated to affect water main improvement recommendations of this master plan; however, it will likely affect ongoing and future design efforts on new land development projects.*

6.6 Vulnerabilities

This section focuses on major vulnerabilities of the water system as a whole; specific deficiencies and consequent, or associated, vulnerabilities are discussed elsewhere as applicable.

6.6.1 Climate Change

Climate change forecasts call for increased winter rains and storms, and hotter, drier summers. In addition, sea level increases of six inches to several feet are forecasted tooccur over the next 50 years. Sources vary considerably on the projections based on the models and assumptions utilized. Increased duration and intensity of winter precipitation could result in increased flooding in affected areas and increased slide potential that could impact water system facilities and infrastructure. Parts of Manzanita are located on higher hillsides that are largely protected from sea level increases, but some homes near the ocean could be directly affected or affected by enhanced erosion associated with the higher wave action. Of greater concern is the potential for lower stream flows associated with hotter, drier summers.

6.6.2 Slides

Slides and slumps are not uncommon in the greater area that includes Manzanita. There are some areas with steeper hillsides that could be susceptible, especially under seismic conditions. Avoidance of known problem areas is the obvious solution but may not be possible based on local service requirements, limited alternatives for infrastructure location, and limited knowledge of the slide potential in any given area. Engineered solutions may be possible but will require geotechnical evaluations of the sites in question. Slides often occur on a geological timescale; consequently, problems may not occur until well into the constructed life of the infrastructure.

6.6.3 Seismic Risk

As noted in Section 2.2.4, the area could be subject to the full force of a Cascadia subduction zone earthquake. Effects of such a quake were examined in the “Oregon Resilience Plan” prepared by the Oregon Safety Policy Advisory Committee, February 2013. General findings for the Oregon Coast suggest that under current conditions, it will take three to six months to restore electrical service and one to three years to restore drinking water service. More recent studies in Washington County (near Portland) suggest extensive damage (breaks) would occur in the distribution system and that earthquake mitigation efforts should focus on the water supply.

Heightened awareness, and appreciation of the risks to Oregon water systems, has resulted in the Oregon Health Authority (OHA) adding a requirement, OAR 333-061- 0060(5)(J), requiring the inclusion of a seismic risk assessment and mitigation plan in new Water Master Plans for communities with over 300 connections, and meeting the rule’s location requirements. A Water System Resiliency Study is included in Appendix A of this Water Master Plan to fulfill this requirement.

Critical facilities are designed to meet seismic code requirements, but no amount of engineering or expense can guarantee service after a large magnitude earthquake.

The City’s reservoirs are all older, and per Appendix A, do not meet the current seismic code. The City’s largest reservoir is located above a hillside that is vulnerable to slides associated with a moderate seismic event.

Tsunami inundation is a concern in the lower elevations in the City.

6.6.4 Infrastructure Deficiencies

This is a very broad category with most of the specifics more appropriately discussed elsewhere (Section 6.7). Some general comments are warranted here. Older systems often have elements that are functional, but of an obsolete design and utilized well beyond the intended design life. These elements can be problematic and costly to maintain and may harbor undetectable material deficiencies that could result in unforeseen and catastrophic failures.

6.6.5 Security

All water systems have susceptibilities to security issues, and these issues are typically addressed in a vulnerability assessment and emergency response plan. System security has not been evaluated as part of this master plan; the City should review its emergency response plan and update it as appropriate. Proposed new water system facilities typically include basic security elements (fencing, lighting, locks, and alarms). Additional elements can be developed as warranted during the preliminary design phase of project development.

6.6.6 Reliability and Resiliency

Reliability and resiliency issues associated with the water system are discussed in Appendix A.

6.7 Infrastructure

6.7.1 Water Supply and Transmission

From an infrastructure standpoint, capacity of the water supply system is generally adequate for Manzanita and the Joint Water System during the planning period. Pumping capacity of the wells was recently upgraded to 750 gpm in duplex mode, a 50% increase over the prior simplex only capacity of 500 gpm. Capacity of the system is adequate for the planning period; with the recent supply improvements (new well pumps, CO_2 stripper, booster pumps, and hypochlorite disinfection system), no additional improvement project is envisioned for water supply associated with Well No. 1 and Well No. 2.

Construction of the proposed emergency supply well near the water treatment plant is recommended. The project is discussed in detail in Appendix P; an updated opinion of probable cost is included in Appendix S. The recommended budget for completing the project is $400,000.

Recommended improvements associated with the transmission main from the wells to Manzanita are developed and discussed in Appendix A. These improvements improve the resiliency of the backbone water system that conveys water from the wells to Manzanita's reservoirs. A summary of these improvements is provided below. More information can be found in Appendix A; updated costs can be found in Appendix S.

6.7.1.1 Recommended Transmission Main Improvements:

- Construct a bleed out control vault (with pressure sustaining valve) at the Manzanita City limits near the Fire and Rescue Station. "Bleed out control" is terminology used in the Appendix A document to describe a facility, typically with a pressure sustaining valve, that will close if there is a major leak or break downstream, thereby protecting the upstream part of the system from draining through the downstream break.

- Construct a bypass line and flow control at the water treatment plant. Currently the line passes through the treatment plant and is booster pumped to the reservoirs. The bypass line allows continued service if the treatment building collapses in a major earthquake, or to backfeed the transmission main.

- Construct a connection to the distribution system that will normally be closed but if opened will allow flow from the transmission main directly to the distribution system. This allows bypassing the City's reservoirs if they fail in a major earthquake.

- Construct an emergency connection to the Fire and Rescue facility. Currently, the facility is served by the City of Nehalem; the connection provides an alternate supply connection thereby improving facility reliability under severe seismic conditions or other disruptions in water supply.

- Construct a bleed out control valve and vault at the RT 53 Water, Inc. connection.
- Construct a bleed out control valve and vault at the Tidelands Services Coop connection.
- Replace the intertie with the City of Nehalem.
- Bury the transmission main at the pedestrian bridge crossing.
- Bury the transmission main at the bridge crossing (at Hwy 101 and Hwy 53).

Appendix A includes an exhibit that shows the location of the recommended improvements. The updated budget figure for the projects noted above is $1,235,000. Updated budget figures for the individual projects are included in Appendix S.

6.7.2 Storage

6.7.2.1 Capacity Analysis

Total storage capacity of the existing, above ground reservoirs is 2,350,0000 gallons (Table 6-1).

Table 6-1: Existing Reservoir Storage Capacity

Existing Reservoirs	Volume (gallons)
Reservoir No. 1	500,000
Reservoir No. 2	250,000
Reservoir No. 3	1,600,000
Total	2,350,000

For the water system, the recommended *minimum* storage capacity is three times the average day demand (3xADD) plus fire flow (FF). Recommended FF is 2,000 gpm for two hours (240,000-gallon reserve). Table 6-2 projects storage capacity for the City as a whole. Capacity is adequate throughout the planning period.

Table 6-2: Projected Reservoir Capacity Needs

District Total	Average Day Demand (mgd)	3x ADD (MG)	Reservoir Volume Needed at 3xADD + FF (MG)	Existing Reservoir Volume (MG)	Additional Volume Needed (MG)
Total 2020	0.33	0.99	1.23	2.35	-1.12
Total 2025	0.35	1.05	1.29	2.35	-1.06
Total 2030	0.38	1.14	1.38	2.35	-0.97
Total 2035	0.40	1.20	1.44	2.35	-0.91
Total 2040	0.43	1.29	1.53	2.35	-0.82
Total 2070	0.51	1.29	1.77	2.35	-0.58

While storage capacity is adequate for the planning period, there are benefits in having the additional storage that has been available.

In general, more storage is better if it does not result in water quality problems. Excessive storage capacity can result in loss of adequate chlorine residual and the creation of disinfection byproducts. Manzanita does not appear to have problems with either.

The higher storage volume has been used during some peak days of usage to supplement the well supply. Recent maximum day usage is based on meter records that show one well pump operating all day at full capacity (when only simplex operation was available). The recent addition of duplex pumping for the well supply, may reduce or eliminate this need for the additional storage capacity (to supplement well capacity) in the near future. However, the potential for curtailment requirements associated with the anticipated water right permit extension may renew the need to have additional stored water available to handle system needs during a period of low water availability but high demand (for basic needs and the difficult to control usage by visitors, tourists, and part-time residents).

Manzanita is bordered by extensive forests; the extra reservoir capacity could be helpful in supplementing fire reserves to limit the impact and spread of potential wildfires in and around the City.

Manzanita has emergency interties with both Neahkahnie and Nehalem. Neahkahnie's water supply is vulnerable to reduced spring flows associated with low precipitation years or long dry summers. Nehalem relies in part on Anderson Creek water that could also have significantly reduced availability under similar weather conditions. Requests for water from either would increase overall system demand and the need for additional, readily available storage for system equalization and emergency storage.

With proper maintenance, reservoirs can provide a 40-60 years (or longer) design life. If the City replaces all their reservoirs with two new ones as is being discussed – then the reservoirs should be design with extra capacity to handle system needs well beyond the standard 20-year planning horizon.

6.7.2.2 Deficiencies and Recommendations

Existing reservoir deficiencies are noted in Section 3.5 and in Appendix A. Based on the findings of Appendix A, especially with regard to the location of the 1.6 MG reservoir next to a slope with high potential for landslide or slope failure, the recommendation is to replace the three existing reservoirs with two new nominal 1,000,000-gallon reservoirs that will be located at the current site of the 0.5 MG reservoir and 0.25 MG reservoir. This will allow simplification of the connecting piping and system operation as well as providing reservoirs that meet current seismic codes. Sizing is consistent with the discussion in Section 6.7.2.1 above with regard to providing for a longer than the 20-year planning horizon if all the reservoir storage is replaced. Two reservoirs provide enhanced reliability (over one larger reservoir) and facilitate operation and maintenance activities. The City is currently undertaking a preliminary design effort that will establish the details of the project including siting, sizing, water surface elevation, etc. The intent is to pursue FEMA funding for design and construction. An updated order of magnitude estimate for the project is $4,000,000.

The Village development is considering design options including potential reservoir storage on a property immediately north of the development on a hilltop with an elevation similar to that of the City's existing reservoir site. Availability of the site has not been determined and no decisions have been made regarding the reservoir itself. The hilltop is immediately south of the City's water treatment plant (WTP). Adding a pump at the WTP that would be connected to the Wells No. 1 and 2 water supply main, and new transmission main to allow direct pumping to the reservoir, would facilitate overall system operation. Minimum reservoir sizing should provide for the Village development's fire storage and equalization needs. Additional capacity would benefit the City by distributing storage to more than one site, thereby enhancing system reliability and system hydraulics. The City would be responsible for costs associated with providing capacity beyond the needs of the development itself.

6.7.3 Distribution

6.7.3.1 General

An assessment of Manzanita's distribution system was developed primarily through map review, review of recent construction and improvements, and information from staff. Modelling of the distribution system was not successful (see discussion in Section 6.5.2).

The system is a combination of looped and dead-end lines. Most of the system is looped; the dead-end lines typically occur in areas where topography and existing development make looping impractical or costly. Many of the mains are substandard in diameter – typically by one or two standard diameters for older mains. Old AC mains are extensively present in the system and represent a significant risk for breakage based on age alone. The concern is exacerbated under seismic conditions. There are a few small diameter "mains" constructed with a substandard material. This material is not appropriate for a water system and should be replaced with water main that meets regulatory requirements and prevailing standards.

Recommended distribution main improvements are shown in Figure 7.1 and described in Table 7.1 (Capital Improvement Plan). Broadly speaking, priority 1 improvements reflect City staff inputs on near-term improvement needs; priority 2 improvements include remaining AC mains – all of which need to be replaced. Recommended main diameters were developed by PACE with input from City staff. Generally, replacement pipe diameters are 6-inch to 8-inch for 2-inch to 6-inch mains. Short lengths of 2-inch to 4-inch main with no fire protection function may be replaced with 4-inch main. 8-inch to 10-inch mains are typically replaced with similar diameter mains.

As discussed in Section 5.4, non-revenue water losses have not been determined. Much of the City is on sand or sandy soils that are very well drained. Staff note that even large leaks may go undetected or be difficult to locate. The City is collecting data and plans to review it to determine the approximate percentage of non-revenue water in the system. If the losses exceed 10 percent, the City should plan and budget for leak detection. Follow-up replacement of leak-prone lines should also reduce water losses as well as operation and maintenance (O&M) costs associated with emergency main repairs. An opinion of probable cost for leak detection is $10,000.

6.7.4 Pumping

There are no capacity or deficiency issues noted, except for the upper zone pump station located near the reservoirs. The current, and ongoing, study for replacement of the City's reservoirs includes consideration of pump station modifications needed to accommodate a yet undetermined revision to the reservoir water surface elevation. Improvements should also address the excessive cycling of pumps (16-18 start/stop cycles per hour).

6.7.5 SCADA, Telemetry, and Data Collection

The City has recently completed improvements that enhance the SCADA system and the ability to record and retain accurate water usage data. The City is now collecting reliable usage data and will be able to use it to calculate the quantity and percentage of non-revenue water in the system. Plans to change out and upgrade the water meters (see Section 6.8.2) to continuous read meters will allow more accurate characterization of peak usage over short time periods (such as the 4th of July holiday). The City is currently developing a GIS that will allow the City to better collect, organize, and maintain information and data related to the City's water system.

6.8 Water System Management

6.8.1 Planning

A general recommendation is to update the Water master Plan every five to ten years, depending on the extent of changes to the community and water system. The next update should be undertaken, or at least considered, by year 2031. Budget $100,000 – actual cost may vary according to issues and level of detail desired.

The water right permit for the wells that supply the Joint Water System is currently in the process of being evaluated by OWRD for an extension. The extension when granted will have additional conditions attached, one of which will be for the preparation and submittal of a Water Management and Conservation Plan (WMCP). This will need to be completed with information for the entire Joint Water System. WMCPs must be updated every five years. Budget $80,000 for the initial plan and $40,000 for each update. The actual budget may need to be revised based on the actual terms of the water right extension. Costs for the WMCP will be shared with the City of Wheeler in accordance with provisions of the intergovernmental agreement. The WMCP includes information that is essentially the same as that developed in a master plan. Updates of the water master plans for Manzanita and Wheeler, coordinated with preparation of the WMCP, could result in significant savings for both cities. Under this scenario, the future Master Plan Update mentioned in the first paragraph of this subsection should be deferred to a later date.

After the water right permit extension for the wells is granted, Manzanita and Wheeler should pursue a partial perfection of the water right. A partial perfection results in a water right certificate for that portion of the water right that has been developed in accordance with terms of the permit. The remaining undeveloped part of the permit is retained and can be developed and perfected later. A certificate provides greater protections for the water right holder than permits. Budget $15,000 for the water right partial perfection.

The GIS and system mapping should be updated periodically. It is recommended that the City create a file with summaries of changes, corrections, and additions for use by the consultant when updating the GIS or other mapping.

6.8.2 Asset Management

The City should consider developing an asset management program. Asset management is a proactive approach that estimates when critical upgrades or replacement of infrastructure is needed based on condition and design life. It allows the utility to plan well in advance of need and, therefore, budget more effectively. It also helps minimize management by crisis or urgent need. Initial efforts can be quite labor intensive, since a detailed inventory that includes each component in the water system must be made along with an evaluation of the asset's condition and remaining life. The EPA has free software (CUPSS) and materials available on its website to assist small communities with asset management.

Periodic leak detection surveys of the water system are recommended as general practice to maintain or possibly reduce overall system water losses. This can also provide data for an asset management program for refining the design life estimates for local conditions, and for prioritizing replacement projects. Many communities have found the costs of leak detection to be largely offset by the savings in cost associated with the otherwise lost water.

Customer water meters should be maintained and replaced periodically to ensure accurate readings. (Old meters tend to underreport, resulting in less rate revenue and in higher non-revenue water calculations.) The City plans to replace 100 meters per year on an approximate 20-year cycle. Budget $500 per meter ($50,000 per year).

6.8.3 Operations and Maintenance (O&M)

The recommended capital improvements will not result in increased O&M costs; however, O&M costs are subject to inflationary pressures, so annual increases are typically required. Budgets and water rates are typically adjusted to take recent or anticipated changes into account; however, system deficiencies that have not been addressed can increase O&M costs. This may occur in ways and to an extent not easily foreseen, and may take the form of emergency (overtime) callouts and extra cost, interim measures that may be needed until the problem can be addressed correctly, and unbudgeted emergency projects of potentially significant expense. Over time, such costs can add significantly to the overall utility budget.

From an O&M standpoint, there are additional tasks that the City could and should be doing:

- Valve exercising (once per year on main lines and once every three to four years on other lines).
- Hydrant exercising (once per year) and repairs as needed.
- Periodic flushing of dead-end lines.

SECTION 7 | CAPITAL IMPROVEMENT PLAN (CIP)

7.1 Introduction

This section focuses on recommended capital improvements. The CIP is not exhaustive and does not include many smaller projects or elements that would be more properly characterized as general O&M.

7.2 Opinions of Probable Cost (OPC)

7.2.1 Introduction

Opinions of probable costs (OPCs) developed in the Water Master Plan are preliminary in nature and based on the level and extent of planning completed. It will be necessary to update costs as specific projects proceed and a more detailed understanding of the issues and opportunities is developed.

For general planning purposes, contingencies, engineering, and administration costs are determined on a percentage-of-construction cost basis (see Sections 7.2.3-7.2.6). This is generally most accurate for larger projects. Smaller projects, undertaken independently, may have additional costs associated with mobilization and/or economics of scale.

7.2.2 Construction Cost

Construction costs in the Plan are based on preliminary layouts and design parameters developed, construction bids for similar work, published cost guides, and the author's experience within the State of Oregon. It is common practice to relate the costs to a specific index that tracks changes in the national economy. A commonly referenced index is the Engineering News Record (ENR) Construction Cost Index (CCI). All costs inthis Plan are referenced to the June 2021, ENR Construction Cost Index of 12112. Costs in the Plan can be updated in the future by multiplying the Plan cost by the current index value and dividing by 12112. This approach is generally valid for a 2 to 3-year period, after which the costs should be updated by an engineer. Construction bids and consequent costs can vary markedly according to the actual and perceived market and economic trends, level of competition, project size, etc.; this is particularly the case during periods of economic uncertainty or volatility.

Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others, or the future contractor's methods for determining prices or competitive bidding, or market conditions, the Engineer's opinion of probable "total project cost and construction cost" provided herein is made on the basis of the Engineer's experience and qualifications and represents the Engineer's best judgment as an experienced and qualified professional engineer familiar with the construction industry as it relates to water system improvements. The Engineer cannot and does not guarantee that proposals, bids, or actual total project or construction costs will not vary from the opinion of probable costs prepared herein.

7.2.3 Construction Contingencies

The Plan includes a contingency factor of 20 percent of the construction cost to allow for variables associated with the bid and construction process, consistent with the level of planning included.

7.2.4 Engineering, Construction Observation, and Construction Management Costs

The Plan includes a general planning allowance of 20 to 25 percent of the construction cost for engineering, construction observation, and construction management. The higher percentage is typically associated with more complex mechanical and electrical work.

7.2.5 Legal and Administrative Costs

An allowance of 5 percent of the construction costs is included for legal and administrative costs.

7.2.6 Other Costs

Other costs may include specialized studies, property or right-of-way acquisition, specific equipment or supplies, fees, and other items that are not part of the specific categories discussed above.

Typically, these other costs are listed individually in the OPC.

7.3 Capital Improvements

Recommended capital improvements are summarized in Table 7-1. Distribution improvements are shown in Figure 7.1. Table 7-1 includes (referenced) Section numbers where projects are described or shown in more detail. The table was created in Microsoft Excel; a copy of the spreadsheet file has been provided to the City. It allows staff to modify the CIP implementation schedule and update costs by entering a current Engineering News Record (ENR) Construction Cost Index. The spreadsheet uses the ratio of the current ENR, and the June 2021 reference ENR, to update costs. All costs in the table are referenced to the June 2021 ENR; annual updates of the CIP costs can facilitate project budgeting, planning, and implementation. The table also allows the work and costs for any project to be allocated to any year or even several years according to main length or percentage of the project to be undertaken.

All projects should include a pre-design element that verifies any critical project requirement or data need such as key elevations, pipe size/material/location, operation characteristics, etc.

7.4 Project Prioritization

Some projects are noted as high priority in Table 7-1; the high priority designation is based on current condition or current lack of capacity. Ideally, these projects will be addressed as soon as possible, possibly as one large, or several smaller, project(s). Deferral of these projects will result in a lower level of service and, depending on the projects, leave the City vulnerable to system failures. Project prioritization should ultimately be reflected in the CIP scheduling.

District staff provided input on project prioritization (primarily for water main improvements) in relative terms of “low, medium, or high” priorities. A more precise assignment to specific years was not provided. There are some current developments and concerns that could affect the scheduling; consequently, a tentative CIP is offered that provides for:

- (H) High Priority Projects (implementation year 2021-2025)
- (M) Medium Priority Projects (implementation year 2026-2030)
- (L) Low Priority Projects (implementation year 2031-2040)

For high priority projects, all projects are entered under year 2022 – though it is understood that implementation will occur between 2021 and 2025. The CIP table, as previously noted, is in a spreadsheet format that can be readily updated or modified as needed by the City. The CIP and any subsequent modifications will need to be adopted by the City prior to use for SDC (system development charge) purposes.

7.5 Financing and Implementation

Implementation and financing are discussed in Section 8.

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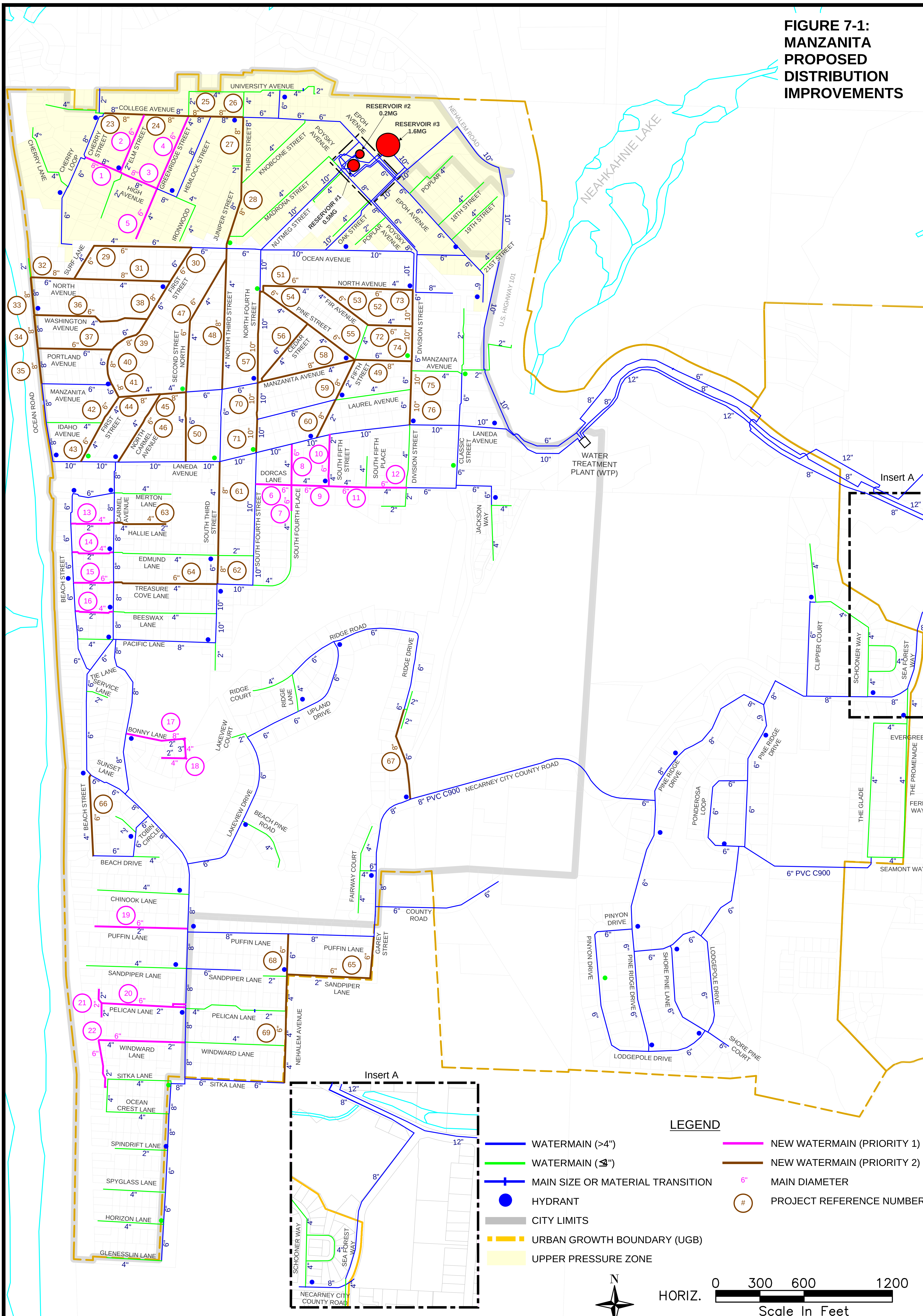
FIGURE 7-1:
MANZANITA
PROPOSED
DISTRIBUTION
IMPROVEMENTS
NEAHKAHNIE LAKE
RESERVOIR #2
0.2MG
RESERVOIR #3
1.6MG
RESERVOIR #1
0.5MG
WATER
TREATMENT
PLANT (WTP)
U.S. HIGHWAY 101
Insert A
LEGEND
WATERMAIN (>4")
WATERMAIN (≤4")
MAIN SIZE OR MATERIAL TRANSITION
HYDRANT
CITY LIMITS
URBAN GROWTH BOUNDARY (UGB)
UPPER PRESSURE ZONE
NEW WATERMAIN (PRIORITY 1)
NEW WATERMAIN (PRIORITY 2)
MAIN DIAMETER
PROJECT REFERENCE NUMBER
N
HORIZ.
0 300 600 1200
Scale In Feet

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Table 7-1: City of Manzanita CIP (All costs in current dollars) **Reference June 2021 ENR CCI:** 12112 **Current ENR CCI: (June 2021)** 12112

City of Manzanita Water Master Plan 2021
Distribution Improvements

Unit Costs June 2021 ($/LF)	Project Priority	Project Reference Number	Project Name (Description)	New Diameter (in.)	Length (LF)	Current Unit Cost ($/LF)	Construction Cost ($)	Total Cost ($)	Implementation (LF and Total Cost) 2021-2025 (LF)	2021-2025 ($)	2025-2030 (LF)	2025-2030 ($)	2031-2040 (LF)	2031-2040 ($)	CIP Totals Length (LF)	Cost ($)
$160	1	1	**High Avenue PR1**	8	250	$160	$40,000	$58,000	250	$58,000		$0		$0	250	$58,000
			Replace existing 8" AC. Elm Street to Cherry Street.													
$145	1	2	**Elm Street PR2**	6	390	$145	$56,550	$81,998	390	$81,998		$0		$0	390	$81,998
			Replace existing 2" ABS with 6". High Avenue to College Avenue.													
$160	1	3	**High Avenue PR3**	8	250	$160	$40,000	$58,000	250	$58,000		$0		$0	250	$58,000
			Replace existing 8". Greenridge Street to Elm Street.													
$145	1	4	**Greenridge Street PR4**	6	510	$145	$73,950	$107,228	510	$107,228		$0		$0	510	$107,228
			Replace existing 4" AC with 6".													
$145	1	5	**Greenridge Street PR4**	6	410	$145	$59,450	$86,203	410	$86,203		$0		$0	410	$86,203
			Replace existing 4"AC with 6".													
$160	1	6	**Dorcas Lane PR6**	8	230	$160	$36,800	$53,360	230	$53,360		$0		$0	230	$53,360
			New 8" main. South Fourth Street to South Fourth Place.													
$145	1	7	**South Fourth Place PR7**	6	230	$145	$33,350	$48,358	230	$48,358		$0		$0	230	$48,358
			Replace existing 4"PVC with 6". South from Dorcas Lane.													
$145	1	8	**South Fourth Place PR8**	6	280	$145	$40,600	$58,870	280	$58,870		$0		$0	280	$58,870
			Replace existing 4" AC with 6". Dorcas Lane to Laneda Avenue.													
$160	1	9	**Dorcas Lane PR9**	8	230	$160	$36,800	$53,360	230	$53,360		$0		$0	230	$53,360
			Replace existing 4" AC with 8". South Fifth Street to South Fourth Place.													
$145	1	10	**South Fifth Street PR10**	6	360	$145	$52,200	$75,690	360	$75,690		$0		$0	360	$75,690
			Replace existing 2" and 4"with 6". Dorcas Lane to Laneda Avenue.													
$160	1	11	**Dorcas Lane PR11**	8	265	$160	$42,400	$61,480	265	$61,480		$0		$0	265	$61,480
			Replace existing 4" AC with 8". South Fifth Street to South Fifth Place.													
$160	1	12	**Dorcas Lane PR12**	8	250	$160	$40,000	$58,000	250	$58,000		$0		$0	250	$58,000
			Replace existing 4" PVC with 8". Division Street to South Fifth Place.													
$135	1	13	**Hallie Lane PR13**	4	290	$135	$39,150	$56,768	290	$56,768		$0		$0	290	$56,768
			Replace existing 2"ABS with 4". Beach Street to Carmel Avenue.													
$135	1	14	**Edmund Lane PR14**	4	280	$135	$37,800	$54,810	280	$54,810		$0		$0	280	$54,810
			Replace existing 2"ABS with 4". Beach Street to Carmel Avenue.													
$145	1	15	**Treasure Cove Lane PR15**	6	260	$145	$37,700	$54,665	260	$54,665		$0		$0	260	$54,665
			Replace existing 2" PVC with 6". Beach Street to Carmel Avenue.													
$135	1	16	**Beeswax Lane PR16**	4	260	$135	$35,100	$50,895	260	$50,895		$0		$0	260	$50,895
			Replace existing 2" ABS with 4". Beach Street to Carmel Avenue.													
$160	1	17	**Bonny Lane PR17**	8	400	$160	$64,000	$92,800	400	$92,800		$0		$0	400	$92,800
			Replace existing 2" Glued Electrical Conduit with 8". East from connection with South Carmel Avenue.													
$135	1	18	**Bonny Lane PR18**	4	310	$135	$41,850	$60,683	310	$60,683		$0		$0	310	$60,683
			Replace existing 2" and 3" Glued Electrical Conduit with 4". Connects to project PR 17.													
$145	1	19	**Puffin Lane PR19**	6	620	$145	$89,900	$130,355	620	$130,355		$0		$0	620	$130,355
			Replace existing 2" PVC with 6". West from South Carmel Avenue.													
$145	1	20	**Pelican Lane PR20**	6	475	$145	$68,875	$99,869	475	$99,869		$0		$0	475	$99,869
			Replace existing 2" with 6". West from South Carmel Avenue.													
$115	1	21	**Pelican Lane PR21**	6	200	$115	$23,000	$33,350	200	$33,350		$0		$0	200	$33,350
			Replace existing 2". North and south from the west end of project PR20.													
$145	1	22	**Windward Lane PR22**	6	870	$145	$126,150	$182,918	870	$182,918		$0		$0	870	$182,918
			Replace existing 2" ABS and 4" PVC with 6". West from South Carmel Avenue and south to Sitka Lane.													
$160	2	23	**College Avenue PR23**	8	295	$160	$47,200	$68,440		$0	295	$68,440		$0	295	$68,440
			Replace existing 8" AC. Cherry Street to Elm Street.													
$160	2	24	**College Avenue PR24**	8	295	$160	$47,200	$68,440		$0	295	$68,440		$0	295	$68,440
			Replace existing 8" AC. Greenridge Street to Elm Street.													
$160	2	25	**College Avenue PR25**	8	160	$160	$25,600	$37,120		$0	160	$37,120		$0	160	$37,120
			Replace existing 8" AC. Greenridge Street to Hemlock Street.													
$160	2	26	**College Avenue PR26**	8	230	$160	$36,800	$53,360		$0	230	$53,360		$0	230	$53,360
			Replace existing 8" AC. Third Street to Hemlock Street.													

Unit Costs June 2021 ($/LF)	Project Priority	Project Reference Number	Project Name (Description)	New Diameter (in.)	Length (LF)	Current Unit Cost ($/LF)	Construction Cost ($)	Total Cost ($)	Implementation (LF and Total Cost) 2021-2025 (LF)	2021-2025 ($)	2025-2030 (LF)	2025-2030 ($)	2031-2040 (LF)	2031-2040 ($)	CIP Totals Length (LF)	Cost ($)
$160	2	27	**Third Street PR27**	8	230	$160	$36,800	$53,360		$0	230	$53,360		$0	230	$53,360
			Replace existing 8" AC. Knobcone Street to College Avenue.													
$160	2	28	**Juniper Street PR28**	8	430	$160	$68,800	$99,760		$0	430	$99,760		$0	430	$99,760
			Replace existing 8" AC. Knobcone Street to Ocean Avenue.													
$145	2	29	**Ocean Avenue/Surf Lane PR29**	6	940	$145	$136,300	$197,635		$0	940	$197,635		$0	940	$197,635
			Replace existing 4" and 6" AC with 6". From First Street to and southwest along Surf Lane to North Avenue.													
$160	2	30	**First Street PR30**	8	285	$160	$45,600	$66,120		$0	285	$66,120		$0	285	$66,120
			Replace existing 6" AC. Ocean Avenue to North Avenue.													
$160	2	31	**North Avenue PR31**	8	655	$160	$104,800	$151,960		$0	655	$151,960		$0	655	$151,960
			Replace existing 4" AC. First Street to Surf Lane.													
$160	2	32	**North Avenue PR32**	8	270	$160	$43,200	$62,640		$0	270	$62,640		$0	270	$62,640
			Replace existing 6" AC. Ocean Road to Surf Lane.													
$160	2	33	**Ocean Road PR33**	8	250	$160	$40,000	$58,000		$0	250	$58,000		$0	250	$58,000
			Replace existing 8" AC. North Avenue to Washington Avenue.													
$160	2	34	**Ocean Road PR34**	8	220	$160	$35,200	$51,040		$0	220	$51,040		$0	220	$51,040
			Replace existing 8" AC. Portland Avenue to Washington Avenue.													
$160	2	35	**Ocean Road PR35**	8	240	$160	$38,400	$55,680		$0	240	$55,680		$0	240	$55,680
			Replace existing 8" AC. Portland Avenue to Manzanita Avenue.													
$145	2	36	**Washington Avenue PR36**	6	760	$145	$110,200	$159,790		$0	760	$159,790		$0	760	$159,790
			Replace existing 4" AC with 6". From First Street to Ocean Road.													
$145	2	37	**Portland Avenue PR37**	6	500	$145	$72,500	$105,125		$0	500	$105,125		$0	500	$105,125
			Replace existing 6" AC. From First Street to Ocean Road.													
$160	2	38	**First Street PR38**	8	300	$160	$48,000	$69,600		$0	300	$69,600		$0	300	$69,600
			Replace existing 6" AC. Washington Avenue to North Avenue.													
$160	2	39	**First Street PR39**	8	320	$160	$51,200	$74,240		$0	320	$74,240		$0	320	$74,240
			Replace existing 6" AC. Washington Avenue to Portland Avenue.													
$160	2	40	**First Street PR40**	8	240	$160	$38,400	$55,680		$0	240	$55,680		$0	240	$55,680
			Replace existing 6" AC. Manzanita Avenue to Portland Avenue.													
$160	2	41	**First Street PR41**	8	80	$160	$12,800	$18,560		$0	80	$18,560		$0	80	$18,560
			Replace existing 6" AC with 8". From project PR40 south to Manzanita Avenue.													
$145	2	42	**First Street PR42**	6	225	$145	$32,625	$47,306		$0	225	$47,306		$0	225	$47,306
			Replace existing 6" AC. Idaho Avenue to Manzanita Avenue.													
$145	2	43	**First Street PR43**	6	270	$145	$39,150	$56,768		$0	270	$56,768		$0	270	$56,768
			Replace existing 4" AC. Idaho Avenue to Laneda Avenue.													
$160	2	44	**Manzanita Avenue PR44**	8	280	$160	$44,800	$64,960		$0	280	$64,960		$0	280	$64,960
			Replace existing 4" AC with 8". First Street to North Carmel Avenue.													
$160	2	45	**Manzanita Avenue PR45**	8	170	$160	$27,200	$39,440		$0	170	$39,440		$0	170	$39,440
			Replace existing 4" ACwith 8". Second Street North to North Carmel Avenue.													
$145	2	46	**North Carmel Avenue PR46**	6	515	$145	$74,675	$108,279		$0	515	$108,279		$0	515	$108,279
			Replace existing 4" AC. Manzanita Avenue to Laneda Avenue.													
$145	2	47	**Second Street North PR47**	6	935	$145	$135,575	$196,584		$0	935	$196,584		$0	935	$196,584
			Replace existing 4" AC with 6". Manzanita Avenue to North Third Street.													
$160	2	48	**North Third Street PR48**	8	1,000	$160	$160,000	$232,000		$0	1,000	$232,000		$0	1,000	$232,000
			Replace existing 4" AC with 8". Manzanita Avenue to Ocean Avenue.													
$160	2	49	**Manzanita Avenue PR49**	8	235	$160	$37,600	$54,520		$0	235	$54,520		$0	235	$54,520
			Replace existing 6" AC with 8". Fifth Street to Division Street.													
$145	2	50	**Second Street North PR50**	6	460	$145	$66,700	$96,715		$0	460	$96,715		$0	460	$96,715
			Replace existing 4" AC with 6". Manzanita Avenue to Laneda Avenue.													
$145	2	51	**North Avenue PR51**	6	370	$145	$53,650	$77,793		$0	370	$77,793		$0	370	$77,793
			Replace existing 4" AC with 6". Pine Street to Fir Avenue.													
$145	2	52	**North Avenue PR52**	6	625	$145	$90,625	$131,406		$0	625	$131,406		$0	625	$131,406
			Replace existing 4" AC with 6". Division Street to Fir Avenue.													
$145	2	53	**Fir Avenue PR53**	6	405	$145	$58,725	$85,151		$0	405	$85,151		$0	405	$85,151
			Replace existing 4" AC with 6". Fifth Street to North Avenue.													
$145	2	54	**Pine Street PR54**	6	365	$145	$52,925	$76,741		$0	365	$76,741		$0	365	$76,741
			Replace existing 4" AC with 6". Cedar Street to North Fourth Street.													

Unit Costs June 2021 ($/LF)	Project Priority	Project Reference Number	Project Name (Description)	New Diameter (in.)	Length (LF)	Current Unit Cost ($/LF)	Construction Cost ($)	Total Cost ($)	Implementation (LF and Total Cost)						CIP Totals	
									2021-2025 (LF)	2021-2025 ($)	2025-2030 (LF)	2025-2030 ($)	2031-2040 (LF)	2031-2040 ($)	Length (LF)	Cost ($)
$145	2	55	**Pine Street PR55**	**6**	400	$145	$58,000	$84,100		$0	400	$84,100		$0	400	$84,100
			Replace existing 4" AC with 6". Cedar Street to Fifth Street.													
$145	2	56	**Cedar Street PR56**	**6**	500	$145	$72,500	$105,125		$0	500	$105,125		$0	500	$105,125
			Replace existing 4" AC with 6". Pine Street to Manzanita Avenue.													
$185	2	57	**North Fourth Street PR57**	**10**	610	$185	$112,850	$163,633		$0	610	$163,633		$0	610	$163,633
			Replace existing 10" AC. North Avenue to Manzanita Avenue.													
$160	2	58	**Manzanita Avenue PR58**	**8**	640	$160	$102,400	$148,480		$0	640	$148,480		$0	640	$148,480
			Replace existing 4" AC with 8". North Fourth Street to Fifth Street.													
$160	2	59	**Fifth Street PR59**	**8**	295	$160	$47,200	$68,440		$0	295	$68,440		$0	295	$68,440
			Replace existing 2" ABS with 8". Manzanita Avenue to Laurel Avenue.													
$160	2	60	**Fifth Street PR60**	**8**	310	$160	$49,600	$71,920		$0	310	$71,920		$0	310	$71,920
			Replace existing 2" ABS with 8". Laneda Avenue to Laurel Avenue.													
$160	2	61	**South Third Street PR61**	**8**	645	$160	$103,200	$149,640		$0	645	$149,640		$0	645	$149,640
			Replace existing 4" PVC with 8". Laneda Avenue to Edmund Lane.													
$160	3	62	**South Third Street PR62**	**8**	195	$160	$31,200	$45,240		$0		$0	195	$45,240	195	$45,240
			Replace existing 6" C900 with 8". Treasure Cove Lane to Edmund Lane.													
$135	2	63	**Hallie Lane PR63**	**4**	380	$135	$51,300	$74,385		$0	380	$74,385		$0	380	$74,385
			Replace existing 2" ABS and 4" with 4". East from Carmel Avenue.													
$145	2	64	**Treasure Cove Lane PR64**	**6**	690	$145	$100,050	$145,073		$0	690	$145,073		$0	690	$145,073
			Replace existing 4" AC with 6". South Third Street to Carmel Avenue.													
$145	2	65	**Sandpiper Lane PR65**	**6**	800	$145	$116,000	$168,200		$0	800	$168,200		$0	800	$168,200
			Replace existing 2" PVC with 6". Sandpiper Lane from Nehalem Avenue east to, and north along Garey Street to Puffin Lane.													
$145	2	66	**Beach Street PR66**	**6**	600	$145	$87,000	$126,150		$0	600	$126,150		$0	600	$126,150
			Replace existing 4" AC with 6". Beach Drive to Sunset Lane.													
$160	2	67	**Ridge Drive PR67**	**8**	605	$160	$96,800	$140,360		$0	605	$140,360		$0	605	$140,360
			Replace existing 6" AC with 8". From Necarney City Road north 605 feet .													
$145	2	68	**Nehalem Avenue PR68**	**6**	240	$145	$34,800	$50,460		$0	240	$50,460		$0	240	$50,460
			Replace existing 6". Puffin Lane to Sandpiper Lane.													
$145	2	69	**Nehalem Avenue PR69**	**6**	760	$145	$110,200	$159,790		$0	760	$159,790		$0	760	$159,790
			Replace existing 4" AC with 6". Sitka Lane to Sandpiper Lane.													
$185	2	70	**North Fourth Street PR70**	**10**	230	$185	$42,550	$61,698		$0	230	$61,698		$0	230	$61,698
			Replace existing 10" AC . Laurel Avenue to Manzanita Avenue.													
$185	2	71	**North Fourth Street PR71**	**10**	240	$185	$44,400	$64,380		$0	240	$64,380		$0	240	$64,380
			Replace existing 10" AC. Laurel Avenue to Laneda Avenue.													
$145	2	72	**Fir Avenue PR72**	**6**	300	$145	$43,500	$63,075		$0	300	$63,075		$0	300	$63,075
			Replace existing 4" AC with 6". Fifth Street to Division Street.													
$185	2	73	**Division Street PR73**	**10**	230	$185	$42,550	$61,698		$0	230	$61,698		$0	230	$61,698
			Replace existing 6" AC with 10". North Avenue to Fir Avenue.													
$185	2	74	**Division Street PR74**	**10**	230	$185	$42,550	$61,698		$0	230	$61,698		$0	230	$61,698
			Replace existing 6" with 10". Manzanita Avenue to Fir Avenue.													
$185	2	75	**Division Street PR75**	**10**	200	$185	$37,000	$53,650		$0	200	$53,650		$0	200	$53,650
			Replace existing 6" with 10". Manzanita Avenue to Laurel Avenue.													
$185	2	76	**Division Street PR76**	**10**	230	$185	$42,550	$61,698		$0	230	$61,698		$0	230	$61,698
			Replace existing 6" with 10". Laneda Avenue to Laurel Avenue.													
			Distribution CIP Total				**$4,497,075**	**$6,520,759**		**$1,617,656**		**$4,857,863**		**$45,240**		**$6,520,759**

Resiliency and Miscellaneous Improvements

Construction Costs June 2021 ($/LF)	Total Costs June 2021 ($)	Project Priority	Project Name (Description)	Plan Section Number	ENR Ratio	Construction Cost ($)	Total Cost ($)	Implementation (LF and Total Cost) 2021-2025 (%)	2021-2025 ($)	2025-2030 (%)	2025-2030 ($)	2031-2040 (%)	2031-2040 ($)	CIP Totals Length (%)	Cost ($)
	$400,000	H	**Emergency Well**	6.7.1	1	$0	$400,000	100	$400,000		$0		$0	100	$400,000
			See Appendix S for costs of project tasks.												
	$110,000	H	**Bleed Out Control**	6.7.1	1	$0	$110,000	100	$110,000		$0		$0	100	$110,000
			Bleed out control valve and vault at City limits near Fire and Rescue Station.												
	$170,000	H	**Bypass and Flow Control at WTP**	6.7.1	1	$0	$170,000	100	$170,000		$0		$0	100	$170,000
			Allows flow around WTP under seismic conditions leading to building failure.												
	$110,000	H	**Reservoir Bypass Connection and Water Main.**	6.7.1	1	$0	$110,000	100	$110,000		$0		$0	100	$110,000
			Allows flow directly to distribution system if reservoirs fail during a seismic event.												
	$55,000	H	**Emergency Connection**	6.7.1	1	$0	$55,000	100	$55,000		$0		$0	100	$55,000
			Emergency connection to Fire and Rescue facility.												
	$60,000	H	**Bleed Out Control**	6.7.1	1	$0	$60,000	100	$60,000		$0		$0	100	$60,000
			Bleed out control valve and vault at RT 53 Water, Inc. connection.												
	$110,000	H	**Bleed Out Control**	6.7.1	1	$0	$110,000	100	$110,000		$0		$0	100	$110,000
			Bleed out control valve and vault at Tidelands Services Coop connection.												
	$110,000	H	**City of Nehalem Intertie**	6.7.1	1	$0	$110,000	100	$110,000		$0		$0	100	$110,000
			Replace the intertie with the City of Nehalem.												
	$230,000	L	**Transmission Pedestrian Bridge Crossing**	6.7.1	1	$0	$230,000		$0		$0	100	$230,000	100	$230,000
			Remove the transmission main from the pedestrian bridge and replace it with a buried main.												
	$280,000	L	**Transmission Highway Crossing**	6.7.1	1	$0	$280,000		$0		$0	100	$280,000	100	$280,000
			Remove the transmission main from the bridge crossing at Hwy 101 and Hwy 53,and replace it with a buried main.												
	$4,000,000	H	**New Reservoirs**	6.7.2.2	1	$0	$4,000,000	100	$4,000,000		$0		$0	100	$4,000,000
			Construct two 1-million gallon reservoirs to replace existing reservoirs.												
	$1,000,000	H	**New Water Meters**	6.8.2	1	$0	$1,000,000	25	$250,000	25	$250,000	50	$500,000	100	$1,000,000
			Budget 100 water meter replacements per year at $500 per meter.												
	$40,000	H	**Leak Detection**	6.7.3.1	1	$0	$40,000	25	$10,000	25	$10,000	50	$20,000	100	$40,000
			Preliminary budget and frequency is $8,000 per detection survey and once every 5 years. Actual frequency should be based on need as determined by annual non-revenue water evaluations.												
	$50,000	H	**White Water Investigation**	6.5.2	1	$0	$50,000	100	$50,000		$0		$0	100	$50,000
			Study on the City's white water problem. Budget is preliminary and based on an order of magnitude estimate.												
	$100,000	M	**Water Master Plan Update**	6.8.1	1	$0	$100,000		$0	100	$100,000		$0	100	$100,000
			Periodic update of Plan. Actual budget should be adjusted as needed to reflect theanticipated level of effort required. Timing is uncertain but coordination with the preparation of the Water management and Conservation Plan may reduce costs for both.												
	$80,000	M	**Water Management and Conservation Plan**	6.8.1	1	$0	$80,000		$0	100	$80,000	100	$80,000	200	$160,000
			A new plan that will be required as part of the water right extension for the wells. Timing is uncertain but coordination with the preparation of the Water Master Plan may reduce costs for both. Updates are required every 5 years (budget $40,000 per update).												
	$15,000	M	**Water Right Partial Perfection**	6.8.1	1	$0	$15,000	100	$15,000		$0		$0	100	$15,000
			Partial perfection of well water rights. To be completed after complying with the conditions of the extended permit.												
	$25,000	H	**Water Rate Study**	8.2.3	1	$0	$25,000	100	$25,000		$0		$0	100	$25,000
			Complete new water rate study. Additional rate studies will likely be needed during the planning horizon - these should be added to the spreadsheet as needed.												
	$20,000	H	**Water SDC Study**	8.3	1	$0	$20,000	100	$20,000		$0		$0	100	$20,000
			Complete new water system system development charge study and methodology. Additional rate studies will likely be needed during the planning horizon - these should be added to the spreadsheet as needed.												
			Resiliency and Miscellaneous CIP Total			**$0**	**$6,965,000**	**$1,350**	**$5,495,000**	**$250**	**$440,000**	**$400**	**$1,110,000**	**$2,000**	**$7,045,000**
			CIP Total			**$4,497,075**	**$13,485,759**	**$1,350**	**$7,112,656**	**$250**	**$5,297,863**	**$400**	**$1,155,240**	**$2,000**	**$13,565,759**

SECTION 8 | RATES AND FINANCING

8.1 Recent Water Fund Budgets

8.1.1 Water Operating Fund

The City's Water Operating Fund covers personnel and general water utility costs and is funded primarily through water user fees (water rates). Recent budgets for the fund are shown in Table 8-1.

Table 8-1: Water Operating Fund Budgets

Description	Actual Fiscal Year 2016 – 2017	Actual Fiscal Year 2017 – 2018	Actual Fiscal Year 2018 – 2019	Actual Fiscal Year 2019 - 2020
Resources				
Beginning Total	$565,582	$431,109	$473,602	$600,326
Revenue				
User Fees	$987,305	$991,814	$1,011,750	$1,003,237
Investment Earnings	$7,959	$15,099	$31,771	$27,697
Miscellaneous	$1,179	$32,721	$2,822	$599
Revenue Total	$996,443	$1,039,634	$1,046,343	$1,031,533
Resources Total	$1,562,025	$1,470,743	$1,519,945	$1,631,859
Expenses				
Transfer Out	$339,300	$154,800	$89,300	$127,975
Expenditures				
Personnel Services	$341,049	$388,251	$413,291	$411,422
Materials & Services	$265,314	$261,924	$238,683	$422,677
Debt Service	$185,251	$185,251	$178,345	172,931
Capital Outlay	$0	$6,915	$0	$677
Expenditures Total	$791,614	$842,341	$830,319	$1,007,707
Expenses Total	$1,130,914	$997,141	$919,619	$1,135,682
Revenue – Expenditures	$204,829	$197,293	$216,024	$23,826
Resources – Expenses	$431,111	$473,602	$600,326	$496,177

For the four fiscal years shown, "Resources minus Expenses" shows a net increase indicating sufficient resources. Expenditures for materials and services were notably higher in 2019-2020, resulting in a significant reduction in the revenue minus expenditures figure.

8.1.2 Water Construction Fund

The City's Water Construction Fund covers capital outlay for expanding and improving the water system and is funded primarily through system development charges (SDCs). Recent budgets for the fund are shown in Table 8-2.

Table 8-2: Water Construction Fund Budgets

Description	Actual Fiscal Year 2016 – 2017	Actual Fiscal Year 2017 – 2018	Actual Fiscal Year 2018 – 2019	Actual Fiscal Year 2019 - 2020
Resources				
Beginning Total	$2,912,314	$3,030,131	$2,575,338	$2,441,568
Transfers In	$325,000	$183,950	$105,000	$1,800
Revenue				
SDCs	$131,100	$138,000	$117,300	$96,600
Investment Earnings	$33,276	$35,698	$48,049	$38,355
Miscellaneous	$0	$20,593	165,349	$0
Revenue Total	$164,376	$194,291	$165,349	$134,955
Resources Total	$3,401,690	$3,408,372	$2,845,687	$2,578,323
Expenses				
Transfers Out	$106,000	$0	$0	$0
Expenditures				
Materials and Services	$0	$327	0	$0
Capital Outlay	$265,558	$832,707	$404,120	$53,002
Expenditures Total	$265,558	$833,034	$404,120	$53,002
Expenses Total	$371,558	$833,034	$404,120	$53,002
Revenue – Expenditures	$(101,182)	$(638,743)	$(238,771)	$81,953
Resources – Expenses	$3,030,132	$2,575,338	$2,441,567	$2,525,321

The Water Construction Fund budget shows that a total beginning balance of $2,525,321 available for fiscal Year 2020-2021.

8.1.3 Adopted 2020-2021 Budget

The City's 2020-2021 Water Operating and Construction Fund budgets are included in Appendix T.

8.2 Current Water Rates

8.2.1 Rate Structure

Manzanita's current (effective October 1, 2014) water rate schedule is included in Resolution No. 14-12 (see Appendix U). For residential customers inside the City, rates are based on a base monthly service charge of $39.50 that includes an allowance of up to 4,000 gallons per month. To the base charge is added the water usage rate of $2.50 per 1,000 gallons for usage beyond the 4,000 gallons included in the base charge (zero to 20,000 gallons) and $0.0035 per gallon for usage beyond 20,000 gallons. Meter reading and billings are quarterly.

Funding agencies often evaluate a community's rates based on a monthly single-family residential billing associated with 7,500 gallons of usage; for Manzanita, this billing would be $48.25 ($39.50 for base rate plus usage (overage) of $8.75 for 3,500 gallons).

8.2.2 Revenue

For the fiscal year ending June 30, 2020, major sources of revenue included $1,003,327 in rates and $96,600 in System Development Charges.

8.2.3 Comments

The Fund budgets appear healthy with substantial reserves and significant allocations for capital improvements. There does not appear to be an immediate need to raise rates, even though rates have not been adjusted in the last 7 years. Nevertheless, the City should consider retaining a consultant to complete a Rate Study once decisions have been made on implementation of the recommended capital improvements. The rate study can be used to evaluate the benefit and feasibility of any changes in the rate structure in addition to determining rate increases needed for debt service on loan components of the funding package. Budget $25,000 for planning purposes.

8.3 Current System Development Charge (SDC)

The City's current Water SDC is $6,900 for a new service. SDCs were last updated on September 10, 2015 (see Appendix V). SDCs utilize an approved capital improvements plan as the basis for the SDC cost computation. As SDCs are based in part on anticipated project costs, the City should consider revising the SDC after the Water Master Plan has been adopted. Estimated cost for a water SDC study is $20,000.

8.4 O&M Considerations

The recommended capital improvements should not result in increased O&M costs; however, O&M costs are subject to market changes and inflationary pressures, so annual increases are typically required. Budgets and water rates are typically adjusted to take recent or anticipated changes into account; however, system deficiencies that have not been addressed can increase O&M costs in ways and to an extent not easily foreseen. This may take the form of emergency (overtime) callouts and extra costs, interim measures that may be needed until the problem can be addressed correctly, and unbudgeted emergency projects of potentially significant expense. Over time, such costs can add significantly to the overall utility budget.

8.5 Capital Improvement Finance

8.5.1 Introduction

Major capital improvements are often too expensive to fund exclusively with accumulated reserves. Such projects may be economically financed through programs offered by various State and Federal agencies, or a mix of public and local financing. The following discussion identifies potential sources of that funding.

8.5.2 Public Works Funding Sources

This section includes a brief description of several funding programs that are likely to best meet Manzanita's needs. Additional programs are described in Appendix W which includes an excerpt from the Rural Community Assistance Corporation's (RCAC) most recent edition of "Oregon Water & Wastewater Funding and Resource Guide" last updated in March 2016.

- The **Safe Drinking Water Revolving Loan Fund (SDWRLF)** is funded by EPA grants and from the (Oregon) Water/Wastewater Financing Program. The program is managed by Oregon Health Authority (OHA); the loans are managed by Infrastructure Finance Authority (IFA), a part of Business Oregon, a state agency. The program provides up to $6,000,000 per project with a 20-year term.The interest rate was 1.7 percent (July 2021 – the rate changes quarterly andis based on 80 percent of the state/local bond interest rate). The application process includes an initial Letter of Interest which is used by the state to rate and rank projects to determine which applicants will be invited to submit complete applications.
- The **Water/Wastewater Financing Program (W/WW)** is capitalized primarily through Oregon Lottery funds and loan repayments. The program is managed by IFA and the focus is on the design and construction of public works infrastructure to ensure compliance with the Safe Drinking Water Act and the Clean Water Act. The program provides up to $10,000,000 per project with a 25-year term. The interest rate was 2.12 percent (July 2021 – the rate changes quarterly). Grants of up to $750,000 are possible with equivalent matching loans; however, grant eligibility is determined on a case-by-case basis.The application process includes submittal of a Project Notification and Intake Form (PNIF). Qualified applicants are then invited to submit a complete application.
- The **Special Public Works Fund (SPWF)** is capitalized primarily through Oregon Lottery funds and loan repayments. The program is managed by IFA and the focus is on infrastructure projects that support economic growth and job creation.The program provides up to $10,000,000 per project with a 25-year term. The interest rate was 2.30 percent (July 2021 – the rate changes quarterly). Grants of up to $500,000 (or 85 percent of project cost, whichever is less) are possible; however, grants are typically based on up to $5,000 per family wage job created or retained; grant eligibility and extent for the project is determined ona case-by-case basis. If the project is strictly for capacity building, then no grant is awarded. The application process includes submittal of a Project Notification and Intake Form (PNIF). Qualified applicants are then invited to submit a complete application.

  USDA Rural Development (RD) provides funding through the Water & Waste Disposal Direct Loan and Grant Program, and other programs (see Appendix N for information on other programs). The program provides funding for water and waste projects in communities of up to 10,000 persons with priority given to those communities with less than 5,500 persons. Loan terms are up to 40 years with a recent (July 2021) interest rate of 2.25 percent (rates change quarterly). The 2.25 percent rate is based on the City having a median household income (MHI) greater than 80 percent of the statewide MHI of $67,058 (American Community Survey Estimate for 2020, US Department of Commerce, US Census). Grants are possible but are generally lower than the agency guidelines suggest and typically require that a City raise their water rates to the state average for communities undertaking comparable projects; the agency will determine how much grant will be included. Applications for funding must include a preliminary engineering report (PER) – or equivalent – and an environmental report (ER).
- **CoBank** is a national cooperative bank serving all 50 states. It is a member of the Farm Credit System and supports the borrowing needs of U.S. agriculture and the nation's rural economy. CoBank can provide long-term financing of rural water projects. Interest rates are based on market conditions and fluctuate daily. Applications are straightforward and the bank does not have environmental reporting requirements that are typically associated with the other funding sources (state and federal) commonly used for funding infrastructure projects in Oregon.

It is important to understand that funding programs change over time. Interest rates, fund availability, relative grant participation, and eligibility requirements are common areas of change; consequently, the figures and opportunities presented here may not be applicable at the time of funding application and award.

8.5.3 Local Financing Sources

Commonly used local financing sources include the following:

- General obligation (GO) bonds are backed by the full faith and credit of the issuer who is authorized to levy ad valorem (property) taxes for payment. The issuer can use other revenue for payment if desired. A term of 20 years is typical unless RD purchases the bonds (25-year term for RD funding).
- Revenue bonds are backed by the City's pledge to operate the water system in a manner that will generate sufficient revenue to meet the financial obligationsof the bond issue. These are generally paid with water rate revenue.
- Sinking funds basically refer to a process of saving a budgeted amount over a period until enough funds have been accrued to undertake the project. This approach is generally viable for lower cost projects or ones with long lead times. It can be a significant tool in asset management where future projects areanticipated based on remaining design lives; however, it may result in significant near-term rate or fee increases that could be politically challenging to adequately implement for large capital improvement budgets.
- Ad valorem tax or property tax is often used to pay all or part of a GO bond. Property taxes can provide an alternative way of distributing project costs and minimizing financial impacts on homeowners with lower property valuations.
- Water rates are a typical source of monies for debt service on loans from the state and federal funding agencies. Water rates can also be used for sinking funds. Water rate revenue increases with community growth and, as such, may help offset the effects of inflation on O&M costs. The assumption of rate revenue growth, for debt repayment, carries some risk insofar as the projected growth may not occur; it also entails greater attention to water rate increases since the added revenue associated with growth no longer buffers the inflationary costs associated with the annually increasing O&M budget.
- System development charges (SDCs) provide monies for improvements that add capacity to the water system for new growth. SDCs are an important source of financing and in rapidly growing districts, can provide substantial revenues. SDCs may not be adequate for the funding of major projects since they are often used when available and not allowed to accumulate. The assumption of future SDCs for debt service payment carries risk, as the projected growth may not occur.

8.6 Capital Improvement Rate Impacts

Table 8-3 includes debt service and rate impacts on a per EDU basis for projects funded through the programs identified in Section 8.5.2, plus a computation using a 6.5 percent interest rate. Very large projects may require funding through multiple sources; rate impacts for multiple funding sources are simply added together.

Note: Table 8-3 is for general planning purposes only. Actual interest rates, terms, and availability of funds through any given source may vary and are not locked in until an offer of funding is accepted by the City.

Table 8-3: Debt Service and Rate Impacts (per EDU basis)

	AnnualDebt Service	MonthlyPer EDURate Increase	AnnualDebt Service	MonthlyPer EDURate Increase	AnnualDebt Service	MonthlyPer EDURate Increase	AnnualDebt Service	MonthlyPer EDURate Increase
Interest Rate:	1.70		2.12		2.25		6.5	
Term (Years):	20		25		40		25	
EDUs:		2,469		2,469		2,469		2,469
Loan Total $								
$100,000	$5,940	$0.20	$5,194	$0.18	$3,818	$0.13	$8,198	$0.28
$200,000	11,880	$0.40	$10,389	$0.35	$7,635	$0.26	$16,396	$0.55
$300,000	$17,820	$0.60	$15,583	$0.53	$11,453	$0.39	$24,594	$0.83
$400,000	$23,760	$0.80	$20,778	$0.70	$15,271	$0.52	$32,793	$1.11
$500,000	$29,700	$1.00	$25,972	$0.88	$19,089	$0.64	$40,991	$1.38
$600,000	$35,640	$1.20	$31,167	$1.05	$22,906	$0.77	$49,189	$1.66
$700,000	$41,580	$1.40	$36,361	$1.23	$26,724	$0.90	$57,387	$1.94
$800,000	$47,520	$1.60	$41,556	$1.40	$30,542	$1.03	$65,585	$2.21
$900,000	$53,460	$1.80	$46,750	$1.58	$34,360	$1.16	$73,783	$2.49
$1,000,000	$59,401	$2.00	$51,945	$1.75	$38,177	$1.29	$81,981	$2.77

8.7 Capital Improvement Implementation

Capital improvements can be implemented over the planning period according to the natureof the projects, the relative prioritization of the project, and other financial and practical considerations that the City may have. Because of the relatively high costs, funding agency participation may be needed or desired. If the City decides to pursue agency assistance, then once the City has determined which projects to include, the City should contact IFA to set up a One-Stop Meeting in Salem to discuss potential project funding. Representatives of potential funding agencies attend the meeting and can assist in developing an optimal funding approach.

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix A

Water System Resiliency Study
BergerABAM, January 2018

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BergerABAM

Water System Resiliency Study

Submitted to
City of Manzanita
Department of Public Works
Manzanita, Oregon

Submitted by
BergerABAM
700 NE Multnomah Street, Suite 500
Portland, OR 97232

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement 98009016 to the State of Oregon. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

BergerABAM Job No. A18.0071.00

January 2018

Water System Resiliency Study
City of Manzanita

Submitted to

City of Manzanita
Department of Public Works
Manzanita, Oregon

January 2018

Submitted by

BergerABAM
700 NE Multnomah Street, Suite 500
Portland, Oregon 97323

A18.0071.00

WATER SYSTEM RESILIENCY STUDY

City of Manzanita

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1.0 BACKGROUND AND NEED

The City of Manzanita recently obtained a study grant through the Oregon Health Authority's Sustainable Infrastructure Planning Project program to evaluate the seismic resiliency of their water system. The state of Oregon has made resiliency planning a high priority because of the potential for a Cascadia Subduction Zone (CSZ) event. Resiliency planning is particularly important for Oregon's coastal communities because of the risks associated with their geographic location. Those risk include ground accelerations (shaking), tsunami, and landslides/liquefaction. See Figure 1-1 which depicts the plate movement of the Cascadia subduction zone.

The intent of this study is to evaluate Manzanita's existing water system with respect to a possible CSZ event. Specific elements of the study include evaluations of the water supply sources, water transmission, storage, and distribution. From this evaluation, system vulnerabilities were identified. Recommendations were then developed that are believed to address those vulnerabilities and hence increase the City's water system resiliency.

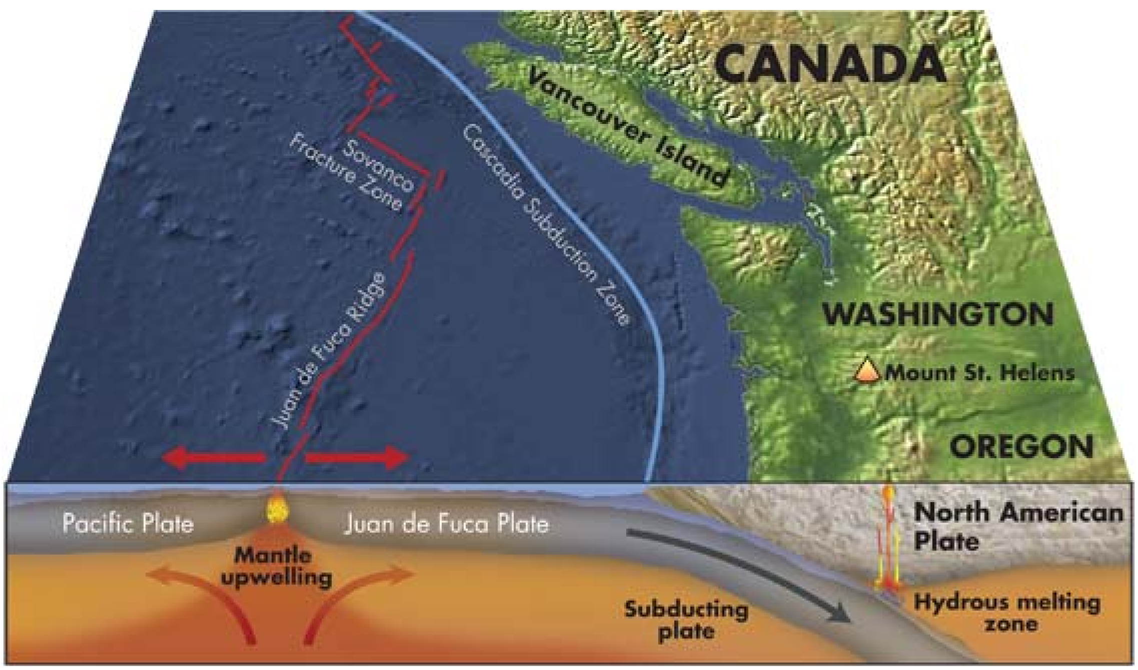


Figure 1-1. Cascadia Subduction Zone (CSZ)

2.0 APPLICABLE RESILIENCY GUIDANCE AND BEST PRACTICES

There are two primary guidance documents that have been developed to aid Oregon communities with hazard assessment and resiliency planning. The Tillamook County Multi-Jurisdictional Natural Hazards Mitigation Plan contains assessments specifically for the City of Manzanita and surrounding areas. The Oregon Resiliency Plan (ORP) is a statewide assessment that focuses solely on the impacts and planning needed for a CSZ event.

Tillamook County Multi-Jurisdictional Natural Hazards Mitigation Plan

This comprehensive plan assesses the probability of hazard occurrence and local vulnerabilities and establishes goals, objectives, and strategies for natural hazard mitigation. It identifies resources for implementing the mitigation strategies and also establishes processes, procedures, and responsibilities for periodically reviewing the plan. The scope of this plan is broader than the Oregon Resiliency Plan by addressing all significant natural hazards present in Tillamook County to include coastal erosion, earthquakes, floods, landslides, severe weather, tsunamis, volcanic ashfall, and wildfires.

Oregon Resiliency Plan (ORP)

This document is a result of Oregon legislation that required development of a plan that would help Oregon communities survive and bounce back from a magnitude 9.0 Cascadia earthquake and tsunami. It summarizes the science of Cascadia subduction zone earthquakes and estimates their impacts, then provides detailed analysis of the current vulnerability of buildings, the business community, transportation, energy, communications, and water/wastewater systems. The plan defines performance targets for each of these subjects and provides recommendations with a goal to meet resilience targets over the next 50 years.

3.0 EXISTING CONDITIONS

Location and Geology

The City of Manzanita is located in Tillamook County on the northwest Oregon coast. It is located north of the City of Tillamook and south of Cannon Beach. Neahkahnie Mountain lies just to the north. There are some smaller communities adjacent to Manzanita such as the City of Wheeler to the south and City of Nehalem to the east. The Nehalem River and Bay are a significant geographic presence to the southeast, as is the Tillamook State Forest to the east.

The City itself extends along the beach from north to south, and then expands to the west in the northern section. Several residents, and some businesses and government buildings, are situated on a hill that rises from the beach line up to an elevation of approximately 200 feet.

Figure 3-1. Coastline photo of Manzanita

Much of Manzanita sits upon old, stable sand dunes and marine terraces. The soils consist primarily of loamy fine sand with intermittent pockets of other types of soils such as Brallier peat with some iron cementation.

3.1 Community

The City is primarily a residential and tourist-oriented community with a population of about 600. There is, however, a high percentage of seasonally occupied housing units (approximately 65 percent). As a result, the population at any given time is significantly greater than the permanent resident population. Seventy percent of resident occupations are white-collar oriented. There is little workforce dependence on the marine environment, farming, or forestry. The population has a high median age and a large percentage of retired residents. Many of the local businesses cater to this population and to the tourism. Population growth is projected to be low; however, some housing development is occurring.

Manzanita shares its water system with some nearby communities. The City of Wheeler has a population of approximately 420 people and Route 53 Water Inc. has approximately 89 residents. An emergency water connection (normally closed) is shared with the City of Nehalem, which has a population of 271. Water is also supplied to Tideland Water District and Neahkahnie. See Figure 3-2 for a view of surrounding communities.

Figure 3-2. Aerial photo of surrounding area

3.2 Existing Water System

The City's water system strategy has evolved over the last two decades as they have managed changing water sources and water quality issues. Some significant improvements have been completed such as construction of two groundwater wells, a high-density polyethylene (HDPE) transmission main, replacement of distribution lines, and improvements to reservoir hydraulics. See Appendix A, Exhibit 2, for a regional water system map.

Water Supply

The City has two available sources of supply. In 2003, two groundwater wells were constructed adjacent to Foss Road, approximately 6-miles to the southeast. The wells are dependable and provide high water quality. Each well is currently rated for 500 gallons per minute (gpm), with a maximum production of 750 gpm when in duplex operation. The City has a water right of up to 1,400 gpm and capacity to build additional groundwater wells if needed. The wellfield site is shown in Figure 3-3.

The second source of supply is the surface water source from Anderson Creek. The diversion structures are located northeast of the City in the Tillamook Forest approximately 3 miles from City limits. The City, however, is no longer using this source and does not consider this a viable option going into the future. There is not enough stream volume for an adequate and consistent supply. Additionally, the diversions and asbestos-cement transmission lines are in disrepair. Repairing the diversions and transmission main would cost several million dollars. The transmission main alignment is also in high-risk landslide zones and access is very limited.

Figure 3-3. Groundwater well site

Transmission Line

Along with the construction of the new groundwater wells, the City constructed approximately 8-miles of 8-inch and 10-inch HDPE transmission main between the wells and the water treatment plant. Many of the significant water crossings were bored underneath the rivers. There are inter-ties with the City of Wheeler, Route 53 Water Inc., and Tideland Water District.

Reservoir Storage

The City has three reservoirs of varying size and age. They are located in the same general area of Manzanita at the northern limits. Reservoir No. 1 was built of welded steel in 1979 and has a capacity of 500,000 gallons. This reservoir was recoated in 2003. Reservoir No. 2 was built of concrete in 1960 and has a capacity of 250,000 gallons. It sits adjacent to Reservoir No. 1. Reservoir No. 3, constructed of glass-fused, bolted steel, was built in 1997 and has a capacity of 1.6 million gallons. The reservoir has experienced some settlement requiring repairs to the bolted panels. This largest reservoir sits below the elevation of the others and is on a separate parcel to the northeast.

Water Distribution

The City has been making improvements to its water distribution system. Some older asbestos cement lines and undersized lines have been replaced in conjunction with other ongoing projects such as roadway improvements. There are still a number of older lines that can be replaced and upsized to improve reliability and flow. The distribution system is split into two pressure zones. The high pressure zone is fed directly from Reservoir No. 1 through a booster pump. This zone serves the higher elevation area on the north side of Manzanita. The lower pressure zone is primarily served by Reservoir No. 3.

4.0 CASCADIA SUBDUCTION ZONE RISK FACTORS

There are several factors to consider when conducting a water system resiliency analysis. Factors include ground accelerations (shaking), tsunami, landslides, and liquefaction. Being located in this coastal geographic location means that all of these factors pose a threat to the water system and to the recovery effort.

Ground Accelerations

The ground accelerations (shaking) from the earthquake can have a damaging effect on the water system. Any component that is not in serviceable condition or is not restrained may pull away at joints and connections. Non-ductile or brittle piping may fracture. This type of damage can occur throughout the system including groundwater wells, pumps, transmission line, well houses and buildings, and distribution pipe. Reservoirs are particularly vulnerable to shaking as it causes sloshing inside the reservoir. This leads to buckling or separation from the foundation.

Tsunami Inundation

The tsunami inundation zones are shown on the Oregon Department of Geology and Mineral Industries (DOGAMI) maps (see Figure 4-1 and appendix A). A significant portion of the City is within the varying levels of the tsunami inundation zone. The yellow shaded areas represent tsunami limits based on the largest CSZ event. The purple shaded areas represent limits of smaller seismic events. The impacts of a tsunami can be devastating for infrastructure within the affected zone. Although many of the water system assets are buried, ground subsidence is anticipated to occur in the 3 to 5 foot range, which can cause the pipeline to shift and shear. Portions of the system that are aboveground will likely be destroyed. The debris and damage left behind will make access and repair very challenging.

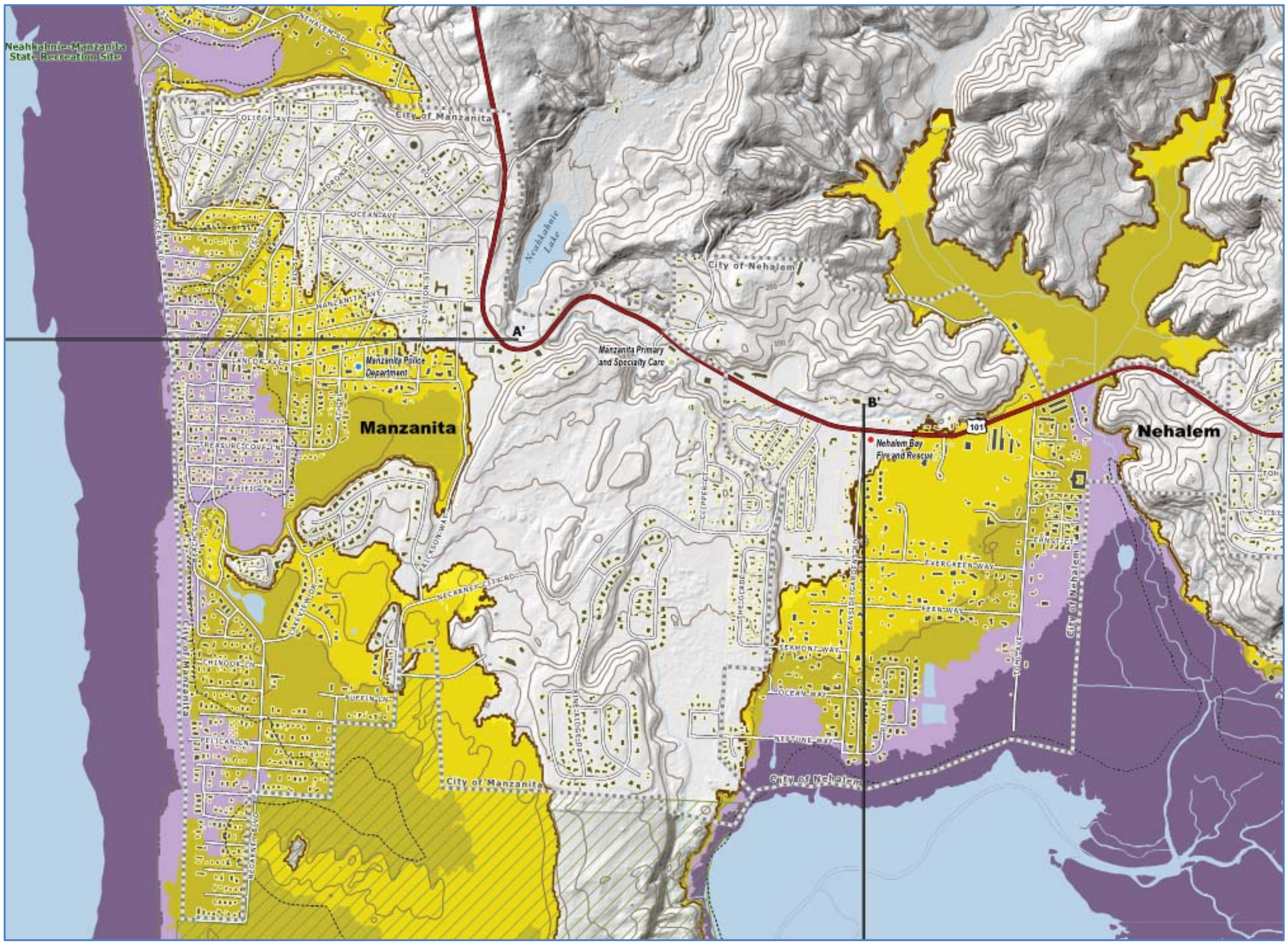


Figure 4-1. DOGAMI map of Manzanita and vicinity

Landslides or Liquefaction

The coastal area, particularly the Tillamook State Forest, is highly vulnerable to landslides and liquefaction. Liquefaction occurs when shaking causes a temporary increase in ground water pressure and a loss of soil bearing capacity. This can cause structures such as reservoirs to settle and pipe connections to shear. Much of Manzanita is located on sandy material and therefore subject to settlement. There are many slopes adjacent to the City limits, or along the transmission alignment, that pose high risks for landslide damage. Figure 4-2 shows hatched areas on the north side of the City where historical landslides have occurred, and are likely to reoccur. Figure 5-1 shows landslide risks in the surrounding areas that include the transmission main alignment.

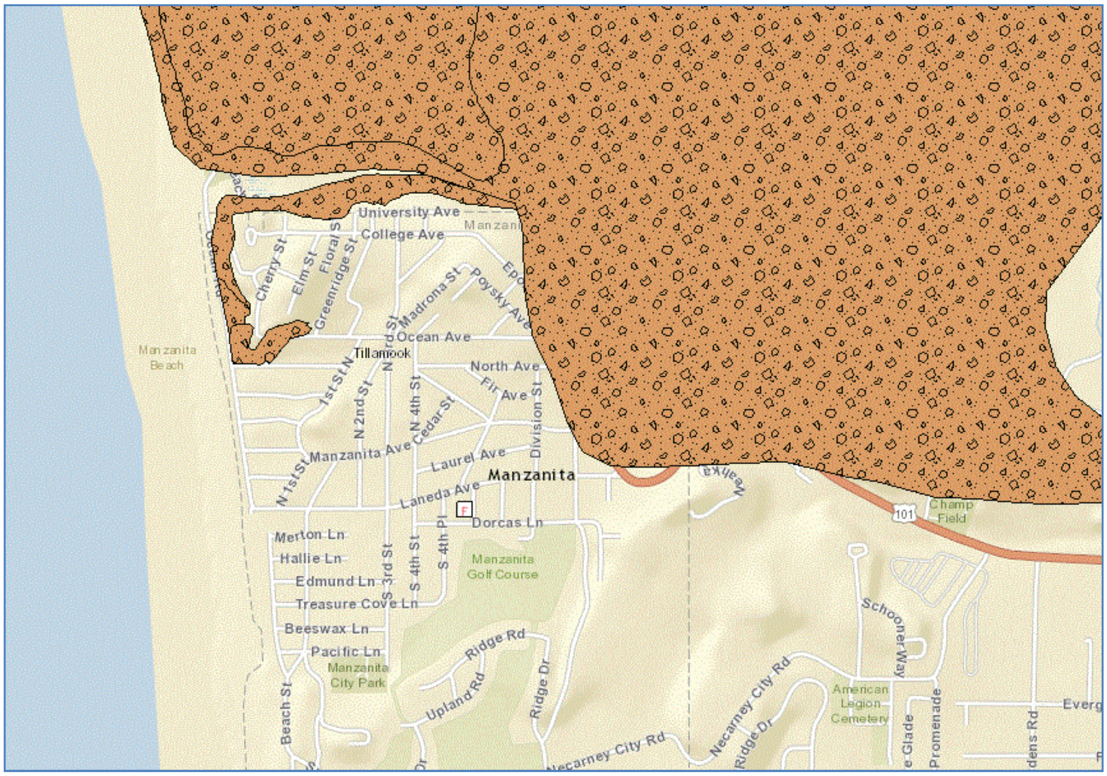


Figure 4-2. Landslide risk areas to the north

5.0 WATER SYSTEM VULNERABILITIES

Each aspect of the City's water system was evaluated with respect to the risk factors presented by the CSZ event. In some cases, a more intermediate level seismic event was considered.

Water Supply Source

The primary water source are the two groundwater wells located southeast of the City along Foss Road. The wells and well house were recently constructed and in good condition. This location is above the tsunami inundation zone and is not expected to be damaged by a tsunami. Primary risks for the wells are the potential landslides on the adjacent slopes, which could result in deep soil deposits over the well production site. Ground accelerations or ground subsidence has the potential to damage the wells and associated distribution lines. See Figure 5-1 which shows high landslide risk levels around the well site and along the transmission main alignment.

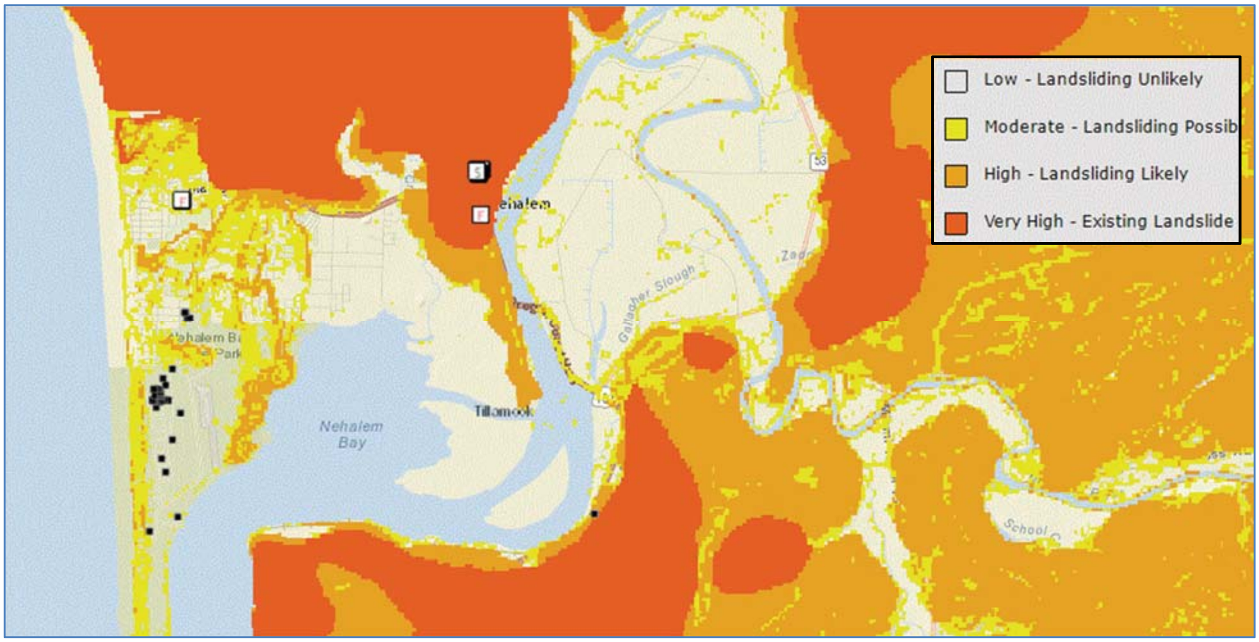


Figure 5-1 Landslide risk areas (broader area)

A significant vulnerability for the City is the lack of an alternative water supply source that can serve as backup for the groundwater wells. Because of the vulnerability of the well locations and the transmission main alignment, it is anticipated that this water supply source will be disabled for a long period of time following a CSZ event.

Water Transmission Main

There are numerous locations along the transmission main alignment vulnerable to a CSZ event. Landslide and tsunami inundation risk follow the majority of the transmission main. Foss Road is particularly susceptible to landslides due to the steep terrain. As the line turns west onto Necanicum Highway, it enters the tsunami inundation zone. Once the pipe turns northwest onto Highway 101, it enters a more vulnerable area within the tsunami inundation zone (designated by the purple shading), and continues in this zone until it crosses the Nehalem River. Based on the DOGAMI mapping, this section of the transmission main is vulnerable to a small and medium tsunami event. For a larger seismic event, these sections of the water transmission are likely to be irreparably damaged.

The water treatment plant (WTP) was constructed in 2003 and has some seismic resiliency per applicable building code requirements. Because the treatment aspect of the plant is currently inactive, this facility is not as critical as others. It is, however, an important part of the water supply chain because all transmission water must travel through the plant prior to reaching the reservoirs. The CSZ event could damage the building and interior piping.

Reservoir Storage
The three existing reservoirs pose a range of vulnerabilities for the water system. Each reservoir is different in terms of age, size, and location. The reservoirs were evaluated individually and as an interconnected group. See Figure 5-3 for an aerial view of the reservoir site. The aerial view is somewhat askew as a result of showing approximate slopes and grades in this area.

Figure 5-2. Aerial view of reservoir site

Reservoir No. 1 (Welded Steel, 500,000 gallons)
Because this reservoir was constructed in 1979, there was very little consideration for seismic resistance. The Oregon Resiliency Plan predicts that reservoirs built in this time frame will most likely fail and release all stored water. The reservoir as-built drawings were reviewed as a part of this study to discern whether a structural retrofit is advisable. The structural review revealed that although the risk of lifting off the foundation is lower, the relatively thin steel wall panels (0.5 inch) would buckle and fail during the CSZ event.

Reservoir No. 2 (Concrete, 250,000 gallons)
This reservoir was constructed in 1960. The Oregon Resiliency Plan predicts that reservoirs built in this time frame are very likely to fail and to release their contents. This reservoir also adds to the complexity of the site distribution piping, which creates more opportunity for damage.

Reservoir No. 3 (Glass-fused Bolted Steel, 1.5 million gallons)
This reservoir was constructed in 1997. The Oregon Resiliency Plan predicts that reservoirs built in this time frame will most likely suffer some damage, but may not release the stored contents. This reservoir, however, has a fatal flaw in terms of its site location. It is located adjacent to a steep slope with a high likelihood for landslide or slope failure. The City has previously observed movement around the reservoir, both immediately after it was built and more recently with pavement cracking in Epoh Avenue. The movement in Epoh Avenue was evaluated by a geotechnical engineer and documented in a report (see Appendix B).

Although further geotechnical review and investigation is recommended, it is possible that slope failure and associated ground movement will cause catastrophic failure of Reservoir No. 3. The tsunami inundation zone is also mapped to reach the toe of this slope, which could accelerate failure. The reservoir also poses a life safety risk to the residents near the toe of the slope.

Figure 5-3. Reservoir No. 3 near the steep slope

BergerABAM also evaluated the hydraulic elevations related to this reservoir, as there was some concern that the amount of accessible water storage may be restricted because of system hydraulics. The inlet and outlet water lines were profiled in comparison to the reservoir storage height, and it was confirmed that all contents of this reservoir would be accessible via gravity outflow.

Reservoir Site

Because the City is built primarily on sandy soils, the reservoirs may be subject to liquefaction and ground movement. Reservoir No. 3 is at the greatest risk for catastrophic failure because of the proximity to the steep slope. A smaller seismic event may be all that is necessary to trigger slope failure. The other two reservoirs have a much greater setback from the slope, but they are also likely to fail because of a lack of lateral reinforcing and ground subsidence.

The complex network of piping, connections, and valving between the three reservoirs creates additional vulnerability for water storage (see Figure 5-5). Even if the reservoir structure survives, the contents will likely spill as a result of sheared pipe connections or joint separations. Losing water storage diminishes the City's capacity for first-response and recovery actions such as fighting fires and providing potable water for residents and critical facilities.

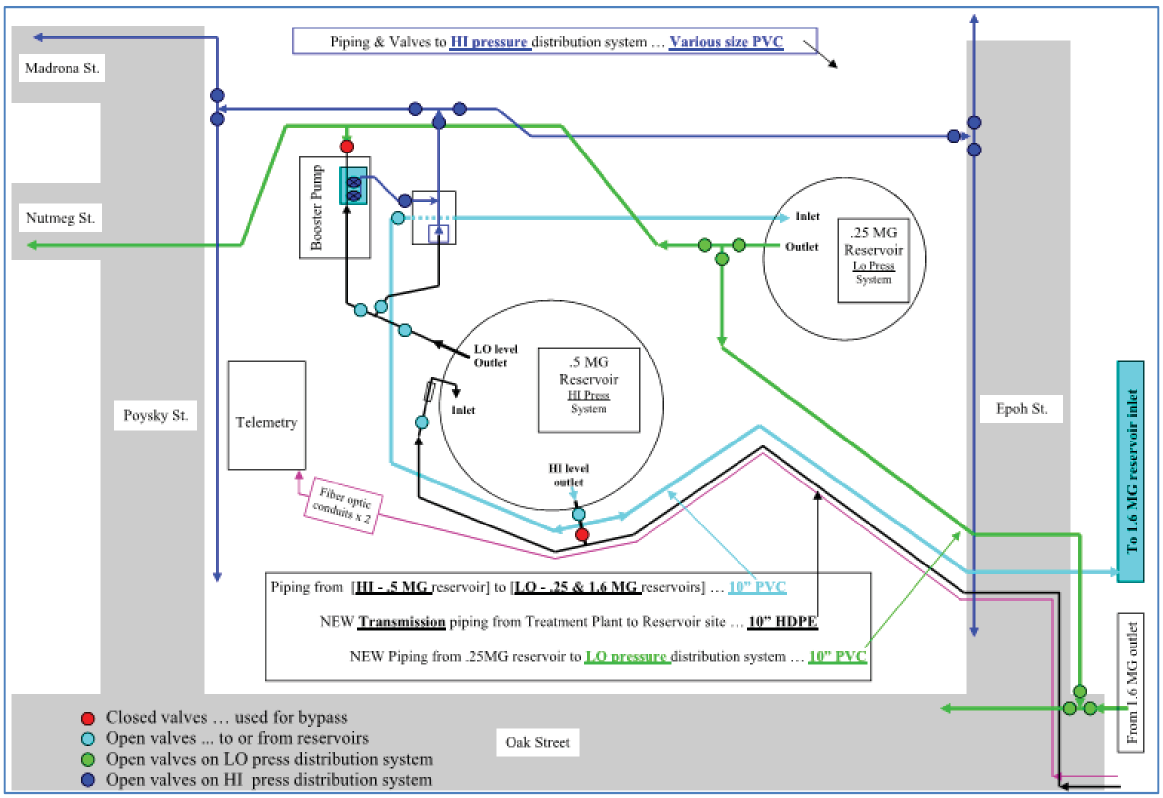


Figure 5-4. Pipe network at reservoir site

Water Distribution System

Vulnerabilities in the distribution system stem from older, non-ductile, pipe materials such as asbestos-cement and cast iron pipe, and unrestrained joints/connections. Although some progress replacing older water mains has been made, there remains a significant amount of vulnerable distribution pipe. Damage to the distribution system will likely cause bleed out of reservoir storage.

Water System Information Management System
The City does not currently have a water system information management system in place. These systems are typically based upon a Geographic Information System (GIS) platform that ties utility information to local mapping. Such a system will allow water system operators to record, catalogue, analyze, and manage all critical information relating to the system. Most importantly, all water system components can be accurately located and described with respect to operations and maintenance needs. Not having a GIS system creates vulnerability with respect to effective emergency response. If the operator cannot accurately and efficiently locate critical water system components (i.e. valves, interties, pipelines) then the emergency response effort may be hindered.

6.0 RECOMMENDATIONS

There are several actions the City can take to increase the seismic resiliency of the water system. The Oregon Resiliency Plan recommends that communities focus on improving the backbone of their water system. It states the following:

> *"The backbone water system would be capable of supplying key community needs, including fire suppression, health and emergency response, and community drinking water distribution points, while damage to the larger system is being addressed."*

The backbone of the water system generally consists of those facilities that provide key needs as described above. For Manzanita, it includes the groundwater wells, primary transmission main, reservoirs, and key distribution lines. The goal for recovery of the backbone system after the CSZ event is shown in Appendix A, Exhibit 4. As a reference, time to achieve 50 to 60 percent operability is three to seven days for transmission mains, booster pumps, and reservoirs; three to seven days for fire suppression at key locations; and two to four weeks for wells and water supply to critical facilities. See Exhibit 1 in Appendix A for a map of water system recommendations.

Water Supply Source
It is critical for the City to establish another water supply source that has a higher probability for recovery. Based on discussions with the City, this initiative is already in progress. The City is planning to build a test well near the existing WTP, which is outside of the tsunami inundation zone. The well would be close enough to the WTP and transmission main that repairing any damage between the well and other facilities becomes more feasible. The proposed third well is expected to produce about 80 gpm. This new well would be considered surface water and would require filtration and treatment at the existing WTP. Some minor WTP modifications would be required.

If considering improvements that could increase resiliency for a smaller seismic event, then additional groundwater wells can be constructed at the existing well site. These wells would serve as backup to the existing wells, and increase the probability that at least one well would remain serviceable. This improvement is unlikely to increase resiliency for the maximum CSV event.

Transmission Main

Even though much of the transmission main is likely to be irreparably damaged within the tsunami inundation zone, there are improvements that can be made outside of the zone to increase water system resiliency. Those improvements include:

- Provide a pressure sustaining valve at the City limits, next to the Fire Rescue Station, to prevent system bleed out from tsunami damage.
- Provide a bypass line around the WTP in the case of WTP building collapse, or to backfeed the transmission main.
- Provide an emergency connection (normally closed) to the distribution system that will serve to bypass the reservoirs if they have failed. Connect at Manzanita Avenue and replace the water main branch in the street.
- Provide an emergency water connection to the other critical facilities along the transmission main alignment such as the Fire Rescue Station.

If considering improvements that could increase resiliency for a smaller seismic event, then the following also represent resiliency opportunities:

- Bury the pipeline where it is aboveground. See appendix A, Exhibit 1 for aboveground locations. See Figure 6-1 for the aboveground pedestrian bridge crossing.
- Provide flow control valves or automated valves that will prevent bleed out of the system at key connections and locations. Connections needing bleed out protection include Zaddock Creek and Tideland Water District.

Figure 6-1. Aboveground crossing of transmission main

Reservoir Storage

Because the existing groundwater wells and transmission line are vulnerable in the CSZ event, reservoir storage becomes the primary focus for resiliency and recovery. The following improvements are recommended:

- In concert with thorough geotechnical review, build two new reservoirs to replace the existing three reservoirs on the site of Reservoirs No. 1 and No. 2.
    - ❖ Design new reservoirs with seismically resilient foundations and structural design.
    - ❖ Provide seismic connections at inlets and outlets.
    - ❖ Install automated valving to prevent the potential for bleed out in the case that the transmission lines or distribution is severed.
    - ❖ Ensure adequate storage sizing for extended reliance on emergency water use.

If not wanting to replace the reservoirs, and considering a smaller seismic event, the following improvements can be considered:

- Structurally reinforce Reservoir No. 1 by stiffening walls, steel interior columns, and new anchorage into a fortified ring foundation.
- Provide seismic connections at the inlet and outlet of each reservoir.
- Take Reservoir No. 2 offline and isolate from the system.

- Provide protection from bleed out at strategic locations by installing pressure sustaining valves.

Distribution System

It is important to protect the reservoir storage from bleeding out through damaged locations in the distribution system. This will require pressure sustaining valves near the reservoirs and at strategic locations in the distribution system. It is also important to continue upgrading the distribution with more resilient water pipe even though most of the distribution system is not part of the backbone. Replacement of older, non-ductile lines—particularly asbestos cement or cast iron—is recommended. If the distribution system is more resilient, then the recovery period is reduced.

Water System Information Management System

Building a GIS mapping platform for the water system, and potentially other infrastructure systems, can greatly enhance the City's ability to understand, plan, and respond to emergency situations. Current and future employees can be thoroughly trained with regard to the location and function of all critical water system components. Operations and maintenance data pertaining to emergency response can be stored and tagged to specific valves, interties, or pipeline segments. This will allow for a much more expedient and focused response when needed.

7.0 SUMMARY OF RECOMMENDATIONS AND FUNDING

Recommended project improvements have been organized in the tables below. Reference Exhibit 1 in Appendix A, which shows general locations of these improvements. A resiliency value has been estimated for each improvement as either low, medium, or high. This estimate refers to the perceived increase in resiliency associated with completion of that improvement. An order-of-magnitude cost estimate has been provided for each improvement.

Table 7-1. Water Supply Source Improvements

Project	Resiliency Value	Cost Range
Establishment of third well and WTP upgrades	High	$250K
Two backup wells at current well site	Low	$350K

Table 7-2. Water Transmission/Distribution

Project	Resiliency Value	Cost Range
Bleed out control vault at City limits	High	$100K
Bypass and flow control at WTP	Medium	$150K
Reservoir bypass connection and water main	Medium	$100K
Emergency connection to fire and rescue	Medium	$50K
Bleed out control at Zaddock Creek	Medium	$50K
Bleed out control at Tidelands Water District	Medium	$100k
Replace connection with City of Nehalem	Medium	$100k

Bury trans. main at pedestrian bridge crossing	Low	$200K
Bury trans. main at bridge crossing (101/53)	Low	$250K

Table 7-3. Reservoir Storage

Project	Resiliency Value	Cost Range
Build two 1-million gallon reservoirs	High	$3,500K
Bleed out flow control vaults (4) at reservoirs	Medium	$400K
Structurally reinforce Reservoir #1	Medium	$500K
Seismic connections at three reservoirs	Medium	$150K
Decommission Reservoir #2	Medium	$25K

Table 7-4. Water System Information Management System

Project	Resiliency Value	Cost Range
Build GIS System for Water Infrastructure	High	$31K

Replacement of older water distribution mains will also add to water system resiliency. An average cost factor for replacement of water mains is $125 per linear foot.

7.1 Project Funding

There are several funding opportunities for these projects; many geared for seismic resiliency and emergency planning.

Oregon Office of Emergency Management (OEM) – Provides several grant opportunities to local governments to assist in preparedness and mitigation activities. Two specific programs are the Emergency Management Performance Grant and the Hazard Mitigation Assistance program, funded through the Federal Emergency Management Agency (FEMA). Within the Hazard Mitigation Assistance program, there is also a Pre-Disaster Mitigation Grant.

FEMA Earthquake State Assistance Program – This program is developed to reduce the risks of life and property from future earthquakes through the establishment and maintenance of an effective earthquake risk reduction program.

Water and Wastewater Financing Program – This is a program funded by the state of Oregon through the Infrastructure Finance Authority. This program funds reasonable costs for construction of drinking water systems. Grants are available up to $750,000 depending on financial review.

There are several other financing programs to consider such as Oregon's Water Resource Department (WRD) funds, the Department of Environmental Quality's Clean Water Revolving Loan Fund, and the U.S. Department of Agriculture.

8.0 CONCLUSION

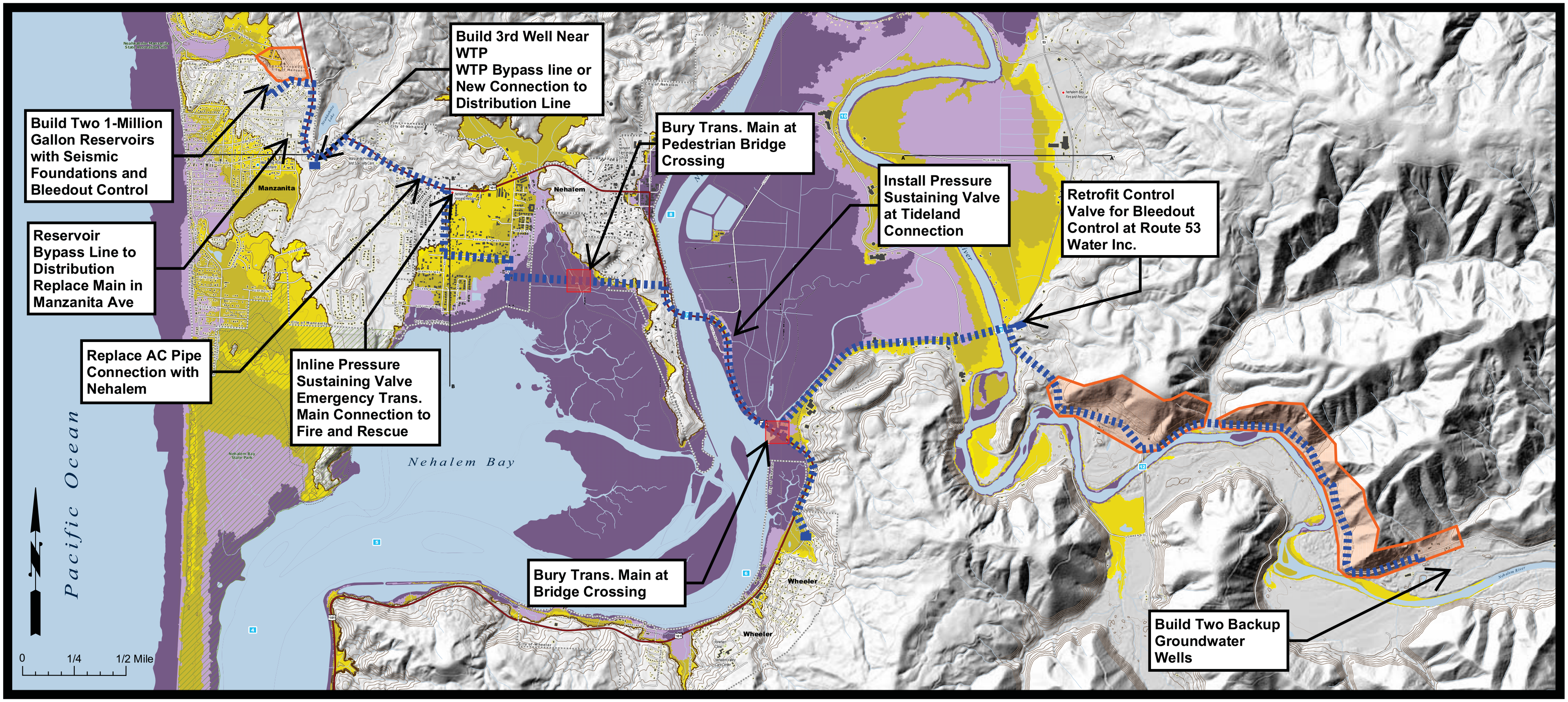
Planning for the Cascadia Subduction Zone seismic event can be a daunting task given the risk factors associated with coastal locations. However, there are several meaningful projects the City can undertake to improve water system resiliency. These projects can be prioritized over a longer time period depending on level of importance and funding opportunities. By incorporating these projects into the water masterplan and/or the capital facilities plan, the City is then prepared to seek funding and grant opportunities. BergerABAM can assist the City in the research and coordination of those funding opportunities.

As discussed throughout the report, it is recommended that the City focus on those projects with the highest resiliency return. Those projects relating to an alternate water supply and to reservoir storage are believed to provide the greatest value. An alternate water supply in a secure location increases the probability that water can be supplied in a much shorter timeframe following the CSV event. Replacement of the reservoirs increases the probability that there will be water storage to fight fires and provide emergency water for residents.

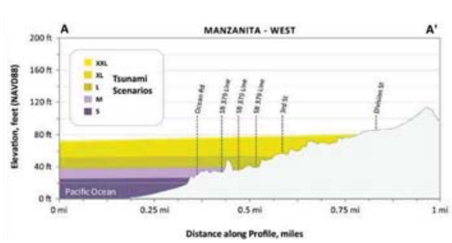
If there are any question or comments about the content of this report, please contact Dan Johnston at anytime at phone number 503/872-4121.

City of Manzanita
Water System Resiliency Study
Manzanita, Oregon

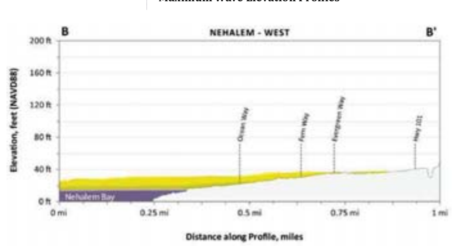
Appendix A
Exhibits



Maximum Wave Elevation Profiles



Maximum Wave Elevation Profiles



lip t)	Maximum Slip Range (ft)	Time to Accumulate Slip (yrs)	Earthquake Magnitude
	118 to 144	1,200	~9.1
	115 to 144	1,050 to 1,200	~9.1
	72 to 98	650 to 800	~9.0
	46 to 62	425 to 525	~8.9
	30 to 36	300	~8.7
one			

Urban Growth Boundary
Building Footprint
Simulated Gauge Station
Profile Location
Senate Bill 379 Line
State Park
Elevation Contour (25 ft intervals up to 200 ft)
Landslide Hazard Area
Existing Transmission Main
Fire Station
Police Station
School
Hospital/Urgent Care Clinic
U.S. Highway
State Highway
Improved Road
Above-Ground Bridge Crossing Hazard

BergerABAM

January 2018

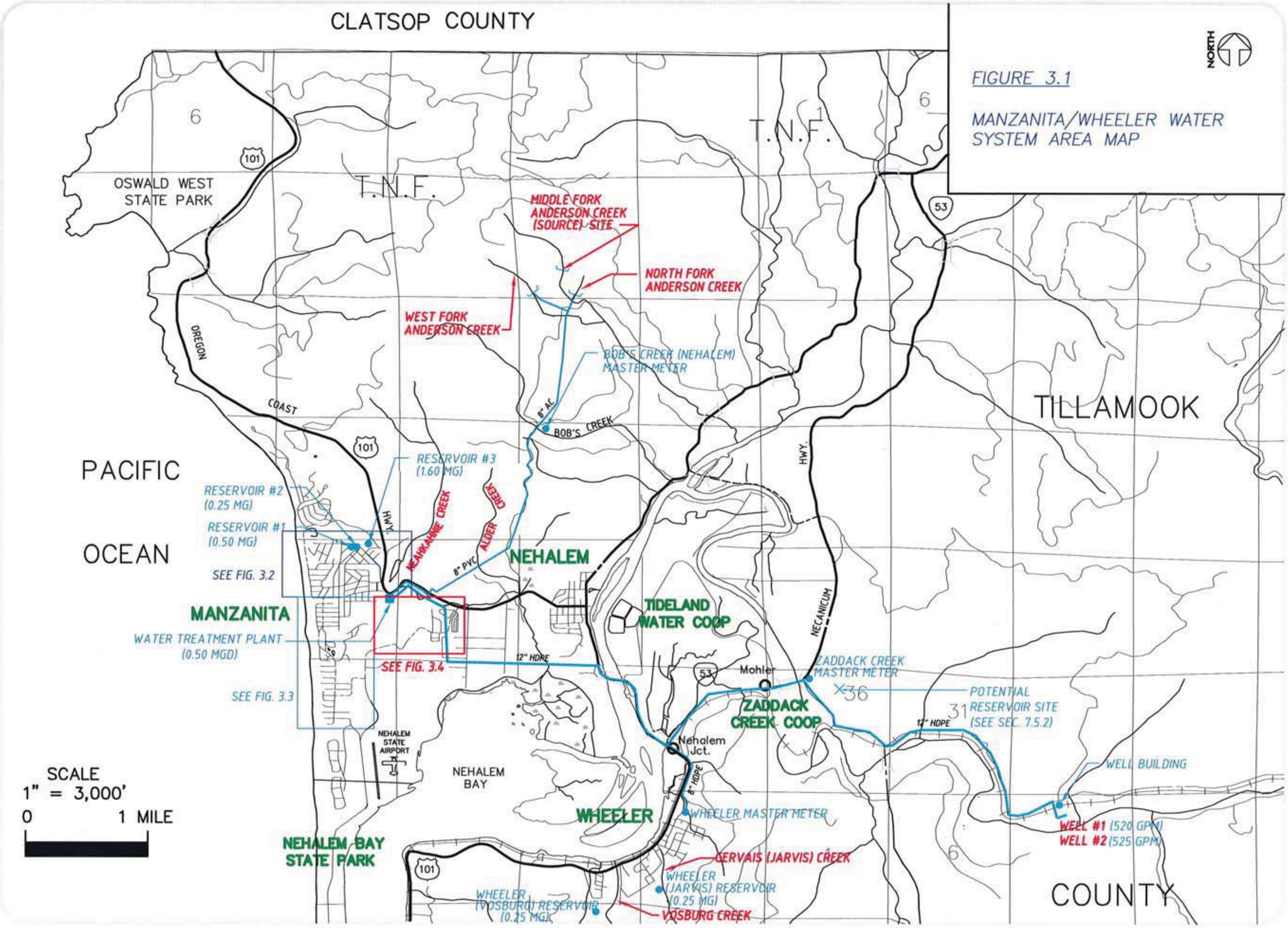
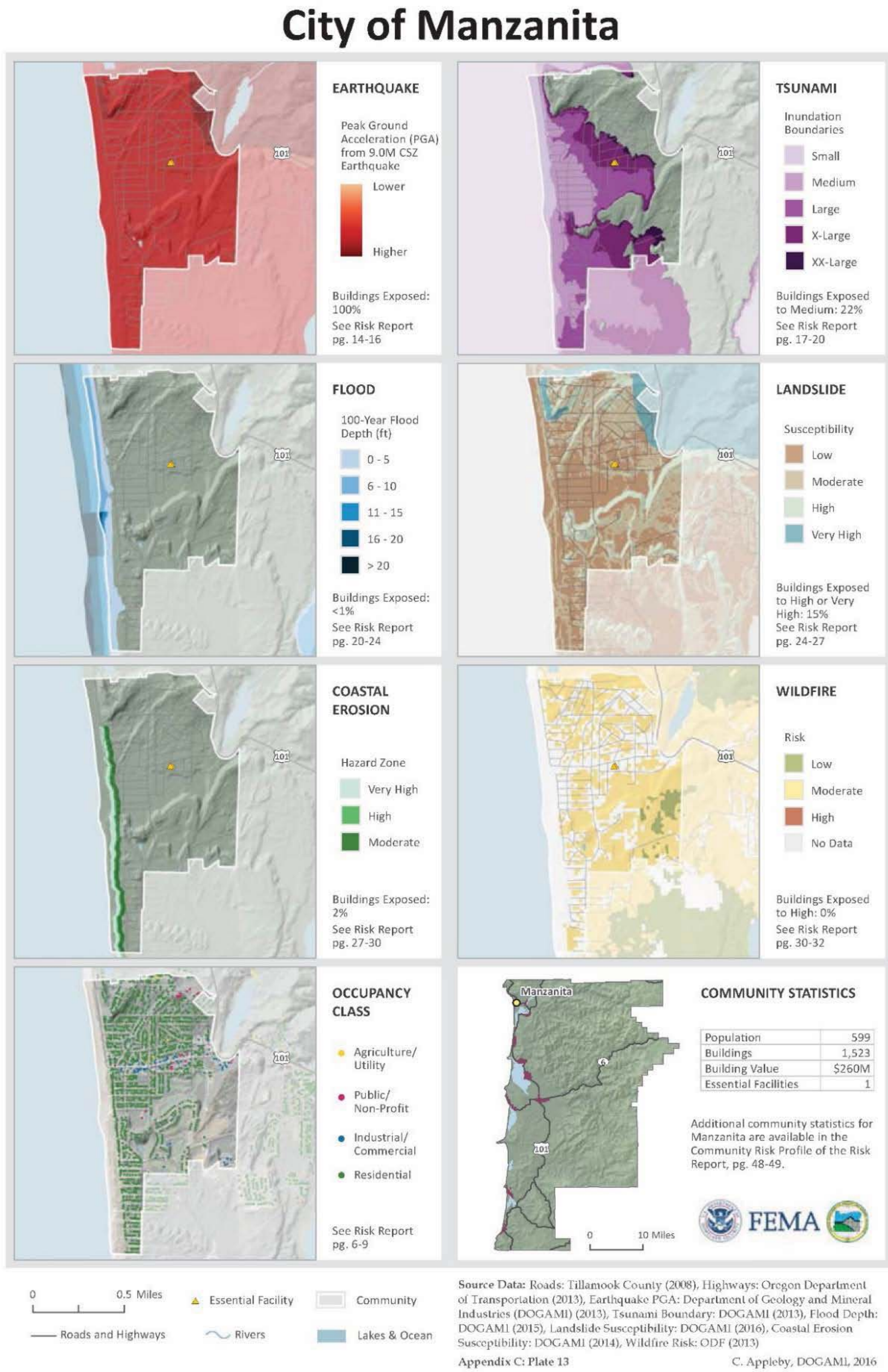


FIGURE 3.1

MANZANITA/WHEELER WATER SYSTEM AREA MAP

Figure 116. Multi-Hazard Community Map Set: City of Manzanita



Population	599
Buildings	1,523
Building Value	$260M
Essential Facilities	1

Source: DOGAMI (2016)

KEY TO THE TABLE

TARGET TIMEFRAME FOR RECOVERY:

Desired time to restore component to 80–90% operational	G
Desired time to restore component to 50–60% operational	Y
Desired time to restore component to 20–30% operational	R
Current State (90% operational)	X

TARGET STATES OF RECOVERY: WATER & WASTEWATER SECTOR (COAST)

	Event occurs	0–24 hours	1–3 days	3–7 days	1–2 weeks	2 weeks – 1 month	1–3 months	3–6 months	6 months–1 year	1–3 years	3 + years
Domestic Water Supply											
Potable water available at supply source (WTP, wells, impoundment)				R		Y		G		X	
Main transmission facilities, pipes, pump stations, and reservoirs (backbone) operational			R	Y	G					X	
Water supply to critical facilities available				R		Y		G		X	
Water for fire suppression—at key supply points			R		Y			G		X	
Water for fire suppression—at fire hydrants						R	Y	G		X	
Water available at community distribution centers/points				R	Y	G	X				
Distribution system operational					R		Y	G			X

(To be continued on next page)

City of Manzanita
Water System Resiliency Study
Manzanita, Oregon

Appendix B
Geotechnical Report

OTAK; kyle.ayers@otak.com

GEOTECHNICAL ENGINEERING SERVICES - Road Slide Reconnaissance
Epoh and College Avenues - Manzanita, OR

This letter summarizes our reconnaissance services for the roadway slide near the water tank on Epoh Avenue in Manzanita, Oregon. You and the City stated that the road movement has occurred over many years and months, has accelerated this year, but does not appear to be rapidly progressing or causing a major safety issue at this time. If that occurs we should be contacted for emergency approaches. The purpose of our services for this phase was to complete a slope reconnaissance and provide qualitative approaches to stabilization, with a scope of work for investigation and more in depth stabilization design parameters if requested. Our scope of work included the following:

- Complete a site reconnaissance of the existing slope conditions, taking clinometer readings of site slopes and observing soil exposures and slope conditions.
- Provide qualitative recommendations for slope repair approaches, and prepare a scope of work for geotechnical parameters for slope repair investigation and design parameters for design by others if requested.
- Summarize our observations and recommendations in a letter report.

SITE CONDITONS

Surface Conditions

We completed a site reconnaissance on August 9, 2017. We observed the asphalt concrete roadway surface and abutting features, and traversed the upper portion of the slope below the guardrail. The primary affected roadway area on Epoh Avenue is located roughly 180 feet NW of the NW edge of the water tank, beginning near the 428 Epoh address driveway, and extends through the radius of the roadway just past the manhole. The cracked and deformed pavement is on the downhill half of the roadway from the centerline, and is roughly 130 feet long. Cracks are up to roughly ¾" wide and are deflected up to 6 inches downhill in aggregate, in a series of longitudinal offset cracks. Much of the cracking is limited to the downhill ¼ of the roadway, with the larger deflections nearer the edge of pavement. A guardrail has been noted as tilting outward over time to its present state. Cracking was noted by the City to have grown this year, particularly after winter rainfall. Lesser cracking is present upslope of the primary area, and dissipates prior to the tank area and around the radius.

The City stated no utilities are located in this downhill half of the roadway, and stated the manhole near the centerline is connected to the south. Old discharge lines from the water tank were stated as not routed in the roadway, and not under use.

The slope below the roadway is inclined at roughly 1.5H:1V in the upper 20-25 vertical feet with brush and small trees present, and below that includes mature conifer growth on roughly 2H:1V slopes on an overall slope roughly 120 feet high.

1112 7th Street, Oregon City, OR 97045 *ph 503.657.3487 fax 503.722.9946*

Subsurface Conditions

We completed two drive probes to depths of up to 5 feet on the slope below the roadway, and observed exposed soils above the roadway. Driving resistance indicated loose conditions in the observed poorly graded fine sand. The upper hillside surface below the roadway is likely comprised of fill placed for roadway construction. Conditions uphill of the roadway were loose to medium dense, and this likely represents the native sand condition.

CONCLUSIONS AND RECOMMENDATIONS

Loose sand fill will maintain slopes near the angle of repose in unsaturated conditions with no cohesion. That is likely near 30 degrees for this sand. The upper slopes are steeper than this. Capillary tension, root involvement, bedding, and aging can result in slopes temporarily holding higher angles. Medium dense sand will hold even steeper angles, particularly if deposited and bedded/laminated with a dip opposite the slope (such as the lee side of dunes). The angle of repose on the native loose to medium dense sand is likely near 32 degrees. The lower slopes are generally flatter than this.

It is our opinion that the upper slope is composed of sand fill downhill from the centerline, and is likely creeping downslope toward equilibrium with its angle of repose, particularly in wet or dry conditions or if heavy vibration was induced. This condition has led to the pavement deformation and cracking. This will likely continue over the long term to a slope edge projected to be near the centerline.

If the present deformation and rates are unsuitable, we recommend reconstructing the downhill half of the roadway in the affected area (approx. 130 foot length) to reduce deformation and cracking. There are two levels of repair described for this herein - Options 1 and 2. The first is more intensive/costly and designed to arrest more movement and limit cracking over the long term (sans earthquake conditions). Both are intended to limit individual crack sizes and offsets, but will likely result in cracking near the centerline over time. Option 3 would simply be to accept the deformation but attempt to reduce seasonal impacts from runoff. Option 4 is only a short term measure that may help until another Option can be completed.

Total upper slope repair is not included herein, and would require more stability analyses, and likely a short wall with pile support at the guardrail combined with Option 1. We can provide a scope for evaluating that level of repair on request.

For each of the following options we recommend roadway runoff be prevented onto the downhill slope, such as with an extruded asphalt concrete curb at pavements edge, with proper runoff routing south on College Avenue.

Option 1

This would involve removal of pavement and 4 feet of roadbed from the centerline to the downhill pavement edge and reconstructing a reinforced crushed rock fill roadbed that extends to the guardrail, and deepening guardrail post depths to 6 feet. After removal, a non-woven geosynthetic could be placed, for separation, such as a Propex Geotex 801 or equivalent. Then a layer of geogrid, such as a Propex Gridpro BXP12 or equivalent, could be placed at the base and every one foot (except the top) to grade, with crushed rock structural fill infill. The grids should be wrapped back over the overlying rock (in a form of loop) and extend back 4 feet toward the centerline tapering down to within 4 inches of itself at the end. This is to aid in retaining the rock should it become exposed. The rock should

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consist of 1-1/2 "- 0 well graded angular clean crushed rock with less than 6% fines, which can also serve as road base. The desired asphalt concrete thickness could then be placed. Future excavation through the grid would damage this repair and that in Option 2.

Option 2
This option would cost less than Option 1 but result in more cracking over time. This option includes removing the top two feet of roadbed on the downhill half of the road, placing geogrid at the base and wrapping it back over to the centerline, then covering it with one foot of the preceding crushed rock and repaving.

Option 3
Mill and regrade and/or repave the roadway with an inverted crown and route the runoff away from the affected area south on College Avenue to suitable discharge, without adding more than a few inches of fill to the downhill edge

Option 4
This is intended to be short term only. Crack seal the roadway and install an extruded asphalt curb.

LIMITATIONS AND OBSERVATION DURING CONSTRUCTION

We have prepared the preceding information for use by OTAK and the City of Manzanita and members of their design and construction teams for the subject slide only. Recommendations for more geotechnical parameters can be provided as addenda to our agreement. The information herein can be used for bidding or estimating purposes, but should not be construed as a warranty of subsurface conditions. We have made observations only at the aforementioned locations, and only at the stated depths. These observations do not reflect soil types, strata thicknesses, water levels or seepage that may exist between observations or at other areas of the site. We should be consulted to review final design and specifications in order to see that our recommendations are suitably followed. If any changes are made to the anticipated locations, loads, configurations, or construction timing, our recommendations may not be applicable, and we should be consulted. The preceding recommendations should be considered preliminary, as actual soil conditions may vary. In order for our recommendations to be final, we must be retained to review final plans, to observe actual subsurface conditions encountered, and to observe pile, grid, and rock fill installation. Our observations will allow us to adapt to actual conditions and to update our recommendations if needed.

1112 7th Street, Oregon City, OR 97045 *ph 503.657.3487 fax 503.722.9946*

We appreciate the opportunity to work with you on this project and look forward to our continued involvement. Please contact us if you have any questions.

Sincerely,

Don Rondema, MS, PE, GE
Principal

Attachments: Site Location, Site photo

1112 7th Street, Oregon City, OR 97045 *ph 503.657.3487 fax 503.722.9946*

N

NOT TO SCALE

BASE PHOTO FROM GOOGLE EARTH 2016 AERIAL

Geotech Solutions Inc.

SITE PLAN

otak-17-1-consult


photo provided by OTAK

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix B

The Village at Manzanita Conceptual Site Plan
Highlighted by the developer to show intended phasing of development, 10/02/2017

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Scale: 1" = 100'

The Village at Manzanita

Conceptual Site Plan **10/2/2017**

Encore Investments, LLC
Developer

Dawson Associates
Planning

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix C

Demographic Data
Oregon Gazetteer
Manzanita, Oregon, July 1, 2019

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Manzanita, OR Profile: Facts & Data

Manzanita, Oregon - Basic Facts

The City of Manzanita had a population of 647 as of July 1, 2019.

The primary coordinate point for Manzanita is located at latitude 45.7184 and longitude -123.9351 in Tillamook County. The formal boundaries for the City of Manzanita encompass a land area of 0.82 sq. miles and a water area of 0 sq. miles. Tillamook County is in the Pacific time zone (GMT -8). The elevation is 59 feet.

Quick & Easy Tools

- Recent Data for Cities, Towns, and ZIP Codes
- Neighborhood Maps, Data, Home Values
- Locate Physical & Cultural Features
- City, Town, and ZIP Code Maps

The City of Manzanita (GNIS ID: 2411027) has a C1 Census Class Code which indicates an active incorporated place that does not serve as a county subdivision equivalent. It also has a Functional Status Code of "A" which identifies **an active government providing primary general-purpose functions**.

Oregon is one of 20 states where Census County Divisions (CCDs) are used for statistical tracking of subdivisions within each county. The City of Manzanita is located within Nehalem Division of Tillamook County.

Jump to... (On This Page!)

1. Manzanita 2019 Demographic Data
2. Growth Rates for Manzanita (Historical & 5-Year Forecast)
3. Peer Comparisons (Rank and Percentile)
4. Neighborhoods Demographics (Home Values, Household Income, etc.)
5. Oregon Research Tools (Easy Tools & Current Data)
6. Oregon Data Comparison Tool - 2019 Demographics

Manzanita, OR - Most Popular Things to Do

- Top 20 Most Popular Places Near Manzanita
- Popularity rankings are based on positive reviews, search queries, and other user data.

Also See: Nearby Photos | Nearby Hotels | Driving Directions

Use HTL Address Research for a Oregon Address and get...

Boundary Maps, Demographic Data, School Zones

Review maps and data for the ***neighborhood***, city, county, ZIP Code, and school zone. July 1, 2019, data includes ***home values, household income, percentage of homes owned, rented or vacant***, etc.

321 Main Street, City, OR 12345 Search

Manzanita, OR Data & Demographics (As of July 1, 2019)

NEW **HOUSING AFFORDABILITY INDEX**

Manzanita, OR Housing Affordability Index is 65

NEW **WEALTH INDEX**

Manzanita, OR Wealth Index is 105

State of Oregon Housing Affordability Index is 83

The Housing Affordability Index base is 100 and represents a balance point where a resident with a median household income can normally qualify to purchase a median price home. Values above 100 indicate increased affordability, while values below 100 indicate decreased affordability.

State of Oregon Wealth Index is 94

The Wealth Index is based on a number of indicators of affluence including average household income and average net worth, but it also includes the value of material possessions and resources. It represents the wealth of the area relative to the national level. Values above or below 100 represent above-average wealth or below-average wealth compared to the national level.

These new demographic attributes are availiable for Neighborhoods, Cities, Counties, and ZIP Codes.

More Tools and Resources:

1. For information about **schools** and **school attendance zones**, use the **HTL Address Tool**
2. Our new **HTL Neighborhood Explorer** provides lots of detail about any neighborhood.
3. The new **2-Minute Introduction and Concise Guide to Big Data** which will help you make the most effective use of HomeTownLocator Tools.
4. See the **References & Data Sources** page for more information about methodology and sources of data.

POPULATION	
Total Population	647
Population in Households	646
Population in Familes	461
Population in Group Qrtrs	1
Population Density	788
Diversity Index[1]	26

HOUSING	
Total Housing Units	1,381 (100%)
Owner Occupied HU	256 (18.5%)
Renter Occupied HU	83 (6.0%)
Vacant Housing Units	1,042 (75.5%)
Median Home Value	$435,246
Housing Affordability Index[2]	65

INCOME	
Median Household Income	$52,615
Average Household Income	$73,043
Per Capita Income	$37,727
Wealth Index[3]	105

HOUSEHOLDS	
Total Households	339
Average Household Size	1.91
Family Households	193
Average Family Size	2

NOTES

1. The Diversity Index is a scale of 0 to 100 that represents the likelihood that two persons, chosen at random from the same area, belong to different race or ethnic groups. If an area's entire population belongs to one race AND one ethnic group, then the area has zero diversity. An area's diversity index increases to 100 when the population is evenly divided into two or more race/ethnic groups.
2. The Housing Affordability Index base is 100 and represents a balance point where a resident with a median household income can normally qualify to purchase a median price home. Values above 100 indicate increased affordability, while values below 100 indicate decreased affordability.
3. The Wealth Index is based on a number of indicators of affluence including average household income and average net worth, but it also includes the value of material possessions and resources. It represents the wealth of the area relative to the national level. Values above or below 100 represent above-average wealth or below-average wealth compared to the national level.

GROWTH RATE / YEAR	2010-2019	2019-2024
Population	0.86%	0.85%
Households	0.8%	0.87%
Families	1.0%	0.72%
Median Household Income		1.81%
Per Capita Income		1.75%

Manzanita, OR - Peer Comparisons by Rank and Percentile

The table below compares Manzanita to the other 378 incorporated cities, towns and CDPs in Oregon by rank and percentile using July 1, 2019 data. The location Ranked # 1 has the highest value. A location that ranks higher than 75% of its peers would be in the 75th percentile of the peer group.

Variable Description	Rank	Percentile

Total Population	# 247	35th
Population Density	# 226	40th
Diversity Index	# 250	34th
Median Household Income	# 200	47th
Per Capita Income	# 58	85th

Additional comparisons and rankings can be made with a **VERY EASY TO USE** Oregon Census Data Comparison Tool.

Quick & Easy Ways to...

1. Get Current Demographic Data for Cities, Towns, and ZIP Codes
2. View Boundary Maps, for Cities, Towns, and ZIP Codes
3. Locate Physical, Cultural, and Historical Features

Oregon Census Data Comparison Tool

Compare Oregon July 1, 2019 Data

Data: Population Population Density Diversity Index Housing Affordability Index Wealth Index

Locations: Cites & Towns Counties ZIP Codes

Highest or Lowest: Show Highest Values Show Lowest Values

Results: Show 20 Results Show 300 Results

Submit

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix D

Water Rights Inventory

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Wheeler Wells

STATE OF OREGON

COUNTY OF TILLAMOOK

PERMIT TO APPROPRIATE THE PUBLIC WATERS

THIS PERMIT IS HEREBY ISSUED TO

CITY OF WHEELER
PO BOX 177
WHEELER, OREGON 97147

The specific limits for the use are listed below along with conditions of use.

APPLICATION FILE NUMBER: G-13479

SOURCE OF WATER: Wells #4, #6, #13, and #10 within the Nehalem River Basin

PURPOSE OR USE: Municipal use

Rate of use: 3.6 CFS

Period of allowed use: The period of allowed use under this permit is year round, however, if senior instream water rights are not met, water use will be curtailed for all use except human consumption and livestock watering until those instream water rights are met.

DATE OF PRIORITY: July 29, 1993.

POINTS OF DIVERSION LOCATION:

NE 1/4 NW 1/4, SECTION 5, T 2 N, R 9 W, W.M.: WELL #4 - 989.22 FEET SOUTH AND 2204.31 FEET EAST; WELL #6 - 1087.73 FEET SOUTH AND 2214.81 FEET EAST; WELL #13 - 1055.75 FEET SOUTH AND 2547.09 FEET EAST; WELL #10 - 905.91 FEET SOUTH AND 2543.69 FEET EAST; ALL FROM THE NW CORNER OF SECTION 5

THE PLACE OF USE IS LOCATED AS FOLLOWS:

WITHIN THE SERVICE AREA OF THE PROPOSED NORTH TILLAMOOK COUNTY REGIONAL WATER SUPPLY, TOWNSHIPS 1, 2 AND 3 NORTH, RANGE 10 WEST, W.M.

Measurement, recording and reporting conditions:

A. Before water use may begin under this permit, the permittee shall install a meter or other suitable measuring device as approved by the Director. The permittee shall maintain the meter or measuring device in good working order, shall keep a complete record of the amount of water used each month and shall submit a report which includes the recorded water use measurements to the Department annually or more frequently as may be required by the Director. Further, the Director may require the permittee to report general water use information, including the place and nature of use of water under the permit.

B. The permittee shall allow the watermaster access to the meter or measuring device; provided however, where the meter or measuring device is located within a private structure, the watermaster shall request access upon reasonable notice.

If substantial interference with a senior water right occurs due to withdrawal of water from any well listed on this permit, then use of water from the well(s) shall be discontinued or reduced and/or the schedule of withdrawal shall be regulated until or unless the Department approves or implements an alternative administrative action to mitigate the interference. The Department encourages junior and senior appropriators to jointly develop plans to mitigate interferences.

Within one year of formation of the Regional Water Supply Authority, the permittee shall submit a water management and conservation plan consistent with OAR Chapter 690, Division 86.

STANDARD CONDITIONS

The wells shall be constructed in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon. The works shall be equipped with a usable access port, and may also include an air line and pressure gauge adequate to determine water shall be limited when it interferes with any prior surface or ground water rights.

Prior to receiving a certificate of water right, the permit holder shall submit the results of a pump test meeting the department's standards, to the Water Resources Department. The Director may require water level or pump test results every ten years thereafter.

The use shall conform to such reasonable rotation system as may be ordered by the proper state officer.

Prior to receiving a certificate of water right, the permit holder shall submit the results of a pump test meeting the department's standards, to the Water Resources Department. The Director may require water level or pump test results every ten years thereafter.

Failure to comply with any of the provisions of this permit may result in action including, but not limited to, restrictions on the use, civil penalties, or cancellation of the permit.

This permit is for the beneficial use of water without waste. The water user is advised that new regulations may require the use of best practical technologies or conservation practices to achieve this end.

By law, the land use associated with this water use must be in compliance with statewide land-use goals and any local acknowledged land-use plan.

The use of water shall be limited when it interferes with any prior surface or ground water rights.

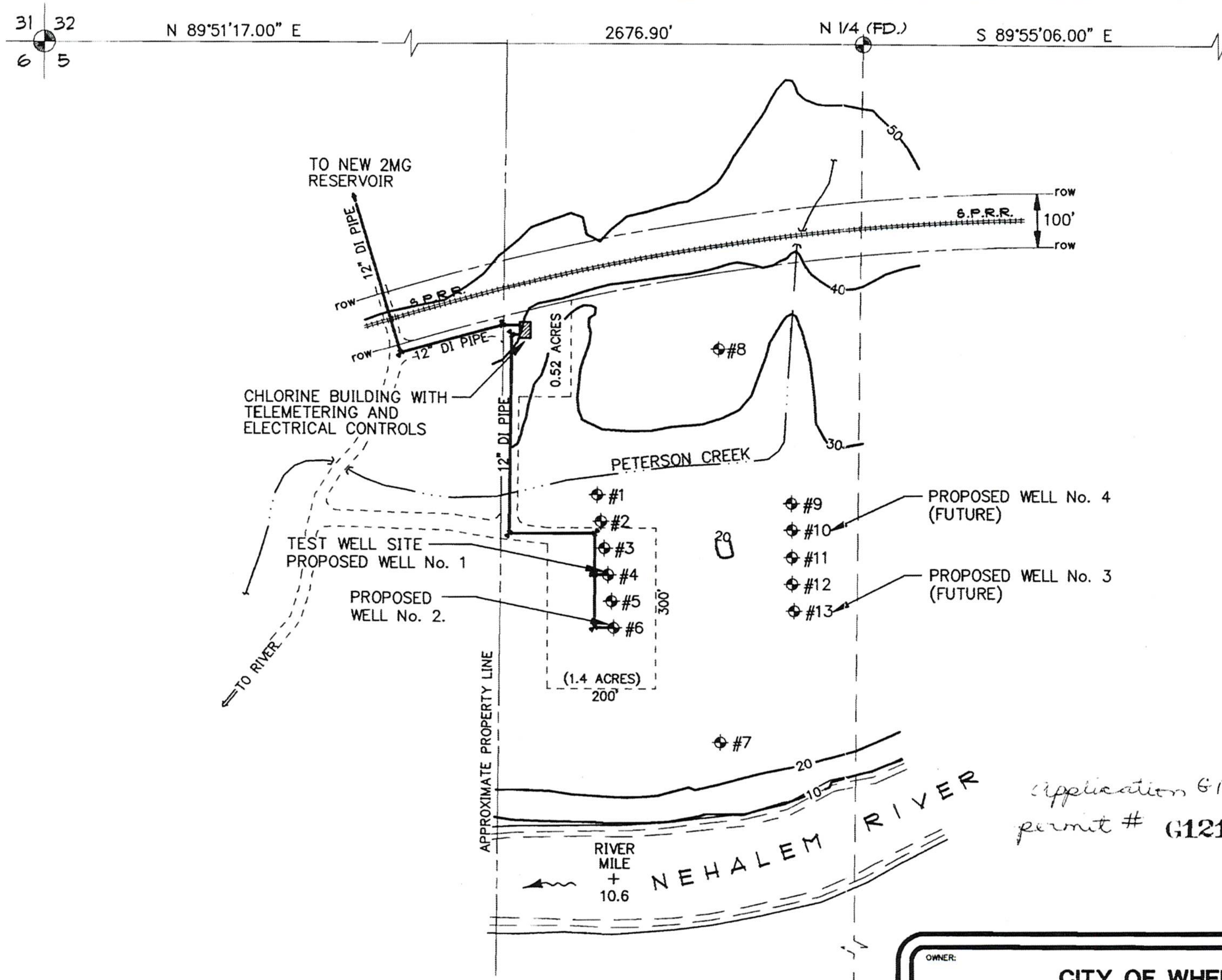
The Director finds that the proposed use(s) of water described by this permit, as conditioned, will not impair or be detrimental to the public interest.

Actual construction of the wells shall begin within one year from permit issuance, and shall be completed on or before October 1, 1997. Complete application of the water to the use shall be made on or before October 1, 1999.

Issued this date, November 6, 1995

Steve Applegate

Water Resources Department
for Martha O. Pagel
Director



T.2N., R.9W., SECTION 5

N

0 100 200 400

(IN FEET)

1 inch = 200 ft.

THIS MAP IS FOR THE PURPOSE OF IDENTIFYING THE LOCATION OF POINT(S) OF DIVERSION AND PLACE(S) OF USE OF THE WATER RIGHTS ONLY AND IS NOT INTENDED TO PROVIDE LEGAL DIMENSIONS OF THE PROPERTIES ILLUSTRATED HEREIN.

WELL SITE LOCATIONS

WELL DISTANCE IN FEET FROM SECTION CORNER OF SECTIONS 5, 6, 31, AND 32. BASIS OF BEARING IS N 89°51'17" E.

WELL No.	NORTH	EAST
1 (#4)	989.22	2204.31
2 (#6)	1087.73	2214.81
3 (#13)	1055.75	2547.09
4 (#10)	905.91	2543.69

Application G13479
permit # G12196

Certified Water Right Examiner
#279 WRE
F. Duane Lee
May 30, 1991
STATE OF OREGON

OWNER: CITY OF WHEELER	LEE ENGINEERING, INC. 1300 JOHN ADAMS ST. OREGON CITY, OR, 97045	
DWG TITLE: GROUND WATER APPLICATION G-13479 WELL LOCATIONS	DATE: 10/31/94 FILE NO: 1384S01 REVISED:	FIGURE 1

Permit A—5M—1-76

21322

SP*32956-090

Anderson Creek
North Fork
Middle Fork

STATE OF OREGON

COUNTY OF TILLAMOOK

CERTIFICATE OF WATER RIGHT

This Is to Certify, *That* CITY OF MANZANITA

of Manzanita *, State of* Oregon, 97130 *, has made proof to the satisfaction of the Water Resources Director, of a right to the use of the waters of* Beniteau Creek and an unnamed stream

a tributary of North Fork Nehalem River *for the purpose of* municipal

under Permit No. 17073 *and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from* December 10, 1945

that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed 0.5 cubic foot per second, being 0.25 c.f.s. from each source

or its equivalent in case of rotation, measured at the point of diversion from the stream. The point of diversion is located in the NW¼ NE¼, Section 15, T. 3 N., R. 10 W., W. M., 200 feet South and 3400 feet East; 300 feet South and 3100 feet East, both from the SW Corner, Section 10

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to——————*of one cubic foot per second per acre,*

and shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use under the right hereby confirmed, and to which such right is appurtenant, is as follows:

All
Section 29
NE¼
E½ SW¼
SE¼
Section 32
SW¼ NE¼
S½ NW¼
SW¼
Section 33
T. 3 N., R. 10 W., W. M.

N½ NW¼
Section 4
N½ NE¼
NE¼ NW¼
Section 5
T. 2 N., R. 10 W., W. M.

The right to the use of the water for the purposes aforesaid is restricted to the lands or place of use herein described and is subject to the existing minimum flow policies established by the Water Policy Review Board.

WITNESS the signature of the Water Resources Director, affixed this date. September 12, 1977

James E. Sexson
Water Resources Director

Recorded in State Record of Water Right Certificates, Volume 36 *, page* 4775

Permit—3M—4-45

Permit No. 17073

CERTIFICATE NO. 44775

*** APPLICATION FOR PERMIT**

To Appropriate the Public Waters of the State of Oregon

I, City of Manzanita ~~Water District~~ (Name of applicant)

of Manzanita (Mailing address), Tillamook County,

State of Oregon, do hereby make application for a permit to appropriate the following described public waters of the State of Oregon, SUBJECT TO EXISTING RIGHTS:

If the applicant is a corporation, give date and place of incorporation

1. The source of the proposed appropriation is Beniteau Creek and an unnamed stream (Name of stream), a tributary of North Fork, Nehalem River

2. The amount of water which the applicant intends to apply to beneficial use is 2½ cubic feet per second. being 1.25 cfs from each source (If water is to be used from more than one source, give quantity from each)

**3. The use to which the water is to be applied is Domestic supplies (Irrigation, power, mining, manufacturing, domestic supplies, etc.)

4. The point of diversion is located ~~1130~~ ~~200~~ 300 ft. ~~North~~ ~~S~~ S (N. or S.) and ~~1500~~ ~~3400~~ 3100 ft. ~~East~~ ~~E~~ E (E. or W.) from the Southwest corner of Section 10, Township 3 North Range 10 West (Section or subdivision)

Willamette Meridian, Tillamook County

(If preferable, give distance and bearing to section corner)

(If there is more than one point of diversion, each must be described. Use separate sheet if necessary)

being within the NW¼ NE¼ (Give smallest legal subdivision) of Sec. 15, Tp. 3 N (N. or S.), R. 10 W (E. or W.), W. M., in the county of Tillamook

5. The pipeline (Main ditch, canal or pipe line) to be approximately 4 miles (Miles or feet) in length, terminating in the (Smallest legal subdivision) of Sec. 29, Tp. 3 N (N. or S.), R. 10 W (E. or W.), W. M., the proposed location being shown throughout on the accompanying map.

DESCRIPTION OF WORKS

Diversion Works—

6. (a) Height of dam 6 feet, length on top 40 feet, length at bottom 30 feet; material to be used and character of construction Concrete (Loose rock, concrete, masonry, rock and brush, timber crib, etc., wasteway over or around dam)

(b) Description of headgate 20' spillway section (Timber, concrete, etc., number and size of openings)

(c) If water is to be pumped give general description (Size and type of pump)

(Size and type of engine or motor to be used, total head water is to be lifted, etc.)

*A different form of application is provided where storage works are contemplated.

**Application for permits to appropriate water for the generation of electricity, with the exception of municipalities, must be made to the Hydroelectric Commission. Either of the above forms may be secured, without cost, together with instructions by addressing the State Engineer, Salem, Oregon.

17073 :8

Canal System or Pipe Line—

7. (a) Give dimensions at each point of canal where materially changed in size, stating miles from headgate. At headgate: width on top (at water line) .... feet; width on bottom .... feet; depth of water .... feet; grade .... feet fall per one thousand feet.

(b) At .... miles from headgate: width on top (at water line) .... ~~feet;~~ width on bottom .... feet; depth of water .... feet; grade .... feet fall per one thousand feet.

(c) Length of pipe, 21120 ft.; size at intake, 8 in.; size at 10560 ft. from intake 6 in.; size at place of use (reservoir) 6" in.; difference in elevation between intake and place of use, 375 ft. Is grade uniform? No Estimated capacity, $2\frac{1}{2}$ sec. ft.

8. Location of area to be irrigated, or place of use City of Manzanita ~~Water District~~

Township	Range	Section	Forty-acre Tract	Number Acres To Be Irrigated
3 N	10 W	29	$N\frac{1}{2}$	

(If more space required, attach separate sheet)

(a) Character of soil ....

(b) Kind of crops raised ....

Power or Mining Purposes—

9. (a) Total amount of power to be developed .... theoretical horsepower.

(b) Quantity of water to be used for power .... sec. ft.

(c) Total fall to be utilized .... (Head) feet.

(d) The nature of the works by means of which the power is to be developed ....

(e) Such works to be located in .... (Legal Subdivision) of Sec. ....,

Tp. .... (No. N. or S.), R. .... (No. E. or W.), W. M.

(f) Is water to be returned to any stream? .... (Yes or No)

(g) If so, name stream and locate point of return ....

........, Sec. ...., Tp. .... (No. N. or S.), R. .... (No. E. or W.), W. M.

(h) The use to which power is to be applied is ....

(i) The nature of the mines to be served ....

Municipal or Domestic Supply—

10. (a) *To supply the city of* Manzanita

Tillamook *County, having a present population of* 800, (300 permanent, 500 transient)
(Name of)

and an estimated population of 650 250 (permanent 400 (transient *in 19*40

(b) *If for domestic use state number of families to be supplied* 320 (120 permanent, 200 transient)

(Answer questions 11, 12, 13, and 14 in all cases)

11. *Estimated cost of proposed works, $* $20,000

12. *Construction work will begin on or before* 2-15-45

13. *Construction work will be completed on or before* 4-15-45

14. *The water will be completely applied to the proposed use on or before* 4-30-45

(Sgd) F E Everhart Chmn

(Sgd) G. L. Adamscheck
(Signature of applicant)

(Sgd) Theo. Jensen

Remarks: Water at present being supplied by City of Nehalem, whose supply is inadequate to serve present and anticipated needs.

STATE OF OREGON, }
County of Marion, } *ss*

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for ....

In order to retain its priority, this application must be returned to the State Engineer, with corrections on or before ...., *194*....

WITNESS my hand this .... *day of* ...., *194*....

....
STATE ENGINEER

17073 c

Application No. 21322

Permit No. 17073

PERMIT

TO APPROPRIATE THE PUBLIC WATERS OF THE STATE OF OREGON

Division No. .... *District No.* ....

This instrument was first received in the office of the State Engineer at Salem, Oregon,

on the 10th *day of* December,

194 5 *at* 1:15 *o'clock* P. *M.*

Returned to applicant:

Corrected application received:

Approved:

October 1, 1946

Recorded in book No. 42 *of*

Permits on page 17073

CHAS. E. STRICKLIN

STATE ENGINEER

Drainage Basin No. 1 *Page* 12A

Fees Paid $12.00

PERMIT

STATE OF OREGON, }
County of Marion, } ss

This is to certify that I have examined the foregoing application and do hereby grant the same, SUBJECT TO EXISTING RIGHTS and the following limitations and conditions:

The right herein granted is limited to the amount of water which can be applied to beneficial use and shall not exceed 2.50 *cubic feet per second measured at the point of diversion from the stream, or its equivalent in case of rotation with other water users, from* Beniteau Creek and an unnamed stream, being 1.25 c.f.s. from each

The use to which this water is to be applied is municipal

If for irrigation, this appropriation shall be limited to - - - - - - - - - - - *of one cubic foot per second*

and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.

The priority date of this permit is December 10, 1945

Actual construction work shall begin on or before October 1, 1947 *and shall thereafter be prosecuted with reasonable diligence and be completed on or before* October 1, 1948

Extended to Oct. 1, 1952
Extended to Oct. 1, 1956
Extended to Oct. 1, 1957
Extended to Oct. 1, 1958
Extended to Oct. 1, 1960
Extended to Oct. 1, 1963
Extended to Oct. 1, 1965
Extended to Oct. 1, 1967
Extended to Oct. 1, 1969
Extended to Oct. 1 1971
Extended to Oct. 1 1972

Complete application of the water to the proposed use shall be made on or before October 1, 1949

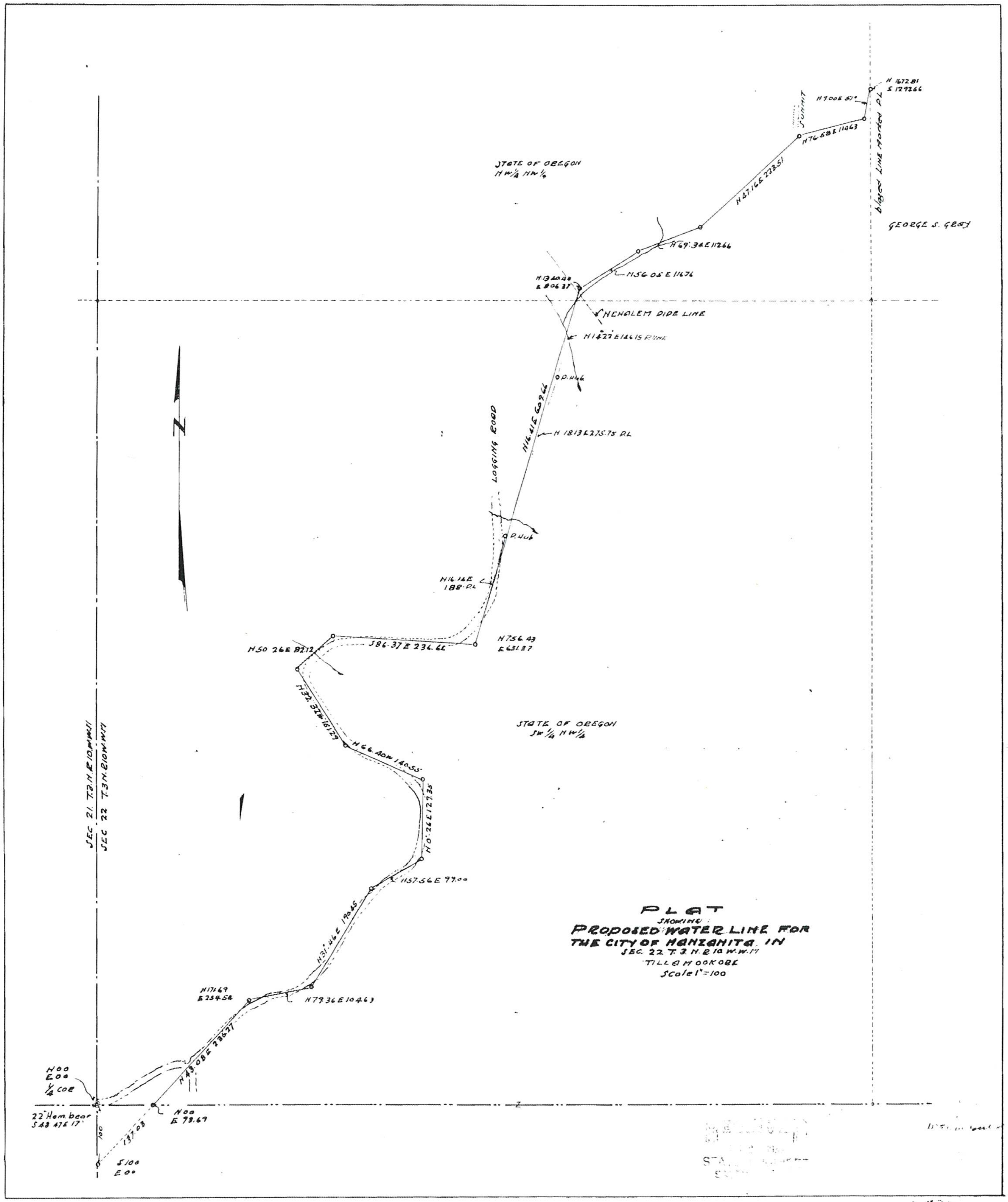
Extended to Oct. 1, 1952
Extended to Oct. 1, 1956
Extended to Oct. 1, 1957
Extended to Oct. 1, 1958
Extended to Oct. 1, 1960
Extended to Oct. 1, 1963
Extended to Oct. 1, 1965
Extended to Oct. 1, 1967
Extended to Oct. 1, 1969
Extended to Oct. 1 1972

WITNESS my hand this 1st *day of* October, 194 6.

CHAS. E. STRICKLIN

STATE ENGINEER

Permits for power development are subject to the payment of annual fees as provided in sections 1 and 2, chapter 74, Oregon Laws 1933.


PLAT
SHOWING
PROPOSED WATER LINE FOR
THE CITY OF MANZANITA IN
SEC. 22 T. 3 N. R 10 W. W. M
TILLAMOOK CO.
Scale 1" = 100
STATE OF OREGON
NW 1/4 NW 1/4
STATE OF OREGON
SW 1/4 NW 1/4
GEORGE S. GRAY
SUMMIT
NEHALEM PIPE LINE
LOGGING ROAD
SEC 21 T.3N.R10W.W.M
SEC 22 T.3N.R10W.W.M
N43.08E 236.21
N79.36E 104.63
N31.46E 190.65
N57.56E 77.00
N0.26E 127.35
N66.40W 140.55
N32.32W 161.29
N50.26E 82.12
S86.37E 234.66
N16.41E 609.66
N56.05E 116.76
N69.36E 112.66
N47.16E 223.51
N76.58E 114.63
N90.05 61'
N 1672.81
S 1292.66
N 756.43
E 631.37
N 171.69
E 254.58
N 00
E 00
1/4 COR
22" Hem. bear
S 48 47 E 17'
N 00
E 79.69
S 100
E 00
P. Hub
P. Hub

A-73

LOCATION MAP
PROPOSED PIPELINE AND DIVERSION
FOR
CITY OF MANZANITA
TILLAMOOK COUNTY
OREGON

PREPARED BY
BOATWRIGHT ENGR. & SURVEY CO.
SALEM, OREGON

Anderson Creek
West Fork

This is a final order in other than a contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review must be filed within the 60 day time period specified by ORS 183.484(2). Pursuant to ORS 536.075 and OAR 137-004-0080 you may either petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the Director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied. In addition, under ORS 537.260 any person with an application, permit or water right certificate subsequent in priority may jointly or severally contest the issuance of the certificate at any time before it has issued, and after the time has expired for the completion of the appropriation under the permit, or within three months after issuance of the certificate.

STATE OF OREGON

COUNTY OF TILLAMOOK

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

CITY OF MANZANITA
P. O. BOX C
MANZANITA, OREGON 97130

confirms the right to use the waters of WEST FORK ANDERSON CREEK, a tributary of NORTH FORK NEHALEM RIVER, for MUNICIPAL USE.

This right was perfected under Permit 43756. The date of priority is DECEMBER 15, 1978. This right is limited to 0.5 CUBIC FOOT PER SECOND or its equivalent in case of rotation, measured at the point of diversion from the source.

The point of diversion is located as follows:

NE 1/4 NW 1/4, SECTION 15, T 3 N, R 10 W, W.M.; 460 FEET SOUTH AND 780 FEET WEST FROM N 1/4 CORNER, SECTION 15.

A description of the place of use to which this right is appurtenant is as follows:

WITHIN THE SERVICE BOUNDARIES OF THE CITY OF MANZANITA

The right to the use of the water for the above purpose is restricted to beneficial use on the lands or place of use described. The use confirmed herein may be made only at times when sufficient water is available to satisfy all prior rights, including rights for maintaining instream flows.

WITNESS the signature of the Water Resources Director, affixed

SEP 01 2006.

Dwight French for
Phillip C. Ward, Director
Water Resources Department

Recorded in State Record of Water Right Certificates Number 82159.

S-57745.JWG

Application No. 57745 *Permit No.* 43756

RECEIVED
DEC 15 1978
WATER RESOURCES DEPT.
SALEM, OREGON

STATE OF OREGON WATER RESOURCES DEPARTMENT

Application for Permit to Appropriate Surface Water

I, City of Manzanita
(Name of Applicant)

of P.O. Box C Manzanita ,
(Mailing Address) (City)

State of Oregon , 97130 (Zip Code) *Phone No.* 368-5343 *do hereby make application for a permit to appropriate the following described waters of the State of Oregon:*

1. The source of the proposed appropriation is West Fork, Anderson Creek aka Beniteau Cr. *, a tributary of* N. Fork, Nehalem River

2. The point of diversion is to be located 322.84 *ft.* S52°34'W (N. or S.) *and* 238.78 *ft.* N66°-26' (E. or W.) 91.99 ft S14°-44-W, 207.49 ft. S30°45'E, 207.49ft.S75-11 W, and 85.61ft N89°-48"W *from the* ¼ *corner of* common to Sections 10 & 15, T3N, R10W, W.M. (Public Land Survey Corner)

(If there is more than one point of diversion, each must be described)

450 ft S & 780 ft W from the [illegible]

being within the NE *¼ of the* NW *¼ of Sec.* 15 *Tp.* 3N (N. or S.) *R.* 10W (E. or W.), *W. M., in the county of* Tillamook

3. Location of area to be irrigated, or place of use if other than irrigation.

Township	Range	Section	List ¼ ¼ of Section	List use and/or number of acres to be irrigated
3N	10W	29	Entire Sec. to Ocean	474) not irrigated;
3N	10W	32	Entire Sec to Ocean	429) comprises urban service
3N	10W	28	SW 1/4	134) area City of
3N	10W	33	NW¼ NW¼ NE¼ NW¼ SW¼	141) Manzanita
			NW¼ plus Ptn SE¼	
			NW¼	

Form 690-1-0-1-77

4. *The amount of water which the applicant intends to apply to beneficial use is* 0.5

cubic feet per second.

(If water is to be used from more than one source, give quantity from each)

5. *The use to which the water is to be applied is* Municipal

6. *DESCRIPTION OF WORKS*

Include dimensions and type of construction of diversion dam and headgate, length and dimensions of supply ditch or pipeline, size and type of pump and motor, type of irrigation system to adequately describe the proposed distribution system.

Reinf. Conc. Diversion Dam 8' high 45' long @top, 15 ft long at bottom with timber flashboards 8' long; 6" pipeline 1377 ft long connecting to existing 8" supply line to City just below existing main diversion dam.

If for domestic use state number of families to be supplied

7. *Construction work will begin on or before* August 1, 1979

8. *Construction work will be completed on or before* October 1, 1979

9. *The water will be completely applied to the proposed use on or before* July 1985

Application No. 57745 *Permit No.* 43756

Remarks:

City of Monzonita
Signature of Applicant
by Howard Welson City Manager

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for

In order to retain its priority, this application must be returned to the Water Resources Director with corrections on or before ..., 19...

WITNESS my hand this ... day of ..., 19...

... *Water Resources Director*

By ...

This instrument was first received in the office of the Water Resources Director at Salem, Oregon, on the 4th *day of* August, *19*78, *at* 8 *o'clock* A *M.*

Application No. 57745

Permit No. 43756

Application No. 57745 Permit No. 43756

Permit to Appropriate the Public Waters of the State of Oregon

This is to certify that I have examined the foregoing application and do hereby grant the same SUBJECT TO EXISTING RIGHTS INCLUDING THE EXISTING FLOW POLICIES ESTABLISHED BY THE WATER POLICY REVIEW BOARD and the following limitations and conditions:

The right herein granted is limited to the amount of water which can be applied to beneficial use and shall not exceed 0.5 *cubic feet per second measured at the point of diversion from the stream, or its equivalent in case of rotation with other water users, from* West Fork Anderson Creek.

The use to which this water is to be applied is Municipal

If for irrigation, this appropriation shall be limited to .... *of one cubic foot per second or its equivalent for each acre irrigated*

and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.

The priority date of this permit is December 15, 1978

Actual construction work shall begin on or before January 10, 1980 *and shall thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 19*80

Extended to October 1, 1988 Extended to October 1, 199?

*Complete application of the water to the proposed use shall be made on or before October 1, 19*81

Extended to October 1, 1988 Extended to October 1, 1993

WITNESS my hand this 10th *day of* January, *19*79

James E. Sexson

Water Resources Director

CITY OF MANZANITA
WATER RIGHTS APP.
JULY, 1978
W. FORK ANDERSON CREEK
(BENITEAU CREEK)

T3N, R10W, W.M.

RECEIVED
AUG 4 1978
WATER RESOURCES DEPT.
SALEM, OREGON

Application No. 57745
Permit No.

Alder Creek

STATE OF OREGON

COUNTY OF TILLAMOOK

CERTIFICATE OF WATER RIGHT

This Is to Certify, *That* CITY OF MANZANITA

of Manzanita *, State of* Oregon *, has made proof to the satisfaction of the STATE ENGINEER of Oregon, of a right to the use of the waters of* Lange Creek *a tributary of* Nehalem Bay *for the purpose of* municipal *under Permit No.* 18634 *of the State Engineer, and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from* September 14, 1948

;

that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed 0.50 cubic foot per second

or its equivalent in case of rotation, measured at the point of diversion from the stream.

The point of diversion is located in the NW$\frac{1}{4}$ SE$\frac{1}{4}$, Section 21, Township 3 North, Range 10 West, W.M.

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to – – – – – – – – *of one cubic foot per second per acre,*

and shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use under the right hereby confirmed, and to which such right is appurtenant, is as follows:

S$\frac{1}{2}$ NE$\frac{1}{4}$
Lot #2 (SE$\frac{1}{4}$ NW$\frac{1}{4}$)
Lot #3 (NE$\frac{1}{4}$ SW$\frac{1}{4}$)
Lot #4 (SE$\frac{1}{4}$ SW$\frac{1}{4}$)
SE$\frac{1}{4}$
Section 29
N$\frac{1}{2}$ NE$\frac{1}{4}$
Lot #1 (NE$\frac{1}{4}$ NW$\frac{1}{4}$)
Section 32
Township 3 North, Range 10 West, W.M.

The right to the use of the water for the purposes aforesaid is restricted to the lands or place of use herein described.

WITNESS the signature of the State Engineer, affixed

this 21st *day of* September *, 19*56 *.*

LEWIS A. STANLEY
State Engineer

Recorded in State Record of Water Right Certificates, Volume 16 *, page* 21684

[redacted]

Permit—12C—1-49

Permit No. 18634

CERTIFICATE NO. 21684

* APPLICATION FOR PERMIT

To Appropriate the Public Waters of the State of Oregon

I, City of Manzanita
(Name of applicant)

of ...., ...,
(Mailing address)

State of Oregon, do hereby make application for a permit to appropriate the following described public waters of the State of Oregon, SUBJECT TO EXISTING RIGHTS:

If the applicant is a corporation, give date and place of incorporation ....

1. The source of the proposed appropriation is Lang Creek
(Name of stream)
..............................., a tributary of Nehalem Bay

2. The amount of water which the applicant intends to apply to beneficial use is 0.50 cubic feet per second.
(If water is to be used from more than one source, give quantity from each)

**3. The use to which the water is to be applied is municipal
(Irrigation, power, mining, manufacturing, domestic supplies, etc.)

4. The point of diversion is located ~~ft. and ft. from the~~
(N. or S.) (E. or W.)
~~corner of~~ N. 43°17' E. 1947.6 ft. from the S $\frac{1}{4}$ corner of Sec. 21, T. 3 N., R. 10 W., W.M.
(Section or subdivision)

(If preferable, give distance and bearing to section corner)

(If there is more than one point of diversion, each must be described. Use separate sheet if necessary)

being within the NE$\frac{1}{4}$ SE$\frac{1}{4}$ of Sec. 21, Tp. 3 N,
(Give smallest legal subdivision) (N. or S.)

R. 10 W, W. M., in the county of Tillamook
(E. or W.)

5. The pipe to be 2 miles
(Main ditch, canal or pipe line) (Miles or feet)

in length, terminating in the .... of Sec. ...., Tp. ....,
(Smallest legal subdivision) (N. or S.)

R. ...., W. M., the proposed location being shown throughout on the accompanying map.
(E. or W.)

DESCRIPTION OF WORKS

Diversion Works—

6. (a) Height of dam 9.9 feet, length on top 20 feet, length at bottom 15 feet; material to be used and character of construction timber
(Loose rock, concrete, masonry, rock and brush, timber crib, etc., wasteway over or around dam)

(b) Description of headgate ....
(Timber, concrete, etc., number and size of openings)

(c) If water is to be pumped give general description gravity flow
(Size and type of pump)

(Size and type of engine or motor to be used, total head water is to be lifted, etc.)

* A different form of application is provided where storage works are contemplated.

** Application for permits to appropriate water for the generation of electricity, with the exception of municipalities, must be made to the Hydroelectric Commission. Either of the above forms may be secured, without cost, together with instructions by addressing the State Engineer, Salem, Oregon.

18634

Canal System or Pipe Line—

7. (a) Give dimensions at each point of canal where materially changed in size, stating miles from headgate. At headgate: width on top (at water line) .... feet; width on bottom .... feet; depth of water .... feet; grade .... feet fall per one thousand feet.

(b) At .... miles from headgate: width on top (at water line) .... feet; width on bottom .... feet; depth of water .... feet; grade .... feet fall per one thousand feet.

(c) Length of pipe, 5,600 ft.; size at intake, 6 in.; size at .... ft. from intake .... in.; size at place of use 6 in.; difference in elevation between intake and place of use, 75 ft. Is grade uniform? .... Estimated capacity, ... sec. ft.

8. Location of area to be irrigated, or place of use ....

Township	Range	Section	Forty-acre Tract	Number Acres To Be Irrigated
3 N	10 W	29	S½ NE¼	
			Lot 2 (SE¼ NW¼)	
			Lot 3 (NE¼ SW¼)	
			N½ SE¼	

(If more space required, attach separate sheet)

(a) Character of soil ....

(b) Kind of crops raised ....

Power or Mining Purposes—

9. (a) Total amount of power to be developed .... theoretical horsepower.

(b) Quantity of water to be used for power .... sec. ft.

(c) Total fall to be utilized .... (Head) feet.

(d) The nature of the works by means of which the power is to be developed ....

(e) Such works to be located in .... (Legal Subdivision) of Sec. ...., Tp. .... (No. N. or S.), R. .... (No. E. or W.), W. M.

(f) Is water to be returned to any stream? .... (Yes or No)

(g) If so, name stream and locate point of return ...., Sec. ...., Tp. .... (No. N. or S.), R. .... (No. E. or W.), W. M.

(h) The use to which power is to be applied is ....

(i) The nature of the mines to be served ....

Municipal or Domestic Supply—

10. (a) To supply the city of Manzanita

.... County, having a present population of 600
(Name of)

and an estimated population of 800 in 19 50

(b) If for domestic use state number of families to be supplied ....

(Answer questions 11, 12, 13, and 14 in all cases)

11. Estimated cost of proposed works, $ 7000.00

12. Construction work will begin on or before One year after approval

13. Construction work will be completed on or before Two years " "

14. The water will be completely applied to the proposed use on or before 3 " " "

City of Manzanita

By (Sgd) Ben S. Lane Meyor
(Signature of applicant)

Remarks: ....

STATE OF OREGON,
County of Marion, } ss.

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for ....

In order to retain its priority, this application must be returned to the State Engineer, with corrections on or before ...., 19......

WITNESS my hand this .... day of ...., 19......

....
STATE ENGINEER

Application No. 23417

Permit No. 18634

PERMIT

TO APPROPRIATE THE PUBLIC WATERS OF THE STATE OF OREGON

Division No. .... District No. ....

This instrument was first received in the office of the State Engineer at Salem, Oregon, on the 14th *day of* September, 1948, *at* 1:40 *o'clock* P. *M.*

Returned to applicant:

Corrected application received:

Approved:

April 25, 1949

Recorded in book No. 45 *of Permits on page* 18634

CHAS. E. STRICKLIN

STATE ENGINEER

Drainage Basin No. 1 *Page* 12 B

Fees Paid 20.00

PERMIT

STATE OF OREGON, }
ss.
County of Marion, }

This is to certify that I have examined the foregoing application and do hereby grant the same, SUBJECT TO EXISTING RIGHTS and the following limitations and conditions:

The right herein granted is limited to the amount of water which can be applied to beneficial use and shall not exceed 0.50 *cubic feet per second measured at the point of diversion from the stream, or its equivalent in case of rotation with other water users, from* Lang Creek

The use to which this water is to be applied is municipal

If for irrigation, this appropriation shall be limited to - - - - *of one cubic foot per second*

and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.

The priority date of this permit is September 14, 1948

Actual construction work shall begin on or before April 25, 1950 *and shall thereafter be prosecuted with reasonable diligence and be completed on or before* October 1, 1951

Complete application of the water to the proposed use shall be made on or before October 1, 1952

WITNESS my hand this 25th *day of* April, 19 49.

CHAS. E. STRICKLIN

STATE ENGINEER

Permits for power development are subject to the payment of annual fees as provided in sections 1 and 2, chapter 74, Oregon Laws 1933.

State Printing Dept. 28175

Neahkahnie Creek
Alder Creek

STATE OF OREGON

COUNTY OF TILLAMOOK

CERTIFICATE OF WATER RIGHT

This Is to Certify, That CITY OF MANZANITA

of Manzanita, State of Oregon, has made proof to the satisfaction of the STATE ENGINEER of Oregon, of a right to the use of the waters of Classic Lake Creek and Lange Creek & reservoir constructed under App. No. R-26028, Per. No. R-1455 a tributary of Nehalem River for the purpose of municipal under Permit No. 21913 of the State Engineer, and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from August 14, 1950;

that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed 1.3 cubic feet per second, being 0.433 c.f.s. from Lange Creek and 0.867 c.f.s. from Classic Lake Creek,

or its equivalent in case of rotation, measured at the point of diversion from the stream. The point of diversion is located in the NW¼SW¼, Section 16 on Classic Lake Creek, and NW¼SE¼, Section 21 on Lange Creek, Township 3 North, Range 10 West, W. M.

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to - - - - - - - - of one cubic foot per second per acre,

and shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use under the right hereby confirmed, and to which such right is appurtenant, is as follows:

S½NE¼
Lot #2 - (SE¼NW¼)
Lot #3 - (NE¼SW¼)
Lot #4 - (SE¼SW¼)
SE¼
Section 29
N½NE¼
Lot #1 - (NE¼NW¼)
Section 32
Township 3 North, Range 10 West, W. M.

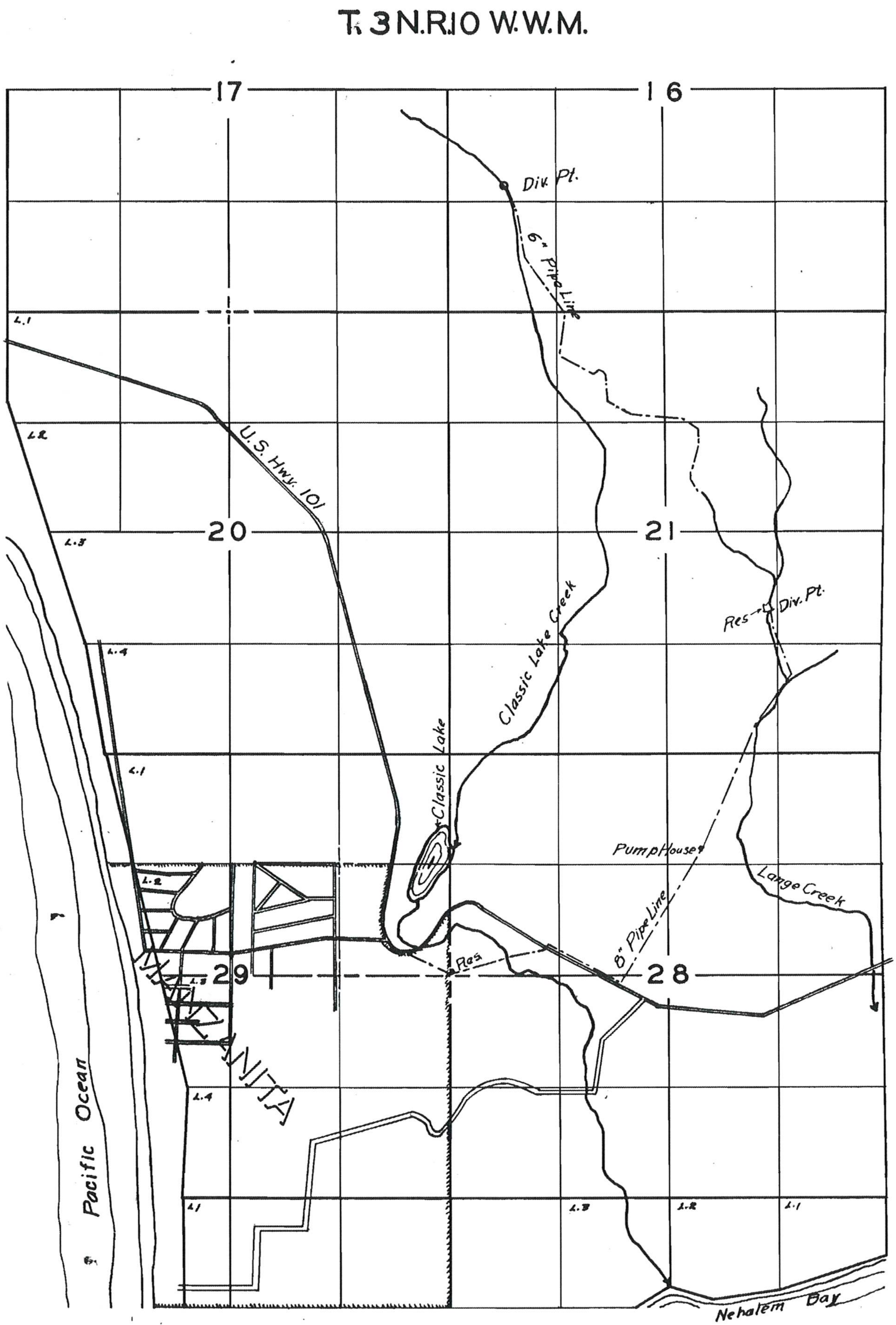
The right to the use of the water for the purposes aforesaid is restricted to the lands or place of use herein described.

WITNESS the signature of the State Engineer, affixed

this 28th day of November, 1956.

LEWIS A. STANLEY
State Engineer

Recorded in State Record of Water Right Certificates, Volume 16, page 21707.



FINAL PROOF SURVEY

UNDER

APPLICATION NO. 23417, 25124, & R-26028 PERMIT NO. 18634, 21913 & R-1455

IN NAME OF

CITY OF MANZANITA

SURVEYED 5 AUGUST 1955, BY Robert W. Beck

See No. R-26[illegible]

Permit No. 21913

*APPLICATION FOR PERMIT

To Appropriate the Public Waters of the State of Oregon

I, City of Manzanita (Name of applicant)

of .... (Mailing address),

State of ...., do hereby make application for a permit to appropriate the following described public waters of the State of Oregon, SUBJECT TO EXISTING RIGHTS:

If the applicant is a corporation, give date and place of incorporation ....

....

1. The source of the proposed appropriation is Classic Lake Creek Formerly Known as Ettenberger Crk. & Lange Cr. (Name of stream) and reservoir (app. No. R-25806), a tributary of Nehalem River

2. The amount of water which the applicant intends to apply to beneficial use is 1.3 cubic feet per second. (If water is to be used from more than one source, give quantity from each)

**3. The use to which the water is to be applied is Municipal (Irrigation, power, mining, manufacturing, domestic supplies, etc.)

....

4. The point of diversion is located Classic Lake Cr. 800 ft. N. (N. or S.) and 850 ft. E. (E. or W.) from the SW corner of Sec. 16 being within the SW¼ SW¼ Sec. 16 (Section or subdivision) Lange Cr. diversion is located 760 ft. S. & 1040 ft. E of the center of Sec. 21

.... (If preferable, give distance and bearing to section corner)

.... (If there is more than one point of diversion, each must be described. Use separate sheet if necessary)

being within the NW¼ SE¼ (Give smallest legal subdivision) of Sec. 21, Tp. 3 N (N or S), R. 10 W (E. or W.), W. M., in the county of Tillamook

5. The .... (Main ditch, canal or pipe line) to be .... (Miles or feet) in length, terminating in the .... (Smallest legal subdivision) of Sec. ...., Tp. .... (N. or S.), R. .... (E. or W.) W. M., the proposed location being shown throughout on the accompanying map.

DESCRIPTION OF WORKS

Diversion Works—

6. (a) Height of dam 9.6 feet, length on top 60 feet, length at bottom 35 feet; material to be used and character of construction timber crib (Loose rock, concrete, masonry, rock and brush, timber crib, etc., wasteway over or around dam)

(b) Description of headgate .... (Timber, concrete, etc., number and size of openings)

....

(c) If water is to be pumped give general description Gravity flow (Size and type of pump)

.... (Size and type of engine or motor to be used, total head water is to be lifted, etc.)

*A different form of application is provided where storage works are contemplated.

**Application for permits to appropriate water for the generation of electricity, with the exception of municipalities, must be made to the Hydroelectric Commission. Either of the above forms may be secured, without cost, together with instructions by addressing the State Engineer, Salem, Oregon.

21913

Canal System or Pipe Line—

7. (a) Give dimensions at each point of canal where materially changed in size, stating miles from headgate. At headgate: width on top (at water line) .... feet; width on bottom .... feet; depth of water .... feet; grade .... feet fall per one thousand feet.

(b) At .... miles from headgate: width on top (at water line) .... feet; width on bottom .... feet; depth of water .... feet; grade .... feet fall per one thousand feet.

(c) Length of pipe, ~~[illegible]~~ 3300 ft.; size at intake, 6 in.; size at .... ft. from intake .... in.; size at place of use 6 in.; difference in elevation between intake and place of use, ~~[illegible]~~ 66 ft. Is grade uniform? .... Estimated capacity, 1.16 sec. ft.

8. Location of area to be irrigated, or place of use City of Manzanita

Township	Range WILLAMETTE MERIDIAN	Section	Forty-acre Tract	Number Acres To Be Irrigated
3N	10W	29		

(If more space required, attach separate sheet)

(a) Character of soil ....

(b) Kind of crops raised ....

Power or Mining Purposes—

9. (a) Total amount of power to be developed .... theoretical horsepower.

(b) Quantity of water to be used for power .... sec. ft.

(c) Total fall to be utilized .... (Head) feet.

(d) The nature of the works by means of which the power is to be developed

....

(e) Such works to be located in .... (Legal subdivision) of Sec. ...., Tp. .... (No. N. or S.), R. .... (No. E. or W.), W. M.

(f) Is water to be returned to any stream? .... (Yes or No)

(g) If so, name stream and locate point of return ....

...................., Sec. ...., Tp. .... (No. N or S.), R. .... (No. E. or W.) W. M.

(h) The use to which power is to be applied is ....

....

(i) The nature of the mines to be served ....

....

Municipal or Domestic Supply—

10. (a) To supply the city of Manzanati

County, having a present population of ~~20~~ 500
(Name of)

and an estimated population of 1000 in 1960

(b) If for domestic use state number of families to be supplied

(Answer questions 11, 12, 13, and 14 in all cases)

11. Estimated cost of proposed works, $ 11000.00

12. Construction work will begin on or before In a few days

13. Construction work will be completed on or before 2 yrs after approval

14. The water will be completely applied to the proposed use on or before 3 yrs.

Ben S. Lane Mayor
(Signature of applicant)

Remarks: Under this application it is proposed to divert water from Classic Lake Creek through about 3300 ft. of 6 in. pipe to Lange Creek. The Classic Lake Creek water will pass down Lange Creek about 1800 ft. where it will be diverted for use in the City of Manzanita through the system described in permit No. 18634

Approximately 1/3 of the water to be obtained from Lange Cr. & 2/3 from Classic Lake Cr.

STATE OF OREGON,
County of Marion, } ss.

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for

In order to retain its priority, this application must be returned to the State Engineer, with corrections on or before , 19

WITNESS my hand this day of 19

STATE ENGINEER

PERMIT

STATE OF OREGON, }
County of Marion, } ss.

This is to certify that I have examined the foregoing application and do hereby grant the same, SUBJECT TO EXISTING RIGHTS and the following limitations and conditions:

The right herein granted is limited to the amount of water which can be applied to beneficial use and shall not exceed 1.3 cubic feet per second measured at the point of diversion from the stream, or its equivalent in case of rotation with other water users, from Classic Lake Cr. formerly known as Effenberger Creek and Lange Creek, being 0.433 cfs from Lange Creek and 0.867 cfs from Classic Lake Creek and reservoir to be constructed under Application No. R-26028, Permit No. R-1455.

The use to which this water is to be applied is municipal

If for irrigation, this appropriation shall be limited to - - - - - - of one cubic foot per second

and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.

The priority date of this permit is August 14, 1950

Actual construction work shall begin on or before June 30, 1954 and shall thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 1955

Complete application of the water to the proposed use shall be made on or before October 1, 1956

WITNESS my hand this 30th day of June, 1953.

STATE ENGINEER

Permits for power development are subject to the payment of annual fees as provided in sections 1 and 2, chapter 74, Oregon Laws 1933.

Application No. 25124

Permit No. 21413

PERMIT

TO APPROPRIATE THE PUBLIC WATERS OF THE STATE OF OREGON

Division No. District No.

This instrument was first received in the office of the State Engineer at Salem, Oregon, on the 14th day of August, 1950, at 11:30 o'clock A.M.

Returned to applicant:

Corrected application received:

Approved:

June 30, 1953

Recorded in book No. 55 of Permits on page 21413

CHAS. E. STRICKLIN
STATE ENGINEER

Drainage Basin No. 1 Page 1 & 3

Fees Paid 22.00

Reservoir on Alder Creek.

STATE OF OREGON

COUNTY OF TILLAMOOK

CERTIFICATE OF WATER RIGHT

This Is to Certify, *That* CITY OF MANZANITA

of Manzanita *, State of* Oregon *, has made proof*

to the satisfaction of the STATE ENGINEER of Oregon, of a right to store the waters of Classic Lake Creek & Lange Creek, tributaries of Nehalem River, to be appropriated under App. No. 25124, Per. No. 21913

for the purposes of

municipal use

under Reservoir Permit No. R-1455 *of the State Engineer, and that said right to store said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from* June 12, 1951

that the amount of water entitled to be stored each year under such right, for the purposes aforesaid, shall not exceed 1.23 *acre-feet.*

The reservoir is located in Section 21 (NW¼SE¼) *, Tp.* 3 N. *, R.* 10 W. *, W.M.*

WITNESS the signature of the State Engineer,

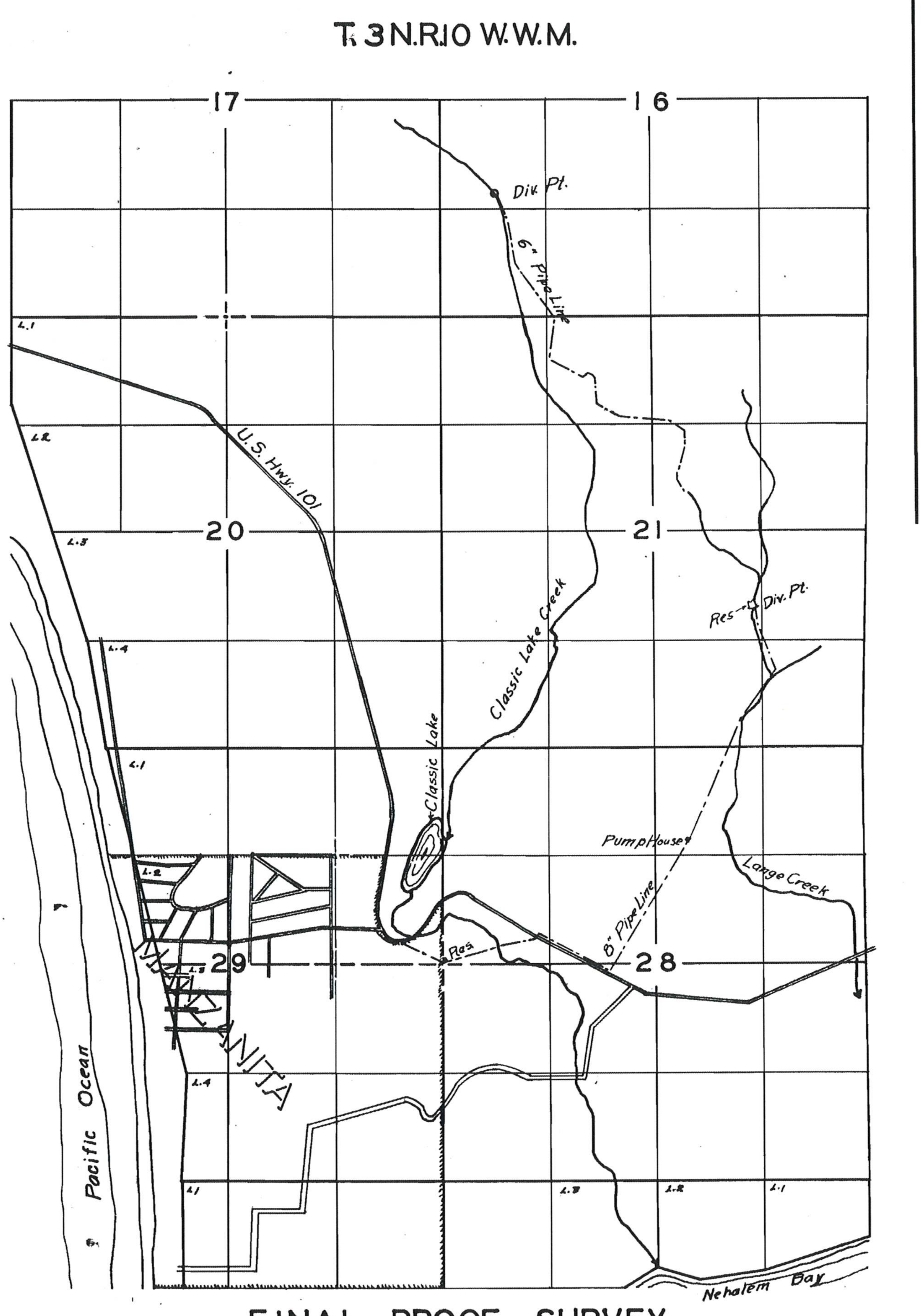
affixed this 28th *day*

of November *,* 1956 .

LEWIS A. STANLEY

State Engineer.

Recorded in State Record of Water Right Certificates, Volume 16 *, page* 21708 .



FINAL PROOF SURVEY

UNDER

APPLICATION NO. 23417, 25124, & R-26028 PERMIT NO. 18634, 21913 & R-1455

IN NAME OF

CITY OF MANZANITA

SURVEYED 5 AUGUST 1955, BY Robert W. Bush

Application for a Permit to Construct a Reservoir and to Store for Beneficial Use the Unappropriated Waters of the State of Oregon

I, [illegible]
(Name of Applicant)

of
(Mailing Address)

State of Oregon, do hereby make application for a permit to construct the following described reservoir and to store the unappropriated waters of the State of Oregon, subject to existing rights.

If the applicant is a corporation, give date and place of incorporation

1. The name of the proposed reservoir is

2. The name of the stream from which the reservoir is to be filled and the appropriation made is Classic Lake Creek and Lange Creek

tributary of Nehalem River

3. The amount of water to be stored is 400,000 gallons ~~acre feet~~

4. The use to be made of the impounded water is Municipal
(Irrigation, power, domestic supply, etc.)

5. The location of the proposed reservoir will be in Sec. 21
(Give sections or townships to be submerged)

Tp. 3 N, R. 10 W, W. M., in the county of Tillamook

(a) State whether situated in channel of running stream and give character of material at outlet

(b) If not in channel of running stream, state how it is to be filled. If through a feed canal, give name and dimensions Classic Lake Cr. water to be diverted by use of 6" steel pipe 3300' of pipe 66' fall

6. The dam will be located in NW¼ SE¼, Sec. 21
(Give smallest legal subdivision)

Tp. 3 N, R. 10 W, W. M. The maximum height will be 9.5 feet above stream bed or ground surface on center line of dam. The length on top will be 60 feet; length on bottom 40 feet; width on top feet; slope of front or water side (feet horizontal to 1 vertical); slope on back (feet horizontal to 1 vertical); height of dam above water line when full 1 feet.

* A different form of application should be used for the appropriation of stored water to beneficial use. Such forms can be secured without charge, together with instructions, by addressing the State Engineer, Salem, Oregon.

7. The construction of dam, the material of which it is to be built, and method of protection from [illegible]: [illegible] made of logs. 2 ft [illegible] with 2"x6" car decking covered x 8"x12" planks.

8. The location of spillway with dimensions are as follows: Over [illegible] (center)
(State whether over or around the dam)

Spills on apron made of 2"x12" planks. Wasteway is 18ft x 22ft. Apron 7.5ft x 12ft. 2 ft corrugated installed to drain reservoir.

9. The location of outlet from the proposed reservoir, with character of construction and dimensions are as follows: 3 in. pipe through center of dam
(State whether through or around the proposed dam)

10. The area submerged by the proposed reservoir, when full, will be 0.14 acres, with a maximum depth of water of 9 feet, and approximate mean depth of water 4 feet.

11. The estimated cost of the proposed work is $ 5000.00

12. Construction work will begin on or before Has been completed

13. Construction work will be completed on or before Has been completed

[illegible]
(Name of applicant)

STATE OF OREGON, } ss.
County of Marion, }

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for correction or completion as follows:

In order to retain its priority, this application must be returned to the State Engineer, with corrections, on or before , 19

WITNESS my hand this day of , 19

STATE ENGINEER

... in channel ... a ... a fall ... of 3300 ft ... (See remarks on Secondary application)

STATE OF OREGON, } ss.
County of Marion, }

This is to certify that I have examined the foregoing application and do hereby grant the same, subject to the following limitations and conditions: The right herein granted is limited to the construction of a reservoir and the storage of water from Classie Lake and Lange Creek to be appropriated under Application No. 25124, Permit No. 21913, for municipal use.

The right hereunder shall be limited to the storage of 1.23 acre feet

The priority date of this permit is June 12, 1951

Actual construction work shall begin on or before June 30, 1954

and shall thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 1955

WITNESS my hand this 30th day of June, 19 53

STATE ENGINEER

Application No. [illegible]

Reservoir Permit No. R-[illegible]

PERMIT

To construct a reservoir and store for beneficial use the unappropriated waters of the State of Oregon

This instrument was first received in the office of the State Engineer at Salem, Oregon, on the [illegible] day of June, 1950, at [illegible] o'clock [illegible] M.

Approved:

June 30, 1953

Recorded in Book No. [illegible] of Reservoirs, on Page [illegible]

CHAS. E. STRICKLIN
STATE ENGINEER

STATE PRINTING DEPT.

Instream
Nehalem River

STATE OF OREGON

COUNTY OF TILLAMOOK

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

STATE OF OREGON
WATER RESOURCES DEPARTMENT
SALEM, OREGON 97310

confirms the right to use the waters of NEHALEM RIVER, a tributary of NEHALEM BAY, in the NORTH COAST BASIN to maintain an instream flow for the purpose of SUPPORTING AQUATIC LIFE.

The right is for flows to be maintained IN THE NEHALEM RIVER AND ITS TRIBUTARIES FROM THE CONFLUENCE OF COOK CREEK (SW 1/4, SECTION 35, T 3 N, R 9 W, W.M.) TO THE MOUTH OF THE NEHALEM RIVER.

The right is established under Oregon Revised Statutes 537.346.

The date of priority is MAY 9, 1973.

The right is limited to not more than the amounts during the time periods listed below:

Period	Flows (cubic feet per second)
OCT 1 - OCT 15	200
OCT 16- APR 30	270
MAY 1 - MAY 31	200
JUN 1 - JUN 30	150
JUL 1 - SEP 30	100

This instream water right shall not affect the use of water for human consumption, livestock consumption or the use of waters legally released from storage.

Witness the signature of the Water Resources Director affixed this 9th day of JUNE, 1989.

William H. Young
Water Resources Director

Recorded in State Record of Water Right Certificates number 59752.

MF36

Instream
Peterson Creek

STATE OF OREGON

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

Oregon Water Resources Department
158 12th Street NE
Salem, Oregon 97310

The specific limits for the use are listed below along with conditions of use.

Source: PETERSON CREEK tributary to NEHALEM RIVER

County: TILLAMOOK

Purpose: Providing required stream flows for migration, spawning, egg incubation, fry emergence, and juvenile rearing of chum and coho salmon, winter steelhead, and sea-run cutthroat trout.

To be maintained in:

PETERSON CREEK FROM THE HEADWATERS AT RIVER MILE 2.0 (SWSE, SECTION 28, TOWNSHIP 3N, RANGE 9W WM); TO THE MOUTH AT RIVER MILE 0.0 (NWNE, SECTION 5, TOWNSHIP 2N, RANGE 9W WM)

The right is established under Oregon Revised Statutes 537.341.

The date of priority is 11/30/1990.

The following conditions apply to the use of water under this certificate:

1. The right is limited to not more than the amounts, in cubic feet per second, during the time periods listed below:

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
12.2	10.8	8.51	4.05	1.45	1.13	0.52	0.23	0.18	0.45	5.98	10.9

2. The water right holder shall measure and report the in-stream flow along the reach of the stream or river described in the certificate as may be required by the standards for in-stream water right reporting of the Water Resources Commission.

3. For the purposes of water distribution, this instream right shall not have priority over human or livestock consumption.

4. The instream flow allocated pursuant to this water right is not in addition to other instream flows created by a prior water right or designated minimum perennial stream flow.

5. The flows are to be measured at the lower end of the stream reach to protect necessary flows throughout the reach.

Witness the signature of the Water Resources Director, affixed AUGUST 20, 1996.

Martha O. Pagel

Martha O. Pagel

Recorded in State Record of Water Right Certificate number 72503.

IS70958

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix E

Comments Regarding ODFW Fist Persistence and Curtailment
City of Wheeler Water Rights Permit G-12196 Extension
PACE Engineers, Inc., February 14, 2018

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Comments Regarding ODFW Fish Persistence and Curtailment

City of Wheeler Water Rights Permit G-12196 Extension

Prepared by: William Pavlich, PE, CWRE

PACE Engineers, Inc.

February 14, 2018

This memo is based on a review of ODFW's proposed curtailment calculations (recently provided by Tim Hardin, Instream Flow Specialist, ODFW, which were originally developed in 2014 and are included here as Attachment #1) and an understanding of the calculation's role in OWRD's development of a permit extension (for City of Wheeler Permit G-12196). The objective is to propose a functional approach for estimating well production for purposes of complying with the curtailment recommendations.

The City's permit provides for rate withdrawal of up to 3.6 cfs from the wells. Current installed (developed) capacity of the two existing wells is 1.17 cfs. The wells are hydraulically connected to Petersen Creek and the Nehalem River, but separated by a distance of 300 feet and 450 feet respectively. The distance and substrata result in a time lag between well pumping and the effects of that pumping on the affected streams. In addition, there is a dampening effect that reduces the magnitude of the peak withdrawal, unless the level of withdrawal is sustained for many days. The following discussion focuses on the dampening effect and a proposed way of taking it into account to better determine the impact of pumping on the streams. Our proposal is to use a multi-day moving average of well production for determining well production relative to the curtailment targets that will be included in the permit extension. We note that the averaged well production is for this purpose only and is not intended to provide a basis for exceeding the instantaneous rate of 3.6 cfs associated with the permit itself.

Attachment #2 is an email from Tim Hardin that includes a clarification of what part of the undeveloped portion of the permit is being conditioned. It notes that 0.56 cfs of the 2.43 cfs undeveloped portion is groundwater and not subject to curtailment, hence the curtailment applies to the remaining undeveloped 1.87 cfs. Based on this understanding, curtailment *according to the ODFW criteria* would only be applicable when well withdrawals exceeded 1.73 cfs (1.17 cfs + 0.56 cfs) and stream flows had reached the noted thresholds. Should stream flows fall below the instream water rights, the existing permit restricts well withdrawals to provide for human consumption and livestock only. This is separate from the curtailment issue, but acknowledged here because of its similarity in requiring some level of curtailment.

Attachment #3 is a page from a September 25, 2006 groundwater review of the wells and impacts on Peterson Creek and the Nehalem River prepared by Ivan Gall, Staff Hydrologist at OWRD. The analysis recommended use of the Hunt (1999) model. This is shown with the heavier line on the graph in Attachment #3. The model assumes the wells are started and then operated continuously for the period indicated. Note that at 10 days, the stream is only being depleted by approximately 62% of the pumping rate; at 30 days it is approximately 76% of the pumping rate. Note that this is with continuous pumping. Municipal usage varies considerably with the seasons as well as diurnally. Typically, the supply should be capable of meeting the peak day demand over the course of the year. The Wheeler wells are currently the only significant source of water supply for the system; consequently, actual utilization is considerably less than peak day usage – even in summer. Figure 1 shows Wheeler well production data for 2013 as 3-day, 7-day, and 10-day moving averages. Figure 2 shows the 10-day moving average against the background of daily production. The figures show the smoothing effects of the averaging and also how the averages track with actual utilization. Attachment #4 includes well usage data for year 2013 that was analyzed for ongoing communications with ODFW and OWRD in 2014 and used as the basis for Figure 1 and Figure 2. The data in Attachment #4 shows how the wells are actually utilized and the relative seasonal peaking associated with the water system.

The variation in daily withdrawals, coupled with the time lag in pumping effects impacting the stream, results in a dampening effect on the peak depletion experienced by the stream such that what the stream sees is more of an average of the pumping activity over a prolonged period. This effect has been acknowledged by both ODFW and OWRD (see the email string correspondence in Attachment #5); however, characterizing it and establishing a workable and readily implementable means of quantifying it has been somewhat elusive. Tim Hardin (April 16, 2014 email in Attachment #5) asked Ivan Gall if a 10-day averaging period would be reasonable. Ivan's response (April 18, 2014 email in Attachment #5) was that model may not be refined enough for ODFW (meaning to precisely answer the question), but he did state that "Giving the city a longer period of time for an average may provide them with more flexibility, allowing for a few days of higher pumping to meet peak demands." Presumably this determination is consistent with OWRD's and ODFW's goal of the actual stream impact being less than or equal to the curtailment criteria utilized.

An additional consideration is how the curtailment is implemented. Cutting back on production can prematurely drain reservoirs if curtailment measures are not taken to restrict demand. Implementing curtailment measures can be relatively time consuming and costly to communicate to the water customers involved; consequently, implementing curtailment for stream flow and well production that can and do vary daily could result in an on-again off-again situation during transitional flow or usage periods. To address this, we are requesting consideration for using a 7-day moving average of well water pumping to determine the water production rate for use in the curtailment calculation. We are also requesting that the trigger for actual curtailment be based on 3 consecutive days of well production at or above the curtailment threshold. This approach would keep within the 10-day period discussed in the previous paragraph and would provide the City with some notice that curtailment is imminent and minimize the potential for an on-again off-again situation. We note that this approach, under the unlikely scenario that the wells pumped continuously, and the maximum pumping capacity consistent with the water right had been installed, would result in an average equal to the full water right and subject to the maximum curtailment noted in ODFW's recommendations. We mention this because the intent of the proposed averaging is not to circumvent the proposed curtailment. We believe our request is consistent with both real world impacts on the streams and the intent of the fish persistence requirement.

Please contact Bill Pavlich at 503.597.3222 if you have any questions or comments or would like to discuss the matter further.

Figure 1: Wheeler Well Production Moving Averages for the Year 2013

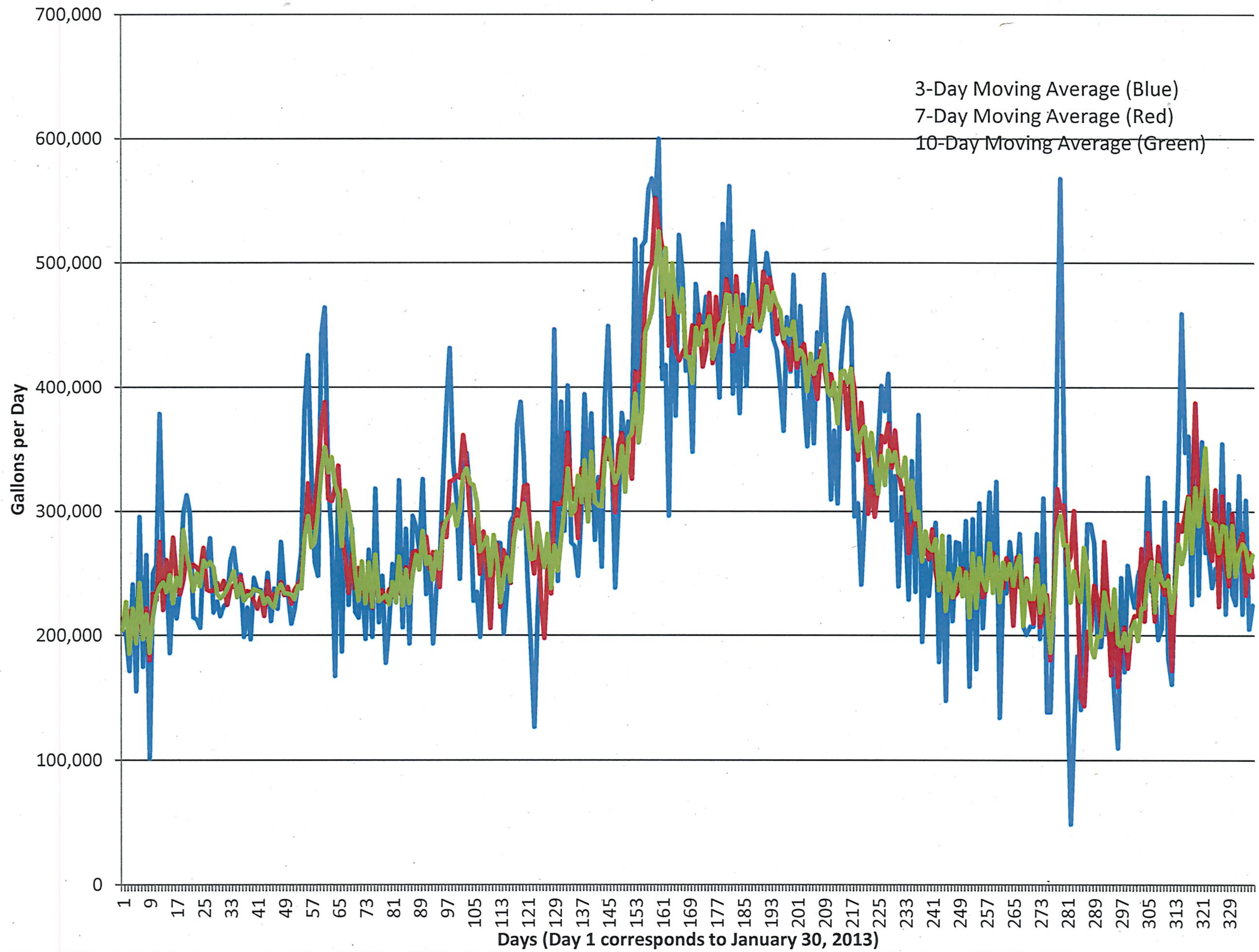
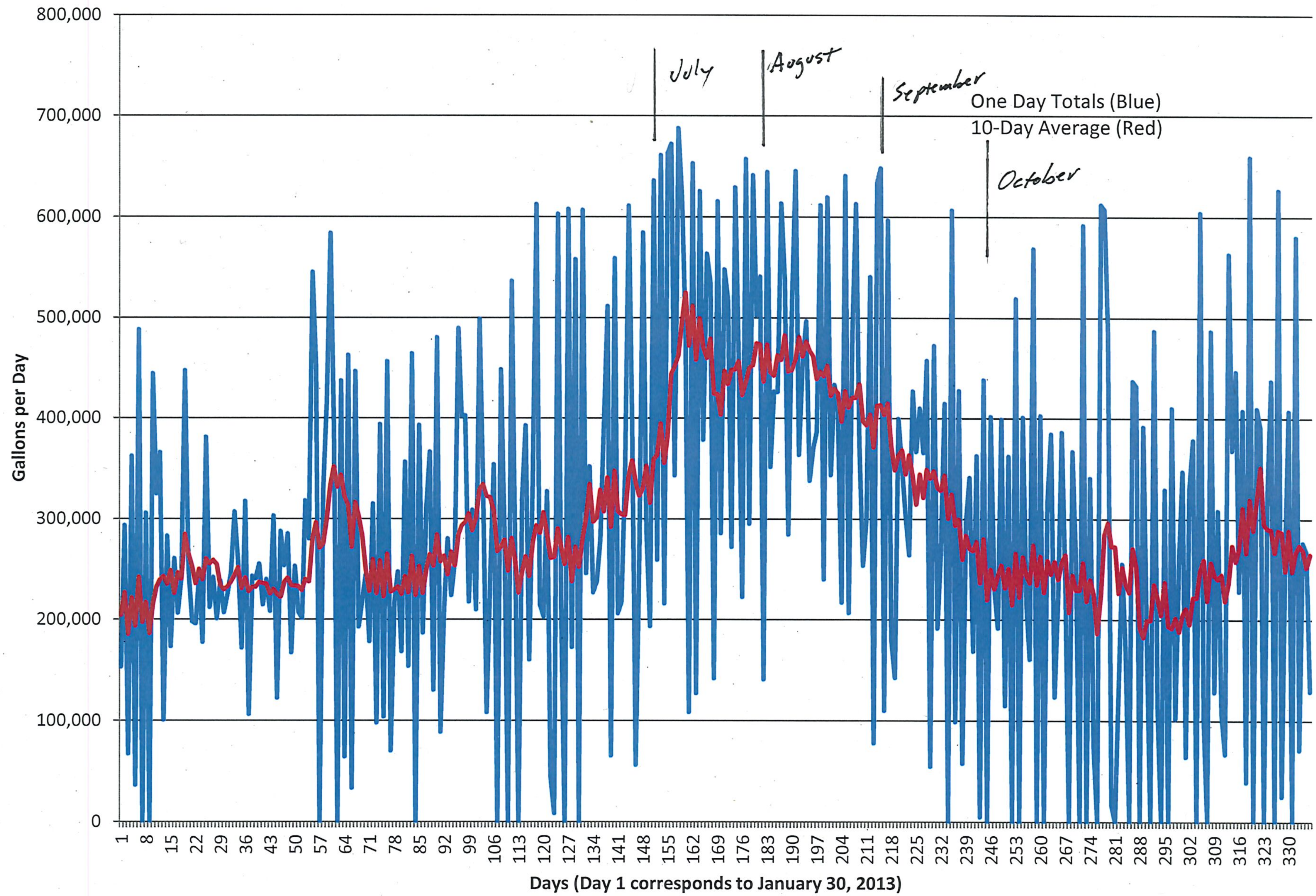


Figure 2: Wheeler Well Production Daily Totals and 10-day Moving Average for the Year 2013



Attachment #1

Calculations to be used in persistence advice for City of Wheeler, Wells affecting Nehalem River and Peterson Creek, G-13479/12196

The undeveloped portion of the permit is 2.43 cfs from wells hydraulically connected to Peterson Creek and the Nehalem River. The developed portion is 1.17 cfs.

WRD has determined that the potential for substantial interference (PSI) is approximately 1.8 cfs to the Nehalem River and 0.6 cfs to Peterson Creek. Since two streams are affected, there are two sets of relevant flow data.

For Peterson Creek, the Basin Investigation Report (BIR) recommended optimum and minimum monthly flows. These were all higher than the WRD estimates of median monthly flows. The instream water right (IS-70958) was thus set at the WRD median flow estimates. The ODFW target flows are equal to these IS-70958 values (Table 1a).

Table 1a. Monthly flow information (cfs) for Peterson Creek.

Month	WRD median natural	BIR-opt	BIR-min	Instream right	**ODFW Target***
Jan	12.2	26	15	12.2	**12.2**
Feb	10.8	26	15	10.8	**10.8**
Mar	8.51	26	15	8.51	**8.51**
Apr	4.05	26	15	4.05	**4.05**
May	1.45	22	6	1.45	**1.45**
Jun	1.13	18	2	1.13	**1.13**
Jul	0.52	14	1	0.52	**0.52**
Aug	0.23	10	1	0.23	**0.23**
Sept	0.18	10	1	0.18	**0.18**
Oct	0.46	17/26	10/15	0.45	**0.45**
Nov	5.99	26	15	5.98	**5.98**
Dec	10.9	26	15	10.9	**10.9**

* Target flows are equal to Instream Water Right IS-70958.

For the Nehalem River, the instream water right is a Minimum Perennial Streamflow, MF-36. This MF was based on Basin Investigation Report (BIR) minimum flow values. Most instream water rights in the North Coast basin are based on BIR optimum values, so these optimum values are used as the fish persistence target flows for the Nehalem River (Table 1b, last column).

Table 1b. Monthly flow information (cfs) for the Nehalem River.

Month	WRD median natural	USGS gage at Foss	BIR-opt	BIR-min	MF 36	**ODFW Target***
Jan	6520	5030	400	265	270	**400**
Feb	5680	3150	400	265	270	**400**
Mar	4530	3545	400	265	270	**400**
Apr	2780	2205	400	265	270	**400**
May	1350	1165	265	200	200	**265**
Jun	673	599	178	150	150	**178**
Jul	330	253	178	100	100	**178**
Aug	185	142	178	100	100	**178**
Sept	192	117	178/265	100/200	100	**178**
Oct	420	290	400	265	200/270	**400**
Nov	3570	2355	400	265	270	**400**
Dec	6180	4885	400	265	270	**400**

* Target flows are based on BIR optima or WRD median natural flow, whichever is less.

Priority dates: The City's water right is 1993 priority. The instream water rights on the Nehalem River and on Peterson Creek have 1973 and 1990 priorities, respectively. Thus both instream water rights are senior to the City's right.

Curtailment/cut-off calculations

<u>In relation to Peterson Creek flows:</u> When Peterson Creek is at or below the IS-70958 flows (Table 1a), it is ODFW's understanding that the City's water right would be subject to regulation by WRD. This regulation would apply to the developed as well as the undeveloped portion, because IS-70958 is the senior right.

<u>In relation to Nehalem River flows:</u> When the Nehalem River is at or below the MF-36 flows, the City's water right would be subject to regulation by WRD. This regulation would apply to the developed as well as the undeveloped portion, because MF-36 is senior.

When the Nehalem River is above MF-36 flows, but below ODFW target flows (Table 1b), curtailment would follow a formula, based on the percentage shortfall of existing measured flow (Q) vs. target flow (Q_T). The percent shortfall is defined as

$$1 - [(Q-E)/Q_T], \qquad \text{Equation 1}$$

where Q is the flow at the point of interest and E is the amount of the extension. An example calculation is provided in Table 2. In August, if flow in the Nehalem River is 140 cfs, the recommended curtailment of the undeveloped portion would be 0.40 cfs.

Table 2. Example curtailment at various flows in August, based on target flow of 178 cfs.

Q	% miss	Curtail cfs	Extension diversion
200	0%	0.00	2.43
180	0%	0.00	2.43
160	11%	0.20	2.23
140	**22%**	**0.40**	**2.03**
120	34%	0.60	1.83
110	39%	0.71	1.72

In relation to both Nehalem River and Peterson Creek:

When the Nehalem River is at or below MF-36 flow levels, and/or when Peterson Creek is at or below IS-70958 levels, it is ODFW's understanding that use of any water under G-13479 is subject to regulation by WRD. This would include any use that caused flows in either stream to go below instream water right levels, and would apply to the developed and undeveloped portions of the City's right.

When the Nehalem River and Peterson Creek are both above instream water right levels, but the Nehalem River is below the target flows in Table 1b, ODFW recommends curtailment of the undeveloped portion, based on the percentage shortfall from the Nehalem River persistence flows, as explained in Equation 1 and Table 2.

Allowance for groundwater connection to surface flow

Based on WRD's ground water review (I. Gall 2006), the wells are connected to both streams. Interference at 30 days is estimated at 77%. WRD may take this information into consideration when setting conditions on the extension.

How often are flows expected to be below persistence (target) levels?

Because the instream water right on Peterson Creek is equal to the WRD estimate of median flow, flows are expected to be below persistence levels about half the time. On the Nehalem River, flows would be below persistence levels, and subject to curtailment, much of the time August-October, but rarely in other months (Table 3).

Table 3. Estimated percent time that target flows would be missed on the Nehalem River.

Month	% time missed
Jan	0%
Feb	0%
Mar	0%
Apr	0%
May	0%
Jun	0%
Jul	10%
Aug	70%
Sep	80%
Oct	60%
Nov	10%
Dec	0%

Attachment #2

Bill Pavlich

From:	Tim S Hardin <tim.s.hardin@state.or.us>
Sent:	Friday, April 25, 2014 11:16 AM
To:	Bill Pavlich
Subject:	curtail calculations
Attachments:	example calculation 4-25-14.xlsx

Hi Bill,

I have spent some time talking about your proposals within ODFW and also with several groundwater people at OWRD.

Here at ODFW, we will write our advice specifying a curtailment amount that corresponds to a given flow at the gage. We won't specify an averaging period.

In practice, curtailment is managed by OWRD, starting with their Proposed Final Order. The PFO will likely contain information on an averaging period as far as the gaged flows are concerned. It could also say something about averaging periods for pumping rates, though I don't recall seeing that on past PFO's. ODFW does review the language and calculations with OWRD, and I believe the City will have a chance to comment as well.

I am attaching a curtailment table. It is basically the same as the old one, but it shows the calculations in a different way. The curtailment is based on the estimate (currently 77%) of the Undeveloped amount that is connected to the stream, i.e. 1.87 cfs. Part of that is curtailed when the flow drops below the target of 178 cfs, but the Unconnected 0.56 cfs is never curtailed.

Thanks for your input on this extension, and please feel free to continue the discussion.

Best regards,

Tim Hardin

Tim Hardin
Instream Flow Specialist
Oregon Department of Fish and Wildlife
4034 Fairview Industrial Drive SE
Salem, OR 97302
ph. 503-947-6093
fax 503-947-6070
email: Tim.S.Hardin@state.or.us

Example for Wheeler, August, with 178 cfs target flow

2.43 is Undeveloped   1.87 is Undeveloped with Connection   0.56 is Unconnected

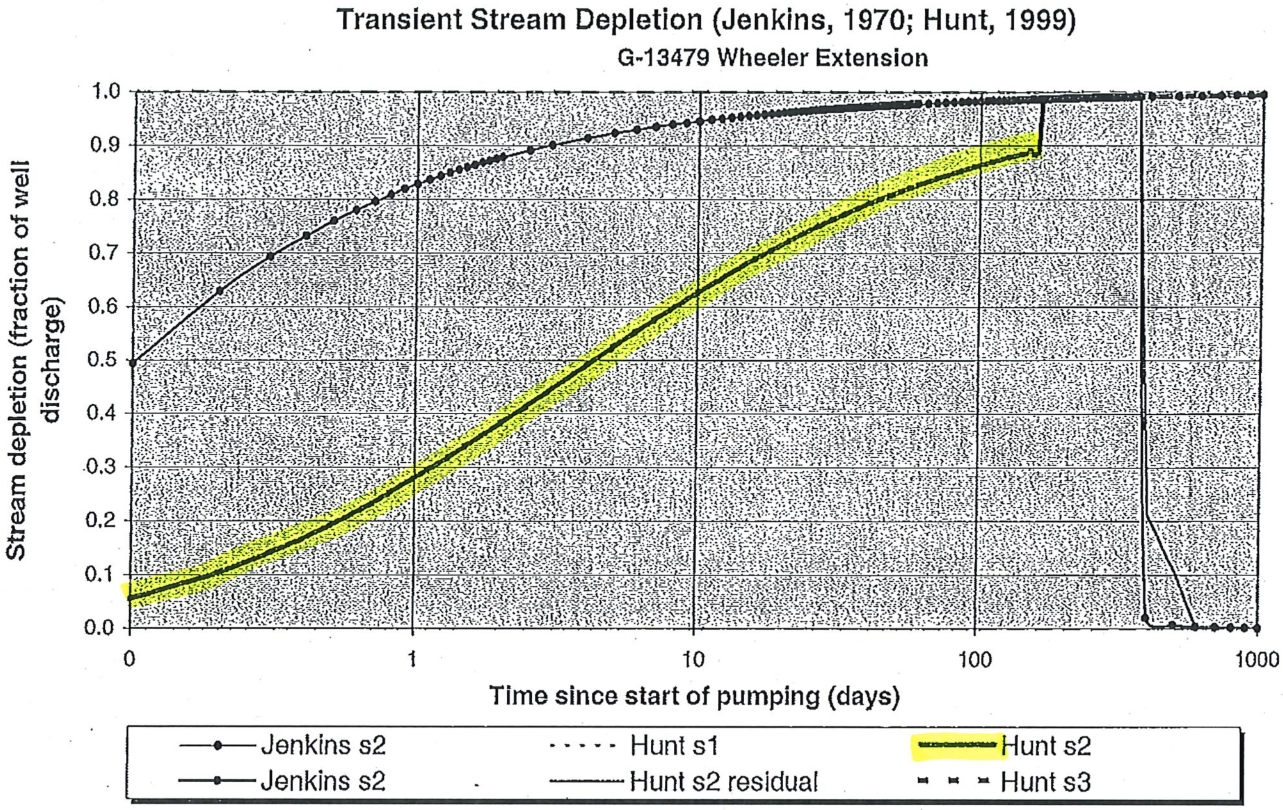
		from Connected amount			
Q at gage	**% miss**	***curtail**	***divert**	**Unconn**	**total diversion**
200	0.00	0	1.87	0.56	2.43
180	0.00	0	1.87	0.56	2.43
160	0.11	0.21	1.66	0.56	2.22
140	0.22	0.41	1.46	0.56	2.02
120	0.34	0.62	1.25	0.56	1.81
110	0.39	0.73	1.14	0.56	1.70
80	0.56	1.04	0.83	0.56	1.39

This is how ODFW has issued advice on other groundwater extensions

curtailment is based on connected amount

City can divert the "unconnected" regardless

Attachment #3



Output for Hunt Stream Depletion, Scenerio 2 (s2):

Days	30	60	90	120	150	180	210	240	270	300	330	360
Hunt SD s2	0.7625	0.8268	0.8569	0.8754	0.8927	0.9872	0.9881	0.9889	0.9895	0.9900	0.9905	0.9909
Qw, cfs	2.430	2.430	2.430	2.430	2.430	2.430	2.430	2.430	2.430	2.430	2.430	2.430
H SD s2, cfs	1.853	2.009	2.082	2.127	2.169	2.399	2.401	2.403	2.405	2.406	2.407	2.408

Parameters:		Scenario 1	Scenario 2	Scenario 3	Units
Net steady pumping rate	Qw	2.43	2.43	2.43	cfs
Distance to stream	a	330	330	330	ft
Aquifer hydraulic conductivity	K	5000	5000	5000	ft/day
Aquifer thickness	b	35	35	35	ft
Aquifer transmissivity	T	175000	175000	175000	ft*ft/day
Aquifer storage coefficient	S	0.15	0.15	0.15	
Stream width	ws	60	60	60	ft
Streambed hydraulic conductivity	Ks	5	5	5	ft/day
Streambed thickness	bs	2	2	2	ft
Streambed conductance	sbc	150	150	150	ft/day
Stream depletion factor (Jenkins)	sdf	0.093342857	0.093342857	0.093342857	days
Streambed factor (Hunt)	sbf	0.282857143	0.282857143	0.282857143	

Attachment #4

City of Manzanita 2013 Well Production Data

	Day					Running Average Well Totals			
Month	Calendar	Graph	Well 1 Total	Well 2 Total	Total of Both	3-Day	7-day	10-day	Peak GPM @ Well
January-13	1		478,393	0	478,393				441
	2		0	24,532	24,532				418
	3		0	507,805	507,805	336,910			434
	4		0	0	0	177,446		-	
	5		519,630	0	519,630	342,478			417
	6		31,844	0	31,844	183,825			412
	7		0	384,369	384,369	311,948	278,082		426
	8		0	125,977	125,977	180,730	227,737		413
	9		175,936	0	175,936	228,761	249,366		434
	10		227,073	0	227,073	176,329	209,261	247,556	417
	11		0	174,763	174,763	192,591	234,227	217,193	419
	12		0	482,642	482,642	294,826	228,943	263,004	436
	13		208,176	0	208,176	288,527	254,134	233,041	416
	14		213,831	0	213,831	301,550	229,771	254,424	419
	15		0	254,882	254,882	225,630	248,186	227,949	424
	16		0	38,999	38,999	169,237	228,624	228,665	430
	17		133,695	0	133,695	142,525	215,284	203,597	417
	18		599,007	0	599,007	257,234	275,890	250,900	427
	19		0	99,455	99,455	277,386	221,149	243,252	431
	20		0	362,839	362,839	353,767	243,244	256,829	416
	21		68,628	0	68,628	176,974	222,501	246,215	434
	22		481,459	0	481,459	304,309	254,869	246,097	412
	23		0	0	0	183,362	249,298	225,280 -	
	24		0	316,506	316,506	265,988	275,413	235,547	416
	25		0	0	0	105,502	189,841	210,059 -	
	26		454,105	0	454,105	256,870	240,505	251,569	431
	27		106,598	0	106,598	186,901	203,899	248,860	416
	28		0	308,943	308,943	289,882	238,230	219,853	419
	29		0	153,475	153,475	189,672	191,375	225,255	413
	30	1	153,190	0	153,190	205,203	213,260	204,290	421
	31	2	293,348	0	293,348	200,004	209,951	226,762	418
February-13	1	3	0	67,183	67,183	171,240	219,549	185,335	358
	2	4	0	362,248	362,248	240,926	206,426	221,560	416
	3	5	36,275	0	36,275	155,235	196,380	193,537	413
	4	6	488,012	0	488,012	295,512	221,962	242,338	431
	5	7	0	0	0	174,762	200,037	196,927 -	
	6	8	0	305,709	305,709	264,574	221,825	216,838	419
	7	9	0	0	0	101,903	179,918	185,944 -	
	8	10	143,975	300,578	444,553	250,087	233,828	215,052	411
	9	11	0	324,745	324,745	256,433	228,471	232,207	431
	10	12	365,694	0	365,694	378,331	275,530	239,442	423
	11	13	100,846	0	100,846	263,762	220,221	242,808	418
	12	14	0	282,930	282,930	249,823	260,640	234,876	431
	13	15	0	173,333	173,333	185,703	241,729	248,582	412
	14	16	260,521	0	260,521	238,928	278,946	225,833	431
	15	17	206,420	0	206,420	213,425	244,927	246,475	417
	16	18	0	241,774	241,774	236,238	233,074	240,082	381
	17	19	0	447,562	447,562	298,585	244,769	284,838	416
	18	20	249,808	0	249,808	313,048	266,050	265,363	423
	19	21	197,883	0	197,883	298,418	253,900	252,677	413
	20	22	0	195,670	195,670	214,454	257,091	235,675	431
	21	23	0	244,631	244,631	212,728	254,821	250,053	431
	22	24	177,390	0	177,390	205,897	250,674	239,499	419
	23	25	381,044	0	381,044	267,688	270,570	260,270	423
	24	26	0	211,886	211,886	256,773	236,902	255,407	416
	25	27	0	242,035	242,035	278,322	235,791	258,968	416
	26	28	200,816	0	200,816	218,246	236,210	254,873	427
	27	29	238,439	0	238,439	227,097	242,320	233,960	427
	28	30 -		206,723	206,723	215,326	236,905	229,652	417
March-13	1	31	0	224,944	224,944	223,369	243,698	232,358	417
	2	32	246,124	0	246,124	225,930	224,424	237,403	419

	3	33	307,094	0	307,094	259,387	238,025	243,650	417
	4	34	0	257,521	257,521	270,246	240,237	251,663	411
	5	35	0	171,932	171,932	245,516	236,111	230,751	423
	6	36	317,282	0	317,282	248,912	247,374	241,291	422
	7	37	106,491	0	106,491	198,568	233,055	227,737	416
	8	38	239,550	3,501	243,051	222,275	235,642	231,960	421
	9	39	240,460	0	240,460	196,667	234,833	232,162	419
	10	40	0	255,147	255,147	246,219	227,412	237,005	417
	11	41	0	214,602	214,602	236,736	221,281	235,970	431
	12	42	239,958	0	239,958	236,569	230,999	235,354	418
	13	43	208,266	0	208,266	220,942	215,425	225,471	422
	14	44	0	303,021	303,021	250,415	243,501	230,021	419
	15	45	0	122,488	122,488	211,258	226,277	225,077	408
	16	46	287,594	0	287,594	237,701	233,011	222,108	399
	17	47	253,623	0	253,623	221,235	232,793	236,821	427
	18	48	0	285,097	285,097	275,438	242,864	241,026	431
	19	49	0	167,255	167,255	235,325	232,478	233,705	423
	20	50	253,138	0	253,138	235,163	238,888	233,504	421
	21	51	207,365	0	207,365	209,253	225,223	232,781	412
	22	52	0	201,316	201,316	220,606	236,484	228,916	401
	23	53	0	317,970	317,970	242,217	240,823	239,887	401
	24	54	280,297	0	280,297	266,528	244,634	237,614	387
	25	55	541,611	3,891	545,502	381,256	281,835	279,916	409
	26	56	155,915	295,285	451,200	425,666	322,398	296,276	408
	27	57	0	0	0	332,234	286,236	270,914 -	
	28	58	327,376	0	327,376	259,525	303,380	275,142	413
	29	59 -		416,259	416,259	247,878	334,086	300,042	417
	30	60 -		583,820	583,820	442,485	372,065	333,111	432
	31	61	392,209 -		392,209	464,096	388,052	351,595	415
April-13	1	62	0	0	0	325,343	310,123	331,463 -	
	2	63	0	437,296	437,296	276,502	308,137	343,396	422
	3	64	0	64,475	64,475	167,257	317,348	321,814	413
	4	65	462,891	0	462,891	321,554	336,707	313,553	410
	5	66	0	33,479	33,479	186,948	282,024	271,781	419
	6	67	0	446,805	446,805	314,392	262,451	316,461	418
	7	68	192,706	0	192,706	224,330	233,950	302,994	422
	8	69	219,265	0	219,265	286,259	265,274	283,295	431
	9	70	0	244,689	244,689	218,887	237,759	249,382	408
	10	71	0	178,343	178,343	214,099	254,025	227,995	366
	11	72	315,040	0	315,040	246,024	232,904	259,499	416
	12	73	98,011	0	98,011	197,131	242,123	225,570	416
	13	74	0	393,817	393,817	268,956	234,553	258,505	423
	14	75	0	103,999	103,999	198,609	221,881	222,615	411
	15	76	456,790	0	456,790	318,202	255,813	264,947	410
	16	77	0	70,145	70,145	210,311	230,878	227,281	433
	17	78	0	216,560	216,560	247,832	236,337	229,666	433
	18	79	247,358	0	247,358	178,021	226,669	232,475	419
	19	80	168,380	0	168,380	210,766	236,721	224,844	389
	20	81	0	356,560	356,560	257,433	231,399	242,666	416
	21	82	0	154,036	154,036	226,325	238,547	226,566	402
	22	83	464,490	0	464,490	325,029	239,647	263,214	419
	23	84	0	0	0	206,175	229,626	223,832 -	
	24	85	0	393,085	393,085	285,858	254,844	252,740	416
	25	86	186,941	0	186,941	193,342	246,213	225,756	419
	26	87	309,385	0	309,385	296,470	266,357	249,680	426
	27	88	0	366,359	366,359	287,562	267,757	264,659	417
	28	89	0	130,588	130,588	268,777	264,407	252,982	417
	29	90	480,505	0	480,505	325,817	266,695	284,195	408
	30	91	0	88,717	88,717	233,270	279,369	257,411	392
May-13	1	92	0	211,096	211,096	260,106	253,370	263,117	416
	2	93	280,401	0	280,401	193,405	266,722	244,708	416
	3	94	224,050	0	224,050	238,516	254,531	267,113	422
	4	95	0	256,964	256,964	253,805	238,903	253,501	413
	5	96	0	489,666	489,666	323,560	290,200	283,773	428
	6	97	402,123	0	402,123	382,918	279,002	293,047	427

	7	98	402,596	0	402,596	431,462	323,842	296,671	426
	8	99	0	217,548	217,548	340,756	324,764	305,367	403
	9	100	0	308,875	308,875	309,673	328,832	288,204	418
	10	101	209,883	0	209,883	245,435	326,808	300,320	421
	11	102	498,644	0	498,644	339,134	361,334	329,075	413
	12	103	0	332,562	332,562	347,030	338,890	334,291	416
	13	104	0	108,598	108,598	313,268	296,958	322,746	431
	14	105	242,168	0	242,168	227,776	274,040	321,266	414
	15	106	353,920	0	353,920	234,895	293,521	307,692	416
	16	107	0	0	0	198,696	249,396	267,479 -	
	17	108	0	448,819	448,819	267,580	283,530	272,102	421
	18	109	0	286,655	286,655	245,158	253,246	279,012	421
	19	110	0	0	0	245,158	205,737	248,125 -	
	20	111	536,661	0	536,661	274,439	266,889	280,803	414
	21	112	286,488	0	286,488	274,383	273,220	259,587	426
	22	113	0	0	0	274,383	222,660	226,331 -	
	23	114	0	319,029	319,029	201,839	268,236	247,374	423
	24	115	392,588	0	392,588	237,206	260,203	262,416	408
	25	116	160,444	0	160,444	290,687	242,173	243,068	416
	26	117	0	337,541	337,541	296,858	290,393	276,823	418
	27	118	0	612,593	612,593	370,193	301,240	293,200	431
	28	119	0	214,302	214,302	388,145	290,928	285,965	432
	29	120	202,728	0	202,728	343,208	319,889	306,237	416
	30	121	78,125	249,090	327,215	248,082	321,059	285,293	422
	31	122	0	44,871	44,871	191,605	271,385	261,131	413
June-13	1	123	8,439	0	8,439	126,842	249,670	261,975	413
	2	124	603,098	0	603,098	218,803	287,607	290,382	427
	3	125	197,677	0	197,677	269,738	228,333	270,891	416
	4	126	0	0	0	266,925	197,718	254,846 -	
	5	127	0	607,892	607,892	268,523	255,599	281,882	429
	6	128	0	172,826	172,826	260,239	233,543	237,905	416
	7	129	558,134	0	558,134	446,284	306,867	272,288	409
	8	130	0	0	0	243,653	305,661	252,015 -	
	9	131	0	606,884	606,884	388,339	306,202	279,982	416
	10	132	102,143	143,784	245,927	284,270	313,095	300,088	416
	11	134	352,018	0	352,018	401,610	363,383	334,446	409
	12	135	0	226,815	226,815	274,920	308,943	296,817	416
	13	136	0	237,530	237,530	272,121	318,187	300,803	431
	14	137	41,258	237,611	278,869	247,738	278,292	328,690	416
	15	138	0	392,645	392,645	303,015	334,384	307,165	422
	16	139	511,557	0	511,557	394,357	320,766	341,038	409
	17	140	65,339	195	65,534	323,245	294,995	291,778	409
	18	141	559,318	0	559,318	378,803	324,610	347,710	402
	19	142	0	206,063	206,063	276,972	321,645	307,628	416
	20	143	0	217,209	217,209	327,530	318,742	304,756	401
	21	144	342,581	0	342,581	255,284	327,844	303,812	407
	22	145	611,129	0	611,129	390,306	359,056	342,244	398
	23	146	18,425	374,888	393,313	449,008	342,164	357,822	416
	24	147	0	56,475	56,475	353,639	340,870	335,582	413
	25	148	265,497	0	265,497	238,428	298,895	322,868	416
	26	149	584,677	0	584,677	302,216	352,983	330,180	432
	27	150	0	287,424	287,424	379,199	363,014	352,369	416
	28	151	77,274	116,232	193,506	355,202	341,717	315,787	416
	29	152	635,954	0	635,954	372,295	345,264	358,777	426
	30	153	135,810	123,575	259,385	362,948	326,131	362,994	501
July-13	1	154	0	661,159	661,159	518,833	412,515	394,852	442
	2	155	118,469	97,400	215,869	378,804	405,425	355,326	476
	3	156	663,770	0	663,770	513,599	416,724	382,372	476
	4	157	672,296	0	672,296	517,312	471,706	443,954	473
	5	158	76,120	266,940	343,060	559,709	493,070	451,710	481
	6	159	0	687,913	687,913	567,756	500,493	462,034	462
	7	160	0	620,139	620,139	550,371	552,029	495,305	473
	8	161	491,986	0	491,986	600,013	527,862	525,153	487
	9	162	0	108,763	108,763	406,963	512,561	472,434	462
	10	163	0	653,111	653,111	417,953	511,038	511,807	437

	11	164	127,430	0	127,430	296,435	433,200	458,434	437
	12	165	297,869	327,541	625,410	468,650	473,536	499,388	438
	13	166	325,188	53,426	378,614	377,151	429,350	470,872	416
	14	167	563,672	0	563,672	522,565	421,284	460,010	431
	15	168	0	534,863	534,863	492,383	427,409	479,190	419
	16	169	142,136	0	142,136	413,557	432,177	424,612	428
	17	170	615,657	0	615,657	430,885	426,826	424,164	425
	18	171	0	285,902	285,902	347,898	449,465	403,556	416
	19	172	0	548,233	548,233	483,264	438,440	447,503	428
	20	173	0	517,223	517,223	450,453	458,241	433,914	458
	21	174	0	272,197	272,197	445,884	416,602	448,391	467
	22	175	0	629,147	629,147	472,856	430,071	448,764	432
	23	176	0	460,497	460,497	453,947	475,551	456,953	489
	24	177	0	222,624	222,624	437,423	419,403	422,848	477
	25	178	0	657,294	657,294	446,805	472,459	435,091	463
	26	179	0	295,286	295,286	391,735	436,324	450,406	481
	27	180	0	641,404	641,404	531,328	454,064	452,981	475
	28	181	0	502,380	502,380	479,690	486,947	474,629	475
	29	182	0	541,294	541,294	561,693	474,397	473,935	473
	30	183	0	141,225	141,225	394,966	428,787	436,335	468
	31	184	0	644,746	644,746	442,422	489,090	473,590	472
August-13	1	185	0	351,703	351,703	379,225	445,434	445,845	471
	2	186	0	426,760	426,760	474,403	464,216	442,472	468
	3	187	0	426,179	426,179	401,547	433,470	462,827	470
	4	188	0	613,494	613,494	488,811	449,343	458,447	468
	5	189	0	536,501	536,501	525,391	448,658	482,569	470
	6	190	0	284,812	284,812	478,269	469,171	446,909	437
	7	191	0	514,513	514,513	445,275	450,566	448,123	433
	8	192	0	645,726	645,726	481,684	492,569	458,566	426
	9	193	0	363,849	363,849	508,029	483,582	480,828	436
	10	194	0	454,998	454,998	488,191	487,699	461,854	417
	11	195	0	496,830	496,830	438,559	471,033	476,366	423
	12	196	0	337,961	337,961	429,930	442,670	467,486	413
	13	197	0	369,816	369,816	401,536	454,813	461,850	417
	14	198	0	386,898	386,898	364,892	436,583	439,190	403
	15	199	0	611,901	611,901	456,205	431,750	446,730	428
	16	200	0	240,029	240,029	412,943	414,062	442,252	461
	17	201	0	619,684	619,684	490,538	437,588	452,769	479
	18	202	0	343,590	343,590	401,101	415,697	422,556	431
	19	203	0	433,392	433,392	465,555	429,330	429,510	427
	20	204	0	407,084	407,084	394,689	434,654	424,719	416
	21	205	0	217,160	217,160	352,545	410,406	396,752	426
	22	206	0	641,003	641,003	421,749	414,563	427,056	425
	23	207	0	206,801	206,801	354,988	409,816	410,754	481
	24	208	0	484,319	484,319	444,041	390,478	420,496	429
	25	209	0	612,988	612,988	434,703	428,964	420,605	426
	26	210	0	374,380	374,380	490,562	420,534	434,040	481
	27	211	0	253,730	253,730	413,699	398,626	397,445	416
	28	212	0	300,910	300,910	309,673	410,590	393,177	423
	29	213	0	541,061	541,061	365,234	396,313	403,944	427
	30	214	0	78,001	78,001	306,657	377,913	371,035	413
	31	215	0	633,319	633,319	417,460	399,198	412,651	428
September-13	1	216	0	648,488	648,488	453,269	404,270	413,400	416
	2	217	0	110,307	110,307	464,038	366,545	403,750	427
	3	218	0	596,999	596,999	451,931	415,584	415,018	419
	4	219	0	180,628	180,628	295,978	398,400	371,782	416
	5	220	0	142,744	142,744	306,790	341,498	348,619	431
	6	221	0	399,794	399,794	241,055	387,468	363,225	476
	7	222	0	351,769	351,769	298,102	347,247	368,311	481
	8	223	0	303,939	303,939	351,834	298,026	344,599	413
	9	224	0	264,325	264,325	306,678	320,028	363,231	463
	10	225	0	427,055	427,055	331,773	295,751	342,605	481
	11	226	0	366,921	366,921	352,767	322,364	314,448	477
	12	227	0	410,169	410,169	401,382	360,567	344,434	468
	13	228	0	365,810	365,810	380,967	355,713	321,315	481

	14	229	0	457,926	457,926	411,302	370,878	349,045	481
	15	230	0	54,975	54,975	292,904	335,312	340,268	430
	16	231	0	472,669	472,669	328,523	365,075	347,556	421
	17	232	0	191,526	191,526	239,723	331,428	331,532	429
	18	233	0	271,371	271,371	311,855	317,778	328,275	481
	19	234	0	415,073	415,073	292,657	318,479	343,350	461
	20	235	0	0	0	228,815	266,220	300,644 -	
	21	236	0	606,811	606,811	340,628	287,489	324,633	405
	22	237	0	99,210	99,210	235,340	293,809	293,537	418
	23	238	0	427,623	427,623	377,881	287,373	299,718	476
	24	239	0	58,081	58,081	194,971	268,310	259,734	481
	25	240	0	296,624	296,624	260,776	271,917	283,899	419
	26	241	0	341,317	341,317	232,007	261,381	270,764	427
	27	242	0	168,796	168,796	268,912	285,495	268,491	481
	28	243	0	362,920	362,920	291,011	250,653	277,646	416
	29	244	0	5,041	5,041	178,919	237,200	236,642	477
	30	245	0	438,320	438,320	268,760	238,728	280,474	439
October-13	1	246	0 -		0	147,787	230,431	219,793 -	
	2	247	0	401,725	401,725	280,015	245,446	250,045	478
	3	248	0	232,636	232,636	211,454	229,920	230,546	419
	4	249	0	191,694	191,694	275,352	233,191	243,907	468
	5	250	0	399,151	399,151	274,494	238,367	254,160	473
	6	251	0	115,362	115,362	235,402	254,127	231,565	418
	7	252	0	362,355	362,355	292,289	243,275	250,920	429
	8	253	0 -		0	159,239	243,275	214,628 -	
	9	254	0	519,382	519,382	293,912	260,083	266,063	432
	10	255	0 -		0	173,127	226,849	222,231 -	
	11	256	0	401,045	401,045	306,809	256,756	262,335	433
	12	257	0	216,835	216,835	205,960	230,711	243,846	471
	13	258	0	160,960	160,960	259,613	237,225	236,678	466
	14	259	312,338	256,659	568,997	315,597	266,746	274,409	481
	15	260	0	0	0	243,319	266,746	234,494 -	
	16	261	0	402,810	402,810	323,936	250,092	263,238	483
	17	262	0	0	0	134,270	250,092	227,003	0
	18	263	1,272	316,849	318,121	240,310	238,246	258,815	413
	19	264	0	384,463	384,463	234,195	262,193	245,323	433
	20	265	124,045	0	124,045	275,543	256,919	257,728	487
	21	266	225,069	0	225,069	244,526	207,787	240,130	427
	22	267	0	386,111	386,111	245,075	262,946	257,058	481
	23	268	204,589	30,299	234,888	282,023	238,957	264,450	316
	24	269	0	0	0	207,000	238,957	207,551 -	
	25	270	0	367,001	367,001	200,630	245,940	244,251	461
	26	271	0	254,200	254,200	207,067	227,331	229,390	488
	27	272	0	0	0	207,067	209,610	229,390 -	
	28	273	591,687	190	591,877	282,026	262,011	256,765	466
	29	274	0	0	0	197,292	206,852	218,319 -	
	30	275	0	340,654	340,654	310,844	221,962	239,980	481
	31	276	0	75,716	75,716	138,790	232,778	225,045	463
November-13	1	277	0	0	0	138,790	180,350	186,434 -	
	2	278	612,328	0	612,328	229,348	231,511	224,178	368
	3	279	607,701	0	607,701	406,676	318,325	284,948	460
	4	280	483,169	0	483,169	567,733	302,795	296,565	462
	5	281	0	16,958	16,958	369,276	305,218	272,840	473
	6	282	0	0	0	166,709	256,553	272,840 -	
	7	283	128,419	0	128,419	48,459	264,082	226,495	471
	8	284	213,432	41,863	255,295	127,905	300,553	252,024	438
	9	285	166,719	0	166,719	183,478	236,894	234,631	462
	10	286	0	0	0	140,671	150,080	227,059 -	
	11	287	0	437,297	437,297	201,339	143,527	270,789	481
	12	288	0	432,266	432,266	289,854	202,857	252,782	427
	13	289	0	0	0	289,854	202,857	192,012 -	
	14	290	34,819	356,761	391,580	274,615	240,451	182,853	483
	15	291	0	181,483	181,483	191,021	229,906	199,306	481
	16	292	0	0	0	191,021	206,089	199,306 -	
	17	293	486,897	0	486,897	222,793	275,646	235,154	476

	18	294	116,798	0	116,798	201,232	229,861	221,304	416
	19	295	0	0	0	201,232	168,108	204,632 -	
	20	296	0	329,224	329,224	148,674	215,140	237,555	486
	21	297	0	0	0	109,741	159,200	193,825 -	
	22	298	0	410,171	410,171	246,465	191,870	191,615	481
	23	299	69,005	33,203	102,208	170,793	206,471	201,836	461
	24	300	141,654	114,977	256,631	256,337	173,576	188,341	472
	25	301	264,411	82,680	347,091	235,310	206,475	204,902	436
	26	302	0	64,295	64,295	222,672	215,660	211,332	481
	27	303	0	330,175	330,175	247,187	215,796	195,659	478
	28	304	378,431	0	378,431	257,634	269,857	221,823	416
	29	305	0	0	0	236,202	211,262	221,823	0
	30	306	0	604,313	604,313	327,581	282,991	249,332	481
December-13	1	307	0	103,557	103,557	235,957	261,123	259,687	481
	2	308	0	0	0	235,957	211,539	218,670	0
	3	309	486,656	0	486,656	196,738	271,876	257,115	479
	4	310	128,573	0	128,573	205,076	243,076	244,309	477
	5	311	89,701	218,513	308,214	307,814	233,045	240,421	483
	6	312	107,937	0	107,937	181,575	248,464	244,786	451
	7	313	0	67,063	67,063	161,071	171,714	218,474	481
	8	314	0	563,316	563,316	246,105	237,394	236,963	483
	9	315	2,336	365,664	368,000	332,793	289,966	273,763	384
	10	316	0	446,579	446,579	459,298	284,240	257,990	475
	11	317	228,068	0	228,068	347,549	298,454	270,441	476
	12	318	407,662	0	407,662	360,770	312,661	311,207	765
	13	319	0	39,384	39,384	225,038	302,867	266,480	481
	14	320	0	659,106	659,106	368,717	387,445	319,533	468
	15	321	0	0	0	232,830	306,971	288,712	0
	16	322	409,877	0	409,877	356,328	312,954	318,906	464
	17	323	0	390,842	390,842	266,906	304,991	351,283	469
	18	324	0	0	0	266,906	272,410	294,952	0
	19	325	325,201	0	325,201	238,681	260,630	290,672	469
	20	326	437,140	0	437,140	254,114	317,452	289,728	463
	21	327	0	0	0	254,114	223,294	266,921	0
	22	328	0	626,471	626,471	354,537	312,790	288,802	473
	23	329	0	25,255	25,255	217,242	257,844	287,389	0
	24	330	267,622	0	267,622	306,449	240,241	248,241	462
	25	331	406,956	0	406,956	233,278	298,378	288,936	481
	26	332	0	0	0	224,859	251,921	247,949	463
	27	333	0	580,272	580,272	329,076	272,368	266,892	477
	28	334	0	71,121	71,121	217,131	282,528	274,004	481
	29	335	276,417	0	276,417	309,270	232,520	269,125	469
	30	336	267,491	0	267,491	205,010	267,126	252,161	467
	31	337	0	129,395	129,395	224,434	247,379	265,100	481
				Annual Avg.	294,755				
				Annual Max.	687,913	600,013	552,029	525,153	765
				Annual Min.	0	48,459	143,527	182,853	0

Attachment #5

Bill Pavlich

From:	THOMA Michael J <michael.j.thoma@state.or.us>
Sent:	Tuesday, May 20, 2014 4:04 PM
To:	Bill Pavlich
Cc:	GALL Ivan K; WOZNIAK Karl C; HARDIN Tim S
Subject:	RE: Wheeler- wells cyclical pumping impacts
Attachments:	Pumping Impact Fig1.bmp

Hi Bill,
Attached is a figure showing the results of our analysis for pumping from the City of Wheeler well at a 1 day on, 1 day off cycle. These results were estimated using the Hunt 1999 analytical model for stream depletion (citation below) and assumes a zero-pumping initial state. Sequential Single Day Impacts (blue lines) were summed to estimate cumulative impact (red lines). Black lines are the impact if pumping were constant. You see that from a no-pumping state the cumulative impact fairly quickly reaches a quasi-stable level of ~ 45% of the pumping rate (i.e., 45 % of the pumped volume coming from the river). Over a long-period though, this should approach 50%. The lower figure shows the impact for a 30 day period during mid-year (~ 45% on average with a maximum impact of ~ 58%). This is percentage of the pumping rate so if rate changes, the total volume captured from the river changes also, but the impact would again reach ~45-50% of the pumping rate. Let myself or Karl know if have any questions.

- Mike

Hunt, B., 1999, Unsteady stream depletion from ground water pumping: Ground Water, v. 37, no. 1, p. 98-102

Michael J Thoma, Ph.D.
Hydrogeologist
Oregon Water Resources Department
725 Summer St. NE, Suite A
Salem, OR 97301
503-986-0845
Michael.J.Thoma@wrd.state.or.us

From: GALL Ivan K
Sent: Thursday, May 15, 2014 6:39 PM
To: WOZNIAK Karl C; THOMA Michael J
Subject: Fwd: Wheeler- wells

For call at 8

Ivan Gall's Mobile

Begin forwarded message:

From: HARDIN Tim S <tim.s.hardin@state.or.us>
Date: May 15, 2014 at 16:22:57 PDT
To: GALL Ivan K <ivan.k.gall@state.or.us>
Subject: RE: Wheeler- wells

I did talk this over at length with Rick Kepler, and then talked to Bill about it. ODFW will write advice recommending curtailment of the rate of withdrawal. We likely won't get into the details of what the appropriate averaging period is for that rate. But our intent would be that the impact on the streamflow would not exceed that of a surface withdrawal of that same rate.

So, if for a given Q in the stream, we recommended a limit of 0.5 cfs from the well, we would want the effect of that well use to be no more than if the city was diverting 0.5 cfs directly from the creek.

Hope that makes sense. Thanks for your help on this,

Tim

From: GALL Ivan K [mailto:ivan.k.gall@state.or.us]
Sent: Thursday, May 15, 2014 3:27 PM
To: HARDIN Tim S
Subject: RE: Wheeler- wells

Hi Tim-
Bill (contact info below) wants to talk to us about the City of Wheeler well analysis we did. We hope to try and call him around 8 tomorrow morning.
Have you finalized your analysis yet? I'll let you know what we hear.
Thanks -- Ivan

Bill Pavlich

www.paceengrs.com

Bill Pavlich | Sr. Project Manager
5000 Meadows Road | Suite 345 | Lake Oswego, OR 97035
p. 503.597.3222 | *f.* 503.597.7655
Celebrating 20+ Years of Success

Ivan Gall - Manager
Groundwater Section
Oregon Water Resources Department
725 Summer St. NE, Suite A
Salem, OR 97301-1271
503.986.0847 503.986.0902 FAX
ivan.k.gall@wrd.state.or.us

From: Tim S Hardin [mailto:tim.s.hardin@state.or.us]
Sent: Friday, April 18, 2014 11:05 AM
To: GALL Ivan K
Cc: WOZNIAK Karl C; THOMA Michael J
Subject: RE: Wheeler- wells

A quick question on overall PSI. I am going off Ivan's material in my files which showed 30 day PSI of 0.39 (Peterson) + 1.46 (Nehalem) = 1.85 or about 76%.

Based on your recent calculations, is there any reason to change this PSI estimate?

Thanks!

TH

From: GALL Ivan K [mailto:ivan.k.gall@state.or.us]
Sent: Friday, April 18, 2014 8:30 AM
To: HARDIN Tim S
Cc: WOZNIAK Karl C; THOMA Michael J
Subject: RE: Wheeler- wells

Hi Tim,
One question we have is what is the average volume of water pumped per day, and then convert that to a rate in gpm or cfs.
We tend to look at water availability in monthly time steps; I don't know if that is refined enough for ODFW. Overall, the broader impact to the stream comes as a result of the volume of water the city pumps over some period of time. As an example, if the well pumps 100 gpm for 12 hour cycles on, then off for 12 hours, the impact to the stream in the long run is like pumping 50 gpm continuously (the volume per day is the same for each case). Giving the city a longer period of time for an average rate may provide them more flexibility, allowing for a few days of higher rate pumping to meet peak demands.
Karl and I are in the field today; call my cell at 503.983.3002 and we can discuss.
Thanks - ikg

Ivan Gall - Manager
Groundwater Section
Oregon Water Resources Department
725 Summer St. NE, Suite A
Salem, OR 97301-1271
503.986.0847 503.986.0902 FAX
ivan.k.gall@wrd.state.or.us

From: Tim S Hardin [mailto:tim.s.hardin@state.or.us]
Sent: Wednesday, April 16, 2014 2:44 PM
To: GALL Ivan K
Cc: WOZNIAK Karl C; THOMA Michael J
Subject: RE: Wheeler- wells

I really appreciate your efforts on this.

I am trying to boil it down to a form that I can use to write advice to WRD on this water right. So here is a first shot at it:

-They have an undeveloped 2.43 cfs from these wells.

-If I understand PSI correctly, the 77% means that if they pump at the max rate for 30 days, the effect on the stream is (0.77*2.43 = 1.87. So in theory about the same as if they had a 1.87 surface diversion on the Nehalem River itself.

-Since they are likely to change the pumping rate on a daily or hourly basis, the question is : What is a reasonable period for time-averaging their rate?

-Assume the Nehalem flow is low enough that ODFW would recommend a 30% curtailment of their undeveloped amount. Given the short answer below from Ivan, would it be reasonable to say their pumping rate can be averaged over a 10-day period? Of course the max rate could never exceed the 2.43.

Thanks,

Tim Hardin

Tim Hardin
Instream Flow Specialist
Oregon Department of Fish and Wildlife
4034 Fairview Industrial Drive SE
Salem, OR 97302
ph. 503-947-6093
fax 503-947-6070
email: Tim.S.Hardin@state.or.us

3**From:** GALL Ivan K [mailto:ivan.k.gall@state.or.us]
Sent: Monday, April 14, 2014 4:50 PM
To: HARDIN Tim S
Cc: WOZNIAK Karl C; THOMA Michael J
Subject: FW: Wheeler- wells

Hi Tim-
Attached is some analytical model output and a map from one of my staff.
Short answer is that the pumping impact reaches out fairly quickly to the river, and at a constant pumping rate (unlikely given muni use) the stream depletion approaches over 90 percent of the pumping rate within about 10 days. The 3rd page of the attachment looks at cyclical pumping and this reduces the stream depletion to less than 60% of the pumping rate over time.
I am leaving for Medford in the morning, but have my cell with me.
I will try and have Karl Wozniak call you in the morning first thing before he heads into the field to help explain things. If you don't hear from him give my cell a call at 503.986.3002.
Thanks - Ivan

Ivan Gall - Manager
Groundwater Section
Oregon Water Resources Department
725 Summer St. NE, Suite A
Salem, OR 97301-1271
503.986.0847 503.986.0902 FAX
ivan.k.gall@wrd.state.or.us

From: THOMA Michael J
Sent: Monday, April 14, 2014 4:05 PM
To: GALL Ivan K; WOZNIAK Karl C
Subject: RE: Wheeler- wells

Good Afternoon,
Attached is a pdf of what I've put together for the city of wheeler wells (page 1). Using the Hunt 1999 model to investigate stream depletion (page 2) I estimated pumping impact of cycling by taking the Hunt 1999 results and offsetting stream depletion for one cycle by the cycling time (e.g. 1 day, 10 days) then summing the impact (page 3: blue = specific cycle period – e.g. effect of 1 day on then off at each cycle; red = summed effect; black = constant pumping for 1 yr). Cycling does seem to lessen the impact to the stream provided there is enough time allowed for some recovery. It looks like the model is not too sensitive to K_aq but Ks and bs have a decent impact. The other parameters seem fairly accurate (distance, depth, etc.).

I'll spend a bit more time going through the reports, but hopefully this should answer the questions posed. Let me know if there is anything else needed.

- Mike

Michael J Thoma
Hydrogeologist
Oregon Water Resources Department
725 Summer St. NE, Suite A
Salem, OR 97301
503-986-0845
Michael.J.Thoma@wrd.state.or.us

From: WOZNIAK Karl C
Sent: Friday, April 11, 2014 9:27 AM
To: THOMA Michael J
Subject: FW: Wheeler- wells

FYI

Karl C. Wozniak
Hydrogeologist
Oregon Water Resources Dept
725 Summer St NE Suite A
Salem, OR 97301
503.986.0843

From: GALL Ivan K
Sent: Thursday, April 10, 2014 4:45 PM
To: WOZNIAK Karl C
Subject: Fwd: Wheeler- wells

I need some help in the am researching this. Thoma may have done something.
Thanks. Ikg

Ivan Gall's Mobile

Begin forwarded message:

From: Tim S Hardin <tim.s.hardin@state.or.us>
Date: April 10, 2014 at 4:09:20 PM PDT
To: GALL Ivan K <ivan.k.gall@state.or.us>
Subject: Wheeler- wells

Hello Ivan,

Are you around on Friday? If so I will try to give you a call in the AM.

Basically, the questions are,

-if they are pumping say, 2 cfs, how long does it take for this to affect water level in the Nehalem River?

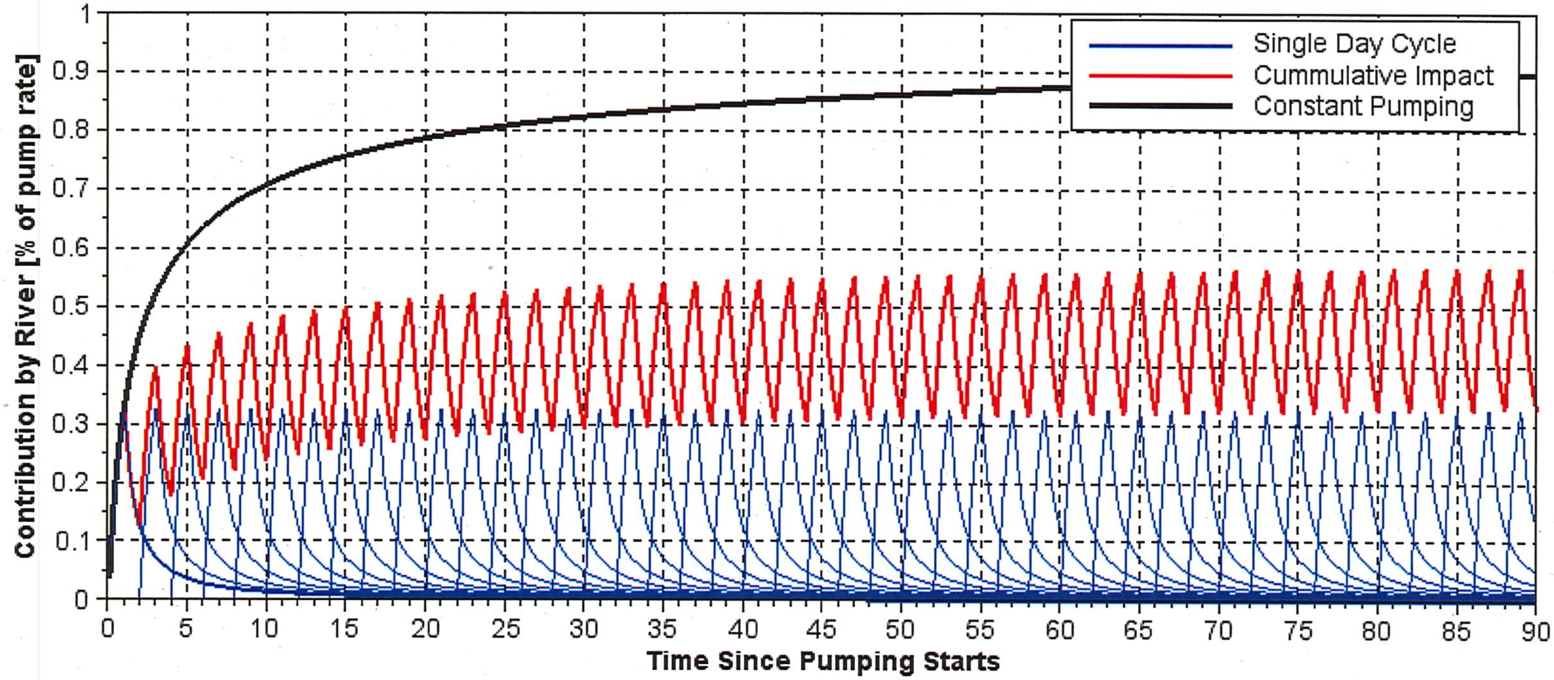
-and, in a related question, if our curtailment advice said 2.0 cfs was their limit (out of the 2.4 that is undeveloped), what kind of time-averaging is reasonable? That is, can they go up to 2.4 cfs for hours or days at a time, as long as their average is 2.0, without having a "2.4 impact" on the stream for some detectable period of time?

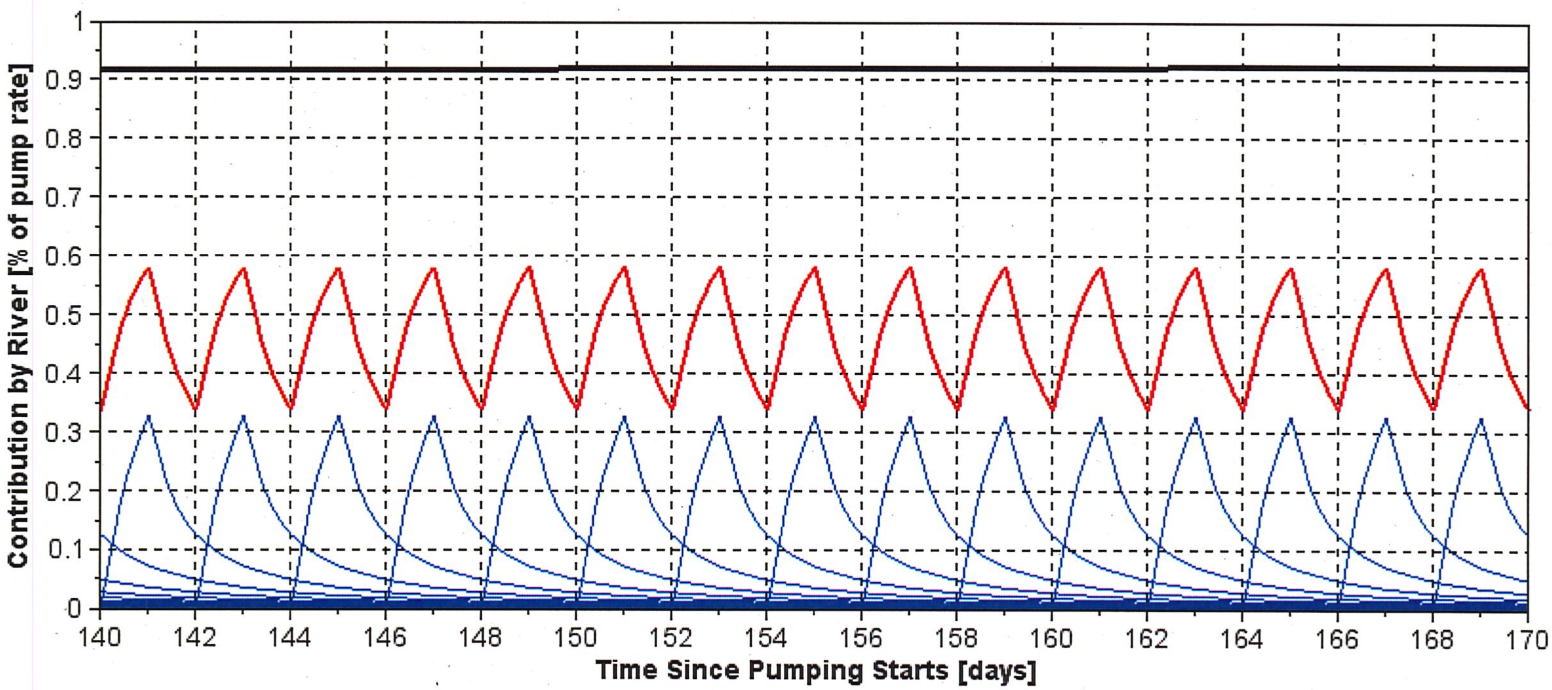
-I guess a shorter way to put this second question is: on what kind of time scale is the pumping effect on the stream dampened?

Thanks,

Tim H.

Tim Hardin
Instream Flow Specialist
Oregon Department of Fish and Wildlife
4034 Fairview Industrial Drive SE
Salem, OR 97302
ph. 503-947-6093
fax 503-947-6070
email: Tim.S.Hardin@state.or.us


Single Day Cycle
Cummulative Impact
Constant Pumping
Contribution by River [% of pump rate]
Time Since Pumping Starts


Contribution by River [% of pump rate]
Time Since Pumping Starts [days]

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix F

Well Logs for Well No. 1 and Well No. 2

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TILL 51052 Well No. 1

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

Instructions for completing this report are on the last page of this form.

WELL I.D. # L 01906
START CARD # W143371

(1) LAND OWNER Well Number 1
Name City of Wheeler
Address PO Box 177
City Wheeler State OR Zip 97147

(2) TYPE OF WORK
☐ New Well ☐ Deepening ☒ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD:
☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Auger
☐ Other NA

(4) PROPOSED USE:
☐ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☒ Other Municipal

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☒ No Depth of Completed Well 63 ft.
Explosives used ☐ Yes ☐ No Type ____ Amount ____

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☐ Other ____
Backfill placed from ____ ft. to ____ ft. Material ____
Gravel placed from ____ ft. to ____ ft. Size of gravel ____

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Drive Shoe used ☐ Inside ☐ Outside ☐ None
Final location of shoe(s) ____

(7) PERFORATIONS/SCREENS: Not Changed
☐ Perforations Method ____
☐ Screens Type ____ Material ____

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
						☐	☐
						☐	☐
		Not Changed				☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.
	NA		

Temperature of water ____ Depth Artesian Flow Found ____
Was a water analysis done? ☐ Yes By whom ____
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other ____
Depth of strata: ____

(9) LOCATION OF WELL by legal description:
County Tillamook Latitude ____ Longitude ____
Township 2N N or S Range 9W E or W. WM.
Section 5 NE 1/4 NW 1/4
Tax Lot 200 Lot ____ Block ____ Subdivision ____
Street Address of Well (or nearest address) 22095 Foss Rd Wheeler, OR

(10) STATIC WATER LEVEL:
16.9 ft. below land surface. 16'9" Date ____
Artesian pressure ____ lb. per square inch Date ____

(11) WATER BEARING ZONES:
Depth at which water was first found NA

From	To	Estimated Flow Rate	SWL
	NA		

(12) WELL LOG:
Ground Elevation ____

Material	From	To	SWL
*			
Installed a 12x6 pitless			
unit on the 12" well casing			
Removed 7' of 12" casing.			
Added 7' combined length			
of 14" Barrol & pitless			
unit.			
Top of casing remains the			
same above ground.			
Placed 3/8" hole plug			
around casing as excavated			
Hole was backfilled			
(12 ea 50lb bags)			

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SEP 23 2002
WATER RESOURCES DEPT.
SALEM, OREGON

Date started 7-19-02 Completed 8-23-02

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
WWC Number 1578
Signed [signature] Date 9-17-02

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 673
Signed Thomas A. Schwecher Date 9/17/02

ORIGINAL – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER

2002-22

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AUG 20 1996
WATER RESOURCES DEPT.
SALEM, OREGON

Till
50076

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)
Instructions for completing this report are on the last page of this form.

WELL I.D. # L01906

(START CARD) # 89998

(1) OWNER: Well Number 1
Name CITY OF WHEELER
Address P.O. BOX 177
City WHEELER State OR Zip 97147

(2) TYPE OF WORK
[XX] New Well [ ] Deepening [ ] Alteration (repair/recondition) [ ] Abandonment

(3) DRILL METHOD:
[ ] Rotary Air [ ] Rotary Mud [XX] Cable [ ] Auger
[ ] Other

(4) PROPOSED USE:
[ ] Domestic [ ] Community [ ] Industrial [ ] Irrigation
[ ] Thermal [ ] Injection [ ] Livestock [XX] Other MUNICIPAL

(5) BORE HOLE CONSTRUCTION:
Special Construction approval [ ] Yes [XX] No Depth of Completed Well 63 ft.
Explosives used [ ] Yes [XX] No Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
18	0	8				
16	8	63				
			NEAT CEMENT	33.5	0	59 SACKS

How was seal placed: Method [ ] A [ ] B [XX] C [ ] D [ ] E
[ ] Other
Backfill placed from 33.5 ft. to 35 ft. Material SAND & BENT. CHIPS
Gravel placed from 35 ft. to 55 ft. Size of gravel PEA ROCK
55 63 DRAIN ROCK

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12	+3	43	.250	XX		XX	
	12	50	55		XX		XX	
Liner:								

Final location of shoe(s) NONE

(7) PERFORATIONS/SCREENS:
[ ] Perforations Method
[XX] Screens Type JOHNSON V-WIRE Material SS

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
43	53	100		12" p/s		XX	

(8) WELL TESTS: Minimum testing time is 1 hour
[XX] Pump [ ] Bailer [ ] Air [ ] Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.
1012	3.5		24

Temperature of water 49 Depth Artesian Flow Found
Was a water analysis done? [XX] Yes By whom AGI TECHNOLOGIES
Did any strata contain water not suitable for intended use? [ ] Too little
[ ] Salty [ ] Muddy [ ] Odor [ ] Colored [ ] Other
Depth of strata:

(9) LOCATION OF WELL by legal description:
County TILLAMOOK Latitude Longitude
Township 2N N or S Range 9W E or W. WM.
Section 5 NE 1/4 NW 1/4
Tax Lot 200 Lot Block Subdivision
Street Address of Well (or nearest address)
22095 FOSS RD., WHEELER, OR

(10) STATIC WATER LEVEL:
14 ft. below land surface. Date 7-24-96
Artesian pressure 0 lb. per square inch. Date

(11) WATER BEARING ZONES:
Depth at which water was first found 9'

From	To	Estimated Flow Rate	SWL
9	16	15	
16	23	50	14
42.5	50	500	14

(12) WELL LOG:
Ground Elevation

Material	From	To	SWL
SAND GREY LOOSE (overbank dep)	0	2	
SAND GREY SILTY	2	9	
SAND & GRAVEL MED SILTY	9	11	
SAND & GARVEL COURSE SILTY	11	16	
SAND GRAVEL COBBLES 10"MINUS	16		
BRN LOOSE (semi clean)		23	
COBBLES SAND & GRAVEL 10"	23		
MINUS PACKED BRN SOME SILT	BRN	27	
SILT BROWN GRAVELY	27	28	
SAND & GRAVEL SILTY BRN 5"	28		
MINUS SOME COBBLES		31	
GRAVEL BRN COURSE TO FINE	31		
SOME SAND SEMI LOOSE		32.5	
SAND GRAVEL COBBLES 10"	32.5		
MINUS PACKED BRN		34.5	
GRAVEL & COBBLES 8" MINUS	34.5		
BROWN LESS SAND		39	
SAND GRAVEL COBBLES BRN 8"	39		
MINUS MORE SAND SEMI TIGHT		42.5	

Date started 6-21-96 Completed 7-24-96

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
WWC Number 1487
Signed Date 7-29-96

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 688
Signed Steven N. Stoddle. Date 7-29-96

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

RECEIVED

AUG 20 1996

WATER RESOURCES DEPT.
SALEM, OREGON

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)
Instructions for completing this report are on the last page of this form.

WELL I.D. # L01906

(START CARD) # 89998

(1) OWNER: Well Number

Name CITY OF WHEELER
Address P.O. BOX 177
City WHEELER State OR Zip 97147

(2) TYPE OF WORK
[XX] New Well [ ] Deepening [ ] Alteration (repair/recondition) [ ] Abandonment

(3) DRILL METHOD:
[ ] Rotary Air [ ] Rotary Mud [XX] Cable [ ] Auger
[ ] Other

(4) PROPOSED USE:
[ ] Domestic [ ] Community [ ] Industrial [ ] Irrigation
[ ] Thermal [ ] Injection [ ] Livestock [XX] Other MUNICIPAL

(5) BORE HOLE CONSTRUCTION:
Special Construction approval [ ] Yes [ ] No Depth of Completed Well ____ ft.
Explosives used [ ] Yes [ ] No Type ____ Amount ____

HOLE			SEAL			
Diameter	From	To	Material	From	To	Sacks or pounds

How was seal placed: Method [ ] A [ ] B [ ] C [ ] D [ ] E
[ ] Other
Backfill placed from ____ ft. to ____ ft. Material ____
Gravel placed from ____ ft. to ____ ft. Size of gravel ____

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:					[ ]	[ ]	[ ]	[ ]
Liner:					[ ]	[ ]	[ ]	[ ]

Final location of shoe(s)

(7) PERFORATIONS/SCREENS:
[ ] Perforations Method
[ ] Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
						[ ]	[ ]

(8) WELL TESTS: Minimum testing time is 1 hour

[ ] Pump [ ] Bailer [ ] Air [ ] Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.

Temperature of water ____ Depth Artesian Flow Found ____
Was a water analysis done? [ ] Yes By whom ____
Did any strata contain water not suitable for intended use? [ ] Too little
[ ] Salty [ ] Muddy [ ] Odor [ ] Colored [ ] Other
Depth of strata:

(9) LOCATION OF WELL by legal description:
County TILLAMOOK Latitude ____ Longitude ____
Township 2N N or S Range 9W E or W. WM.
Section 5 ____ 1/4 ____ 1/4
Tax Lot ____ Lot ____ Block ____ Subdivision ____
Street Address of Well (or nearest address)
22095 FOSS RD., WHEELER, OR

(10) STATIC WATER LEVEL:
____ ft. below land surface. Date ____
Artesian pressure ____ lb. per square inch. Date ____

(11) WATER BEARING ZONES:

Depth at which water was first found ____

From	To	Estimated Flow Rate	SWL

(12) WELL LOG:
Ground Elevation ____

Material	From	To	SWL
GRAVEL GREY 6" MINUS CLEAN	42.5		
SOME SAND		50	
GRAVEL 8" MINUS BRN SANDY	50		
PACKED		54	
SILT BROWN GRAVELY	54	55	
GRAVEL BRN SILTY 6" MINUS	55	59.5	
BED ROCK BLUE GREY SOFT	50.5		
BROKEN WEATHERED		63	

Date started 6-21-96 Completed 7-24-96

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
WWC Number 1487
Signed [signature] Date 7-29-96

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 688
Signed Steven N. Stadeli Date 7-29-96

51063

Well No. 2

TILL 51063

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)
Instructions for completing this report are on the last page of this form.

WELL I.D. # L 01907
START CARD # W143372

(1) LAND OWNER Well Number ______
Name City of Wheeler
Address PO Box 177
City Wheeler State OR Zip 97147

(2) TYPE OF WORK
☐ New Well ☐ Deepening ☒ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD:
☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Auger
☒ Other NA

(4) PROPOSED USE:
☐ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☒ Other Municipal

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☒ No Depth of Completed Well 63 ft.
Explosives used ☐ Yes ☐ No Type ______ Amount ______

HOLE			SEAL			
Diameter	From	To	Material	From	To	Sacks or pounds

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☐ Other ______
Backfill placed from ______ ft. to ______ ft. Material ______
Gravel placed from ______ ft. to ______ ft. Size of gravel ______

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Drive Shoe used ☐ Inside ☐ Outside ☐ None
Final location of shoe(s) ______

(7) PERFORATIONS/SCREENS: Not Changed
☐ Perforations Method ______
☐ Screens Type ______ Material ______

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
						☐	☐
						☐	☐
						☐	☐
		Not Changed				☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.
	NA		

Temperature of water ______ Depth Artesian Flow Found ______
Was a water analysis done? ☐ Yes By whom ______
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other ______
Depth of strata: ______

(9) LOCATION OF WELL by legal description:
County Tillamook Latitude ______ Longitude ______
Township 2N N or S Range 4W E or W. WM.
Section 5NE 1/4 NW 1/4
Tax Lot 200 Lot ______ Block ______ Subdivision ______
Street Address of Well (or nearest address) 22095 Foss Rd
Wheeler, OR

(10) STATIC WATER LEVEL: NA
16.0 ft. below land surface. Date ______
Artesian pressure ______ lb. per square inch Date ______

(11) WATER BEARING ZONES:
Depth at which water was first found NA

From	To	Estimated Flow Rate	SWL
	NA		

(12) WELL LOG:
Ground Elevation ______

Material	From	To	SWL
*			
Installed a 12x6 pitless			
unit on the existing 12"			
well casing.			
Removed 7' of 12" casing &			
added 7' of combined length			
of 14" Barrol & pitless			
unit top of casing remains			
the same above ground.			
Placed 3/8" hole plug			
around casing as excavated			
Hole was backfilled--			
(12 ea. 50lb bags)			

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SEP 23 2002
WATER RESOURCES DEPT.
SALEM, OREGON

Date started 7-19-02 Completed 8-23-02

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
WWC Number 1578
Signed [signature] Date 9-17-02

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 673
Signed [signature] Date 9/17/02

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AUG 2 0 1996

WATER RESOURCES DEPT.

SALEM, OREGON

Till 50077

Pg 1 of 2

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)
Instructions for completing this report are on the last page of this form.

WELL I.D. # L01907

(START CARD) # 90000

(1) OWNER: Well Number #2
Name CITY OF WHEELER
Address P.O. BOX 177
City WHEELER State OR Zip 97147

(2) TYPE OF WORK
[XX] New Well [ ] Deepening [ ] Alteration (repair/recondition) [ ] Abandonment

(3) DRILL METHOD:
[ ] Rotary Air [ ] Rotary Mud [XX] Cable [ ] Auger
[ ] Other

(4) PROPOSED USE:
[ ] Domestic [ ] Community [ ] Industrial [ ] Irrigation
[ ] Thermal [ ] Injection [ ] Livestock [XX] Other MUNICIPAL

(5) BORE HOLE CONSTRUCTION:
Special Construction approval [ ] Yes [XX] No Depth of Completed Well 63 ft.
Explosives used [ ] Yes [XX] No Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
18	0	8				
16	8	63				
			NEAT CEMENT	33.5	0	42 SACKS

How was seal placed: Method [ ] A [ ] B [XX] C [ ] D [ ] E
[ ] Other
Backfill placed from 33.5 ft. to 35 ft. Material BENT. CHIPS & SAND
Gravel placed from 35 ft. to 63 ft. Size of gravel PEA ROCK

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12	+3	45	.250	XX		XX	
	12	60	63	.250	XX		XX	
Liner:								

Final location of shoe(s)

(7) PERFORATIONS/SCREENS:
[ ] Perforations Method
[XX] Screens Type JOHNSON V-WIRE Material SS

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
45	60	100		12p/s		XX	

(8) WELL TESTS: Minimum testing time is 1 hour

[XX] Pump [ ] Bailer [ ] Air [ ] Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.
1025	3.5		24 HOUR

Temperature of water 49° Depth Artesian Flow Found
Was a water analysis done? [ ] Yes By whom
Did any strata contain water not suitable for intended use? [ ] Too little
[ ] Salty [ ] Muddy [ ] Odor [ ] Colored [ ] Other
Depth of strata:

(9) LOCATION OF WELL by legal description:
County TILLAMOOK Latitude Longitude
Township 2N N or S Range 4W E or W. WM.
Section 5 NE 1/4 NW 1/4
Tax Lot 200 Lot Block Subdivision
Street Address of Well (or nearest address)
22095 FOSS RD., WHEELER, OR

(10) STATIC WATER LEVEL:
14 ft. below land surface. Date 7-28-96
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:

Depth at which water was first found 16'

From	To	Estimated Flow Rate	SWL
16	32.5	<15 GPM	14
32.5	44.5	<100 GPM	14
44.5	63	>400 GPM	14

(12) WELL LOG:
Ground Elevation

Material	From	To	SWL
SAND GREY LOOSE FLOOD DEPOSIT	0	2	
SAND GREY SILTY	2	7	
SAND & GRAVEL SILTY	7	9	
SAND & GRAVEL LESS SILT	9	16	
GRAVEL GREY BRN RED W/SILT	16		
BROWN		19	
GRAVEL & SAND SOME COBBLES	19	26	
GREY BRN 2" MINUS PACKED	26		
GRAVEL BROWN SILTY		30	
GRAVEL COURSE BRN 8" MINUS	30		
SOME SILT SOME SAND		32.5	
GRAVEL RED BRN SEMI CLEAN	32.5	44.5	
GRAVEL GREY BRN 6" MINUS	44.5		
CLEAN LOOSE SOME SAND		50.5	
GRAVEL GREY COURSE 10"	50.5		
MINUS CLEAN LOOSE SOME SAND		58.5	
GRAVEL GREY COURSE TRACE OF	58.5		
SILT		59.0	
GRAVEL GREY COURSE 10" MINUS	59.0		
SEMI LOOSE MORE SAND		63.0	

Date started 7-1-96 Completed 7-25-96

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
WWC Number 1487
Signed Date 7-29-96

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 688
Signed Steven N. Stedeli Date 7-29-96

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

RECEIVED Till 50077 Pg 2 of 2

AUG 2 0 1996

WATER RESOURCES DEPT.
SALEM, OREGON

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)
Instructions for completing this report are on the last page of this form.

WELL I.D. # L01907

(START CARD) # 90000

(1) OWNER: Well Number ______
Name CITY OF WHEELER
Address P.O. BOX 177
City WHEELER State OR Zip 97147

(2) TYPE OF WORK
[X] New Well [ ] Deepening [ ] Alteration (repair/recondition) [ ] Abandonment

(3) DRILL METHOD:
[ ] Rotary Air [ ] Rotary Mud [X] Cable [ ] Auger
[ ] Other

(4) PROPOSED USE:
[ ] Domestic [ ] Community [ ] Industrial [ ] Irrigation
[ ] Thermal [ ] Injection [ ] Livestock [X] Other MUNICIPAL

(5) BORE HOLE CONSTRUCTION:
Special Construction approval [ ] Yes [X] No Depth of Completed Well 63 ft.
Explosives used [ ] Yes [X] No Type ______ Amount ______

HOLE			SEAL			
Diameter	From	To	Material	From	To	Sacks or pounds

How was seal placed: Method [ ] A [ ] B [ ] C [ ] D [ ] E
[ ] Other
Backfill placed from ____ ft. to ____ ft. Material ______
Gravel placed from ____ ft. to ____ ft. Size of gravel ______

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:					[ ]	[ ]	[ ]	[ ]
Liner:					[ ]	[ ]	[ ]	[ ]

Final location of shoe(s) ______

(7) PERFORATIONS/SCREENS:
[ ] Perforations Method ______
[ ] Screens Type ______ Material ______

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
						[ ]	[ ]

(8) WELL TESTS: Minimum testing time is 1 hour

[ ] Pump [ ] Bailer [ ] Air [ ] Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.

Temperature of water ______ Depth Artesian Flow Found ______
Was a water analysis done? [ ] Yes By whom ______
Did any strata contain water not suitable for intended use? [ ] Too little
[ ] Salty [ ] Muddy [ ] Odor [ ] Colored [ ] Other ______
Depth of strata: ______

(9) LOCATION OF WELL by legal description:
County TILLAMOOK Latitude ______ Longitude ______
Township 2N N or S Range 4W E or W. WM.
Section 5 ______ 1/4 ______ 1/4
Tax Lot ______ Lot ______ Block ______ Subdivision ______
Street Address of Well (or nearest address)
22095 FOSS RD., WHEELER, OR

(10) STATIC WATER LEVEL:
______ ft. below land surface. Date ______
Artesian pressure ______ lb. per square inch. Date ______

(11) WATER BEARING ZONES:

Depth at which water was first found ______

From	To	Estimated Flow Rate	SWL

(12) WELL LOG:
Ground Elevation ______

Material	From	To	SWL
ROCK BROKEN WEATHERED BLUE	63		
GREY		?	

Date started 7-1-96 Completed 7-25-96

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
WWC Number 1487
Signed [signature] Date 7-29-96

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 688
Signed Steven N. Stadeli Date 7-29-96

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix G

Selected Record Drawings from Air Stripper, Well, and Booster Pump Project
HBH Consulting Engineers, October 18, 2018

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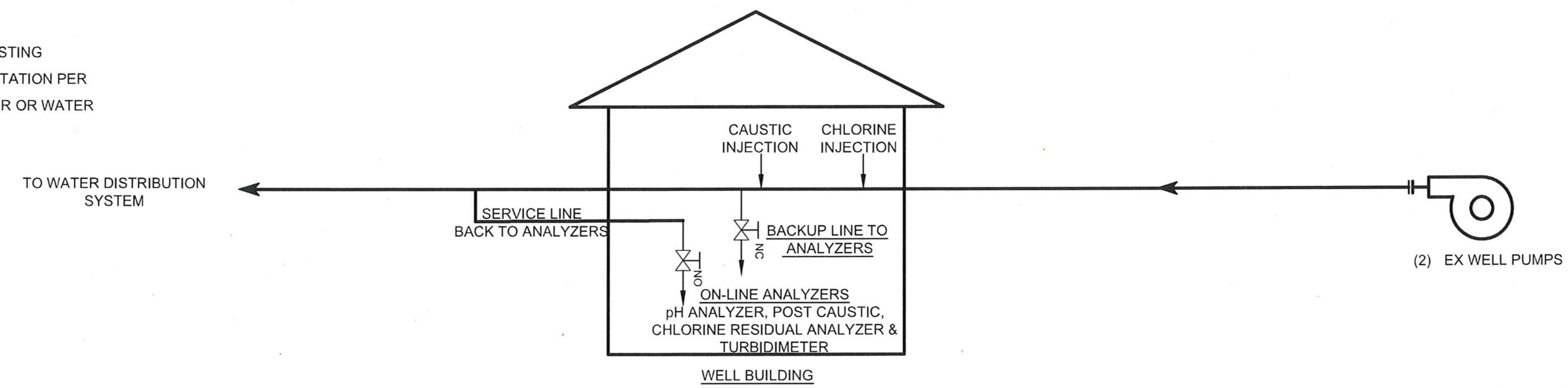
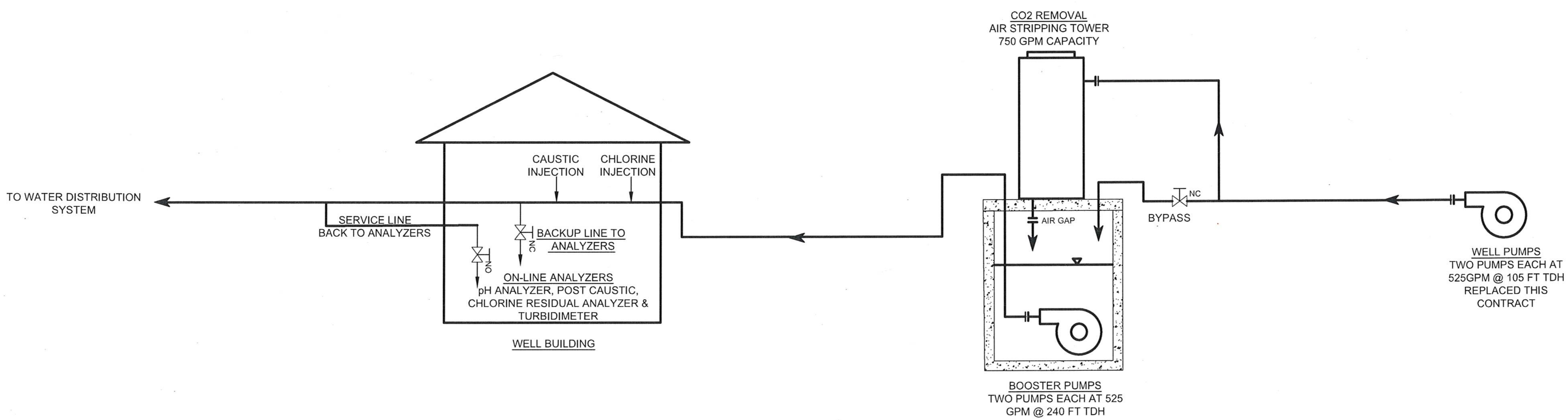
CONSTRUCTION PROCESS NOTES:

GENERAL SEQUENCE OF CONSTRUCTION:

1. REPLACE ONE WELL PUMP
2. COMPLETE CONSTRUCTION SETUP WITH TWO DI TEES AND TEMPORARY FLOW THROUGH FLANGE AS SHOWN IN DETAIL 4, SHEET M-2. USE TREATED SURFACE WATER OR WATER SUPPLY RESERVOIR DURING THIS PHASE.
3. COMMISSION BOOSTER STATION
4. COMMISSION STRIPPING TOWER
5. REMOVE CONSTRUCTION SETUP AND CONNECT EXISTING SYSTEM TO AIR STRIPPING TOWER AND BOOSTER STATION PER DETAIL 5, SHEET M-3. USE TREATED SURFACE WATER OR WATER SUPPLY RESERVOIR DURING THIS PHASE.
6. REPLACE 2ND WELL PUMP



EXISTING PROCESS FLOW



PROCESS FLOW

PROCESS DIAGRAM N.T.S.

REFER TO ORIGINAL DRAWINGS FOR SIGNATURES AND SEALS

H B H Consulting Engineers
2316 Portland Road, Suite H
Newberg, Oregon 97132
503/554-9553 ■ fax 503/537-9554
email: mail@hbh-consulting.com

Designed By: JTM | Drawn By: JTM | Checked By: RMH | Submittal No: AS BUILT

File: ...Record Drawings/AIR STRIPPING TOWER_JTM | Layout: PID

REV.	DATE	DESCRIPTION	BY

IF THIS LINE IS NOT 1 INCH SCALE IS NOT AS SHOWN

MANZANITA WATER DEPARTMENT
PO BOX 129 MANZANITA, OREGON 97130

AIR STRIPPER, WELL + BOOSTER PUMPS
MANZANITA WATER DEPARTMENT, OREGON

PROCESS FLOW DIAGRAM

RECORD DRAWING 10/18/2018

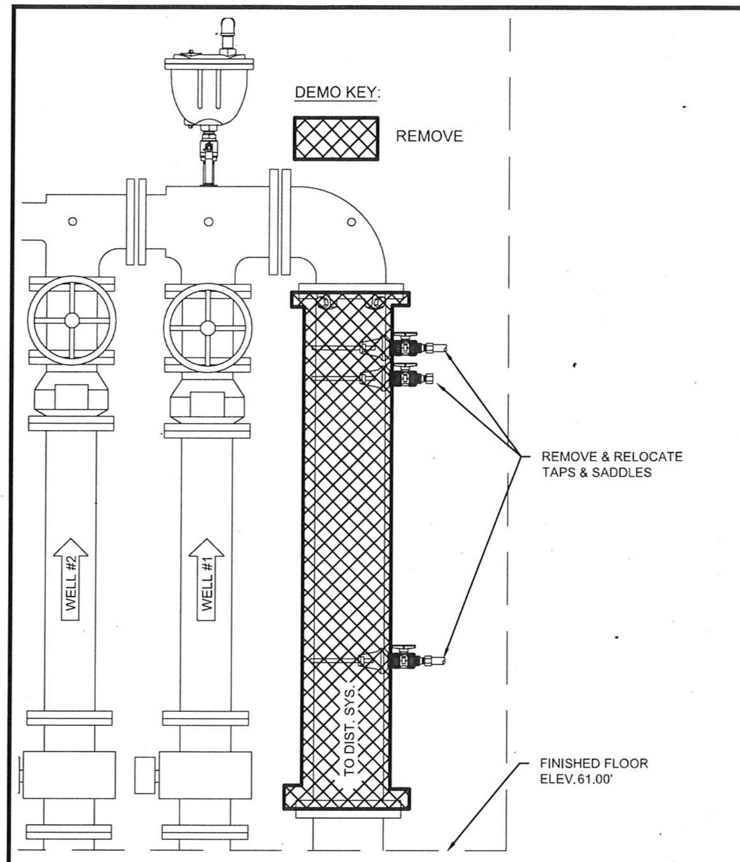
RECORD DRAWINGS ARE PER AS BUILT SURVEY SUPPLIED BY STETLER SUPPLY AND CONSTRUCTION AND SITE OBSERVATIONS.

Sheet No. M-1

04 of 08

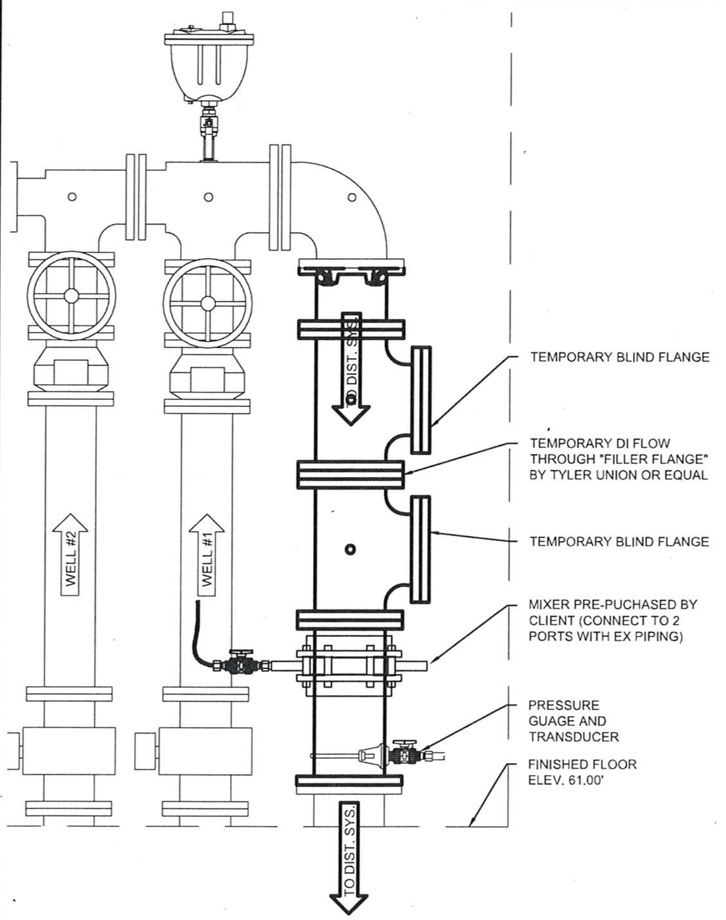
Date 7-26-16

2015-004



DETAIL 3 - EX. BUILDING PIPING - DEMOLITION ELEV.

SCALE: 1" = 1' (1/2" = 1' AT HALF SCALE-11x17)

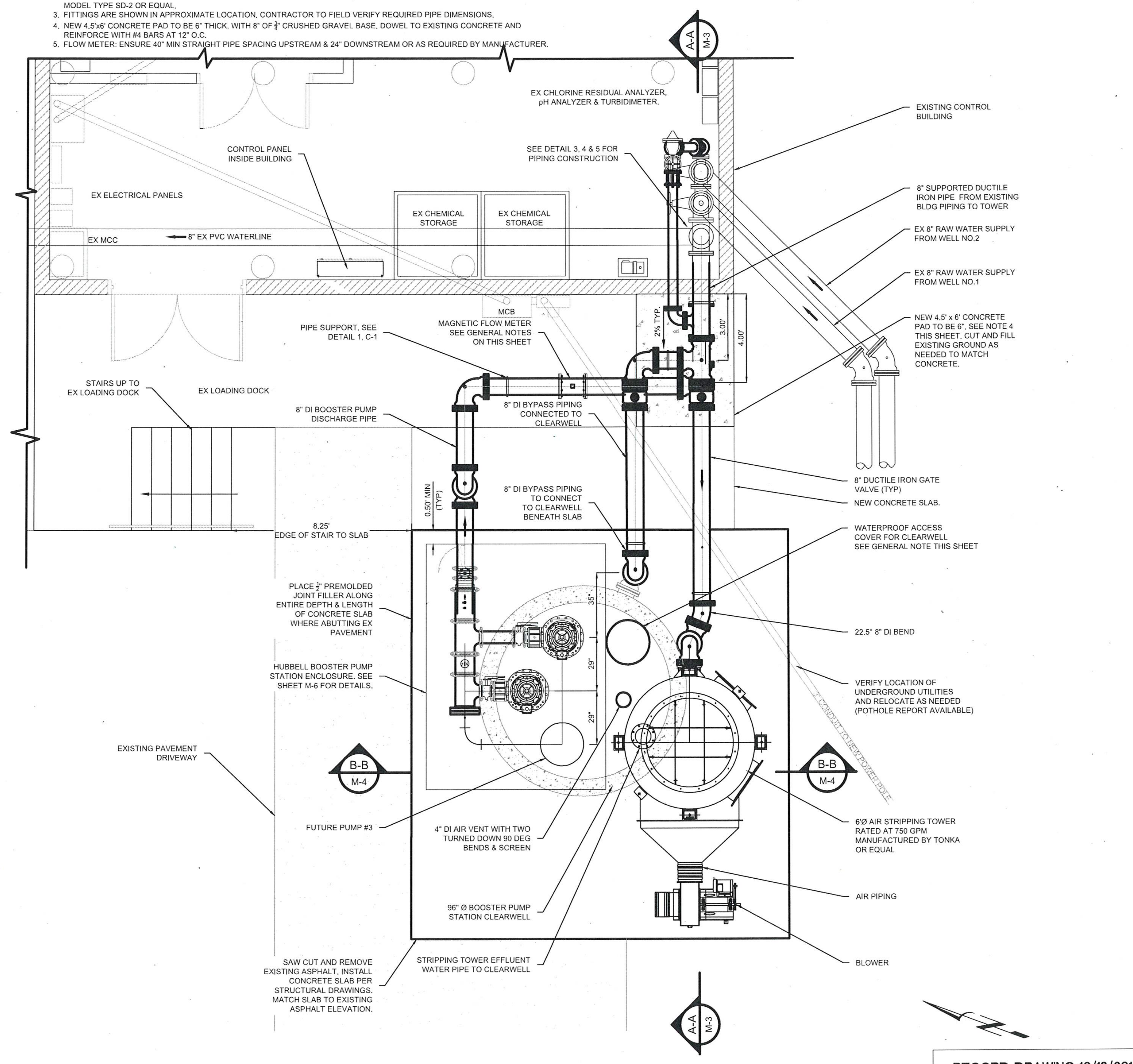


DETAIL 4 - EX. BUILDING PIPING - PHASED CONSTRUCTION ELEVATION (SEE M-3 FOR COMPLETED SECTION)

SCALE: 1" = 1' (1/2" = 1' AT HALF SCALE-11x17)

NOTES:

1. ALL WETTED MATERIALS SHALL BE NSF 61 APPROVED.
2. S.S. WATERPROOF COVER FOR CLEARWELL TO BE BY HUBER TECHNOLOGY, MODEL TYPE SD-2 OR EQUAL.
3. FITTINGS ARE SHOWN IN APPROXIMATE LOCATION, CONTRACTOR TO FIELD VERIFY REQUIRED PIPE DIMENSIONS.
4. NEW 4.5'x6' CONCRETE PAD TO BE 6" THICK, WITH 8" OF ¾" CRUSHED GRAVEL BASE, DOWEL TO EXISTING CONCRETE AND REINFORCE WITH #4 BARS AT 12" O.C.
5. FLOW METER: ENSURE 40" MIN STRAIGHT PIPE SPACING UPSTREAM & 24" DOWNSTREAM OR AS REQUIRED BY MANUFACTURER.



SITE PLAN

SCALE: 1" = 2'-6" (1/2" = 1'-3" AT HALF SCALE-11X17)

RECORD DRAWING 10/18/2018

RECORD DRAWINGS ARE PER AS BUILT SURVEY SUPPLIED BY STETLER SUPPLY AND CONSTRUCTION AND SITE OBSERVATIONS.

REFER TO ORIGINAL DRAWINGS FOR SIGNATURES AND SEALS

H B H Consulting Engineers
2316 Portland Road, Suite H
Newberg, Oregon 97132
503/554-9553 ■ fax 503/537-9554
email: mail@hbh-consulting.com

Designed By: JTM | Drawn By: JTM | Checked By: RMH | Submittal No: AS BUILT

File: ...Record Drawings/AIR STRIPPING TOWER_JTM | Layout: PLAN

REV.	DATE	DESCRIPTION	BY

0" 1"
IF THIS LINE IS NOT 1 INCH SCALE IS NOT AS SHOWN

MANZANITA WATER DEPARTMENT
PO BOX 129 MANZANITA, OREGON 97130

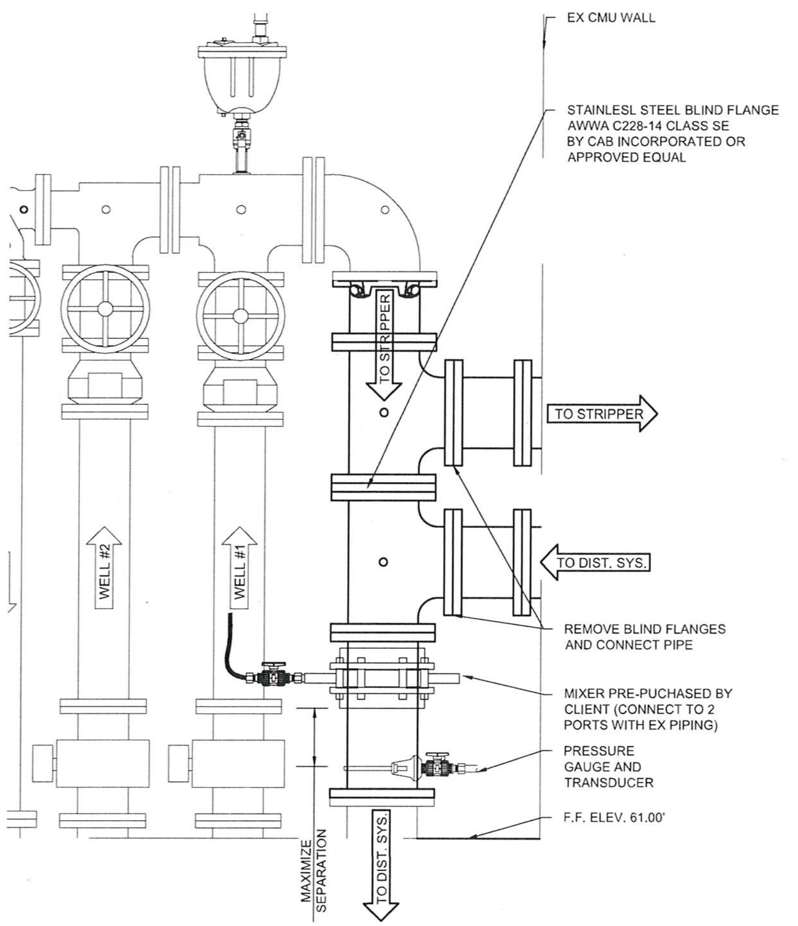
AIR STRIPPER, WELL + BOOSTER PUMPS
MANZANITA WATER DEPARTMENT, OREGON

AIR STRIPPER SITE PLAN + DETAILS

Sheet No. M-2 | 05 of 08

Date 7-26-16

2015-004



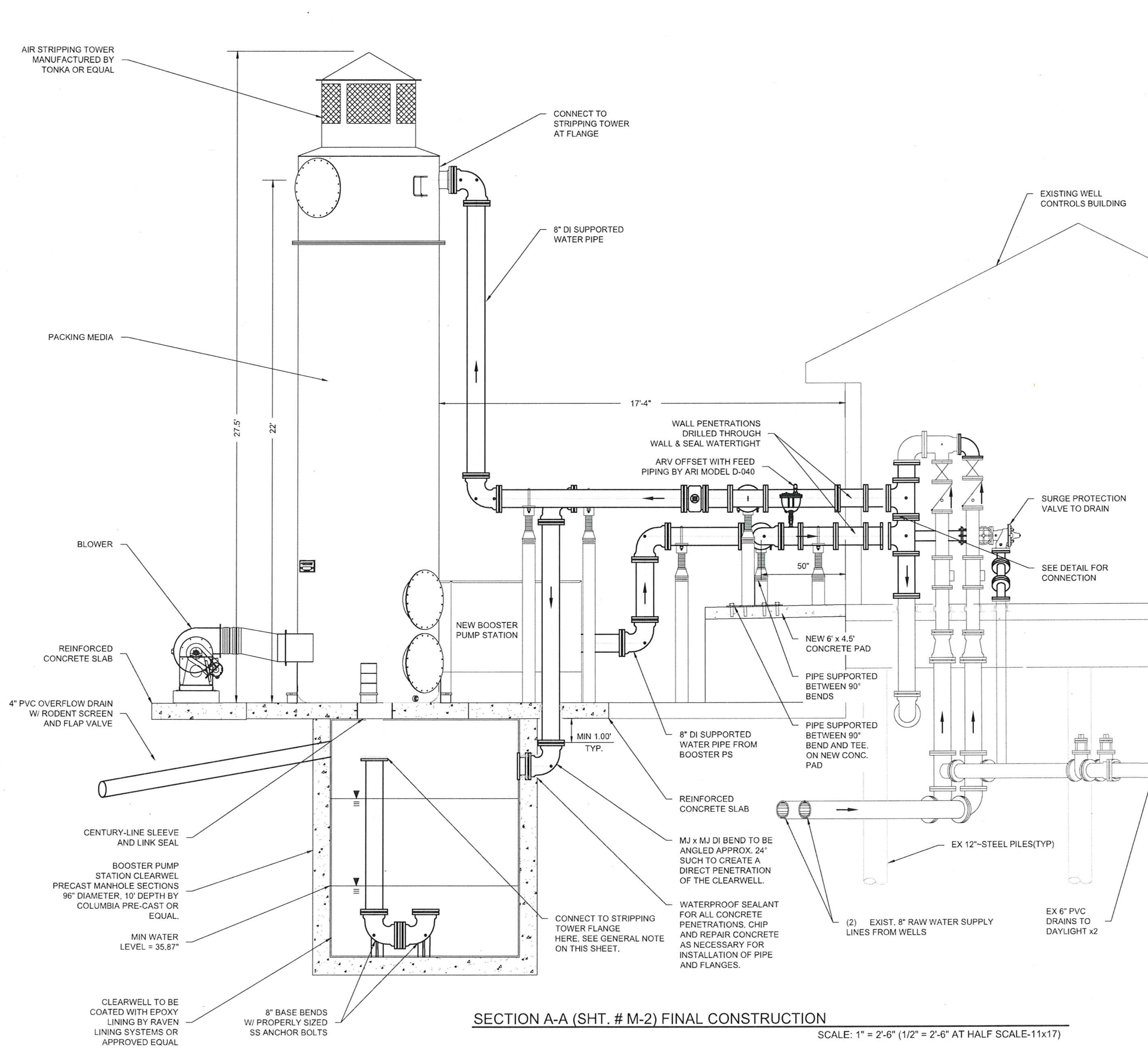
DETAIL 5 (SHT. # M-2) - FINAL CONSTRUCTION
BUILDING PIPE ELEVATION

SCALE: 1" = 1' (1/2" = 1' AT HALF SCALE- 11X17)

RECORD DRAWING 10/18/2018

RECORD DRAWINGS ARE PER AS BUILT SURVEY SUPPLIED BY STETLER SUPPLY AND CONSTRUCTION AND SITE OBSERVATIONS.

NOTES:
1. NOTE THAT FLANGE PIECE AT BOTTOM OF STRIPPING TOWER COMES ATTACHED PRE-FAB. MAKE CONSTRUCTION PROVISIONS ACCORDINGLY, INCLUDING SUFFICIENT SLAB PENETRATION WIDTH FOR INSTALL. TONKA RECOMMENDS A 17.5"Ø SLAB PENETRATION.
2. USE CENTURY-LINE SLEEVE AND LINK SEAL FOR ALL PENETRATIONS.
3. PIPE SUPPORTS MUST NOT BE PLACED MORE THAN 14' O.C., OR PER MANUFACTURER SPECIFICATIONS



SECTION A-A (SHT. # M-2) FINAL CONSTRUCTION

SCALE: 1" = 2'-6" (1/2" = 2'-6" AT HALF SCALE-11x17)

REFER TO ORIGINAL DRAWINGS FOR SIGNATURES AND SEALS

H B H Consulting Engineers
2316 Portland Road, Suite H
Newberg, Oregon 97132
503/554-9553 ■ fax 503/537-9554
email: mail@hbh-consulting.com

Designed By: JTM | Drawn By: JTM | Checked By: RMH | Submittal No: AS BUILT
File: ...Record Drawings/AIR STRIPPING TOWER_JTM | Layout: PROFILE 1

REV.	DATE	DESCRIPTION	BY

0" 1"
IF THIS LINE IS NOT 1 INCH SCALE IS NOT AS SHOWN

MANZANITA WATER DEPARTMENT
PO BOX 129 MANZANITA, OREGON 97130

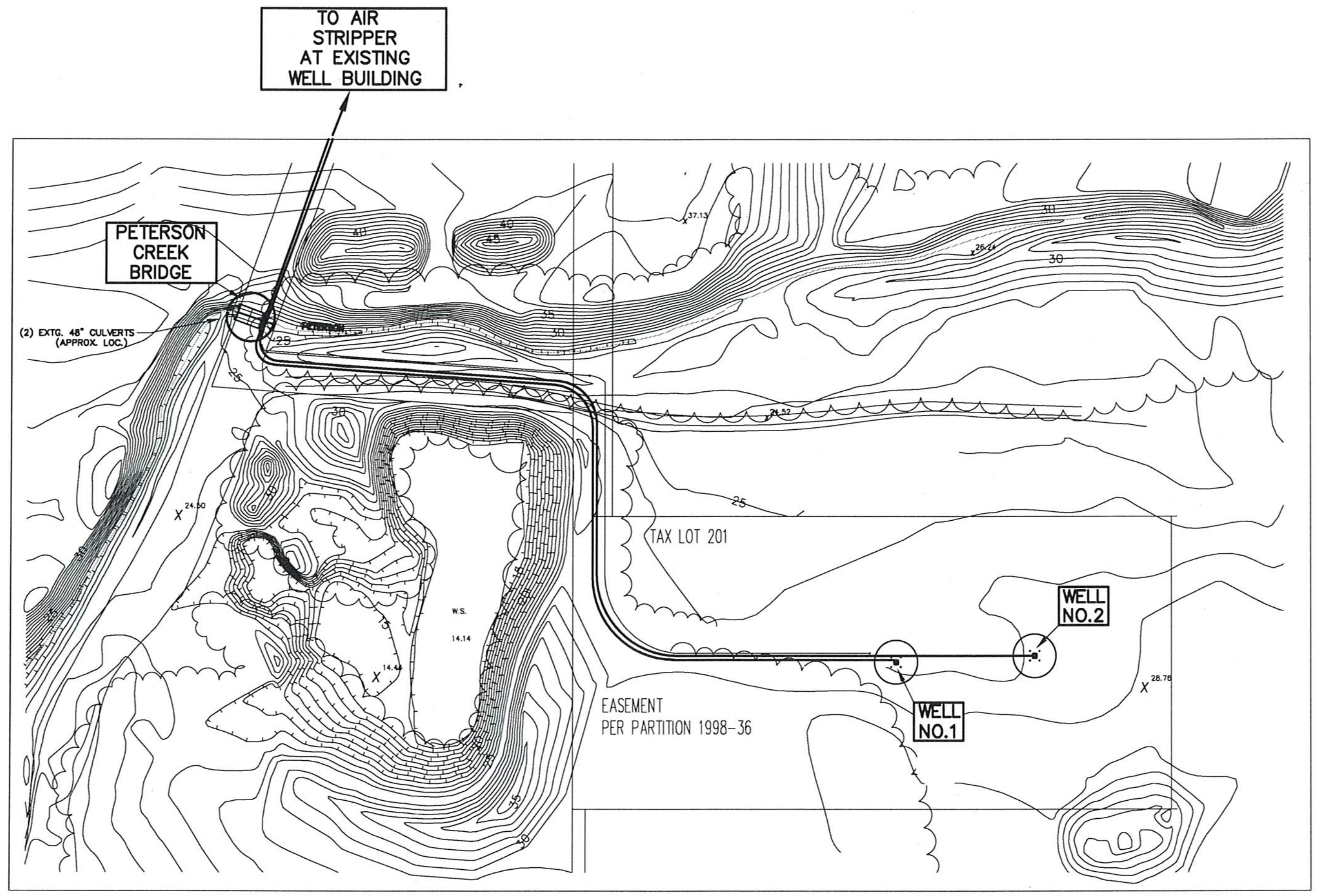
AIR STRIPPER, WELL + BOOSTER PUMPS
MANZANITA WATER DEPARTMENT, OREGON
AIR STRIPPER SITE PROFILE 1

Sheet No. M-3
Date 7-26-16
06 of 08
2015-004

RECORD DRAWING 10/18/2018

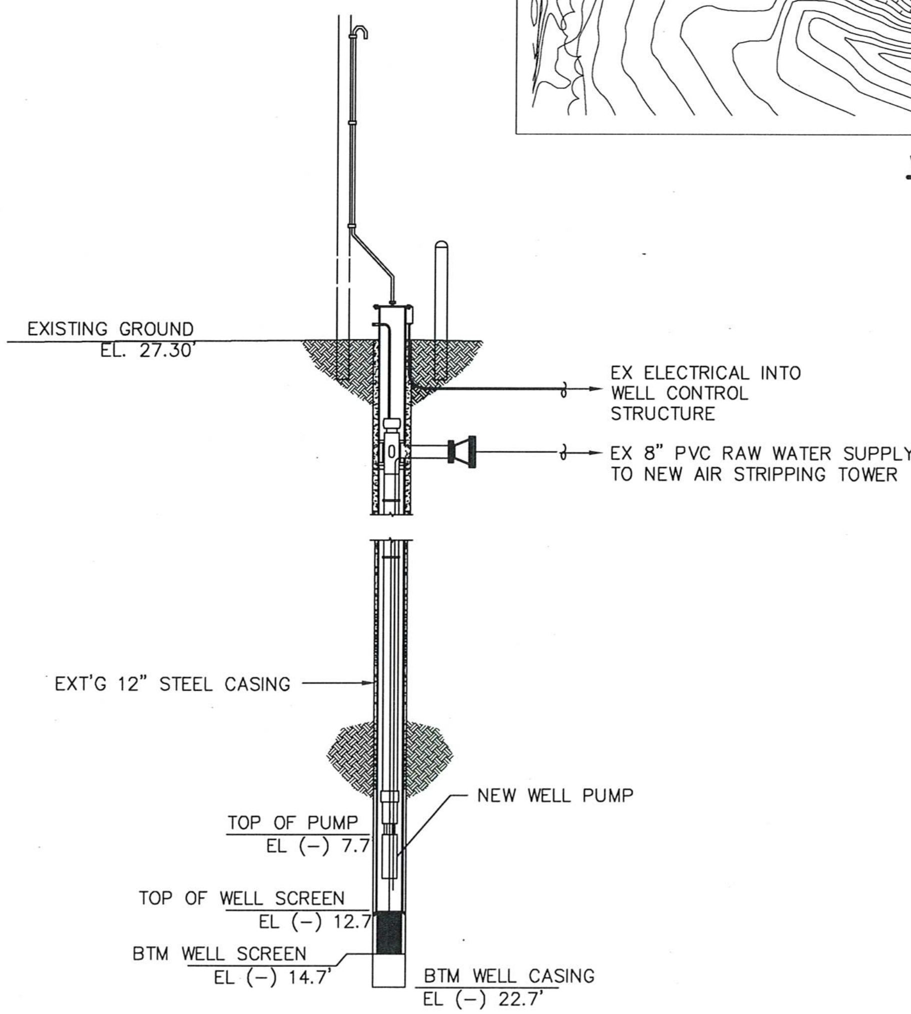
RECORD DRAWINGS ARE PER AS BUILT SURVEY SUPPLIED BY STETLER SUPPLY AND CONSTRUCTION AND SITE OBSERVATIONS.

REFER TO ORIGINAL DRAWINGS FOR SIGNATURES AND SEALS



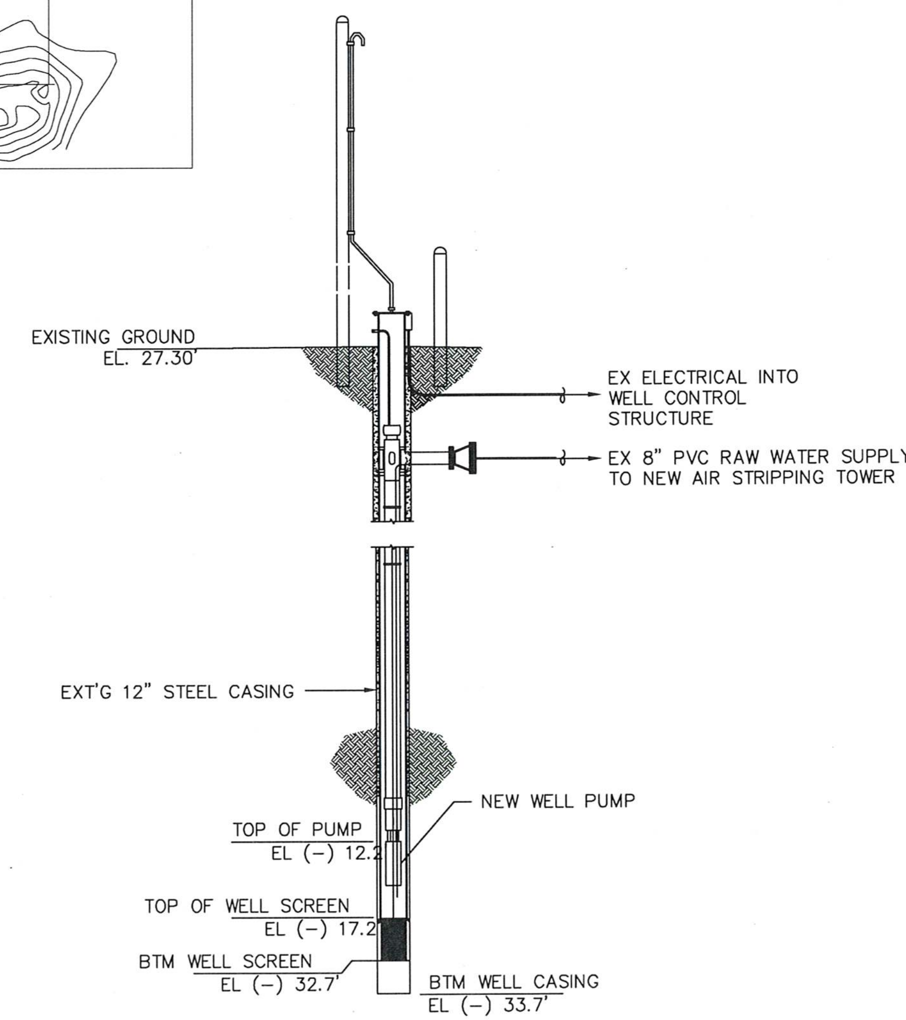
WELL SITE AREA MAP

SCALE: 1" = 250' (1" = 500' AT HALF SCALE - 11X17)



PUMP SECTION FOR WELL NO. 1

SCALE: 1/4" = 1'-0" (1/8" = 1'-0" AT HALF SCALE-11X17)



PUMP SECTION FOR WELL NO. 2

SCALE: 1/4" = 1'-0" (1/8" = 1'-0" AT HALF SCALE-11X17)

H B H
Consulting Engineers
2316 Portland Road, Suite H
Newberg, Oregon 97132
503/554-9553 ■ fax 503/537-9554
email: mail@hbh-consulting.com

Designed By: JTM | Drawn By: JTM | Checked By: RMH | Submittal No: AS BUILT

File: ...6-Construction/Record Drawings/WellPumps_JTM | Layout: WELL PUMPS

REV.	DATE	DESCRIPTION	BY

IF THIS LINE IS NOT 1 INCH SCALE IS NOT AS SHOWN

MANZANITA WATER DEPARTMENT
PO BOX 129 MANZANITA, OREGON 97130

AIR STRIPPER, WELL + BOOSTER PUMPS
MANZANITA WATER DEPARTMENT, OREGON

WEL PUMPS PLAN + PROFIE

Sheet No. M-5

08 of 08

Date 7-26-16

2015-004

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix H

Selected Plan Sheets from City of Manzanita Water Treatment Plant Improvements
HGE, Inc., Architects, Engineers, Surveyors & Planners, 2000

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DESIGN CRITERIA

DESCRIPTION	CRITERIA
PLANT CAPACITY	
INITIAL:	350 GALLONS / MINUTE
FUTURE:	690 GALLONS / MINUTE
MICROFILTRATION UNIT	
INITIAL:	
UNITS TYPE:	30M 10C
NUMBER OF UNITS:	2
MODULE PER UNIT:	30
TOTAL MODULES:	60
FUTURE: (ADDITIONAL MODULES TO INITIAL UNITS)	
UNIT TYPE:	48M 10C
NUMBER OF UNITS:	2
MODULE PER UNIT:	48
TOTAL MODULES:	96
RAW WATER PUMPS	
INITIAL:	
PUMP TYPE:	VARIABLE SPEED
-	VERTICAL TURBINE
AVERAGE FEED RATE:	371 GALLONS / MINUTE
BACKWASH FEED RATE:	756 GALLONS / MINUTE
FUTURE:	
PUMP TYPE:	VARIABLE SPEED
-	VERTICAL TURBINE
AVERAGE FEED RATE:	736 GALLONS / MINUTE
BACKWASH FEED RATE:	1223 GALLONS / MINUTE
PREFILTERS	
CAPACITY	700 GALLONS / MINUTE
BACKWASH	
INITIAL:	
DURATION:	140 SECONDS
FREQUENCY:	30 MINUTES
BACKWASH AS % OF FEED:	5.73%
FLOW RATE DURING BACKWASH	756 GALLONS / MINUTE
AVERAGE BACKWASH FLOW RATE:	21.3 GALLONS / MINUTE
FUTURE:	
DURATION:	150 SECONDS
FREQUENCY:	30 MINUTE
BACKWASH AS % OF FEED:	4.64%
FLOW RATE DURING BACKWASH	1223 GALLONS / MINUTE
AVERAGE BACKWASH FLOW RATE:	33.6 GALLONS / MINUTE
BACKWASH EQUALIZATION TANK:	
CAPACITY:	1,150 GALLONS
BACKWASH STORAGE BASIN:	
CAPACITY:	82,500 GALLONS
DEPTH:	11.5 FT
GALLONS/FT:	7,180 GALLONS/FT
BACKWASH PUMPS:	2 PUMPS
CAPACITY PER PUMP:	40 GALLONS/MINUTES
RAW WATER BASIN:	
CAPACITY:	29,500 GALLONS
DEPTH:	11.5 FT
GALLON/FT OF DEPTH:	2,565

DESCRIPTION	UNITS	CRITERIA
TREATED WATER BASIN		
CAPACITY:		69,350 GALLONS
DEPTH:		10.5 FT
GALLON/FT. :		6,600 GALLONS/FT.
DETENTION TIME: (350 GAL/MIN)		198 MINUTES
CHLORINATION SYSTEM:		
MIXED - OXIDANT GENERATION EQUIPMENT:		20 POUNDS PER DAY OF CHLORINE PLUS 4 POUND PER DAY OF CHLORINE EQUIVALENT OXIDANTS
DOSAGE: (AVG.)		2 mg/l
MIXED - OXIDANT STORAGE TANK:		500 GALLONS
FEED PUMPS:		2 PUMPS
CAPACITY PER PUMP:		60 GALLON/HOUR
SODA ASH SYSTEM:		
STORAGE TANK:		500 GALLONS
DOSAGE: (AVG.)		12 mg/l
FEED PUMP		1 PUMP
PUMP CAPACITY:		11.3

MEMCOR MICROFILTRATION SYSTEM SPECIFICATIONS

MEMBRANE	
MATERIAL OF CONSTRUCTION:	POLYPROPYLENE
PORE SIZE:	0.2 MICRONS (NOMINAL)
VALIDATION:	PRESSURE DECAY TEST
CONFIGURATION:	HOLLOW FIBER (CAPILLARY)
MODULE	
TYPE:	M10C
LENGTH:	1 METER
MEMBRANE SURFACE AREA:	15 SQUARE METERS (INSIDE OF FIBER)
ORIENTATION	VERTICAL
SYSTEM	
FEED CONFIGURATION:	DIRECT FLOW
OPERATING PRESSURE:	30 - 35 psi (NOMINAL)
TRANSMEMBRANE:	7 TO 22 psid
PRESSURE DIFFERENTIAL	-
MEMBRANE SYSTEM:	5 psid (PIPE LOSS ALLOWANCE)
BACKWASH	
MEDIUM:	REVERSE FLOW COMPRESSED AIR (95 psi)
-	WITH RAW WATER SWEEP
INTERVAL:	22 - 60 MINUTES
DURATION:	2 1/2 MINUTES
VOLUME:	5 TO 10% (TYPICAL)
GENERAL	
MAXIMUM FEED PRESSURE:	100 psi
MAXIMUM CONTINUOUS:	-
OPERATING RANGE:	50 psi
DESIGN TEMPERATURE:	32°F - 104°F (0° - 40° C)
	0°C (32°F)
pH RANGE	0.5 TO 14
COMPRESSED AIR:	100 psi MINIMUM PRESSURE
	LESS THAN 0.01 ppm OF OIL
	37.5 SCF/MODULE MAX. INSTANT. DELIVERY (TYPICAL)
	APPROX. 7.5 SCFM/MODULE USED PER BACKWASH (TYP.)

MEMCOR - REQUIREMENTS

1) WATER TO MEMCOR UNITS MUST BE UNCHLORINATED.

2) WATER TO MEMCOR UNIT MUST BE PREFILTERED TO 500 MICRONS.

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1 2
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

HGE INC
ARCHITECTS, ENGINEERS, SURVEYORS, & PLANNERS
375 Park Avenue/Coos Bay, Oregon 97420 (541) 269-1166
19 N. W. Fifth Avenue/Portland, Oregon 97209 (503) 222-1687

SHEET TITLE: GENERAL DESIGN CRITERIA

PROJECT: CITY OF MANZANITA WATER TREATMENT PLANT MANZANITA, OREGON

REGISTERED PROFESSIONAL ENGINEER
OREGON

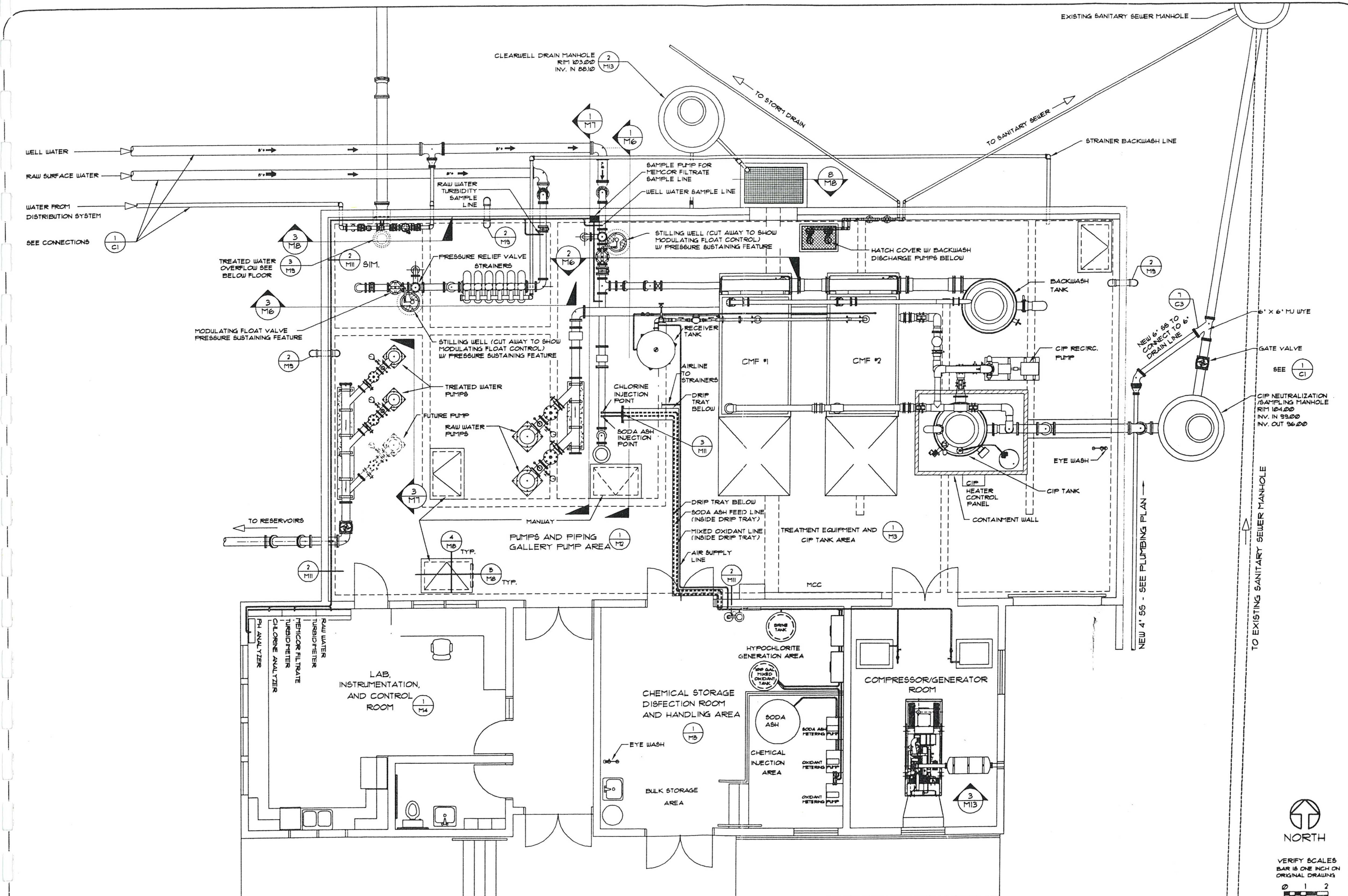
PROJECT NO. 9973.1

DATE: MAY 2000

REVISIONS

DATE	BY

SHEET NO. G2



MECHANICAL OVERVIEW

SCALE 1/8" = 1'

NOTE: THRUST BLOCKS ARE REQUIRED ON ALL WATER PIPING AT BENDS, TEES, DEAD END & REDUCERS.

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1 2
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

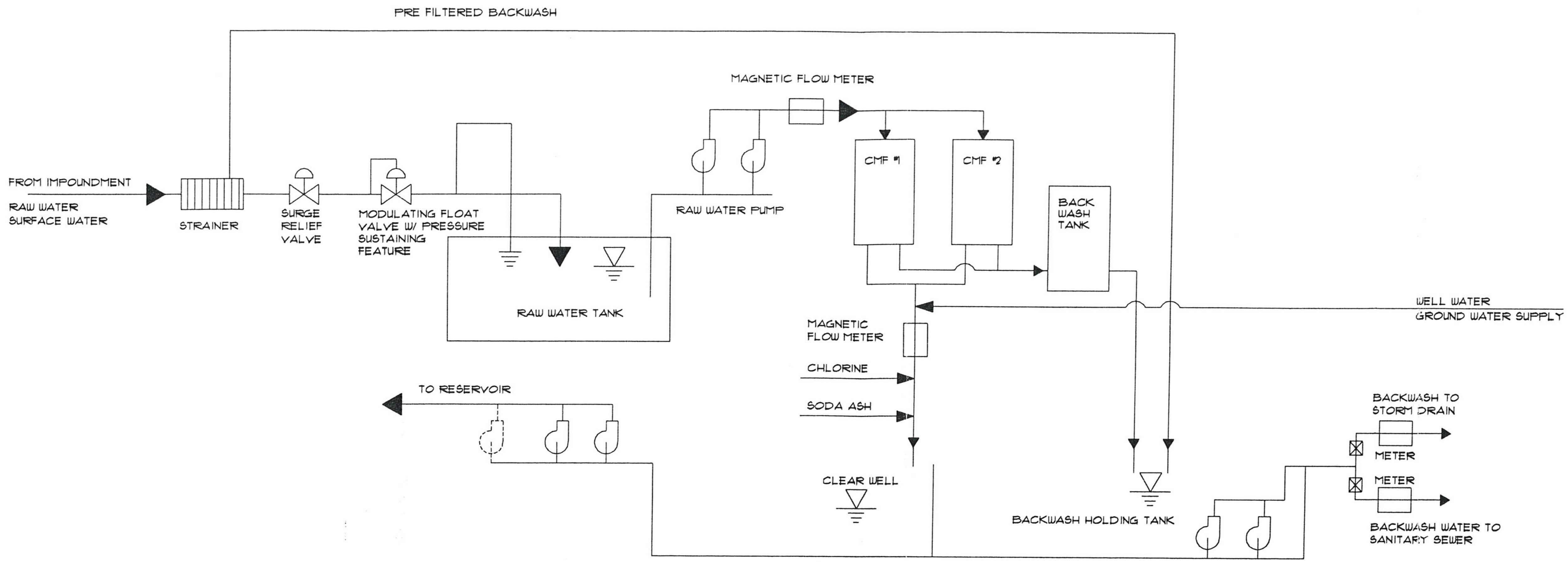
HGE INC
ARCHITECTS, ENGINEERS, SURVEYORS, & PLANNERS
375 Park Avenue/Coos Bay, Oregon 97420 (541) 269-1166
19 N. W. Fifth Avenue/Portland, Oregon 97209 (503) 222-1687

SHEET TITLE:
MECHANICAL
MECHANICAL FLOOR PLAN

PROJECT:
CITY OF MANZANITA
WATER TREATMENT PLANT
MANZANITA, OREGON

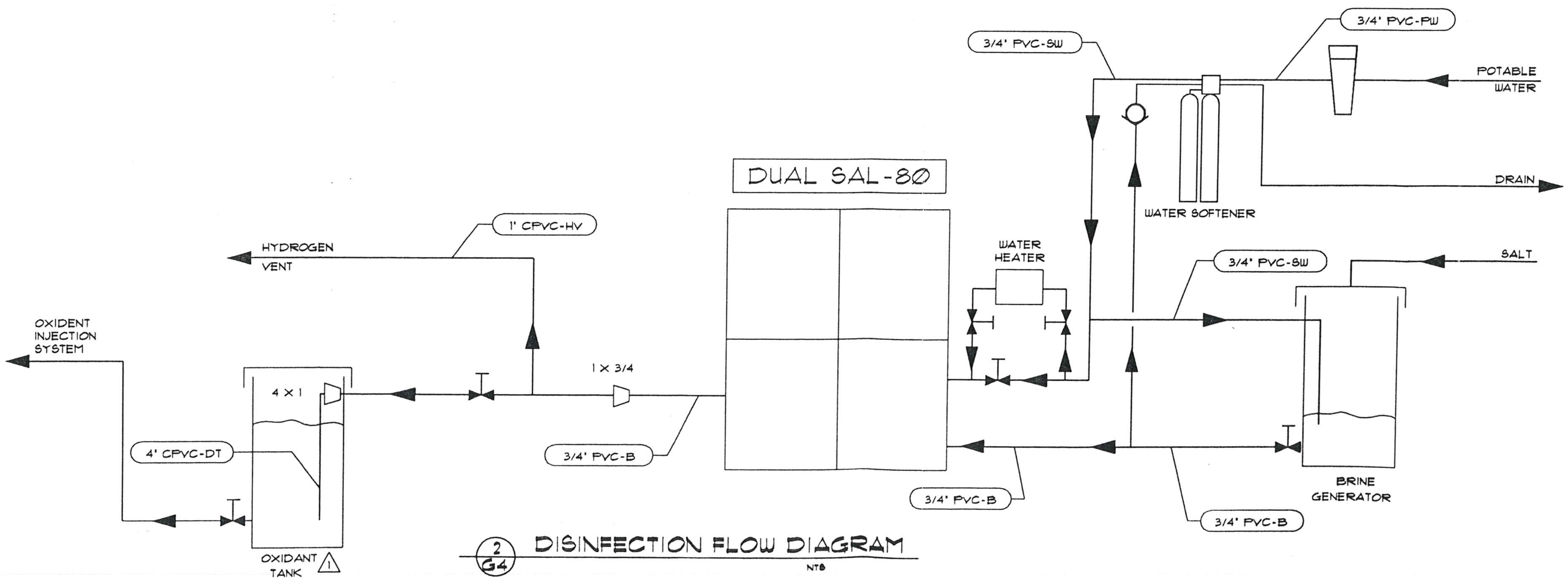
REGISTERED PROFESSIONAL ENGINEER 6489
OREGON
JULY 11, 1984
RICHARD B. NOBLE
EXPIRES 12-31-02

PROJECT
9973.1
DATE:
MAY 2000
SHEET NO.
M1



1/G4 TREATMENT PROCESS FLOW DIAGRAM

NTS



2/G4 DISINFECTION FLOW DIAGRAM

NTS

VERIFY SCALES
BAR IS ONE INCH ON
ORIGINAL DRAWING
0 1 2
IF NOT ONE INCH
ON THIS SHEET, ADJUST
SCALES ACCORDINGLY

HGE INC
ARCHITECTS, ENGINEERS,
SURVEYORS, & PLANNERS
375 Park Avenue/Coos Bay, Oregon 97420 (541) 269-1166
19 N. W. Fifth Avenue/Portland, Oregon 97209 (503) 222-1687

SHEET TITLE:
CATEGORY
PROCESS & DISINFECTION
FLOW DIAGRAMS

PROJECT:
CITY OF MANZANITA
WATER TREATMENT PLANT
MANZANITA, OREGON

REGISTERED PROFESSIONAL ENGINEER
6489
OREGON
JULY 11, 19__
RICHARD D. NORED
EXPIRES 12-31-02

PROJECT NO.
9973.1

DATE:
MAY 2000

REVISIONS	
DATE	BY

SHEET NO.
G4

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix I

Air Entrainment Update
HGE, Inc., Architects, Engineers, Surveyors & Planners, May 11, 2005

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AIR ENTRAINMENT UPDATE
City of Manzanita
May 11, 2005

Prepared by: William M. Pavlich, P.E.
HGE, Inc. Architects, Engineers, Surveyors & Planners

INTRODUCTION

We have recently made significant progress in identifying the source and possible solutions to the City's air entrainment problem. Last week, operational changes were implemented that resulted in a sharp drop in dissolved oxygen concentrations. Most water customers that had problems should have clear water now; however, the operational changes are only a temporary solution. This update describes some of the recent efforts and some near-term improvements intended to address significant deficiencies in the distribution system. We believe these deficiencies are either the source, or a contributing factor, of the air entrainment problem.

RECENT EFFORTS

Recent efforts have focused on water system operational changes that were implemented around the same time as the Laneda Project. Table 1 (attached) provides a general timeline for the period prior to the first recorded customer complaint dated April 9, 2004. The timeline is based on operational logs and interviews with City staff. Reservoir modifications and operational changes paralleled the Laneda Project. The first incident of air in the system was not recorded. Verbal reports of problems were made prior to April 9th - possibly as early as late January 2004.

Figure 1 (attached) shows the water flow path prior to the isolation of Reservoir #2. Water was routed primarily through Reservoir #1 to Reservoir #2 and then to the lower level distribution system. The secondary flow path through Reservoir #3 is believed to have not been very efficient - resulting in most water being delivered to the system via Reservoir #2.

Figure 2 (attached) shows the modified flow path. All water to the lower level system is delivered via Reservoir #3 with Reservoir #2 just floating on the system.

Reservoir locations can be found on Figure 3 (attached).

The reservoirs are all at atmospheric pressure and all dissolved oxygen (D.O.) measurements at the reservoirs have shown levels of less than 100 percent saturation. Increases in system D.O. is therefore due to changes occurring within the system itself. In examining the line from Reservoir #3 to its connection with the 10" line from Reservoir #2 (at Ocean Avenue and Nutmeg Street) we note:

- The line from Reservoir #3 is 10" diameter. This is much smaller than would be anticipated given the size and modernity of the reservoir. A more typical size would be 16". The larger size allows greater flow and reduces frictional losses thereby enhancing system fire flows. The 10" line extends 916 feet.
- At Oak Street and Ocean Avenue, the 10" line enters a tee and transitions to an 8" line that extends approximately 440 feet.
- Near Ocean Avenue and Nutmeg Street, the 8" line transitions to 6" - or, at least, passes through a reducer and 6" valve prior to the connection with the 10" line from Reservoir #2. The size of the 6" valve was verified by counting the number of turns to open or close to the valve.
- The nature of the connection with the 10" line is not known. Based on the probable location of the 10" line in relation to the valve, it is likely to be a 6" tee connection; however, other types or sizes of connection are possible.

The final necking down of the 10" line to 6" may act like a nozzle to accelerate flow. The effect could create a vacuum that pulls air in via a defect. This would be somewhat analogous to situations described in engineering literature of transmission lines pulling in air through defective air release valves or pumps entraining air through defective suction seals. In this particular case, the nature of the connection is not known so its potential as an air source is just inferred at this time. The location in the system is relatively high in elevation; consequently there is less internal static pressure for a vacuum to overcome. Sampling of D.O. concentrations in town over the past year consistently showed the highest levels in the city to be in the vicinity of this connection.

As a partial test of this hypothesis, City staff closed the 6" valve at Ocean Avenue and Nutmeg Street and routed flow to the lower level system via reservoir #1 and Reservoir #2. Reservoir #3 is essentially off-line, feeding only the few active connections along Ocean Avenue. The modifications were implemented on Tuesday, May 5th. By the next day, D.O. levels were at less than 100% saturation at the various test locations. The only location showing high D.O. levels was on the isolated part of the system where there are few active connections. City staff will be flushing this isolated part of the system to draw in fresh water from Reservoir #3. It is expected that D.O. levels will drop accordingly. At some time in the near future, the 6" valve will be opened and the City's leak detection equipment used to listen for abnormal sounds at key features including the 6" valve at Nutmeg Street and at the existing air release valve at Poysky Street and Ocean Avenue. This last test will introduce some air back into the system for the duration of the test.

OTHER CONSIDERATIONS

The current "fix" is a temporary arrangement; Reservoir #3 needs to be brought back online. Going back to the old mode of operation is not recommended since the changes that were made at that time addressed other system deficiencies and concerns.

Circulation in reservoirs is also important to minimize the formation of disinfection by-products and loss of chlorine residuals.

The existing connection at Ocean Avenue and Nutmeg Street also constitutes a serious risk to system reliability. If the connection failed, the reservoirs would be essentially off-line. Flow could still be available by opening connections to the upper-zone system; however, this could over-pressurize the lower system and could cause breaks. The city would be most at risk during a prolonged fire flow situation both from the stresses placed on the connection and from the lack of water for fire flow if a break should occur.

A second line connecting Reservoir #3 to the lower level system is recommended to alleviate the risk of having a single connection, to improve system flow capabilities, and to reduce higher flow velocities that could be contributing to the air problem.

RECOMMENDATIONS

At this time, we are recommending two small improvement projects that should alleviate, or eliminate the air entrainment problem, and address the system reliability issues. Figure 3 shows project locations. Annotated photographs showing the existing water system and proposed improvements are referenced on Figure 3 and shown on the Photo Plate 1 (attached). The projects include:

- Ocean and Nutmeg Project - Provides a 10" tee connection, 10" valve, and 10" line to replace the existing 6" configuration. Eventually, the City could replace the 8" line to the connection at Oak Street. This would provide a continuous 10" connection to Reservoir #3.
- Ocean and Division Project - Provides a new connection to the City's distribution system. The 10" line size will allow the City, in the future, to extend a second 10" line from Reservoir #3 down to the existing 10" line on Laneda.

An opinion of probable cost for the recommended projects is approximately $50,000, including construction, contingencies, engineering, legal, and administration (see Table 2 attached).

The projects can and should be implemented immediately.

CONTEXT

The recent findings and recommendations are made in the context of prior efforts and research to determine the source, or sources, of the air entrainment problem. Earliest efforts focused on possible construction related sources associated with the Laneda project. "White Water" is commonly associated with waterline construction. Lines were flushed and air release valves checked, but no notable improvement occurred. Dissolved oxygen (D.O.) levels were sampled at many locations. Elevated D.O. levels were found at all locations except the wells, water treatment plant, reservoirs, and upper level distribution system. Changing from surface water to well water resulted in some reduction of D.O. levels; however, levels were still above saturation. Pressure reduction devices were installed in some test locations with limited benefit. Chemical additions for corrosion control (soda ash) and disinfection (MIOX) were reviewed as possible sources. Isolation tests at the wells and water treatment plant of various durations and combinations of water, disinfectant, and corrosion control showed elevated D.O. levels only with prolonged (two week) detention and the presence of either, or both, the disinfectant and soda ash. The City's reservoirs have excess capacity - in fact, water is held approximately two weeks, during the winter, prior to entering the distribution system. An association of time and chemical effects was suspected, but no clear theoretical support for the association has been found. Further review and understanding of the water system as part of the ongoing master planning process contributed to the recent focus on reservoir routing as the probable source.

We now believe the air problem is primarily associated with the nature of the connection of Reservoir #3 to the lower level distribution system; however, until the problem is permanently solved, we cannot fully rule out other sources or contributing factors. We believe some of the observations associated with the air entrainment problem can be explained as follows:

- Flows to the upper level system are not fed by water from the lower level system; therefore, there are no elevated D.O. levels.
- Water in Reservoir #2 floats on the system and is fed via Reservoir #3. D.O. levels in Reservoir #2 are less than saturated because it is vented and open to atmospheric pressure.
- During high flow conditions, the water level in Reservoir #2 drops faster than in Reservoir #3 because of the higher frictional effects associated with the transmission line from Reservoir #3. Water entering the system from Reservoir #2 would not have the high D.O. levels; therefore, there might be some short lived and local reprieve from "white water" until the hydraulic conditions return to normal. This was observed during early City efforts to flush the lines.
- D.O. levels in town were approximately 100-120 percent of saturation. Supersaturated water will not necessarily form "white water" when poured into a glass. Formation of air bubbles can be effected by temperature changes, manipulation of local pressures and turbulence (through the manipulation of valves and selection of faucet aerators), chemical interactions with service pipes and fixtures, and the extent to which the D.O. is dissolved (as a result of extended time and increased system pressure). Elevated D.O. levels can also increase corrosional effects. Changing temperature, pressure, and material contact can affect pH and drive chemical equilibrium reactions in directions that favor any given constituent. Generation of micro-particulate phases can provide seed particles for bubble formation. Without going into all the details, these

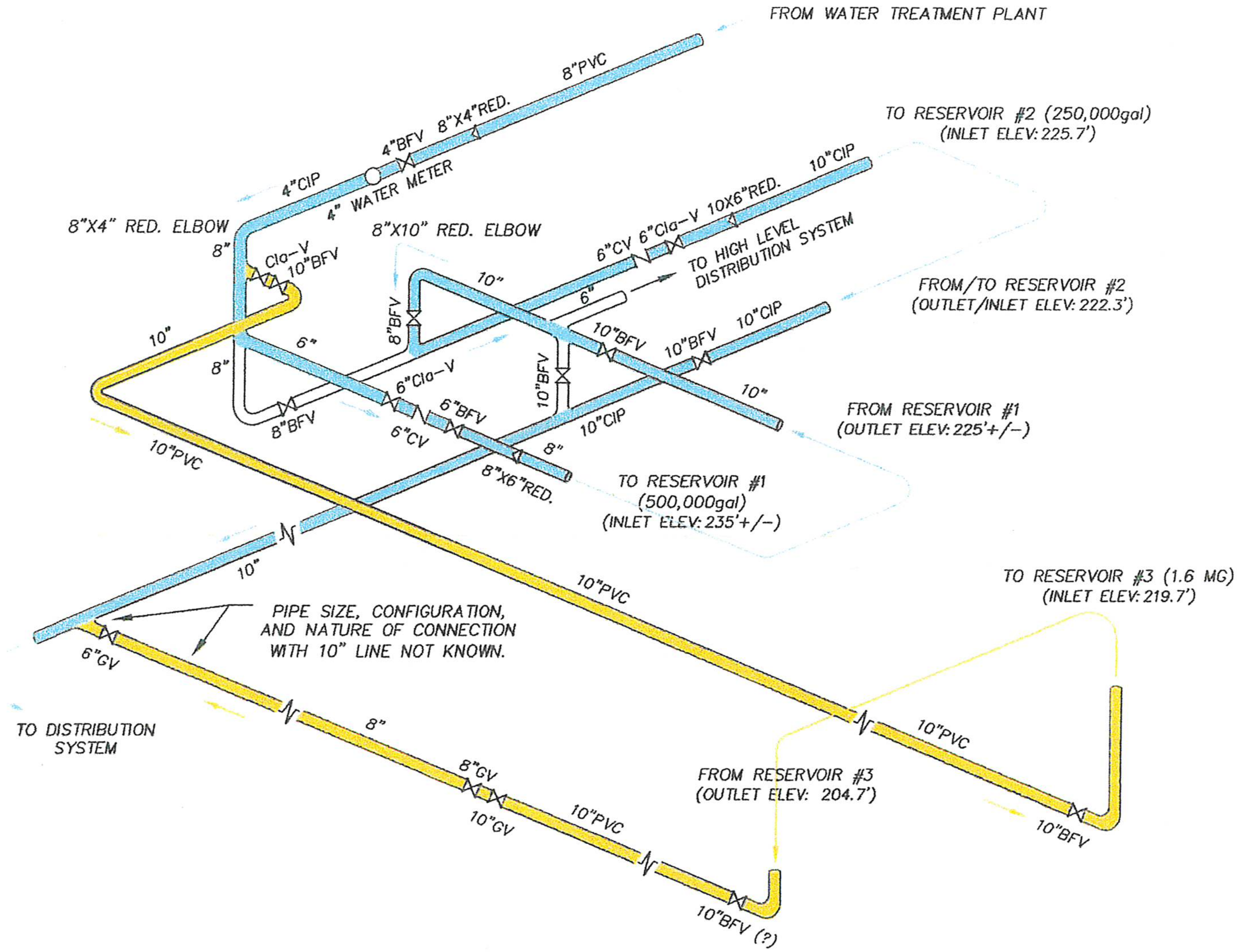
considerations can explain why some customers have the problem and some do not; why some can clear the white water by just running the tap for a short time; why changing a faucet aerator may make a difference; and why one neighbor may have a problem while another does not.

Table 1: Timeline

(March 2003 - April 9, 2004)

Date	Reservoir Projects	Laneda Project	Air Complaints	Comments
March 2003				WTP and wells online.
Oct. 31, 2003	Reservoir #1 drained for painting and modifications.			
Dec. 15-20, 2003	Reservoir #1 disinfect and fill.			
Dec. 20, 2003	Reservoir #1 online.			
Jan. 7, 2004		Filled and flushed new pipelines (Ocean Rd to 3rd St.).		Flush using a hose connection- not via open hydrant.
Jan. 12-13, 2004		Transfer 20 services and 7 main laterals.		
Jan. 16-18, 2004 (approximate; date not known)	Reservoir #2 isolated for cleaning.			All water fed to lower level system via Reservoir #3.
(Between Reservoir #2 drain and fill dates.)				Staff had concerns with possible vacuum creation in old 10" line due to the isolation of Reservoir #2.
Jan. 22, 2004	Reservoir #2 connection to system resumed.			Routing of all water to lower level system via Reservoir #3 maintained.

Date	Reservoir Projects	Laneda Project	Air Complaints	Comments
End of Feb. 2004 (very approx.)	Removed Cla-valves.			
Mar. 3-4, 2004		Filled and flushed new lines (3rd to Division).		
Mar. 18-19, 2004		Service and lateral transfers.		
Mar. 29, 2004		Install 10" valves.		
Apr. 9, 2004			First official (recorded) air complaint.	Verbal air complaints occurred before April 9th - possibly as early as late January.



Primary Flow Path

Secondary Flow Path

FIGURE 1: Piping Gallery and Reservoir Connections; Water Flow from WTP to Lower Level Distribution System (Pre-Jan 16, 2004 Flow Configuration)

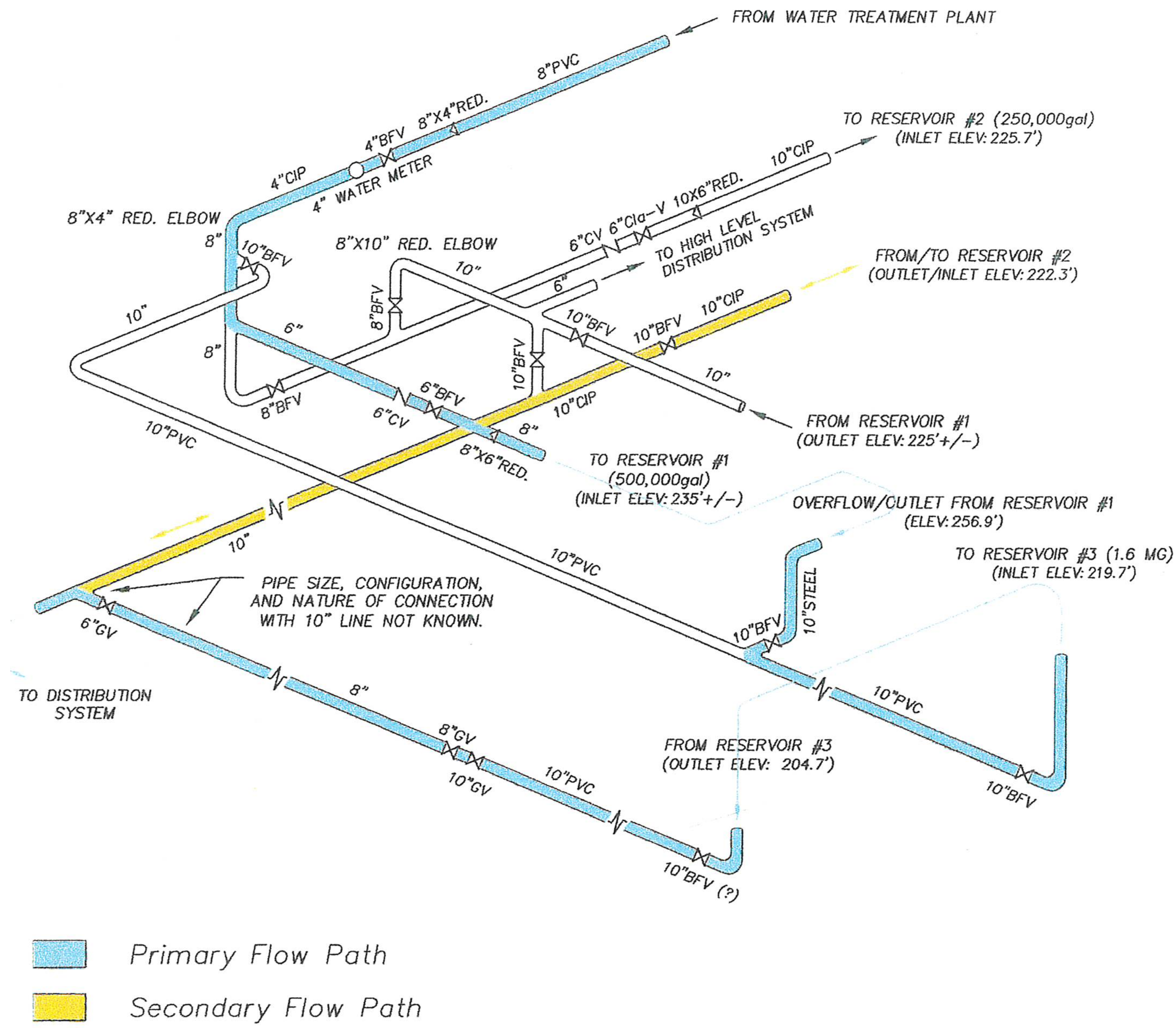


FIGURE 2: Piping Gallery and Reservoir Connections; Water Flow from WTP to Lower Level Distribution System (Post–Jan 16, 2004 Flow Configuration)

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix J

Anderson Creek (Historic) Water Quality
City of Manzanita Water System Master Plan
HGE, Inc., Architects, Engineers, Surveyors & Planners, April 2006

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Table 6.2: Recent (Raw) Anderson Creek Water Test Results

Parameter	MCL (mg/l)[1]	Result (mg/l)	Date
Antimony	0.006	ND[2]	7/06/05
Arsenic	0.05	ND	4/19/05
Asbestos	7 MFL	**0.614 MFL**	8/13/04
Barium	2.0	ND	7/06/05
Beryllium	0.004	ND	7/06/05
Cadmium	0.005	ND	7/06/05
Calcium	-	**5**	1/27/98
Chloride	-	**16**	1/27/98
Chromium	0.1	ND	7/06/05
Copper	1.3	**<10 ug/l**	1/27/98
Cyanide	0.2	ND	7/06/05
Flouride	4	ND	7/06/05
Iron	-	**0.03**	2/4/98
Lead	0.015	ND	7/06/05
Magnesium	-	**2.0**	7/12/96
Manganese	0.05	**0.08**	2/4/98
Mercury	0.002	ND	7/06/05
Nickel	0.1	ND	7/06/05
Nitrate	10.0	**0.6**	4/19/05
Nitrite	1.0	ND	7/06/05
Phosphate	-	**0.03**	1/27/98
Selenium	0.05	ND	7/06/05
Silica	-	**7.7**	1/27/98
Sodium	-	**5.93**	7/06/05
Sulfate	-	**2.0**	1/27/98
Thallium	0.002	ND	7/06/05
TOC (9 samples)	-	**0.95-1.73**	5/04-10/05
pH	-	**6.3-7.1 units**	Continuous
Temperature	-	**5-16 C**	Continuous
Total Dissolved Solids	-	**31.8**	1/27/98
Hardness	-	**25**	2/4/98
Total Alkalinity	-	**10.0**	4/16/98
Conductivity	-	**45.0 umhos/cm**	4/16/98
SOC Regulated	(varies)	ND	4/19/05
VOC Regulated	(varies)	ND	4/19/05
Gross Apha	15 pCi/l	ND	12/5/03
Radium 226/228	5 pCi/l	ND	12/5/03
Uranium	30ug/l	**0.0097 ug/l**	12/5/03

1. mg/l or as noted
2. ND: "Not detected"

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix K

2019 Oregon Fire Code
Appendix B: Fire-Flow Requirements for Buildings
Appendix C: Fire Hydrant Locations and Distribution

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APPENDIX B
FIRE-FLOW REQUIREMENTS FOR BUILDINGS

The provisions contained in this appendix are adopted by the State of Oregon.

User note:

About this appendix: *Appendix B provides a tool for the use of jurisdictions in establishing a policy for determining fire-flow requirements in accordance with Section 507.3. The determination of required fire flow is not an exact science, but having some level of information provides a consistent way of choosing the appropriate fire flow for buildings throughout a jurisdiction. The primary tool used in this appendix is a table that presents fire flow based on construction type and building area based on the correlation of the Insurance Services Office (ISO) method and the construction types used in the International Building Code®.*

The availability of water is essential for fire fighting operations. The amount of water required to fight a fire depends on many things, including the type of construction, the location of the fire, the contents of the building, response time and the capabilities of the fire department. Limiting the maximum fire flow to 3,000 gallons per minute provides local water purveyors with a predictable and cost-effective method to forecast infrastructure expenditures and can serve to lessen local fire services' apparatus capital expenditures.

SECTION B101
GENERAL

B101.1 Scope.

The procedure for determining *fire-flow* requirements for buildings or portions of buildings hereafter constructed shall be in accordance with this appendix and as required by the *fire code official*. This appendix does not apply to structures other than buildings.

B101.2 Protected areas.

The provisions of Section B105 are intended for use by the *fire code official* in *protected areas* in which adequate and reliable water systems exist. Refer to Section B106 for additional alternative provisions regarding limiting *fire flows*. Refer to Section B107 *fire flow* for buildings in *protected areas* without adequate and reliable water systems.

SECTION B102
DEFINITIONS

B102.1 Definitions.

For the purpose of this appendix, certain terms are defined as follows:

FIRE FLOW. The flow rate of a water supply, measured at 20 pounds per square inch (psi) (138 kPa) residual pressure, that is available for fire fighting.

FIRE-FLOW CALCULATION AREA. The floor area, in square feet (m^2), used to determine the required *fire flow*.

PROTECTED AREAS. Geographic areas where a service or an agency has been established for the purpose of providing fire suppression services for buildings and other structures. Examples of agencies typically include public fire departments, rural fire protection districts and private fire protection services.

UNPROTECTED AREAS. Geographic areas where no organized service or agency exists to provide fire suppression services for buildings and other structures. Examples of *unprotected areas* typically include areas where wildland fire protection is provided by federal (USFS, BLM, BIA, etc.), state (ODF), or regional (forest protection associations) organizations and other areas that are generally in remote or rural isolated areas where no structural fire protection service is present.

SECTION B103
MODIFICATIONS

B103.1 Decreases.

The *fire code official* is authorized to reduce the *fire flow* where the development of full *fire-flow* requirements is impractical based on, but not limited to, the following: type of occupancy, type of construction, location on property, floor area, height and number of stories, yards as defined by the *International Building Code*, fire walls and the fire-fighting capabilities of the jurisdiction.

B103.2 Increases.

The *fire code official* is authorized to increase the *fire-flow* requirements where conditions indicate an unusual susceptibility to group fires or conflagrations. An increase shall be not more than twice that required for the building under consideration.

B103.3 Limiting.

The *fire code official* is authorized to limit the maximum required *fire flow* based on, but not limited to, the fire-fighting capabilities of the jurisdiction. *Fire-flow* limitations shall be in accordance with Section B106, which are in addition to the *fire-flow* requirements as specified in Section B105.

SECTION B104
FIRE-FLOW CALCULATION AREA

B104.1 General.

The *fire-flow calculation area* shall be the total floor area of all floor levels within the *exterior walls*, and under the horizontal projections of the roof of a building, except as modified in Sections B104.2 and B104.3.

B104.2 Area separation.

Portions of buildings that are separated by *fire walls* constructed in accordance with the *International Building Code* are allowed to be considered as separate *fire-flow calculation areas.*

B104.3 Type IA and Type IB construction.

The *fire-flow calculation area* of buildings constructed of Type IA and Type IB construction shall be the area of the three largest successive floors.

Exception: *Fire-flow calculation area* for open parking garages shall be determined by the area of the largest floor.

SECTION B105
FIRE-FLOW REQUIREMENTS FOR BUILDINGS IN PROTECTED AREAS WITH ADEQUATE AND RELIABLE WATER SYSTEMS

B105.1 One- and two-family dwellings, Group R-3 and R-4 buildings and townhouses.

The minimum *fire-flow* and flow duration requirements for one- and two-family *dwellings*, Group R-3 and R-4 buildings and *townhouses* shall be as specified in Tables B105.1(1) and B105.1(2).

Exception: Where there is not more than one each of Group R, Division 3 and Group U occupancies or agricultural buildings, as defined by Oregon Revised Statute (ORS) 455.315, on a single parcel of not less than 1 acre, the requirements of this section may be modified provided that the occupancy does not require a *fire flow* in excess of 1,500 gallons per minute (5678 L/min) and in the opinion of the *fire code official*, fire-fighting or rescue operations would not be impaired.

TABLE B105.1(1)
REQUIRED *FIRE FLOW* FOR ONE- AND TWO-FAMILY DWELLINGS, GROUP R-3 AND R-4 BUILDINGS AND TOWNHOUSES

FIRE-FLOW CALCULATION AREA (square feet)	AUTOMATIC SPRINKLER SYSTEM (Design Standard)	MINIMUM FIRE FLOW (gallons per minute)	FLOW DURATION (hours)
0–3,600	No automatic sprinkler system	1,000	1
3,601 and greater	No automatic sprinkler system	Value in Table B105.1(2)	Duration in Table B105.1(2) at the required *fire-flow* rate
0–3,600	Section 903.3.1.3 of the *International Fire Code* or Appendix T of the *Oregon Residential Specialty Code*	500	$^1/_2$
3,601 and greater	Section 903.3.1.3 of the *International Fire Code* or Appendix T of the *Oregon Residential Specialty Code*	$^1/_2$ value in Table B105.1(2)	1

For SI: 1 square foot = 0.0929 m^2, 1 gallon per minute = 3.785 L/m

TABLE B105.1(2)
REFERENCE TABLE FOR TABLES B105.1(1) AND B105.2

FIRE-FLOW CALCULATION AREA (square feet)					FIRE FLOW (gallons per minute)[b]	FLOW DURATION (hours)
Type IA and IB[a]	Type IIA and IIIA[a]	Type IV and V-A[a]	Type IIB and IIIB[a]	Type V-B[a]		
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	2
22,701-30,200	12,701-17,000	8,201-10,900	5,901-7,900	3,601-4,800	1,750	
30,201-38,700	17,001-21,800	10,901-12,900	7,901-9,800	4,801-6,200	2,000	
38,701-48,300	21,801-24,200	12,901-17,400	9,801-12,600	6,201-7,700	2,250	
48,301-59,000	24,201-33,200	17,401-21,300	12,601-15,400	7,701-9,400	2,500	
59,001-70,900	33,201-39,700	21,301-25,500	15,401-18,400	9,401-11,300	2,750	
70,901-83,700	39,701-47,100	25,501-30,100	18,401-21,800	11,301-13,400	3,000	3
83,701-97,700	47,101-54,900	30,101-35,200	21,801-25,900	13,401-15,600	3,250	
97,701-112,700	54,901-63,400	35,201-40,600	25,901-29,300	15,601-18,000	3,500	
112,701-128,700	63,401-72,400	40,601-46,400	29,301-33,500	18,001-20,600	3,750	
128,701-145,900	72,401-82,100	46,401-52,500	33,501-37,900	20,601-23,300	4,000	4
145,901-164,200	82,101-92,400	52,501-59,100	37,901-42,700	23,301-26,300	4,250	
164,201-183,400	92,401-103,100	59,101-66,000	42,701-47,700	26,301-29,300	4,500	
183,401-203,700	103,101-114,600	66,001-73,300	47,701-53,000	29,301-32,600	4,750	
203,701-225,200	114,601-126,700	73,301-81,100	53,001-58,600	32,601-36,000	5,000	
225,201-247,700	126,701-139,400	81,101-89,200	58,601-65,400	36,001-39,600	5,250	
247,701-271,200	139,401-152,600	89,201-97,700	65,401-70,600	39,601-43,400	5,500	
271,201-295,900	152,601-166,500	97,701-106,500	70,601-77,000	43,401-47,400	5,750	
295,901-Greater	166,501-Greater	106,501-115,800	77,001-83,700	47,401-51,500	6,000	
—	—	115,801-125,500	83,701-90,600	51,501-55,700	6,250	
—	—	125,501-135,500	90,601-97,900	55,701-60,200	6,500	
—	—	135,501-145,800	97,901-106,800	60,201-64,800	6,750	
—	—	145,801-156,700	106,801-113,200	64,801-69,600	7,000	
—	—	156,701-167,900	113,201-121,300	69,601-74,600	7,250	
—	—	167,901-179,400	121,301-129,600	74,601-79,800	7,500	
—	—	179,401-191,400	129,601-138,300	79,801-85,100	7,750	
—	—	191,401-Greater	138,301-Greater	85,101-Greater	8,000	

For SI: 1 square foot = 0.0929 m^2, 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa

a. Types of construction are based on the *International Building Code*.

b. Measured at 20 psi residual pressure.

TABLE B105.2
REQUIRED FIRE FLOW FOR BUILDINGS OTHER THAN ONE- AND TWO-FAMILY DWELLINGS, GROUP R-3 AND R-4 BUILDINGS AND TOWNHOUSES

AUTOMATIC SPRINKLER SYSTEM (Design Standard)	MINIMUM FIRE FLOW (gallons per minute)	FLOW DURATION (hours)
No automatic sprinkler system	Value in Table B105.1(2)	Duration in Table B105.1(2)
Section 903.3.1.1 of the *International Fire Code*	25% of the value in Table B105.1(2)[a]	Duration in Table B105.1(2) at the reduced flow rate
Section 903.3.1.2 of the *International Fire Code*	25% of the value in Table B105.1(2)[b]	Duration in Table B105.1(2) at the reduced flow rate

For SI: 1 gallon per minute = 3.785 L/m.

a. The reduced fire flow shall be not less than 1,000 gallons per minute.

b. The reduced fire flow shall be not less than 1,500 gallons per minute.

B105.3 Water supply for buildings equipped with an automatic sprinkler system.

For buildings equipped with an *approved automatic sprinkler system*, the water supply shall be capable of providing the greater of:

1. The *automatic sprinkler system* demand, including hose stream allowance.
2. The required *fire flow*.

SECTION B106
LIMITING FIRE-FLOW REQUIREMENTS FOR BUILDINGS IN PROTECTED AREAS WITH ADEQUATE AND RELIABLE WATER SYSTEMS

B106.1 General.

The provisions of Section B106 are intended for use by the *fire code official* in addition to the provisions specified in Section B105 as authorized by Section B103.3. This section is intended to apply in *protected areas* in which adequate and reliable water systems exist.

B106.2 Limiting required *fire flow*.

No building shall be constructed, altered, enlarged, moved or repaired in a manner that, by reason of size, type of construction, number of stories, occupancy, or any combination thereof, creates a need for a *fire flow* in excess of 3,000 gallons per minute (11 356 L/min) at 20 pounds per square inch (138 kPa) residual pressure, as specified in Table B105.2, or exceeds the available *fire flow* at the site of the structure.

> **Exception:** *Fire-flow* requirements in excess of 3,000 gallons per minute (11 356 L/min) may be allowed if, in the opinion of the *fire code official*, all reasonable methods of reducing the *fire flow* have been included within the development and no unusual hazard to life and property exists.

B106.3 Existing buildings.

Existing buildings, regardless of the time of construction, that require a *fire flow* in excess of 3,000 gallons per minute (11 356 L/min) are not required to comply with the *fire-flow* requirements of this section. Additionally, changes in use or occupancy, alterations, or repairs, shall not necessitate further increases in the required *fire flow*. Additions to the building shall not require a *fire flow* in excess of 3,000 gallons per minute (11 356 L/min).

SECTION B107
FIRE-FLOW REQUIREMENTS FOR BUILDINGS IN PROTECTED AREAS WITHOUT ADEQUATE AND RELIABLE WATER SYSTEMS

B107.1 Areas without water supply systems.

The provisions of Section B107 are intended for use by the *fire code official* in *protected areas* in which adequate and reliable water supply systems do not exist. In determining the *fire flow* for buildings, the *fire code official* is authorized to utilize the following nationally recognized standards: NFPA 1142, the *International Wildland-Urban Interface Code* or the *ISO Guide for Determining Needed Fire Flow*.

SECTION B108
FIRE-FLOW REQUIREMENTS FOR BUILDINGS IN UNPROTECTED AREAS
(RESERVED)

SECTION B109
REFERENCED STANDARDS

ICC	IBC—18	International Building Code	B103.1, B104.2
ICC	IFC—18	International Fire Code	B105.3
ICC	IWUIC—18	International Wildland-Urban Interface Code	B107.1
ICC	IRC—18	International Residential Code	Table B105.1(1)
ISO	06—2014	Guide for Determining Needed Fire Flow	B107.1
NFPA	13—16	Standard for the Installation of Sprinkler Systems	B105.2.1, B105.3
NFPA	13D—16	Standard for the Installation of Sprinkler Systems in One- and Two-family Dwellings and Manufactured Homes	B105.2.1.1
NFPA	13R—16	Standard for the Installation of Sprinkler Systems in Low-rise Residential Occupancies	B105.2.1.1
NFPA	72—16	National Fire Alarm and Signaling Code	B105.2.1.2
NFPA	1142—17	Standard on Water Supplies for Suburban and Rural Fire Fighting	B107.1

APPENDIX C
FIRE HYDRANT LOCATIONS AND DISTRIBUTION

The provisions contained in this appendix are adopted by the State of Oregon.

User note:

About this appendix: *Appendix C focuses on the location and spacing of fire hydrants, which is important to the success of fire-fighting operations. The difficulty with determining the spacing of fire hydrants is that every situation is unique and has unique challenges. Finding one methodology for determining hydrant spacing is difficult. This particular appendix gives one methodology based on the required fire flow that fire departments can work with to set a policy for hydrant distribution around new buildings and facilities in conjunction with Section 507.5.*

SECTION C101
GENERAL

C101.1 Scope.

In addition to the requirements of Section 507.5.1, fire hydrants shall be provided in accordance with this appendix for the protection of buildings, or portions of buildings, hereafter constructed or moved into the jurisdiction.

SECTION C102
NUMBER OF FIRE HYDRANTS

C102.1 Minimum number of fire hydrants for a building.

The number of fire hydrants available to a building shall be not less than the minimum specified in Table C102.1.

TABLE C102.1
REQUIRED NUMBER AND SPACING OF FIRE HYDRANTS[h]

FIRE-FLOW REQUIREMENT (gpm)	MINIMUM NUMBER OF HYDRANTS	AVERAGE SPACING BETWEEN HYDRANTS[a, b, c, f, g] (feet)	MAXIMUM DISTANCE FROM ANY POINT ON STREET OR ROAD FRONTAGE TO A HYDRANT[d, f, g]
1,750 or less	1	500	250
1,751–2,250	2	450	225
2,251–2,750	3	450	225
2,751–3,250	3	400	225
3,251–4,000	4	350	210
4,001–5,000	5	300	180
5,001–5,500	6	300	180
5,501–6,000	6	250	150
6,001–7,000	7	250	150
7,001 or more	8 or more[e]	200	120

For SI: 1 foot = 304.8 mm, 1 gallon per minute = 3.785 L/m.

a. Reduce by 100 feet for dead-end streets or roads.

b. Where streets are provided with median dividers that cannot be crossed by fire fighters pulling hose lines, or where arterial streets are provided with four or more traffic lanes and have a traffic count of more than 30,000 vehicles per day, hydrant spacing shall average 500 feet on each side of the street and be arranged on an alternating basis.

c. Where new water mains are extended along streets where hydrants are not needed for protection of structures or similar fire problems, fire hydrants shall be provided at spacing not to exceed 1,000 feet to provide for transportation hazards.

d. Reduce by 50 feet for dead-end streets or roads.

e. One hydrant for each 1,000 gallons per minute or fraction thereof.

f. A 50-percent spacing increase shall be permitted where the building is equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1 of the *International Fire Code*.

g. A 25-percent spacing increase shall be permitted where the building is equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.2 or 903.3.1.3 of the *International Fire Code* or Section P2904 of the *International Residential Code*.

h. The fire code official is authorized to modify the location, number and distribution of fire hydrants based on site-specific constraints and hazards.

User note:

Previous editions of Table C102.1 had large gaps between *fire-flow* requirements. These gaps provided the *fire code official* with discretion based on site-specific considerations. "Note h" provides that same discretion based on the jurisdiction's determination that conditions particular to a location justify either an increase or a decrease in the number of hydrants, or a change in their arrangement. Any decreases in the general fire protection scheme should take into account possible future development that may occur.

SECTION C103
FIRE HYDRANT SPACING

C103.1 Hydrant spacing.

Fire apparatus access roads and public streets providing required access to buildings in accordance with Section 503 shall be provided with one or more fire hydrants, as determined by Section C102.1. Where more than one fire hydrant is required, the distance between required fire hydrants shall be in accordance with Sections C103.2 and C103.3.

C103.2 Average spacing.

The average spacing between fire hydrants shall be in accordance with Table C102.1.

> **Exception:** The average spacing shall be permitted to be increased by 10 percent where existing fire hydrants provide all or a portion of the required number of fire hydrants.

C103.3 Maximum spacing.

The maximum spacing between fire hydrants shall be in accordance with Table C102.1.

SECTION C104
CONSIDERATION OF EXISTING FIRE HYDRANTS

C104.1 Existing fire hydrants.

Existing fire hydrants on public streets are allowed to be considered as available to meet the requirements of Sections C102 and C103. Existing fire hydrants on adjacent properties are allowed to be considered as available to meet the requirements of Sections C102 and C103 provided that a fire apparatus access road extends between properties and that an easement is established to prevent obstruction of such roads.

SECTION C105
REFERENCED STANDARD

ICC	IRC—18	International Residential Code	Table C102.1

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix L

Intergovernmental Agreement between the City of Wheeler and the City of Manzanita

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INTERGOVERNMENTAL AGREEMENT
BETWEEN
THE CITY OF WHEELER AND THE CITY OF MANZANITA
(PERSON IN DIRECT-RESPONSIBLE-CHARGE)

This AGREEMENT is between the CITY OF WHEELER, an Oregon Municipal Corporation (hereinafter "Wheeler"), and the CITY OF MANZANITA, an Oregon Municipal Corporation (hereinafter "Manzanita").

RECITALS:

1. The City of Manzanita and the City of Wheeler entered into an Intergovernmental Cooperative Agreement (IGA) dated October 24, 2000 for the operation and maintenance of a jointly operated well water system.
2. Pursuant to OAR 333-061-0225 "General Requirements Applying to Water Systems", each water system owner delegates the responsibility of operating the water system to a certified operator known as the person in direct responsible charge.
3. The Oregon Department of Health Services/Drinking Water Program (DHS/DWP) interprets "system owner" for the purpose of delegating a person in direct responsible charge, to be the "Holder on Record" of the Water Right.
4. The Water Rights for the jointly operated well field are listed under the City of Wheeler's name.
5. Wheeler wishes to comply with requirements of OAR 333-061-0225 for employing, contracting with and designating an operator to be in Direct Responsible Charge - (DRC Treatment) of the water system.
6. The design of the recently completed system is such that, any changes at the well site also affects the operation of the City of Manzanita Treatment Plant.
7. Manzanita employs staff persons who are qualified to serve as the person in direct responsible charge of the treatment system (DRC –Treatment)

NOW, THEREFORE, IT IS AGREED BY AND BETWEEN THE PARTIES HERETO AS FOLLOWS:

1. DRC (DIRECT RESPONSIBLE CHARGE) DELEGATION. Manzanita will make available a City staff person who will be designated by Wheeler as the Person in Direct Responsible Charge (DRC - Treatment) of the jointly operated well system. Such staff person shall possess the certifications at or above the level required by the State of Oregon for the operation of the ground water well portion of the system. The Person in Direct Responsible Charge will supervise the technical operations of the system, establish and execute specific practices and policies for operating the system in accordance with policies and practices of the Cities and the requirements of the public water system rules, and will be engaged in the actual day-to-day operation and/or supervision of the system.
2. DURATION: This agreement shall be effective upon approval and execution by both City of Wheeler and City of Manzanita. The initial term of this agreement shall be from February 1, 2005 to January 31, 2006 and shall be automatically renewed for one year on

February 1 of each year thereafter unless either Wheeler or Manzanita provides to the other written notice of intent not to renew at least sixty (60) days prior to the annual renewal date.

3. <u>TERMINATION:</u> This agreement may be terminated by mutual consent of both parties; ~~or by either party at any time,~~ upon sixty days (60) notice in writing and delivered by certified mail or personal service.

4. <u>DISPUTE RESOLUTION</u>: If a dispute arises as to the operation of the joint system by the Person in Direct Responsible Charge, the two City Administrators shall first attempt to develop a solution. If both City Councils do not approve of the solution, the Mayors of both Cities shall call a special joint meeting of the two City Councils to discuss the dispute and attempt to reach a solution. In the event the City Councils cannot reach an agreement on the dispute, both City Councils agree to mediate the dispute. A mediator, agreeable to both City Councils, shall be selected. If mediation fails, the two Cities may pursue judicial resolution through the court system.

5. <u>WRITTEN NOTICE ADDRESS</u>: All written notices required under this Agreement shall be sent to:

WHEELER:	City Manager City of Wheeler P.O. Box 177 Wheeler, OR. 97147
MANZANITA:	City Manager City of Manzanita P.O. Box 129 Manzanita, OR. 97130-0129

IN WITNESS WHEREOF, the parties have caused this instrument to be executed in two (2) duplicate originals, either as individuals, or by their officers, thereunto duly authorized.

Dated this 9th day of March, 2005.

CITY OF MANZANITA	CITY OF WHEELER
By: ______________ Mayor	By: ______________ Mayor
By: ______________ City Manager	By: ______________ City Manager

INTERGOVERNMENTAL COOPERATIVE AGREEMENT
BETWEEN
THE CITY OF WHEELER AND THE CITY OF MANZANITA

This AGREEMENT is between the CITY OF WHEELER, an Oregon Municipal Corporation (hereinafter "Wheeler"), and the CITY OF MANZANITA, an Oregon Municipal Corporation (hereinafter "Manzanita").

RECITALS:

1. Wheeler and Manzanita are under Compliance Orders by the Oregon Health Division to bring their water systems into compliance with the Safe Drinking Water Act's surface water treatment rules.

2. While Wheeler is presently experiencing moderate growth and Manzanita substantial growth, available studies conclude that more growth in north Tillamook County is inevitable.

3. Based on present water regulations, a groundwater source of water is the most cost effective and long term solution to meet present and future water needs for the area.

4. A groundwater source of water has been located at river mile 10.6 on the South Fork of the Nehalem River and tests have concluded that sufficient water is available for a 40-50 year period. Although a groundwater source is not subject to the filtration requirements of surface water, future tests may determine some form of filtration is necessary.

5. Wheeler and Manzanita acknowledge that they have authority to execute this Cooperative Agreement pursuant to the powers of the respective municipal charters and pursuant to ORS 225.050.

NOW, THEREFORE, IT IS AGREED BY AND BETWEEN THE PARTIES HERETO AS FOLLOWS:

1. PURPOSE: The purpose of this Agreement is to develop, manage, maintain, and control a water supply distribution system to provide wholesale finished domestic water supply to Wheeler, Manzanita and future contractual surplus water purchasers.

2. JOINT SYSTEM: The joint system shall mean the well field, wells, disinfection plant, the transmission line from the wells to the intersection of Highway 101 and Highway 53, and two (2) master meters. Decisions on major changes to the joint system are subject to approval of both City Councils. Major changes are defined as one or more of the following:

(1) Addition or discontinuation of a water treatment process;
(2) Addition of a wholesale water customer, including addition of a wholesale customer to an individual City system, not anticipated in the original regional Master Plan.
(3) Increase in number of wells or capacity of existing wells;
(4) Increase in size of transmission line;
(5) Any contract for maintenance of the jointly operated facilities;
(6) Non-emergency repairs with a cost greater than 15% of the previous year's operations costs;
(7) Any capital improvements intended to become part of the joint system.

3. OWNERSHIP OF THE JOINT SYSTEM: Wheeler shall own the well field (T2N, R9W, Section 5, Tax Lot 201), access easement thereto, wells, and a telemetry monitoring station. Manzanita shall own the disinfection plant, the telemetry system, the transmission line from the wells to the junction of Highway 101, and the two (2) master meters.

Manzanita shall be responsible for the design and construction of the joint system as part of its water system improvement project. This water system improvement project will also include the construction of a new water filtration plant which will be used to filter the Anderson Creek water source and the transmission line extending west from the intersection of Highway 101 and Highway 53 to Manzanita.

Wheeler shall be given a reasonable opportunity to review and comment on the plans and specifications, change orders, and proposed cost overruns in relation to to the design and construction of the joint system. If the two parties cannot agree on the plans, specifications, change orders, or cost overruns, then this dispute shall be resolved in accordance with paragraph 14.

4. OTHER TRANSMISSION LINES: The transmission line extending west from the intersection of Highway 101 and Highway 53 to Manzanita, and the water filtration plant for Anderson Creek shall be owned and maintained by the City of Manzanita. The transmission line extending southeast from the intersection of Highway 101 and Highway 53 to Hemlock Street in Wheeler shall be owned by the City of Manzanita and maintained by the City of Wheeler. These transmission lines and filtration plant are not part of the joint system.

5. WATER RIGHTS: Water rights to the groundwater, certificates and permits shall be in the name of and owned by Wheeler.

6. WATER COST DISTRIBUTION: Manzanita will take responsibility for reading meters and billing wholesale customers along the jointly operated portion of the water system, from which funds received will be applied to directly offset joint system operation costs. Manzanita will bill on a monthly basis for water usage measured at Wheeler's master meter. The rate per gallon Wheeler will be charged will be based on the two cities' best

estimate of the actual operating costs for the previous year. The allocation of actual costs of operating the joint system will be reconciled annually by using the following procedure:

The cost of providing water through the well system will be compiled by Manzanita in March of each year for the previous twelve (12) month period ending the last day of February. Such costs shall include labor and materials provided by each City to operate and maintain the wells, disinfection plant, and the transmission line to the intersection of Highway 101 and Highway 53, electricity, permits and mileage. Debt amortization will not be considered a cost for this purpose, except for repayment of State of Oregon loans #A92003 and #V94009. Operations costs will include filtration plant operations costs of supplying water requested by Wheeler in the event the well field is shut down.

The total costs shall be divided as follows: The costs associated with the readiness.to serve or standby capability of the joint system will be divided based on each.City's percentage of equivalent dwelling units served by the total of the two communities. The costs in this category will be those which would be incurred even if no water was used (e.g., permits, line repair and labor). The costs associated with the actual production of water (e.g., electricity, chlorine, labor) will be divided based on the percentage of actual water usage by the respective Cities for the previous twelve (12) month period ending on the last day of February as determined by the master meters.

Based on this formula, if one City owes the other City money, the debt will be payable by May 31st of that year.

7. OPERATION, MAINTENANCE AND ADMINISTRATION OF JOINT SYSTEM: Routine joint system operation, maintenance and administration will be the responsibility of Manzanita and Wheeler through the use of existing staff and equipment. While both Cities will provide staff and equipment when needed, Manzanita shall have primary responsibility for repairs and billing. Manzanita will provide quarterly reports to Wheeler as to maintenance activities and the related costs. The telemetry system will be located in Manzanita and Wheeler will have a monitoring station directly linked to it.

8. TERMINATION OF AGREEMENT: After receipt of either grant assistance or loans from Rural Utility Service (RUS) to Manzanita and/or grant assistance or loans from RUS to Wheeler, this agreement cannot be terminated without the written consent of RUS.

9. ASSUMPTION OF BONDED DEBT: Any outstanding debt related to capital improvements not part of the joint system shall remain the responsibility of the respective party.

10. RESPONSIBILITY FOR OBLIGATIONS: All debts, liabilities and obligations related to the operation of the joint system shall be borne by the parties based on the proportionate share of operation costs in effect at the time the obligation is incurred.

11. <u>SALES TO OUTSIDE USERS</u>: Requests for permanent access to the joint system shall be required and approved by a respective majority of the Manzanita and Wheeler City Councils. For purposes of this section, outside users are those entities or individuals which are not presently full or part time customers of either Manzanita or Wheeler. Requests for permanent access to the joint system shall be reviewed on an individual basis and shall include a proposed rate analysis to reimburse the joint system for any capital expenditures and operation costs. In the event a majority of the Manzanita and Wheeler City Councils vote to deny any person in the service areas of Manzanita or Wheeler access to the joint system, before this denial shall be final RUS must concur in the denial.

12. <u>TERMS OF AGREEMENT</u>: This Agreement shall remain in effect for an initial period of forty (40) years from the date of the proposed loans from RUS to Manzanita and Wheeler. This agreement shall continue after the fortieth (40^{th}) anniversary of such date on a year-to-year basis unless terminated by one of the parties. The agreement shall terminate upon either party giving the other six (6) months advance written notice of such termination. Prior to receipt of either grants or loans by both Cities from RUS, this Agreement may be terminated by a majority vote by each of the City Councils of Manzanita and Wheeler.

13. <u>AMENDMENT PROVISIONS</u>: Terms of this Agreement may be amended by mutual agreement of the parties with approval by RUS. Any such agreement shall be in writing and shall refer specifically to this agreement and shall be executed by the parties.

14. <u>DISPUTE RESOLUTION</u>: If a dispute arises as to the operation of the joint system, the two City Administrators shall first attempt to develop a solution. If both City Councils do not approve of the solution, the Mayors of both Cities shall call a special joint meeting of the two City Councils to discuss the dispute and attempt to reach a solution. In the event the City Councils cannot reach an agreement on the dispute, both City Councils agree to mediate the dispute. A mediator, agreeable to both City Councils, shall be selected. If mediation fails, the two Cities may pursue judicial resolution through the court system.

15. <u>EFFECTIVE DATE</u>: This Agreement shall be effective on the date signed by the respective Mayor and City Administrator of the City of Wheeler and the City of Manzanita following adoption of this agreement by the respective City Councils.

16. <u>WRITTEN NOTICE ADDRESS</u>: All written notices required under this Agreement shall be sent to:

WHEELER: City Manager
City of Wheeler
P.O. Box 177
Wheeler, OR. 97147

MANZANITA:	City Manager City of Manzanita P.O. Box 129 Manzanita, OR. 97130-0129
RUS:	Rural Utilities Service 101 SW Main, Suite 1410-A Portland, OR 97204-3222

IN WITNESS WHEREOF, the parties have set their hands and affixed their seals as of the date and year herein below written.

Wheeler is acting in this matter pursuant to Ordinance No.2000-04 and adopted by the Wheeler City Council on the 24th day of October, 2000.

Manzanita is acting in this matter pursuant to Ordinance No. 00-02 and adopted by the Manzanita City Council on the 4th day of October, 2000.

CITY OF MANZANITA	CITY OF WHEELER
By: Joyce Baker Mayor	By: Steve S. Burden Mayor
By: Judd P. Taylor City Manager	By: City Manager

City of Manzanita
Water Master Plan Update
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Appendix M

Water Production Data
January 2017 – May 2020

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Monthly Averages

Year/Month	Well 1	Well 2	Production	Manzanita	Wheeler	RT53 + Tideland
2017						
January	0.251	0.000	0.251	0.132	0.093	0.027
February	0.255	0.000	0.255	0.144	0.085	0.026
March	0.298	0.000	0.298	0.182	0.094	0.022
April	0.339	0.000	0.339	0.233	0.088	0.018
May	0.299	0.000	0.299	0.201	0.078	0.020
June	0.349	0.000	0.349	0.235	0.097	0.016
July	0.482	0.000	0.482	0.353	0.116	0.013
August	0.505	0.000	0.505	0.356	0.135	0.014
September	0.380	0.000	0.380	0.253	0.108	0.018
October	0.277	0.000	0.277	0.164	0.093	0.020
November	0.257	0.000	0.257	0.142	0.093	0.022
December	0.269	0.000	0.269	0.143	0.103	0.022
2018						
January	0.222	0.000	0.222	0.132	0.070	0.020
February	0.223	0.000	0.223	0.139	0.060	0.023
March	0.216	0.031	0.247	0.160	0.068	0.020
April	0.000	0.243	0.243	0.345	-0.122	0.019
May	0.000	0.272	0.272	0.189	0.065	0.018
June	0.000	0.346	0.346	0.249	0.080	0.017
July	0.000	0.480	0.480	0.363	0.104	0.014
August	0.000	0.464	0.464	0.345	0.102	0.017
September	0.000	0.338	0.338	0.247	0.073	0.018
October	0.000	0.283	0.283	0.189	0.072	0.022
November	0.000	0.260	0.260	0.166	0.075	0.020
December	0.000	0.298	0.298	0.200	0.079	0.019
2019						
January	0.000	0.237	0.237	0.136	0.076	0.025
February	0.000	0.230	0.230	0.119	0.083	0.028
March	0.000	0.281	0.281	0.158	0.094	0.029
April	0.000	0.266	0.266	0.149	0.088	0.028
May	0.000	0.305	0.305	0.196	0.082	0.028
June	0.000	0.377	0.377	0.253	0.098	0.027
July	0.000	0.443	0.443	0.325	0.099	0.019
August	0.000	0.440	0.440	0.312	0.107	0.021
September	0.000	0.318	0.318	0.210	0.079	0.029
October	0.000	0.259	0.259	0.151	0.078	0.030
November	0.000	0.240	0.240	0.148	0.063	0.029
December	0.000	0.217	0.217	0.126	0.059	0.032
2020						
January	0.000	0.225	0.225	0.132	0.063	0.031
February	0.000	0.219	0.219	0.128	0.061	0.030
March	0.025	0.001	0.025	0.004	0.000	0.004
April	0.137	0.093	0.230	0.129	0.047	0.035
May	0.116	0.143	0.258	0.158	0.050	0.030

Monthly Totals (MG)

Year/Month	Well 1	Well 2	Production	Manzanita	Wheeler	RT53 + Tideland
2017						
January	7.795	0.000	7.795	4.087	2.887	0.822
February	7.138	0.000	7.138	4.020	2.391	0.727
March	9.239	0.000	9.239	5.656	2.902	0.680
April	10.180	0.000	10.180	7.000	2.640	0.539
May	9.280	0.000	9.280	6.238	2.422	0.620
June	10.462	0.000	10.462	7.045	2.923	0.495
July	14.941	0.000	14.941	10.938	3.606	0.397
August	15.649	0.000	15.649	11.043	4.179	0.427
September	11.388	0.000	11.388	7.599	3.251	0.538
October	8.586	0.000	8.586	5.095	2.872	0.619
November	7.721	0.000	7.721	4.271	2.784	0.666
December	8.329	0.000	8.329	4.439	3.205	0.685
2018						
January	6.868	0.000	6.868	4.089	2.172	0.607
February	6.248	0.000	6.248	3.900	1.690	0.657
March	6.689	0.976	7.666	4.946	2.100	0.620
April	0.000	7.279	7.279	10.359	-3.655	0.575
May	0.000	8.429	8.429	5.868	2.003	0.558
June	0.000	10.376	10.376	7.461	2.391	0.524
July	0.000	14.888	14.888	11.250	3.216	0.422
August	0.000	14.388	14.388	10.685	3.169	0.534
September	0.000	10.133	10.133	7.407	2.187	0.539
October	0.000	8.780	8.780	5.864	2.236	0.680
November	0.000	7.807	7.807	4.972	2.239	0.596
December	0.000	9.242	9.242	6.191	2.462	0.589
2019						
January	0.000	7.343	7.343	4.219	2.363	0.761
February	0.000	6.442	6.442	3.322	2.337	0.783
March	0.000	8.710	8.710	4.890	2.920	0.901
April	0.000	7.380	7.380	4.054	2.495	0.831
May	0.000	9.467	9.467	6.069	2.538	0.861
June	0.000	11.308	11.308	7.576	2.933	0.800
July	0.000	13.727	13.727	10.064	3.065	0.598
August	0.000	13.645	13.645	9.662	3.319	0.664
September	0.000	10.167	10.167	6.790	2.560	0.817
October	0.000	7.976	7.976	4.646	2.400	0.931
November	0.000	7.204	7.204	4.432	1.890	0.883
December	0.000	6.722	6.722	3.903	1.841	0.978
2020						
January	0.000	6.975	6.975	4.078	1.950	0.948
February	0.000	6.350	6.350	3.725	1.755	0.869
March	0.739	0.019	0.758	0.125	-0.003	0.129
April	4.114	2.782	6.896	3.876	1.406	1.046
May	3.363	4.133	7.496	4.588	1.463	0.864

Monthly Max Day (mgd)

Year/Month	Well 1	Well 2	Production	Manzanita	Wheeler	RT53 + Tideland
2017						
January	0.528	0.000	0.528	0.346	0.174	0.046
February	0.563	0.000	0.563	0.396	0.182	0.047
March	0.694	0.000	0.694	0.548	0.168	0.045
April	0.692	0.000	0.692	0.642	0.151	0.031
May	0.699	0.000	0.699	0.651	0.255	0.037
June	0.578	0.000	0.578	0.446	0.193	0.032
July	0.693	0.000	0.693	0.642	0.193	0.031
August	0.693	0.000	0.693	0.551	0.232	0.036
September	0.696	0.000	0.696	0.595	0.215	0.038
October	0.600	0.000	0.600	0.425	0.175	0.035
November	0.523	0.000	0.523	0.353	0.187	0.040
December	0.492	0.000	0.492	0.327	0.189	0.034
2018						
January	0.629	0.000	0.629	0.431	0.195	0.032
February	0.625	0.000	0.625	0.462	0.209	0.061
March	0.626	0.467	0.626	0.461	0.220	0.033
April	0.000	0.691	0.691	2.866	0.169	0.042
May	0.000	0.718	0.718	0.547	0.210	0.043
June	0.000	0.674	0.674	0.506	0.194	0.040
July	0.000	0.717	0.717	0.674	0.198	0.035
August	0.000	0.722	0.722	0.529	0.239	0.054
September	0.000	0.686	0.686	0.521	0.171	0.031
October	0.000	0.711	0.711	0.567	0.223	0.045
November	0.000	0.539	0.539	0.384	0.151	0.038
December	0.000	0.588	0.588	0.429	0.155	0.039
2019						
January	0.000	0.664	0.664	0.499	0.247	0.048
February	0.000	0.679	0.679	0.469	0.291	0.047
March	0.000	0.597	0.597	0.431	0.165	0.049
April	0.000	0.597	0.597	0.431	0.158	0.046
May	0.000	0.636	0.636	0.460	0.174	0.049
June	0.000	0.671	0.671	0.531	0.207	0.050
July	0.000	0.718	0.718	0.649	0.203	0.050
August	0.000	0.708	0.708	0.602	0.230	0.059
September	0.000	0.498	0.498	0.356	0.148	0.046
October	0.000	0.576	0.576	0.407	0.212	0.055
November	0.000	0.505	0.505	0.344	0.188	0.055
December	0.000	0.483	0.483	0.396	0.185	0.047
2020						
January	0.000	0.524	0.524	0.391	0.170	0.049
February	0.000	0.623	0.623	0.431	0.191	0.047
March	0.356	0.019	0.356	0.169	0.000	0.048
April	0.448	0.324	0.448	0.288	0.150	0.057
May	0.486	0.481	0.510	0.297	0.155	0.048

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Appendix N

Section 3 and Section 4 from Manzanita/Wheeler Water Management & Conservation Plan
HGE, Inc., Architects, Engineers, Surveyors & Planners, September 2005
Updated by John Handler (City of Manzanita Consultant), March 2010

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SECTION 3: CONSERVATION ELEMENT

3.1 PREVIOUS AND CURRENT CONSERVATION EFFORTS

3.1.1 Metering

Metering and data acquisition is currently in place for:

- All raw water sources. Anderson Creek North Fork and West Fork water passes thru the same meter; Manzanita assumes a 50/50 contribution from each of these sources.
- All interties and bulk sales. The only exception is the emergency finished water intertie with Nehalem. Manzanita has purchased a new 4" meter which is scheduled to be installed during the summer of 2010. This connection has not been used over the past 18 months.
- All customer service connections.
- Reservoir inlets.
- Treatment processes including backwashing and discharge to waste.

Full metering of customer service connections provides data for usage based rates and billing. Metering and usage rates are probably the single most effective means of promoting water conservation. Both Manzanita and Wheeler are fully metered and water billings in part are based on metered water usage.

Service meters are read quarterly in Manzanita and every odd numbered month in Wheeler.

Manzanita has an active meter testing and replacement program. Approximately one tenth of Manzanita's service meters are replaced annually.

3.1.2 Monitoring

Manzanita is highly vigilant in monitoring data for changes, discrepancies, or other indicators of problems in the system. The City's SCADA system is set up to compile and compare usage throughout the system, including Wheeler's.

Leaks as small as that occurring in ¾" service lines can be detected. (The SCADA system is configured to establish the general area in which a leak occurs; it cannot establish the exact location.)

Manzanita's Public Works Department maintains exhaustive computer files and spreadsheets that track and compare planning, flow, water quality and usage data. These are located at the Treatment Plant/ SCADA location. The City's billing software also tracks usage and notes departures from previous usage patterns and / or excessive use.

3.1.3 Leak Detection and Repair

Reported Leaks and potential leaks identified by the SCADA system or billing programs are promptly addressed by public works personnel. Manzanita also monitors (via SCADA) Wheelers system and notifies Wheeler Public Works if there is a potential leak detected.

Manzanita has installed new valves in many areas to facilitate isolation of lines and repairs. Manzanita has replaced sections of the raw water transmission line from the Anderson Creek sources to correct leaks. This line also has a pressure detection system connected to the SCADA system, which is used for monitoring potential leaks.

Both Manzanita and Wheeler have replaced many older AC lines. Manzanita replaced approximately 1+ miles of distribution mains throughout the downtown area in 2008.

Wheeler has located and repaired several large leaks in the 2005 thru 2009 time period that has reduced consumption by almost 40% from pre 2003 usage.

3.1.4 Policies

Manzanita currently requires installation of Lo-Flow water fixtures on all new (or remodel) construction. The City also recommends native plant landscaping during plan review; however, there are no requirements that recommendations be implemented. The City reports that most new homes in the area are opting for native landscaping. Drip irrigation is recommended for those that do choose to irrigate plantings. The City also reports a significant number of residents have changed their plantings to low (or no-use) water demand landscaping because of the relatively high water rates stemming, in part, from debt service on recent improvements.

Manzanita Public Works will check suspected leaks, or customers' suspicions of a leak, at no charge to the customer. Customers who have a leak repaired are eligible to have the effected billing adjusted to what the average billing would have been upon proof of the repair (such as a receipt from a plumber) and a City follow-up check of the water meter. Manzanita also follows up (with an on-site visit) on water accounts that are flagged by the City's billing software as exhibiting abnormal usage.

3.2 PLANNED CONSERVATION MEASURES

3.2.1 City of Manzanita - Conservation

Currently the area has sufficient water rights and source development to meet customer needs and to allow for system growth; consequently, conservation efforts are not being driven by water demand. Both Manzanita and Wheeler have recently completed extensive improvement projects including source development/expansion and a new surface water treatment plant in Manzanita; consequently, conservation efforts are also not being driven by economics. Manzanita's conservation efforts to date reflect a progressive attitude toward the inherent benefits of conservation and the long-term sustainability and reliability of its water supply. It also reflects a commitment by the City and Public Works Department to promptly address system deficiencies within the constraints of affordability and practicability. Manzanita extends its assistance to Wheeler in monitoring the system and providing technical assistance.

Policies and practices currently in place are anticipated to be carried forth indefinitely into the future. Additional measures to be implemented by the City of Manzanita include:

- Install a water meter on the (finish) water line that connects to the City of Nehalem's system. The line is currently unmetered and used for emergencies only. ... *Meter is purchased, installation scheduled for summer 2010*
- Replace the existing transmission line from the Anderson Creek sources. The line is old and susceptible to breakage. ... *Ongoing*
- Replace AC and other old mains as practicable and affordable. ... *Ongoing*
- Develop short articles and information on conservation for inclusion in the City's quarterly newsletter. ... *Included in Annual CCR to customers*
- Annual water audit that includes detailed estimates of all unmetered usage (such as hydrant flushing). ... *Ongoing and completed quarterly*
- Complete a new Water Master Plan. ... *Completed May 2006*

OAR 690-086-0150(4) requires all water suppliers to implement the following conservation measures:

- An annual audit. ... *Ongoing and completed quarterly*
- Full metering of service connections. ... *Both systems are 100% metered*

- A meter testing and maintenance program.
- A rate structure that reflects and incorporates consideration of metered water consumption. ... *Implemented in 2005*
- A leak detection program if the annual water audit indicates system leakage in excess of 10 percent. ... *Manzanita audit indicated leakage at < 5%*
- A public education program to encourage efficient water use and low water use landscaping.

Manzanita is largely in compliance with these requirements.

3.2.2 City of Wheeler - Conservation

Wheeler needs to develop programs and policies that reflect the requirements noted under OAR 690-086-0150(4). The City of Wheeler has not, to date, implemented specific conservation related measures other than replacement of defective mains, and repairs of leaks, to the extent practicable and affordable.

Wheeler has completed metering on 100 percent of service connections, and the implementation of usage based water rates.

The City of Wheeler has recently hired a new employee for the Public Works duties. This new employee has multiple responsibilities and a very limited public works budget. Implementation of new conservation measures is unlikely until the new employee is oriented and allowed to catch up on other pressing matters. The implementation schedule reflects this consideration.

Specific conservation measures to be implemented by Wheeler include:

- Compile list of known and suspected leaks (if any) that need to be checked or corrected.
- Develop a plan to check and correct known or suspected leaks.
- Implement leak correction plan.
- Conduct an annual audit. The audit should include all metered connections and estimates of unmetered usage (such as hydrant flushing).
- Develop a plan for service meter testing/repair and/or replacement.
- Implement service meter plan.

- Develop a public education program that, at a minimum, provides information on low water use landscaping, encourages efficient water use, and provides information on Wheeler's conservation activities and implementation schedule.

- Implement public education program.

3.3 CONSERVATION MEASURE SUMMARY AND 5-YEAR IMPLEMENTATION PLAN

3.3.1 City of Manzanita ... 5-Year Plan

OAR 690-086-0150(4) requires a list of the 5-year conservation measures (benchmarks) and an implementation schedule. 5-year benchmarks and implementation schedules are provided below in Table 3.1 for Manzanita.

Manzanita completed a Water System Master Plan in May 2006, which addresses recommended Near-Term Capital Improvement Projects; consequently, improvement scheduling is noted in that plan and included in Table 3.1.

3.3.2 City of Wheeler ... 5-Year Plan

OAR 690-086-0150(4) requires a list of the 5-year conservation measures (benchmarks) and an implementation schedule. 5-year benchmarks and implementation schedules are provided below in Table 3.2 for Wheeler.

Wheeler last completed a Water System Master Plan in 1994, which addresses recommended projects; scheduling is noted in that plan and included in Table 3.2.

Wheeler has had several staff changes in recent years; consequently, there is limited knowledge/experience base or extant records upon which to draw for planning and implementation of the measures listed. The benchmark schedule for Wheeler is therefore also tentative and subject to change; however, the overall goal is full implementation of the listed measures prior to the WMCP update in five years (2015).

Table 3.1: City of Manzanita 5-Year Conservation Benchmarks

Benchmark	Date (Goal)	Frequency
Ongoing Efforts		
Service meter replacement	September 2005	10 year cycle
Service meter checking	September 2005	On-call
System monitoring	September 2005	Varies by parameter
Leak detection and repair	September 2005	As required
Lo-flow fixture requirements	September 2005	Policy
Financial incentives for leak repair	September 2005	Policy
Water audit	September 2005	Annually
Newsletter with information on conservation	September 2005	Annually
Upgrade Anderson Creek transmission main	2005 - 2015	As required
Complete water system master plan	November 2005	**Completed May 2006**
Replace selected AC and other old mains	2005 – 2015	Ongoing projects
Planned programs		
Install water meter on Nehalem connection	2010	-
Public information on conservation	January 2010	Quarterly

Table 3.2: City of Wheeler 5-Year Conservation Benchmarks

Benchmark	Date (Goal)	Frequency
Planned programs		
Compile list of known or suspected leaks	June 2010	-
Develop plan to check and correct leaks	July 2010	-
Implement leak correction	August 2010	-
Develop public education program	October 2010	According to plan
Implement public education plan	November 2010	According to plan
Conduct annual water audit	March 2011	Annually
Develop plan for service meter check/repair and/or replacement program	June 2011	-
Implement service meter plan	July 2011	According to plan

SECTION 4: CURTAILMENT PLAN ELEMENTS

4.1 CONTEXT

With development of the new well source and transmission mains, it is unlikely that water supply will be affected by seasonal weather patterns or changes in raw water availability. Disruptions in supply will likely be limited to emergencies or localized impacts from construction or maintenance activities. Manzanita has prepared a detailed emergency response plan, updated annually, that addresses water related emergencies. Construction and maintenance activities are typically coordinated to avoid unnecessary disruptions of water supplies.

4.2 CURTAILMENT PLAN

A proposed curtailment plan is described in Table 4.1. Development of a water curtailment ordinance would allow designated City authorities to promulgate a water supply emergency, enact the curtailment plan, and police customer compliance through the issuance of warnings and fines. Without an ordinance, the curtailment plan becomes an advisory plan that can be used as a reference to base requests for public actions to reduce consumption. The issue is complicated by the multiple jurisdictions involved. It is strongly recommended that Manzanita and Wheeler coordinate prior to the development and adaption of curtailment ordinances (should they desire to do so) so as to maintain consistency and to avoid potential conflicts.

Table 4.1: Proposed Curtailment Plan

Stage	Trigger	Goal	Implementation Measures
Mild	Use reaches 80% of capacity	General awareness and Modest reductions in Consumption.	• Activate curtailment plan • Provide information (guidance) to the public on conservation methods. • Request customers to limit irrigation. • Avoid flushing hydrants
Moderate	Use reaches 90% of capacity	Enhanced awareness and moderate reductions in consumption.	• Continue "mild" stage measures. • Request irrigation be minimized to that necessary for plant survival. • No lawn irrigation.
Critical	Use reaches 95% of capacity	Awareness of critical supply shortage and maximum reduction in consumption.	• Continue "moderate" stage measures. • No outdoor irrigation • No vehicle washing. • No hosing of paved surfaces.

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Appendix O

Section 5.6: Anderson Creek Water Supply Recommendations from 2006 Manzanita Water System Master Plan

HGE, Inc., Architects, Engineers, Surveyors & Planners, May 2006

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5.6 ANDERSON CREEK WATER SUPPLY RECOMMENDATIONS

The two existing dam structures are functional notwithstanding reservations discussed in Section 5.3.1. Improvement recommendations are complicated by the current regulatory context which in which they are made. The existing dams could not be constructed today because they lack fish passage provisions (fish ladders). Any substantial work on the existing dams that will require permits or other regulatory oversight (or funding agency participation) is likely to trigger a regulatory response and requirement that fish passage be provided consistent with provisions of ORS 509.580 through 910 and OAR 635, Division 412. Laws requiring owners of artificial obstructions to address fish passage requirements under such circumstances have been in place since August 2001. Oregon Department of Fish and Wildlife (ODF&W) has developed fish passage guidelines.

Improvement options for the North Fork Anderson Creek (Lower Dam) and West Fork Anderson Creek (Upper Dam) include:

1) "Do nothing." Under this option, the City would only undertake work as needed to maintain the existing structures. Major improvements or modifications would be avoided so as not to trigger the regulatory requirements for provision of fish passage. The primary benefit of this option is the deferment of major expenditures on source improvement projects.

2) Provide fish passage. Construction costs for fish passage structures on small streams with an elevation change of 12 feet or less are on the order of $15,000 per vertical foot. An opinion of probable cost *for each dam*, is $200,000 for construction ($270,000 for total costs including contingencies, engineering, legal and administration). Fish passage design requires considerable involvement of ODF&W to determine and/or approve site specific design parameters and to provide review and approval of designed facilities. Other agencies (Corps of Engineers, NOAA, Oregon Water Resources, and others) may also have varying levels of involvement in design development and permitting.

   ODF&W criteria for minimum design flows (October 22, 2004) for fishways are:

   > "Low flow design should be used to assure the *Minimum Water Depth* criteria for the migration period of the fish species/stage of concern and may be either:
   >
   > - the 2-year, 7-consecutive-day low flow discharge, or

- the 95% exceedence flow"

Maintaining the minimum flow through the fishway during summer/fall low flow periods is likely to result in a reduction of flow availability (compared with that historically utilized prior to construction of the fishway). Lowest streamflows typically occur during prolonged dry weather extending into the fall season. Highest water consumption in Manzanita is during the Fourth of July weekend and, to a lesser extent, during the July-August peak tourist and irrigation season; consequently, the reduced flow availability from the Anderson Creek sources (resulting from fishway construction) may not adversely affect the City's ability to manage peak seasonal needs. The City may, however, need to rely on the well sources to a greater extent during these periods.

3) Construct infiltration gallery. This option involves the construction of an infiltration gallery in the stream bed upstream of the existing dams. The existing dams would be removed. Infiltration galleries consist of buried pipe and screens that collect water as the stream percolates through the overburden to the screens and is conveyed via a pipe manifold to the transmission main. Infiltration galleries require a careful assessment of site specific conditions. Failure rate is high - Washington State reports up to 50% failure with the primary cause being siltation and plugging of the screens with fines. Successful sites have sufficient slopes and hydraulics to keep fine sediments in suspension. A low loading rate also contributes to viability. An opinion of probable construction cost *for each infiltration gallery* is \$200,000 (\$270,000 for total costs including contingencies, engineering, legal and administration.)

There is a fourth option: to move all the Anderson Creek sources downstream, consolidate the water rights, develop a well(s) next to Anderson Creek, and pump back up to the transmission main. The result would not be significantly different than the existing situation with wells #1 and #2. The City had selected and constructed a surface water treatment facility because of citizen desires to maintain its surface water sources; consequently, this option is not further developed or recommended at this time.

The Middle Fork source currently has no constructed facilities. Permitting, design, and construction of a new dam is likely to be very costly (on the order of \$1,000,000+) and require approximately 4-5 years for completion. The location appears to be susceptible to stream meandering; consequently, it may not be a good location for an infiltration gallery. Assuming the other two sources are maintained, the Middle Fork source could be used to supplement flow to the City during the lower flow, higher demand periods of the summer and fall by construction an intake and box near the stream. Location and design would be such as to facilitate capture of low flows, to close and isolate the box during periods of higher flows to exclude materials that could damage or plug the screens, and to facilitate manual cleaning of sediments that may accumulate in the box. A preliminary opinion of probable construction cost for this work is $37,000 ($50,000 for total costs).

Another related issue is the poor condition of the AC (asbestos-cement) transmission line. The City has repaired or replaced sections of the line as a result of line failures; however, the entire remaining AC portion should be replaced. An opinion of probable cost for the replacement of 15,200 lineal feet of 8-inch AC line is $912,000 for construction ($1,231,000 for total costs including contingencies, engineering, legal, and administration). Repair or replacement on an ad hoc basis is possible; however, the ramifications of this approach will invariable be: water loss associated with leaks, inconvenience to the City - especially staff, and cost inefficiencies due to multiple mobilizations and emergency procurement of materials and services.

In addition to the three sources and the main raw water transmission line, there are connecting lines to each source (3,560 lineal feet total) that meet at a junction box. Any comprehensive approach to upgrading source and transmission facilities should include replacement of these lines and the junction box. The junction box should include pressure reducing valves (to compensate for source elevation differences, isolation values, and three flowmeters). An opinion of probable construction cost is $284,000 ($214,000 for lines, $70,000 for the junction box, valving, and flowmeters) with a total project cost of $383,000.

A summary of costs is presented in Table 5.4.

Table 5.4: Anderson Creek Source and Transmission Improvements Opinion of Probable Cost (OPC)

Item	**Construction Cost**
Sources	
North Fork	
Fishway or Infiltration Gallery	$200,000
West Fork	
Fishway or Infiltration Gallery	$200,000
Middle Fork	
Seasonal Intake	$37,000
Existing dam upgrade allowance	$50,000
Junction Box and Transmission Lines from Source	
Lines (3,560 LF - 8"diameter)	$214,000
Junction Box, valves, PRVs, flowmeters	$70,000
Transmission Main	
Replace 8" AC with HDPE (15,200 LF)	$912,000
Replace 8" PVC with HDPE (5,000 LF)	$300,000
Project Construction Subtotal	$1,983,000
Contingencies @ 10%	$198,000
Engineering and Construction Observation @ 20%	$397,000
Legal and Administration @ 5%	$99,000
Environmental and Permitting (allowance)	$50,000
OPC Project Total	**$2,727,000**

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix P

Emergency Well Feasibility Study
(Appendices not included.)
PACE Engineers, Inc., May 2017

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CITY OF MANZANITA
EMERGENCY WELL FEASIBILITY STUDY

Project No. 16846 | May 2017 - Final

REGISTERED PROFESSIONAL ENGINEER
#18309PE
OREGON
JANUARY 16, 1996
WILLIAM M. PAVLICH

Renews: 12/31/18

PACE
An Engineering Services Company

Completed By:

PACE ENGINEERS, INC.

5000 Meadows Road | Suite 345

Lake Oswego, OR 97035

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EXECUTIVE SUMMARY

The proposed project consists of constructing an emergency water supply well near the City's Water Treatment Plant, transferring one of the City's water rights to the well, and connecting the well to the treatment plant.

Based on our study, the proposed well appears to be feasible with good potential for success; but there is still a chance that facts or findings that will be established during the course of project development could adversely impact the project. Because of this, as well as the complexity of the project, we are recommending that the project be implemented as a series of sequential tasks. This will minimize potential cost risks associated with an adverse finding. (Discussions related to these concerns are included in the Feasibility Study.)

The first series of tasks include: City review of the Feasibility Study and concurrence in moving forward, OHA plan review of materials developed to date, easement acquisition, hydrogeological evaluation, and water right transfer application/approval. Our opinion of probable cost (OPC) for these tasks is $24,000. Estimated time for completion is 8 months. The OHA submittal is incomplete at this time, but it starts the process and could provide valuable agency feedback. A hydrogeological evaluation is necessary because of the nature of the water right transfer; and it is a required attachment for the water right transfer application. The timeline assumes an expedited water right process. Information and regulatory findings associated with this series of tasks should provide a much more solid basis for deciding whether or not to move forward with well construction.

Well design, bid, construction, and testing will take an estimated 4-5 months to complete. The OPC is $160,000.

Conceivably, the above discussed work can be completed in a year; therefore, we recommend budgeting $184,000 for the upcoming budget year.

The next task will be to design the improvements to install the well pump, pipelines, and other infrastructure needed to connect the well to the WTP; and to construct the improvements and finalize the water right transfer. The OPC is $131,000. Estimated time for completion is 3 months, assuming that City staff are doing much of the work with assistance from specialty contractors as needed. The OPC cost is based on typical bid costs; consequently the City should see significant savings to the extent that it is able to complete the work in-house.

OPC for the whole project is $315,000. We recommend that the City budget an additional $5,000 as an allowance for miscellaneous legal and/or administrative costs.

SECTION 1 | INTRODUCTION

1.1 Background

The City of Manzanita is located off U.S. Highway 101 in Tillamook County approximately 27 miles north of the City of Tillamook. Resident population in 2016 was estimated at 625 persons (source: PSU Population Research Center). Manzanita is a popular tourist stop and approximately 75 percent of the housing stock is associated with second homes and vacation use; consequently, water demands are considerably higher at times than the resident population would suggest.

Manzanita owns and operates a water system. It is also part of the Joint Water System with the City of Wheeler. Manzanita has several water sources (three forks of Anderson Creek) and a membrane microfiltration water treatment plant (WTP), but currently obtains all its water from the Joint Water System wells located near the Nehalem River. The two wells are separated from the WTP by 40,300 lineal feet of transmission main that includes a bored crossing of the Nehalem River.

Over 20,000 lineal feet of transmission main separates the City's surface water sources from the WTP. This line is predominantly constructed of asbestos cement pipe and is in extremely poor condition and is no longer utilized.

Manzanita does have an emergency intertie with the Neah-Kah-Nie Water District; however, the District constructed the intertie because of dwindling water supplies from its own sources (associated with late summer effects of the recent drought) and the anticipated need for supplemental water from Manzanita. Neah-Kah-Nie has very limited ability to provide water to Manzanita.

The City is concerned about water system reliability and emergency preparedness in general. Located on the coast, the City could bear the full force of a Cascadia Subduction Zone Earthquake as well as impacts from local or distantly generated tsunamis. The Oregon Resilience Plan (2013) estimated that after a major Cascadia earthquake, it could take 3-6 months to restore electricity and 1-3 years to restore water service in areas affected by the earthquake.

City staff developed the idea to construct a well near the WTP with several purposes in mind:

- Provide water in the event of a major disaster that affects the ability of the Joint Water System wells to provide water to the City.
- Provide water that could be treated and provided for local distribution in the event of major damage to the City's distribution system.
- Provide water for periodic WTP operation to maintain its functionality until such time as the Anderson creek sources are restored or a decision is made to decommission the WTP and to not restore the Anderson creek sources.

In addition to the above considerations, it should be noted that the City has been pursuing a water permit extension of time (from the Oregon Water Resources Department) for the Joint Water System wells. The extension may be conditioned to provide for fish and wildlife protection that could, at times, result in reductions in water availability. Under these conditions, an emergency well near the WTP could provide additional water for the system, thereby lessening the impact of the reduced withdrawals from the Joint Water System well.

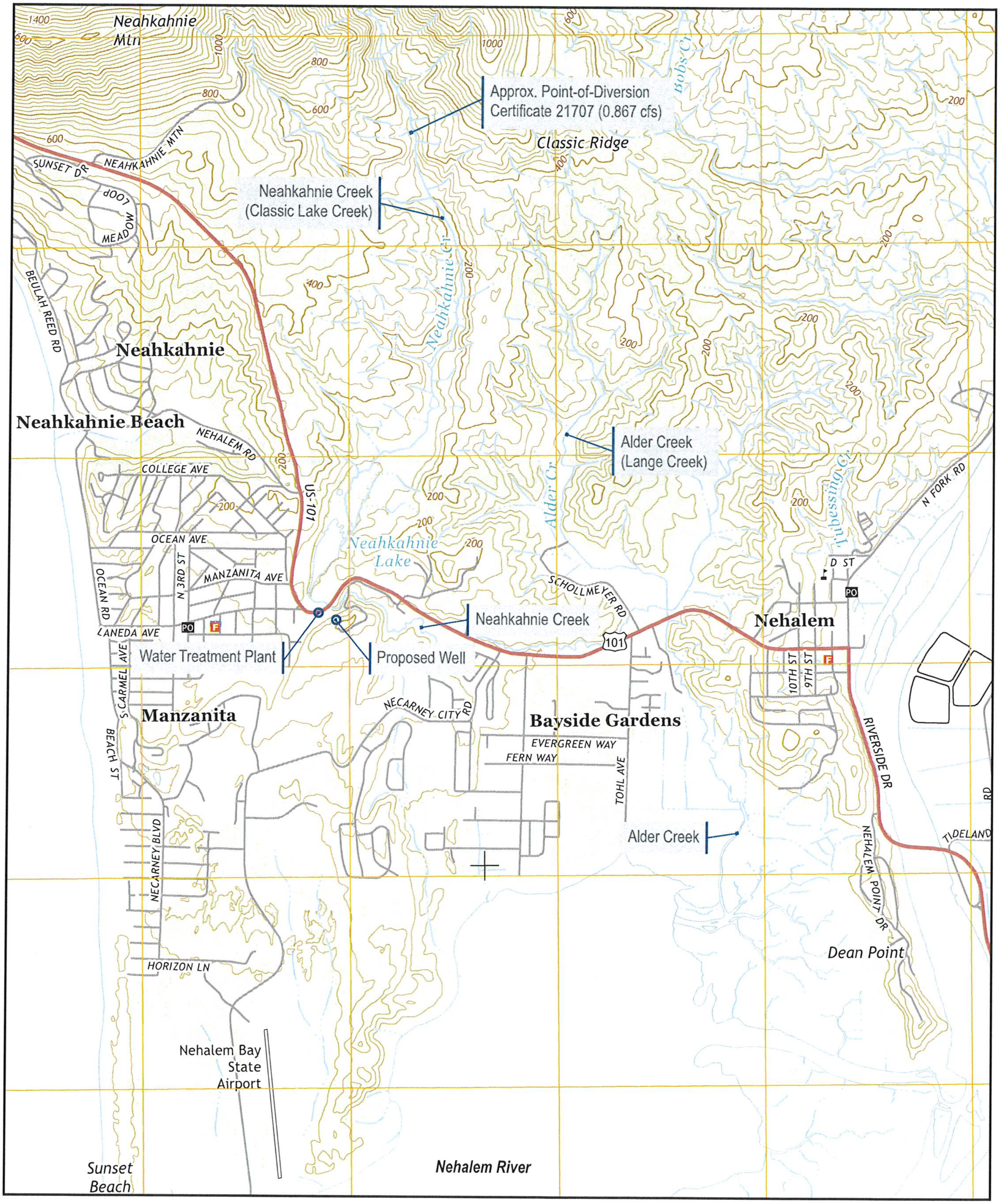


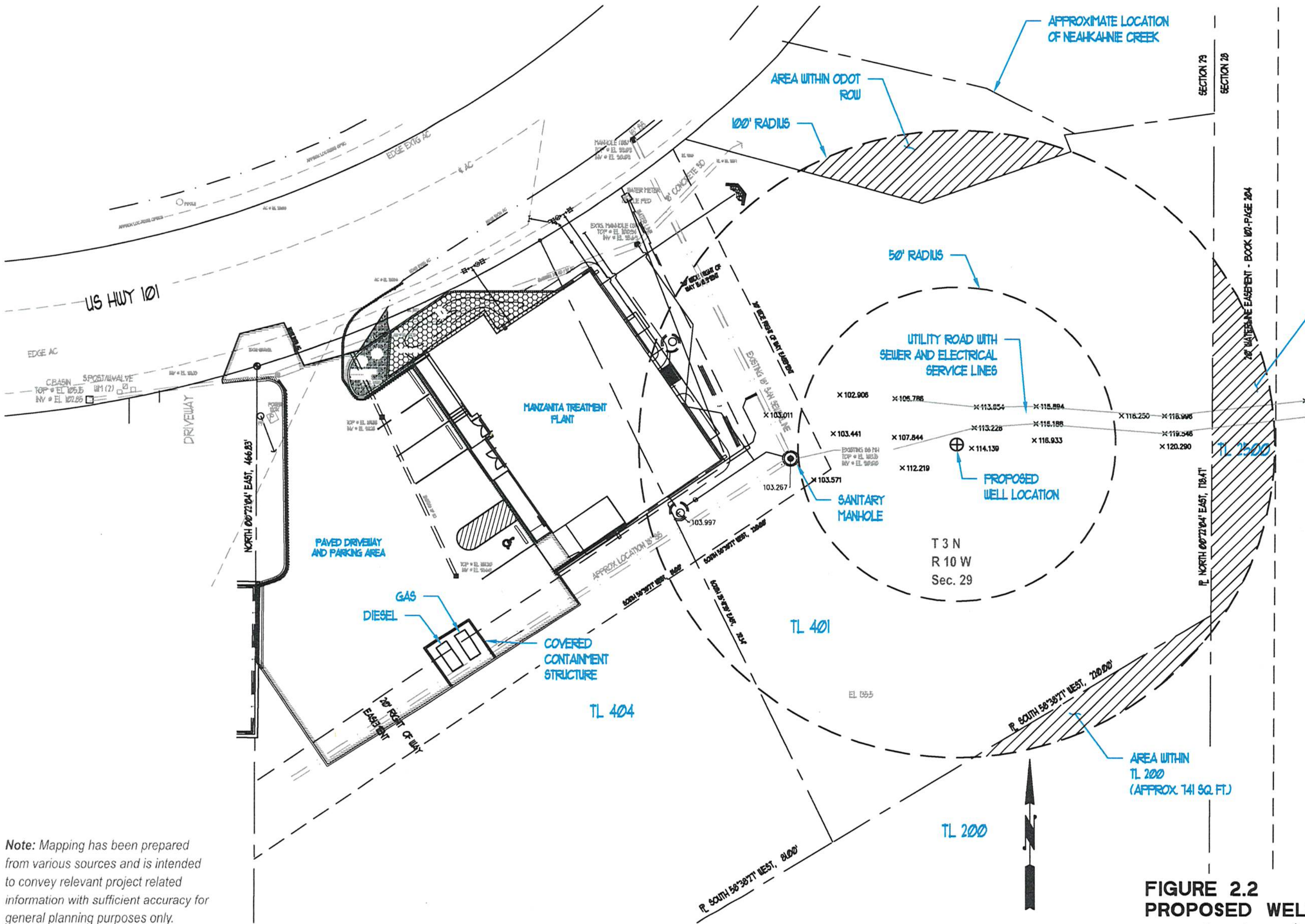
Figure 2.1 - Area Map

Base Map: USGS Nehalem Quadrangle 2014

Scale: 1" = 1,600'

Contour Interval: 40'

This drawing has been prepared under the direction of:
William Pavlich, PE | 503.597.3222



Note: Mapping has been prepared from various sources and is intended to convey relevant project related information with sufficient accuracy for general planning purposes only.

Prepared For:
City of Manzanita Water Department
PWS ID #OR4100505

PACE
An Engineering Services Company

Prepared by:

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FIGURE 2.2
PROPOSED WELL VICINITY MAP
SCALE 1"=~~30'~~ 60'

City staff would like to develop a well of approximately 80 gallons per minute (gpm) capacity. Discussions with a hydrogeologist and a well driller with local experience during the initial scoping of this project suggest that while 80 gpm may be achievable in the area, it is by no means certain. Actual capacity will be determined based on testing after the well is drilled.

The Joint Water System wells produce approximately 500 gpm; consequently, 80 gpm would not provide a true backup to the current well supply. 80 gpm (or even less) could supplement local water needs in such a way as to reduce the use of stored water in the City's reservoirs, thereby extending the period (days) of feasible water system operation in the event of water not being available from the Joint Water System wells. After a major event, depending on the size of the service population, the extent of the functional portion of the water system, and the efficacy of conservation efforts, it may be possible to provide service to part of the system for an extended period of time until restoration of normal service has been achieved.

Planning for an Emergency Drinking Water Supply (EPA 600/R-11/054) notes that 1 gallon per person per day is a plausible planning figure and consistent with FEMA, EPA, and Red Cross estimates for drinking, food preparation, and hygiene. This is under true emergency conditions when distribution is likely direct via jugs or other containers from a local supply site. 80 gpm is over 100,000 gallons a day; consequently, a well of this capacity could provide much more than minimum needed – provided electrical service or emergency power generation is available and functional.

Manzanita's WTP is located approximately 80 feet from Neahkahnie Creek. The City has a municipal water right certificate for Neahkahnie Creek and the intent is to transfer the surface water right to the proposed well that would be located near the WTP (and Neahkahnie Creek). The well will be connected to the WTP's raw water tank and filtered and disinfected prior to use.

1.2 Purpose and Scope

The purpose of this study is to evaluate the feasibility of the project and the probable costs in order to provide the City with information that can be used as a basis for their decision on whether or not to move forward with the project.

1.3 Authorization and Funding

The City authorized PACE Engineers, Inc. on July 8, 2016 to complete the Feasibility study. This study has been funded in its entirety by the City of Manzanita.

SECTION 2 | PROPOSED PROJECT LOCATION AND SITE CHARACTERISTICS

2.1 Proposed Project Location

The general project location is shown in Figure 2.1. Neahkahnie Creek was called Classic Lake Creek in the past and this is the name that appears on the water right that will be transferred to the well. The point of diversion associated with the water right (certificate #21707) is also shown. The proposed well site is located on the hill behind the WTP and is also near Neahkahnie Creek. Neahkahnie Creek at this point flows eastward to Alder Creek (formerly known as Lange Creek). Alder Creek discharges to the Nehalem River (Nehalem Bay).

Figure 2.1: General Location Map

The well site is shown in more detail on Figure 2.2. The map is largely based on January 2004 record drawings for the WTP with newer details (covered containment structure) and recent survey data added.

Figure 2.2: Proposed Well – Vicinity Map

2.2 Site Characteristics

This section focuses on basic descriptions and characterizations of the well site and surrounding area. Site characteristics are also discussed in Section 4 with regard to regulatory concerns and design considerations.

Proximity. The proposed well location is near the Water Treatment Plant (WTP) on City owned property. This reduces overall costs and complexities of the project and facilitates operation under emergency conditions as well as minimizes the length of main connecting the well to the plant.

Property. (See Figure 2.2 and Appendix 2.1 for referenced tax lot locations.) The City owns tax lots 404 and 401. Tax lot 200 is undeveloped and owned by a private party. Tax lot 2500 is also owned by a private party; the property is developed with a single family home on 1.68 acres; however the part adjacent to tax lot 401 is designated as a 20 foot waterline easement. ODOT right-of-way borders the north side of the City owned property (see Appendix 2.2).

Access. The site is adjacent to U.S. Highway 101. Presumably, as a major transportation route, restoration of functionality would be given high priority following a major event. The WTP parking area and area surrounding the plant is open and relatively flat thereby facilitating access for construction or O&M activities.

Existing Utilities. Electrical service, including backup power generation, is available via the WTP. There is an 18-inch sanitary sewer, 13 feet deep, that passes behind the WTP. At its nearest point it is 50-feet away from the proposed well. The proposed well is off to the side of an overgrown service "road" (see Figure 2.2) that contains an electrical service and what is understood to be a sewer lateral from an on-site treatment system (associated with a home located south of the well site) that discharges to the municipal system off the southeast corner of the WTP. The sewer service lateral is likely within 10 feet of the proposed well. There are also drain, storm, and water (raw and finished) lines in the general vicinity of the WTP.

Topography. The WTP, parking area, and area around the WTP extending outward approximately 30 feet is relatively flat and cleared. Southeast of the area described above is a wooded hillside that extends upward with moderate slope. To the northeast, the site drops sharply to Neahkahnie Creek. The proposed well location is located off the edge of the utility road where the hillside rises to the south. Some excavation of the hillside and construction of a retaining structure will likely be needed to keep the well out of the road and to provide access and drainage around the wellhead. Based on recent survey data it appears that the well location is approximately 10 feet higher than the area around the WTP. Approximate site elevations that characterize the site are: Neahkahnie Creek 60 feet, area near WTP 103 feet, and proposed well location 114 feet.

Geology. The WTP area was reviewed in *Geotechnical Report, Proposed Water Treatment Plant, City of Manzanita* prepared by Wright/Deacon & Associates, March 3, 2000. The report included logs for two borings (Appendix 2.3) that were drilled to a depth of 41.5 feet. Results indicate sand to the full depth and no groundwater encountered. The authors speculate that groundwater is at a depth of approximately 50 feet based on the elevation of Neahkahnie Lake. The report characterizes the hillside south of the WTP (where the proposed well will be constructed) as a stabilized sand dune of moderate slope.

The *Geologic Map of the Tillamook Highlands, Northwest Oregon Coast Range,* USGS Open File Report 94-21, Wells et al, 1994 shows the WTP site and areas west and south as Holocene beach and dune deposits.

Based on the boring logs and the estimated depth to groundwater, it is likely that the aquifer is unconfined.

Natural Hazards. A review of Oregon Department of Geology and Mineral Industries (DOGAMI) Statewide Geohazards Mapping indicate no potential for flooding or tsunami inundation. This is consistent with the general location and elevation of the site. Landslide hazard potential is characterized as moderate. This is consistent with the "stabilized dune" characterization noted in the Wright/Deacon report discussed above. Shaking in the vicinity of the site from a Cascadia Earthquake is characterized as very strong – which is less than the map categories of violent or severe.

Other Hazards. The State of Oregon Department of Environmental Quality (DEQ) Underground Storage Tank Cleanup List was checked for potential hazards in the vicinity. Only two listing were found in the area: northwest of where Neahkahnie Creek crosses U.S. Highway 101(36725 N Highway 101), and west of the WTP site (868 Laneda Avenue). The listing for the first was for a heating oil tank with cleanup work completed on April 12, 2004; for the second, it was for the Manzanita underground storage tank with cleanup work completed January 28, 2009.

Gas and diesel above ground storage tanks are located on the south side of the WTP parking area (see Figure 2.2). The structure has a concrete basin for spill containment, and is covered. The tanks are heavy duty with double-wall construction. The installation was designed to minimize the risk of a spill.

A chemical spill on U.S. Highway 101 could result in contamination of Neahkahnie Creek and the local aquifer.

Neahkahnie Creek. Neahkahnie Creek is adjacent to the project site and below the rip-rapped hillside included in ODOT's right-of-way (Appendix 2.2). The creek originates on Neahkahnie Mountain and flows through forest and prime Coho spawning habitat above Neahkahnie Lake. A dam on the south end of Neahkahnie Lake and a perched culvert on the south side of U.S. Highway 101 effectively blocked fish passage for over 80 years. ODOT recently removed the barriers and installed a fish friendly culvert that will allow salmon and steelhead to reach the prime spawning habitat upstream. Just downstream of the ODOT right-of-way, The Lower Nehalem Community Trust (LNCT) acquired 2,100 lineal feet of stream on 7.27 acres with the intent of restoring and preserving the creek in this area. Neahkahnie Creek is tributary to Alder Creek which is tributary to the Nehalem River. Neahkahnie Creek and Alder Creek are shown on Figure 2.1.

Wetlands. The entire site is characterized by sandy soils; there are no identified wetlands present. Wetlands are present northeast of the project site, in the riparian areas surrounding Neahkahnie Creek.

SECTION 3 | WATER RIGHT TRANSFER

3.1 Existing Water Rights

The proposed well requires a water right. Manzanita has a certificated water right (#21707) for withdrawals from Neahkahnie Creek (named Classic Lake Creek in the certificate and, noted as "formerly known as Ettenberger Creek" in the permit application). Copies of the certificate, map, and permit application are included in Appendix 3.1. The water right is for 1.3 cubic feet per second (cfs) of which 0.867 cfs is from Neahkahnie Creek and 0.433 cfs is from Alder Creek (named Lange Creek in the certificate). The intent (see map, Appendix 3.1) was to divert water from Neahkahnie Creek to Alder Creek where it would flow to the City's point of withdrawal on Alder Creek. The water right is unusual in naming two different points of diversion on two different streams in one water right; nevertheless, the intent and logic is clear.

The water right is for municipal use and has a priority date of August 14, 1950.

Oregon Water Resources Department (OWRD) records were reviewed for water rights on Neahkahnie Creek upstream of the WTP site. There was one notable water right (certificate #4956) with a December 3, 1920 priority date for 2.0 cfs for purposes of a fish hatchery on Neahkahnie Creek immediately upstream of Neahkahnie Lake (named Classic Lake in the certificate).

There are no instream water rights on Neahkahnie Creek.

3.2 Transfer Feasibility

Manzanita's water right certificate (#21707) is for municipal use and therefore valid even though it hasn't been used in many years. It can be transferred; however, to do so the transfer must be in accordance with state laws and OWRD's requirements. The transfer is for a new point of diversion (a new well) and a change from surface water to groundwater. The rules governing this are largely covered by ORS 540.531 and OAR 690-380-2130. Relevant details are discussed below; copies of the referenced sections are included in Appendix 3.2.

The new point of diversion must be hydraulically connected to the stream for which the water right was issued. The well is a little over 100 feet from Neahkahnie Creek and available geological data suggests a strong likelihood of a hydraulic connection. Only part (0.867 cfs) of the certificate is for Neahkahnie Creek, so the transfer would have to be for this amount or less.

The new point of diversion must not enlarge the water right or harm other water right holders. One water right was located upstream of the proposed well (see Section 3.1 for description). It is an old water right for a privately owned fish hatchery. City staff were not aware of any hatchery and it is presumed that the water right has not been used in the past five years and is therefore no longer valid. There is no instream water right that would be affected by the change in point of diversion. The proposed well is targeted for 80 gpm (0.1738 cfs); this is approximately 20% of the original water right.

The new point of diversion must have a similar impact on Neahkahnie Creek as the original point of diversion. "Similar" means that the well would draw 50% or more of its water from Neahkahnie Creek if pumping of the well were maintained continuously for 10 days. This is something that may be difficult to determine prior to constructing and testing the well. Proximity is one factor that suggests an adequate hydraulic connection, but ultimately geology and groundwater depth will be the determining factors. Some wells can be very close to a stream and yet not be hydraulically connected.

The proposed well is less than 500 feet from Neahkahnie Creek but farther than 1,000 feet from the original point of diversion. The proposed well is approximately 7,600 feet from the original point of diversion in terms of straight line measurement; it is much longer if the measurement follows the creek's path. Because the proposed well is farther than 1,000 feet from the original point of diversion, the state requires that a licensed geologist demonstrate that the well is hydraulically connected to the creek and will have a "similar" impact on the stream.

As part of the transfer process, the City will be required to retain a certified water rights examiner (CWRE) to complete claim of beneficial use to establish how much of the original water right is being used. The new certificate will retain the original priority date but the flowrate will reflect actual use. The balance of the water right will be lost. The loss includes the original point of diversion, and in this case, the portion of the water right applicable to Alder Creek.

The transfer application should also be prepared by a CWRE. OWRD's review and approval process for the application is estimated by staff at 1-2 years. OWRD has an expedited process option that can shorten the time to 6 months to one year – or even less. The expedited process does cost extra and that cost is determined by OWRD staff after a request by the applicant and an initial review of the application by OWRD to determine the work involved. The applicant's request for an expedited process consists of a simple one page form and a $125 check to cover OWRD's cost of putting together the estimate.

Consideration had been given to designating the balance of the water right for instream use. This is not feasible without additional cost to the City and some complication of the overall process. The City cannot transfer part of the certificate to a well and part to instream in one transfer application. To do so would require two simultaneous applications. In addition, instream rights are typically granted to agencies rather than municipalities or private parties. From a practical standpoint, there is probably very little benefit in having an instream right, since any new water right applications on Neahkahnie Creek would be so heavily conditioned for fish and wildlife protection that water may be unavailable for withdrawal during part of the summer and fall (if the application is even approvable).

In summary, the proposed water right transfer appears to be feasible with the notable qualification that the licensed geologist's findings support the transfer. Discussions with OWRD staff early in the development of this study indicated that the agency may be amenable to approving the transfer even if the geologist's findings do not strictly match the rule requirement. Under this scenario, the City would have to provide mitigation, the exact nature of which is not entirely clear at this time. Giving up some of the water right is a possible option. Since in this case most of the original water right will be lost, the mitigation, if acceptable to OWRD, would have no additional financial impact on the City. Recent discussions with other OWRD staff suggest that this may not be a realistic possibility, so getting around the 50% requirement should not be overly relied on as a basis for moving forward.

SECTION 4 | WELL CONSTRUCTION AND CONNECTION TO WATER TREATMENT PLANT

4.1 Site Considerations

The proposed well site was selected based on proximity to the City's Water Treatment Plant (WTP) and Neahkahnie Creek. The latter consideration reflects the City's desire to transfer a surface water right for the creek to a groundwater point of appropriation much further downstream. The City also owns the site where the proposed well is to be located. Ownership of the site and proximity to the WTP will reduce overall costs and enhance reliability (since the relatively short main that connects the well to the WTP could be more easily repaired, if damaged, and put back online, than if the well were more distantly located).

For the site itself, setback requirements are a major consideration. Setback requirements are described in OAR 333-061-0050 "Construction Standards" (Appendix 4.1).

Figure 2.2 shows key features of the site; elements discussed in the following paragraphs can be located on the figure.

The City is required to demonstrate ownership and control of the area within a 100-foot radius of the well. The City must have perpetual restrictive easements for any property not owned by the City with the exception of public right-of-ways. Most of the required area is owned by the City. There is a small area located within ODOT right-of-way on the north side of the circumscribed area. ODOT has stabilized this area for bank protection above Neahkahnie Creek. This is public right-of-way with no other conceivable use; consequently, an easement should not be required. There is a small area located on the east side of the circumscribed area that is fully within a 20-foot waterline easement on Tax Lot 2500. Protections for the water line should be sufficient for the well. There is a small area on the southeast side of the circumscribed area that extends on to Tax Lot 200. This is uphill of the proposed well and on private property. A restrictive easement will be required for this area.

The proposed well is located 50-feet from the sanitary sewer as required; however, OHA can determine that aquifer sensitivity and the degree of hazard is such as to require a greater setback. The aquifer is likely unconfined and could raise some concerns; however the plan is to treat the water at the WTP prior to use, which could mitigate any concerns. Setbacks were discussed with OHA prior to developing this document, but no conclusions were forthcoming at that time.

Pressure sewer lines are not allowed within 100 feet of the well. The sewer service lateral that passes near the proposed well is believed by staff to be a drain line from an on-site wastewater system associated with the house located approximately 250 feet southeast of the proposed well. The proposed plan is to replace the line (gravity or pressure) with a new line of seamless HDPE that will be cased in a larger diameter seamless HDPE pipe. Agency rules (OARs) allow for the Authority (OHA) to waive the 100 foot requirement. The proposed solution should be adequate to address any concerns for potential contamination of the well based on proximity to the service lateral.

The rules include a lengthy list of items that cannot be within 100 feet of the proposed well. For the record, **the following items are not located within the 100 foot circumscribed area** (they are also not located anywhere within the larger surrounding area unless noted):

- Subsurface sewage disposal drain field.
- Existing or proposed pit privy.
- Cesspool.
- Buried fuel tanks (see Section 2.2 for additional discussion).
- Fuel transfer or storage (see Section 2.2 for additional discussion).
- Animal yard, feedlot, or animal waste storage.
- Untreated storm or grey water disposal.
- Chemical storage, usage, or application.
- Junk/ auto/ storage yard.
- Cemetery.
- Unapproved well.
- A well that was not properly abandoned, or of unknown or suspect construction.
- Source of pathogenic organisms or other similar health hazard.
- Vehicle or machinery maintenance or long-term storage.
- Mineral resource extraction.

OAR 690-210-0030 also addresses placement of water supply wells. Setbacks for some items noted above are more stringent. There is a 50-foot limit for: confined animal feeding area, holding area, or animal waste holding area; closed sewage or storm drainage system; and underground or above ground petroleum storage tanks used for commercial purposes. There is a 5-foot limit for overhanging roof or eaves of a permanent structure, and a 500-foot limit for hazardous waste storage, disposal, or treatment facility. None of these requirements impact the proposed well site.

The site is well above the creek and its associated 100-year floodplain. It is also well above the tsunami inundation zone (see Section 2.2 for additional discussion).

There is easy access to the proposed well location for drilling equipment and future maintenance needs.

4.2 Well Capacity and Water Quality

The City would like to have a well of approximately 80 gpm (see Section 1.1 for discussion of this quantity and adequacy for the intended purpose). Preliminary reviews of wells in the area suggest that this may be possible provided the water bearing layer is sand rather than bedrock. As noted in Section 2.2, sand is very likely the case. Proximity to the creek should also contribute to this goal – assuming there is a direct hydraulic connection. Preliminary discussions with a well driller familiar with the area suggest an 8-inch diameter well is likely needed to achieve the 80 gpm capacity. Actual capacity cannot be determined until after the well is drilled and pump testing of the well completed. *There is no guarantee that the target capacity of 80 gpm will be achieved.*

Dunal water sources are often relatively high in iron and manganese. Proximity to Neahkahnie Creek should reduce the potential for iron and manganese issues through dilution. Water quality testing, after the well is constructed, will indicate whether or not iron and manganese are issues that need to be addressed. The City intends to run the well water through the membrane microfiltration units; additional testing and analysis may be needed to determine if the membranes can handle the raw water without some additional pre-filtration step being necessary. Initial water quality testing includes many parameters; however, iron and manganese are typically the most prevalent issue with dunal sources. Elevated sodium levels are also common with dunal sources, but not typically at levels that would require special actions to address. Again the potential dilution provided by the proximity to Neahkahnie Creek should reduce the potential for sodium levels to be an issue. The broad range of water quality testing required reflects the fact that until test results have been obtained there is no way to know if a contaminant is present in sufficient quantity so as to require adequate treatment or abandonment of the source. *There is no guarantee that water quality will be adequate for the intended purpose without additional, and potentially costly, treatment requirements.*

4.3 Well Construction and Connection to the Water Treatment Plant

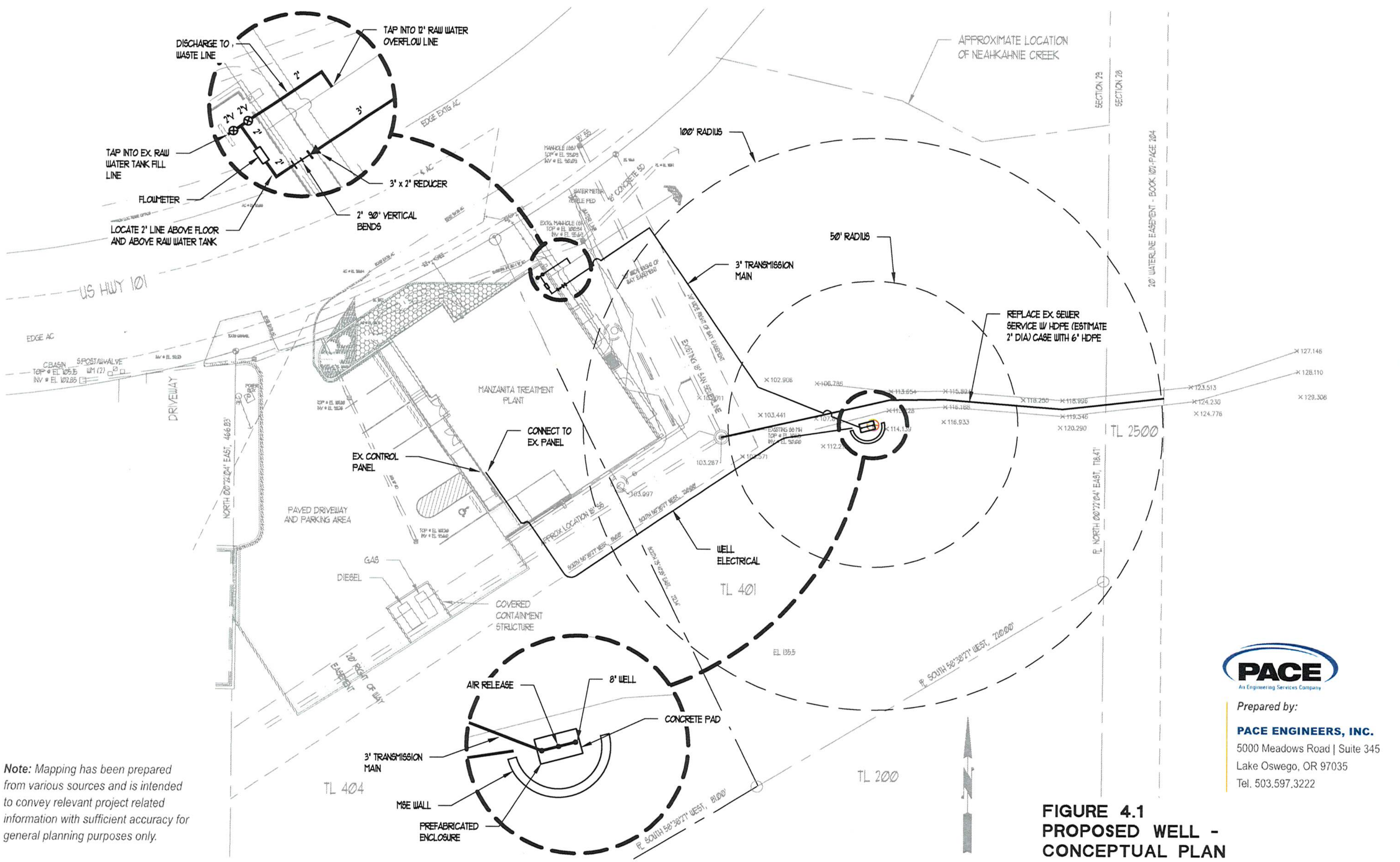
This section describes the proposed well and project to connect it to the existing Manzanita Water Treatment Plant (WTP). Much of the design specifics that follow are based on limited information and will be refined once the well has been drilled and the evaluation of the strata, water levels (static and pumping), capacity, and water quality has been completed. The function of what follows is primarily to describe the project in enough detail to demonstrate intended compliance with state requirements and to establish a reasonable estimate of the work, facilities, and costs for planning and budgeting purposes. A conceptual plan of the proposed improvements is included in Figure 4.1.

General well construction standards are addressed in OAR 333-061-0050, OAR 690-200, and OAR 690-210.

Wells constructed in sand require special construction per OAR 690-210-0130: from the surface and extending down at least 18 feet, construction includes an oversized drill hole (at least 4 inches larger in diameter than the casing), at least 18 feet of unperforated permanent casing, at least 18 feet of temporary casing sized to fit the oversized drill hole, and grout filling the annular space between the two casings, and the temporary casing removed as the grout is placed.

Since the well is in sand, screen selection will need to be based on a sieve analysis conducted during the drilling operation. An alternative design using a filter pack may be recommended by the hydrogeologist and/or driller involved. The concern is in minimizing the passage of fine particles that can reduce pump life and accumulate in the raw water basin.

As noted in Section 4.2, target capacity is 80 gpm and recommended well casing diameter is 8 inches. Depth at this time is roughly estimated at 120 feet for preliminary budget estimates; actual depth will determined as drilling progresses and strata and water levels are evaluated. Depth to ground water is estimated at 40 – 60 feet based geological work noted in Section 2.2 and the well elevation of 114 feet minus the water surface of Neahkahnie Creek of approximately 60 feet. Well operation creates a drawdown of the water levels adjacent to the well; consequently, well pumps are located well below the static water level. Proposed 3-inch piping from the pump to the WTP is approximately 200+ lineal feet. At 80 gpm, this represents a pipe velocity of 3.6 fps and a headloss of 3.3 feet for smooth bore pipe such as PVC or HDPE. Static head is the largest headloss component. For rough pump sizing, we are estimating a total dynamic head (TDH) of 80 feet (includes static head and dynamic headlosses associated with pipe, fittings, and appurtenances). For preliminary planning and cost estimating purposes, a submersible Grundfos SP 85S pump was selected. The pump is 3 Hp and uses 3-phase power; capacity is 80 gpm at 80 feet TDH. Final pump selection will be made after the initial well construction is complete and the capacity of the well determined.



Note: *Mapping has been prepared from various sources and is intended to convey relevant project related information with sufficient accuracy for general planning purposes only.*

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FIGURE 4.1
PROPOSED WELL - CONCEPTUAL PLAN
SCALE 1"=~~30'~~ 60'

The proposed well location is on the edge of the hillside where it meets the overgrown service road. This location will necessitate some excavation of the hillside and construction of a retaining wall. At this time the wall is envisioned as a semi-circle with a radius of approximately 5 feet, a center height of 5 feet tapering on either end to a height of approximately 1 foot. The well casing will project 1 foot above the surrounding reinforced concrete slab. The slab and ground around it will be graded to facilitate drainage away from the well.

The well will include: a screened casing vent, a 1/2-inch access port for water level measurement, a dedicated ¾-inch diameter schedule 40 PVC measuring tube that extends below the pump setting, and a sample tap on the pump discharge line. The well head is higher in elevation than the discharge location at the WTP; consequently, an air release valve (ARV) is recommended and should be located at the well head. The well head, ARV, and flowmeter will be surrounded by a small prefabricated enclosure.

Pipe from the well head to the WTP will likely be 3-inch HDPE – assuming it's available. Alternative diameters and materials will be considered based on actual pump sizing and availability as determined at that time. (Note: odd sizes of HDPE are often not available except by special order in very large quantities.) HDPE is preferable because it is a welded, continuous pipe and it is less subject to damage during earthquakes than most other commonly used pipe materials.

Near the WTP the 3-inch line will be reduced to 2-inch and angle upwards to enter the WTP above the floor that is above the raw water tank. Reducing the pipe diameter to two inch will accelerate the flow and eliminate the need for an air release valve. It will also reduce the size of the core-drill (and Link-seals) required to penetrate the wall. Inside the WTP, the line will be directed horizontally to a flowmeter followed by a tee with one branch connected to the existing raw water line that enters the raw water tank, and the other branch (the pump-to-waste line) will be directed back through the wall and down to connect to the treatment plant's raw water tank overflow line that discharges to the rip-rapped hillside. Gate valves will be provided on each branch. The water will be treated at the WTP prior to consumption.

Key OWRD guideline requirements for a suitable flowmeter for sources with flows of greater than 0.01 cfs (4.5 gpm) include: an accuracy of plus or minus 2% of the actual flow for the full range of permitted flows, an instantaneous flow readout and a totalizer, and that it be located upstream of any diversions.

The WTP's control panel is located on the west wall of the plant. The panel has space for adding controls. Discussions with City staff indicate they intend to work with the consultant that designed the system on connecting the pump and controls. Approximately 140 feet of trench and conduit will be needed between the well and the south wall of the WTP. Inside the plant, the electrical can be run along the wall to the control panel. Controls will be simple and manual. The panel is already connected to the facilities emergency power.

SECTION 5 | IMPLEMENTATION AND OPINION OF PROBABLE COSTS

5.1 Implementation Plan

The implementation approach described herein reflects both the complexity of the project and the goal of reducing losses (primarily monetary losses) if new data or regulatory determinations adversely affect the viability of the project – to the extent that the City decides to terminate the project. Key project tasks, milestones, timing, and opinions of probable costs are outlined below. Each task assumes that the City has been apprised of new information or regulatory findings, and is in agreement with moving forward to the next task.

Implementation Plan

1. City Review of the Feasibility Study and Concurrence on Moving Forward

   The first task is the City's review of the Feasibility Study and concurrence with moving forward with the project. Also, the City will need to decide how it would like to finance the project and budget for work likely to occur in the next budget cycle. An engineering contract should be negotiated for the anticipated work with the understanding that the City can terminate the contract if the City decides to terminate the project at some point during its development.

   Objective: Feasibility Study review and concurrence; budget; and engineering contract.

   Who: City staff and officials

   Timing: at City's discretion

   OPC: not applicable

2. OHA Plan Review

   The second task is to submit the Feasibility Study to OHA for plan review and comment. At this point, the submittal will not be complete but should be sufficient to receive an indication of concerns and/or a provisional determination of project viability. The plan review fee of $3,300 needs to accompany the submittal. This applies to the whole project, not just to this step in the process. Engineering involvement for the initial submittal is limited to submittal preparation, follow up to OHA questions, and coordination with the City. A Land Use Compatibility Statement (LUCS) is also needed (OHA provides the form) and this will require coordination with local planning officials.

   Objective: Preliminary OHA Plan Review submittal and preliminary findings

   Who: Engineer; City staff assistance with LUCS

   Timing: at completion of task #1 above

   OPC: budget $2,000 engineering; $3,300 review fee

3. Begin Easement Acquisition

   The City must have ownership or control of the area within a 100-foot radius of the well for source protection. An easement is needed for a small area on tax lot 200, south of the City owned parcels (see Figure 2.2). The City should initiate conversations with the owner and follow up with preparation of an easement. The easement is required by OWRD as part of task #5 and by OHA prior to task #9 below.

   Objective: obtain easement.

   Who: City staff, surveyor, and attorney

   Timing: after initial OHA plan review comments are obtained and prior to task #5 below.

   OPC: budget $2,000 for easement preparation, legal, and recording.

4. Hydrogeological Technical Memo

   The Technical memo is needed to establish that the well complies with regulatory requirements that 50% or more of the water from the well, after 10 days of continuous pumping originates from the creek, as a condition for transfer of the City's water right to the well. A positive determination is required prior to, and as a basis for, submitting the water right transfer application. An analytic model is used with data being limited to what is available through various sources or otherwise inferable from the information reviewed. Results of the modelling are only as good as the data available; consequently, the results are not guaranteed to be sufficient for OWRD approval. Note, however, that OWRD staff suggested this approach, and it is similar to approaches that they have used to determine well influences on nearby streams for fish persistence considerations relative to water permit extensions.

   Objective: Complete Hydrogeological Technical memo

   Who: Engineer for project management and support; hydrogeological sub-consultant for memo development

   Timing: at completion of task #2 above

   OPC: budget $8,500 engineering and hydrogeological memo preparation

5. Water Right Transfer Application

   This task involves the preparation and submittal of a water right transfer application, plus the hydrogeological technical memo, to OWRD. The submittal requires a fee of $390. The review/approval process can take 1-2 years; the expedited review process can be completed in significantly less time, possible 3-4 months. The expedited review requires the City to first request an estimate for the cost to expedite the process from OWRD. This request, plus a fee of $125 for preparing the estimate, is sent to OWRD along with the transfer application. Costs for expediting the process vary based on OWRD's estimate of the work involved.

   Objective: Prepare and submit water right transfer application

   Who: Engineer/Certified Water Rights Examiner (CWRE)

   Timing: after completion of the hydrogeological technical memo.

   OPC: budget $6,000 for completion of the application and required mapping; $390 for OWRD fee; budget $2,000 for expediting the application review.

6. Funding Application

   See Section 6.1 for a brief discussion of funding alternatives. This step can be skipped if the project is self-funded by the City. Agency funding would likely be loan only and could add six months to two years to the project timeline. Costs for funding application preparation, agency coordination, required environmental reporting can vary greatly depending on the level of consultant involvement and the specific program requirements.

7. Well Design/Bid/Construction/Testing

   This step focuses on the design and construction of the well itself plus the follow up testing to establish capacity and water quality. Complete plans and specifications for the well design will be prepared and sent to OHA for final plan review and approval. Most of this task will be completed by the geological sub-consultant: develop technical specifications; assist with bid review; onsite observation of drilling, construction, and development; bore sample collection and lab testing; well design; well log preparation; pump testing and hydrogeological data collecting; ground water level, temperature, and water quality samples; data analysis; and preparation of a report with findings, conclusions, and recommendations for use in Task #8 below. Civil engineering services include overall project management and coordination; development of bid ready plans and specification (incorporate sub-consultant's technical specifications); assist with bid; general construction administration services; and record drawings. Note: this task does not include the pump, pipe, and other infrastructure needed to connect the well to the WTP.

   Objective: Well Design/Bid/Construction/Testing

   Who: Engineer, Geological Sub-consultant

   Timing: after approval of water rights transfer application and project funding.

   OPC: budget $60,000 for engineering and geological work; budget $100,000 for well construction and development (and water quality testing). Note wells are typically bid on a per unit basis; actual well depth and final design is determined while the project is under construction.

8. Connection to Water Treatment Plant

   Capacity and water quality information, actual well construction, water levels, and other data available after completion of task #7 above will be used to size the pump, pipe, and other system components. Plans and specifications will be prepared. The project may be bid or, more likely, constructed by City staff supplemented by contractors for specific tasks as needed and coordinated by the City. Engineering and construction costs will vary considerably based on how the City proceeds. Construction costs included below assume all the work will be completed by a contractor; the cost are conservative since the City is actually planning to complete much of the work in-house as noted above. Engineering work, in addition to development of plans and specifications for completion of the well, site, and connection to the WTP, will include limited construction management, limited construction observation, and preparation of record drawings, and closeout. The City plans to retain the electrical engineer that designed the existing WTP controls for all electrical design and related work associated with the well project. The civil engineer will provide the pump specifications to the City's electrical engineer who will develop the electrical plans and specifications for City use. Additional engineering costs will be required if the City opts for a conventional bid/award/construction approach.

   Objective: Connection to Water Treatment Plant

   Who: Engineer, Electrical Engineer, City staff, contractors

Timing: after well construction is complete.

OPC: budget $25,000 for civil engineering; budget $10,000 for electrical engineering; and budget $94,000 for construction

9. Finalize Water Right

   Prepare and submit information to OWRD that confirms completion of the well, well design, capacity, use, etc. to complete the transfer and obtain a certificate for the new well.

   Objective: Prepare and submit water right transfer completion information to OWRD

   Who: Engineer/Certified Water Rights Examiner (CWRE)

   Timing: after completion of the project.

   OPC: budget $2,000 for finalization of the water right transfer.

5.2 Budget Summary

Budgets described in detail in Section 5.1 are summarized in Table 5.1.

Table 5.1: Emergency Well Implementation Budget Summary

TASK	TASK BUDGET	ESTIMATED TIME (MONTHS)	
		TASK	CUMULATIVE
1. Feasibility Review/Engineering Contract	NA	2	2
2. OHA Plan Review	$5,300	1	3
3. Easement Acquisition[1]	$2,000	1	3
4. Hydrogeological Tech Memo	$8,500	1	4
5. Water Right Transfer	$8,500	5	9
6. Funding Application[2]	-	-	-
7. Well Design/Bid/Construct/Test	$160,000	5	14
8. Connect to WTP	$129,000	3	17
9. Finalize Water Right	$2,000	1	18
Task Subtotal	**$315,300**	**-**	**18**
Recommended allowance for legal and administrative costs	$4,700	-	-
PROJECT TOTAL	**$320,000**	**-**	**18**

[1]*Easement acquisition conducted in parallel with Task 2 and Task 4 and, therefore, does not add to the cumulative time.*

[2]*The City intends to self-fund the project, so no budget or time is included here. If the City decides to pursue funding: anticipate additional costs associated with funding application preparation ($5,000) plus environmental reporting ($10,000 - $20,000); anticipate additional time of 6 months - 2 years.*

SECTION 6 | PROJECT FINANCING

6.1 Financing the Project – General Discussion

Discussions with City staff indicate a likelihood for self-funding of the proposed well project. Assuming that the City has sufficient funds and is amenable to undertaking the costs, self-funding could greatly expedite completion of the project and may result in lower overall costs to the City.

Many of the state and federal funding programs typically used for municipal water infrastructure are not applicable: the City does not qualify for Community Development Block Grant (CDBG) funding based on income status; there is no regulatory deficiency being addressed therefore Infrastructure Finance Authority's (IFA) Water/Wastewater (W/WW) program is not applicable; and there is no job creation associated with the project, therefore IFA's Special Public Works Fund (SPWF) is not applicable. Both the USDA Rural Development Funding (RD) and the Safe Drinking Water Revolving Loan Fund (SDWRLF) are applicable, but have notable drawbacks. SDWRLF applications are evaluated, given point scores in accordance with the agency priorities, and ranked competitively according to scores. Since there are no water quality or other regulatory deficiencies associated with the well project, the resulting project score is not likely to be high enough to be funded through SDWRLF. RD funding is a potential source, but the RD application can be relatively costly and time consuming to assemble. In addition, submittal will require an environmental report. Costs vary according to the issues involved, $10,000 - $20,000 are lower-end estimates for the environmental report. RD does have relatively low interest rates and a very long term (40 years for municipalities). Agency funding can be complicated with delays associated with timing of the applications, availability of funds, complications associated with environmental issues or concerns. Also, state or federal funding typically adds six months to two years to the overall project timeline.

The discussion above focuses on the more commonly used programs and is not intended to be exhaustive. If the City is interested in pursuing agency based funding, the first should be contact with the local IFA representative to set up a One-Stop Meeting in Salem to discuss potential project funding. Representatives of potential funding agencies attend the meeting and can assist in developing an appropriate funding package. Funding for this project would likely be loan only, based on the nature of the project and the City's income status.

Self-funding eliminates the need for application preparation, environmental reporting, and the wage-rate and other requirements specific to any given program.

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix Q

Streamflow Depletion Analysis
(Appendices not included.)
GeoEngineers, Inc., October 8, 2018

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Streamflow Depletion Analysis

City of Manzanita Water System
Manzanita, Oregon

for
PACE Engineers, Inc.

October 8, 2018

GeoEngineers

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Streamflow Depletion Analysis

City of Manzanita Water System
Manzanita, Oregon

File No. 23092-001-00

October 8, 2018

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Table of Contents

INTRODUCTION

This report presents a summary of hydrogeologic analyses related to the permitting of a planned emergency water supply well (herein designated the backup well) for the City of Manzanita, Oregon (the City). The City currently obtains its potable water from two wells situated near the Nehalem River that are operated as components of a Joint Water System with the City of Wheeler, Oregon. The City is interested in developing the backup well to increase its preparedness for a water system emergency. The planned location of the backup well is the southeast quarter of the northeast quarter of Section 29, Township 3 North, Range 10 West, approximately as shown on the Vicinity Map, Figure 1.

The design well yield for the backup well is 80 gallons per minute (gpm). The planned location of the backup well is approximately 105 feet south of Neahkahnie Creek, approximately as shown on the Well Location Map, Figure 2.

We understand that the City is interested in transferring a portion of a surface water right (Certificate No. 21707) to the backup well for groundwater use. To do so, the backup well must have a "similar" impact on Neahkahnie Creek as the original point of diversion. Per OR Rev Stat ş 540.531 (9)(b), a similar impact is defined by a streamflow depletion of at least 50 percent of the well discharge rate within 10 days of continuous pumping. In this report, streamflow depletion refers to the reduction in Neahkahnie Creek streamflow that results from backup well pumping.

SCOPE OF SERVICES

Our scope of services was presented in our revised proposal dated August 20, 2018, which was authorized by PACE Engineers, Inc. (PACE) on August 29, 2018. The purpose of our proposed hydrogeologic analyses was to estimate the depletion in Neahkahnie Creek streamflow that could result from operation of the backup well.

Our specific scope of hydrogeologic services consisted of the following:

1. Compiled and reviewed readily-available, existing information regarding hydrogeologic conditions surrounding the planned location of the backup well.
2. Conducted hydrogeologic analyses to estimate the streamflow depletion impact to Neahkahnie Creek anticipated as a result of operation of the backup well.
3. Provided a summary of our results to PACE in this report.

REVIEWED DOCUMENTS AND INFORMATION

As a basis for the hydrogeologic conceptual model and aquifer parameter estimates that support the streamflow depletion analyses described herein, GeoEngineers reviewed the following documents and information:

- PACE's City of Manzanita Emergency Well Feasibility Study (PACE 2017).

- Wright/Deacon & Associates, Inc.'s Geotechnical Report for the City's Proposed Water Treatment Plant (Wright/Deacon & Associates, Inc. 2000).
- The State of Oregon Department of Transportation's (ODOT's) Preliminary Plan Set for the Grading, Drainage, Structure, Paving, Signing, and Roadside Development of FFO - US101: Manzanita Ave. – Neahkahnie Creek Sec. (ODOT 2014).
- Murray, Smith & Associates' Stormwater Management Plan for FFO - US101: Manzanita Ave. – Neahkahnie Creek Sec. (Murray, Smith & Associates 2013).
- The State of Oregon Department of Geology and Mineral Industries' report describing Coastal Landforms between Tillamook Bay and the Columbia River (Lund 1972).
- The U.S. Geological Survey's Geologic Map of the Tillamook Highlands (Wells, et al. 1994).
- Water Well Reports on file with the State of Oregon for Sections 28 and 29 of Township 3 North and Range 10 West.

GEOLOGIC SETTING

The City is situated on the Pacific Coast immediately north of Nehalem Bay. Surficial geologic conditions within and surrounding the City are shown on the Surficial Geologic Map, Figure 3. Surficial geologic conditions near and within the City generally consist of Quaternary-age (deposited less than about 2.6 million years ago [MA]) beach/dune deposits, fluvial/estuarine deposits, and landslide deposits. Beach/dune deposits generally consist of Holocene-age (less than about 11,700 years ago) fine- to medium-grained sand. Fluvial/estuarine deposits generally consist of clay, silt, sand, and gravel alluvium deposited in rivers and streams (Wells et al. 1994). These Quaternary sediments are exposed at the surface throughout most of the area within the City limits, with surface elevations generally lower than Elevation 250 feet. Landslide deposits consist of poorly-sorted angular clasts of bedrock in a weathered fine-grained matrix and outcrop north of the City beginning approximately at Nehalem Road.

Stratigraphically, Quaternary sediments in the vicinity of the City are underlain by the Miocene-age (about 5 to 23 MA) Grande Ronde Formation of the Columbia River Basalt Group, the Miocene-age Angora Peak Member, and the Miocene-age/Oligocene-age (about 23 to 34 MA) Alesa Formation. The Grande Ronde Formation consists of basalt flows and interbedded sediments deposited during an extended period of volcanism that extruded a series of very fluid lava flows across Oregon, Washington, and Idaho. The Grande Ronde Formation is exposed at the surface within uplands located less than 1½ miles north of the City. The Angora Peak Member consists of deltaic and shallow marine sandstone and outcrops about one mile north of the City. The Alesa Formation consists of tuffaceous siltstone and sandstone and is exposed at the surface immediately east of the City in the area surrounding Neahkahnie Lake.

HYDROGEOLOGIC SETTING

Groundwater within the area surrounding the City primarily occurs within: (1) relatively coarse-grained Quaternary sediments; and (2) bedrock formations.

Quaternary sediments generally occur in thicknesses that can support production wells within area river valleys and along coastal areas. Aquifers within Quaternary sediments (herein designated Quaternary aquifers) are generally unconfined except where overlain by low permeability confining layers of sufficient thickness and lateral extent to truly confine the underlying aquifer. Transmissivity (a hydraulic property related to the rate of groundwater flow through a unit width of aquifer) and storativity (the ability of an aquifer to store/release water per unit change in hydraulic head) of Quaternary aquifers vary with depositional environment and are generally highest in coarse-grained fluvial deposits and lowest in fine-grained estuarine deposits. Quaternary aquifers are relatively susceptible to degradation from point and non-point sources of contamination because they frequently lack an overlying confining unit and are characterized by a shallow depth to the groundwater table. Recharge to these aquifers is primarily from precipitation, applied irrigation, septic systems, leakage from surface-water courses within losing reaches, and potentially through leakage from the adjacent bedrock aquifers. Quaternary aquifers discharge to water supply wells, underlying bedrock aquifers, gaining reaches of streams, and the Pacific Ocean.

Bedrock underlies the entire area and generally contains confined to semi-confined aquifers of relatively low transmissivity and storativity. Groundwater is most readily transmitted through primary porosity associated with relatively coarse-grained depositional environments (for example, sandstone layers of the Angora Peak Member and/or Alesa Formation) or through broken vesicular and scoriaceous interflow zones that characterize the top of individual basalt flows (for example, within the Grande Ronde Formation). Recharge to the bedrock aquifers occurs through direct precipitation, vertical infiltration from overlying unconfined aquifers, and lateral recharge from adjacent bedrock units. Bedrock aquifers discharge to water supply wells, Quaternary aquifers, gaining reaches of streams, and the Pacific Ocean.

STREAMFLOW DEPLETION ANALYSES

Target Hydrogeologic Unit

Inherent to the streamflow depletion analyses described herein is the assumption that the backup well will be in hydraulic connection with Neahkahnie Creek. That is, the backup well will be screened within/open to the hydrogeologic unit that is in hydraulic continuity with the creek (herein designated the target hydrogeologic unit). The backup well is proposed to be located approximately 105 feet southwest of and 50 feet higher in elevation than Neahkahnie Creek (Figure 2). The target hydrogeologic unit for the backup well is uncertain, based on the following:

- Geotechnical Hole Reports for geotechnical borings associated with the City Water Treatment Plant (located immediately west of the backup well) have been designated TILL 50693 and TILL 50694 by the State of Oregon and are provided in Appendix A. Information from these borings indicates that sand extends from the ground surface to a depth of at least 40 feet, which is approximately equivalent to the stage elevation of Neahkahnie Creek adjacent to the backup well. These borings do not extend deep enough to provide information regarding the composition, thickness and hydraulic properties of the target hydrogeologic unit.
- Available geotechnical exploration information associated with ODOT's FFO - US101: Manzanita Ave. project is contradictory. The reports for the borings from this project have been designated TILL 52599 through TILL 52601 by the State of Oregon and also are provided in Appendix A. The Geotechnical Hole Report for TILL 52599 indicates that sand with wood extends from 40 to 70 feet below ground surface at the time of exploration. This log suggests that unconsolidated sand likely comprises the target hydrogeologic unit. However, the Geotechnical Hole Reports for TILL 52600 and TILL 52601 indicate that siltstone was encountered at depths of 27 to 28 feet below ground surface at the time of

exploration. Borings TILL 52600 and TILL 52601 were located about 100 feet north and 130 feet east of TILL 52599, respectively. These logs suggest that the target hydrogeologic unit is comprised of sedimentary bedrock.

- No Water Well Reports on file with the State of Oregon for Sections 28 and 29 appear to be for wells located in close-enough proximity to the backup well to resolve this uncertainty.

With the goal of providing comprehensive information despite hydrogeologic uncertainty, GeoEngineers evaluated streamflow depletion rate for two target hydrogeologic unit scenarios. These include the following:

Scenario 1. The target hydrogeologic unit is assumed to be an **unconfined medium-grained sand aquifer** that is 20 feet thick. We assumed that the storage coefficient (specific yield) of the Scenario 1 aquifer is 0.2, based on typical values for unconfined aquifers provided by Driscoll (1986).

Scenario 2. The target hydrogeologic unit is assumed to be a **confined sandstone aquifer** that is 30 feet thick. We assumed that the storage coefficient of the Scenario 2 aquifer is 0.0001, based on typical values for sandstone provided by Driscoll (1986).

Minimum Hydraulic Conductivity

Our streamflow depletion analyses are predicated on the assumption that the target hydrogeologic unit will be able to support a design well yield of 80 gpm. For the above-described aquifer scenarios to support a well yield of 80 gpm, the aquifer hydraulic conductivity must meet or exceed respective minimum values. We calculated the minimum hydraulic conductivities that would support project well yield objectives using a simplified analytical model based on the Theis (1935) non-equilibrium well equation for confined aquifers. In the case of Scenario 1, the Theis (1935) values were modified using the Jacob correction for unconfined aquifers (Cooper and Jacob 1946). Maximum allowable drawdown in the aquifer immediately surrounding the backup well was assumed to be 12 feet for Scenario 1 and 15 feet for Scenario 2.

Based on the assumptions described above, the estimated minimum hydraulic conductivities necessary to support the design well yield of 80 gpm are 39 feet per day for Scenario 1 and 25 feet per day for Scenario 2. Use of these minimum hydraulic conductivity values in the below-described streamflow depletion analyses is: (1) appropriate because the project is not viable at lower hydraulic conductivities; and (2) conservative because an increase in assumed hydraulic conductivity tends to increase streamflow depletion percentage.

Analytical Method

Multiple analytical methods for estimating the depletion in streamflow resulting from groundwater pumping have been developed by researchers (Barlow and Leake 2012). These solutions generally assume the following:

- The aquifer is homogeneous, isotropic and extends infinitely away from the stream.
- The aquifer is confined, although the solutions have been extended to unconfined aquifers with the assumption that drawdown caused by pumping will be small compared to aquifer thickness.
- Water is released instantaneously from storage (that is, the effect of delayed yield is negligible).

- The stream is straight, of infinite length, and flowing at all times.
- The groundwater level in the aquifer at the stream remains above the streambed, such that the stream does not become disconnected from the underlying aquifer.
- The well is fully penetrating and pumping at a constant rate.

The most widely-used streamflow depletion solution simulates a stream penetrating the full thickness of the aquifer, with no streambed hydraulic resistance between the stream and the aquifer (Glover and Balmer 1954), and has been designated as the Glover solution. Because small streams similar to Neahkahnie Creek frequently are not fully penetrating nor in perfect hydraulic connection with the adjacent aquifer, we selected an adaptation of the Glover solution introduced by Hunt (1999) which accounts for partial penetration of the aquifer by the stream and streambed hydraulic resistance. This solution also assumes the aquifer is of infinite areal extent in the horizontal direction and not truncated by the stream.

A number of additional analytical solutions for estimating streamflow depletion have been developed by researchers (as summarized by Huang et al. 2018) to address a wide variety of specific hydrogeologic situations, including leaky aquifer conditions, layered aquifers with extensive zones of high and low permeability, stream valleys distant lateral boundaries, etc. Considering the limited amount of site-specific data available, and especially relative to the Glover solution, the modifications inherent to the Hunt (1999) solution tend to reduce the estimated streamflow depletion percentage and, therefore, offer more conservative estimates as a screening method for regulatory review and approval.

We calculated streamflow depletion rates for hydrogeologic Scenarios 1 and 2 (described above) using the Hunt (1999) solution contained within U.S. Geological Survey code STRMDEPL08 (Reeves 2008).

Each model run simulated a continuous pumping period of 30 days. We assumed that streambed conductance was equal to 50 percent of the hydraulic conductivity of the target hydrogeologic unit. The specific parameter values assumed for each analytical scenario are listed in Assumptions for Streamflow Depletion Analysis, Table 1.

Model Results

Raw program output files for the two model runs are provided in Appendix B. Results are provided in tabular form in Results of Streamflow Depletion Analysis, Table 2, provided in graphical form in Streamflow Depletion Percentage, Figure 4, and summarized by the following:

- Primarily driven by the relatively high storage coefficient inherent to unconfined aquifers, the streamflow depletion percentages estimated for Scenario 1 are less than for Scenario 2.
- After a pumping period of 10 days, streamflow depletion percentage estimated for Scenario 1 was approximately 53 percent and increased to approximately 71 percent after a pumping period of 30 days.
- After a pumping period of 10 days, streamflow depletion percentage estimated for Scenario 2 was approximately 98 percent and increased to approximately 99 percent after a pumping period of 30 days.

CONCLUSIONS

The composition, thickness and hydraulic properties of the target hydrogeologic unit are not specifically defined by the reviewed subsurface information. As such, existing data do not support a precise evaluation of the rate of streamflow depletion that will result from operation of the proposed Backup Well. For that reason, we evaluated streamflow depletion for two hydrogeologic scenarios and associated ranges in hydraulic conductivity.

Approval of the City's requested water right transfer is based on a streamflow depletion of at least 50 percent of the well discharge rate within a period of 10 days of continuous pumping. These critical values are highlighted by the blue lines shown in Figure 4. **Model results indicate that, if the project is viable and the target hydrostratigraphic unit is able to support the design well yield of 80 gpm, streamflow depletion associated with backup well operation is likely to comply with these minimum requirements.**

An increase in the precision of these analyses, if necessary to move forward with the City water right transfer, would be best accomplished by site-specific subsurface exploration and testing. This supplemental exploration, testing and analysis program, if performed, should include the following:

1. Drilling to explore the composition and thickness of the target hydrogeologic unit at the proposed location of the backup well and, if possible, adjacent to Neahkahnie Creek.
2. Hydraulic testing and analysis, which could be accomplished through: (1) Test well installation and test pumping; or (2) monitoring well installation and slug testing.
3. Revision of the streamflow depletion analysis described herein, using site-specific inputs for the target hydrogeologic unit.

LIMITATIONS

We prepared this report for use by PACE to assist in the evaluation of the depletion in Neahkahnie Creek streamflow that could result from operation of the proposed backup well. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of hydrogeology in this area at the time this report was prepared. No warranty or other conditions, expressed or implied, should be understood.

Please refer to Appendix C, Report Limitations and Guidelines for Use for additional information pertaining to use of this report.

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Table 1

Assumptions for Streamflow Depletion Analysis

City of Manzanita Emergency Water Supply Well
Manzanita, Oregon

Scenario 1 - Unconfined Sand Aquifer

Parameter	Symbol	Unit	Assumed Value	Source
Well Discharge Rate	Qw	gallons per minute	80	Pace Engineers, Inc. (2017). Page 3.
Distance from Well to Stream	d	feet	105	Pace Engineers, Inc. (2017). Figure 2.2.
Storage Coefficient	S	dimensionless	2.0E-01	Typical value for the storage coefficient (specific yield) for an unconfined, coarse-grained sedimentary aquifer provided by Driscoll (1986). Sand composition of aquifer is based on borings B-1 and B-2 from Wright/Deacon & Associates, Inc. (2000).
Hydraulic Conductivity - Minimum	K_L	feet per day	3.9E+01	Minimum calculated value that can support the design well yield (80 gallons per minute)
		feet per second	4.5E-04	
Aquifer Thickness	b	feet	20	State of Oregon Geotechnical Hole Report TILL 52599
Transmissivity	T_L	square feet per day	780	$T_L = K_L*b$
		square feet per second	9.0E-03	
Duration of Pumping	t	day	30	
Streambed Conductance	S_{cL}	feet per second	2.3E-04	50 percent of minimum hydraulic conductivity

Scenario 2 - Confined Sandstone Aquifer

Parameter	Symbol	Unit	Assumed Value	Source
Well Discharge Rate	Qw	gallons per minute	80	Pace Engineers, Inc. (2017). Page 3.
Distance from Well to Stream	d	feet	105	Pace Engineers, Inc. (2017). Figure 2.2.
Storage Coefficient	S	dimensionless	1.0E-04	Typical value for the storage coefficient of sandstone provided by Driscoll (1986).
Hydraulic Conductivity -Minimum	K_L	feet per day	2.5E+01	Minimum calculated value that can support the design well yield (80 gallons per minute)
		feet per second	2.9E-04	
Aquifer Thickness	b	feet	30	Review and summary of State of Oregon Water Well Reports for Sections 28 and 29 of Township 3 North and Range 10 West.
Transmissivity	T_L	square feet per day	750	$T_L = K_L*b$
		square feet per second	8.7E-03	
Duration of Pumping	t	day	30	
Streambed Conductance - Low	S_{cL}	feet per second	1.4E-04	50 percent of hydraulic conductivity

References:

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Table 2

Results of Streamflow Depletion Analyses

City of Manzanita Emergency Water Supply Well

Manzanita, Oregon

Elapsed Time [2]	Well Pumping Rate		Streamflow Depletion Rate [1]					
			Scenario 1 [3]			Scenario 2 [4]		
(days)	(gpm)	(cfs)	(gpm)	(cfs)	(percent)	(gpm)	(cfs)	(percent)
0	0	0.000	0	0.00	0.0	0	0.00	0.0
1	80	0.178	6.9	0.0153	8.6	76.1	0.1696	95.2
2	80	0.178	15.8	0.0351	19.7	77.2	0.1721	96.6
3	80	0.178	22.2	0.0495	27.8	77.7	0.1732	97.2
4	80	0.178	27.1	0.0603	33.8	78.0	0.1738	97.5
5	80	0.178	30.9	0.0688	38.6	78.2	0.1742	97.7
6	80	0.178	34.0	0.0757	42.5	78.4	0.1746	98.0
7	80	0.178	36.5	0.0814	45.7	78.5	0.1748	98.1
8	80	0.178	38.7	0.0862	48.4	78.6	0.1750	98.2
9	80	0.178	40.6	0.0904	50.7	78.6	0.1752	98.3
10	80	0.178	42.2	0.0940	52.7	78.7	0.1753	98.4
11	80	0.178	43.6	0.0972	54.5	78.8	0.1755	98.5
12	80	0.178	44.9	0.1001	56.2	78.8	0.1756	98.5
13	80	0.178	46.1	0.1027	57.6	78.9	0.1757	98.6
14	80	0.178	47.2	0.1051	59.0	78.9	0.1758	98.6
15	80	0.178	48.1	0.1072	60.1	78.9	0.1758	98.6
16	80	0.178	49.0	0.1092	61.3	79.0	0.1759	98.7
17	80	0.178	49.8	0.1110	62.3	79.0	0.1760	98.7
18	80	0.178	50.5	0.1126	63.2	79.0	0.1760	98.7
19	80	0.178	51.3	0.1142	64.1	79.0	0.1761	98.8
20	80	0.178	51.9	0.1156	64.9	79.0	0.1761	98.8
21	80	0.178	52.5	0.1170	65.6	79.1	0.1762	98.9
22	80	0.178	53.1	0.1182	66.3	79.1	0.1762	98.9
23	80	0.178	53.6	0.1194	67.0	79.1	0.1762	98.9
24	80	0.178	54.1	0.1206	67.7	79.1	0.1763	98.9
25	80	0.178	54.6	0.1216	68.2	79.1	0.1763	98.9
26	80	0.178	55.0	0.1226	68.8	79.2	0.1764	99.0
27	80	0.178	55.5	0.1236	69.3	79.2	0.1764	99.0

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Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2016

Projection: NAD 1983 UTM Zone 10N

Vicinity Map	
City of Manzanita Emergency Water Supply Well Manzanita, Oregon	
GeoEngineers	Figure 1

P:\23\2309200100\GIS\MXD\2309200100_F01_VM.mxd Date Exported: 10/08/18 by ccabrera

P:\23\23092001\GIS\MXD\2309200100_F02_WellLocation.mxd Date Exported: 09/19/18 by ccabrera

Legend

Approximate Planned Emergency Water Supply Well Location

Neahkahnie Creek

200 0 200

Feet

N E S W

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI

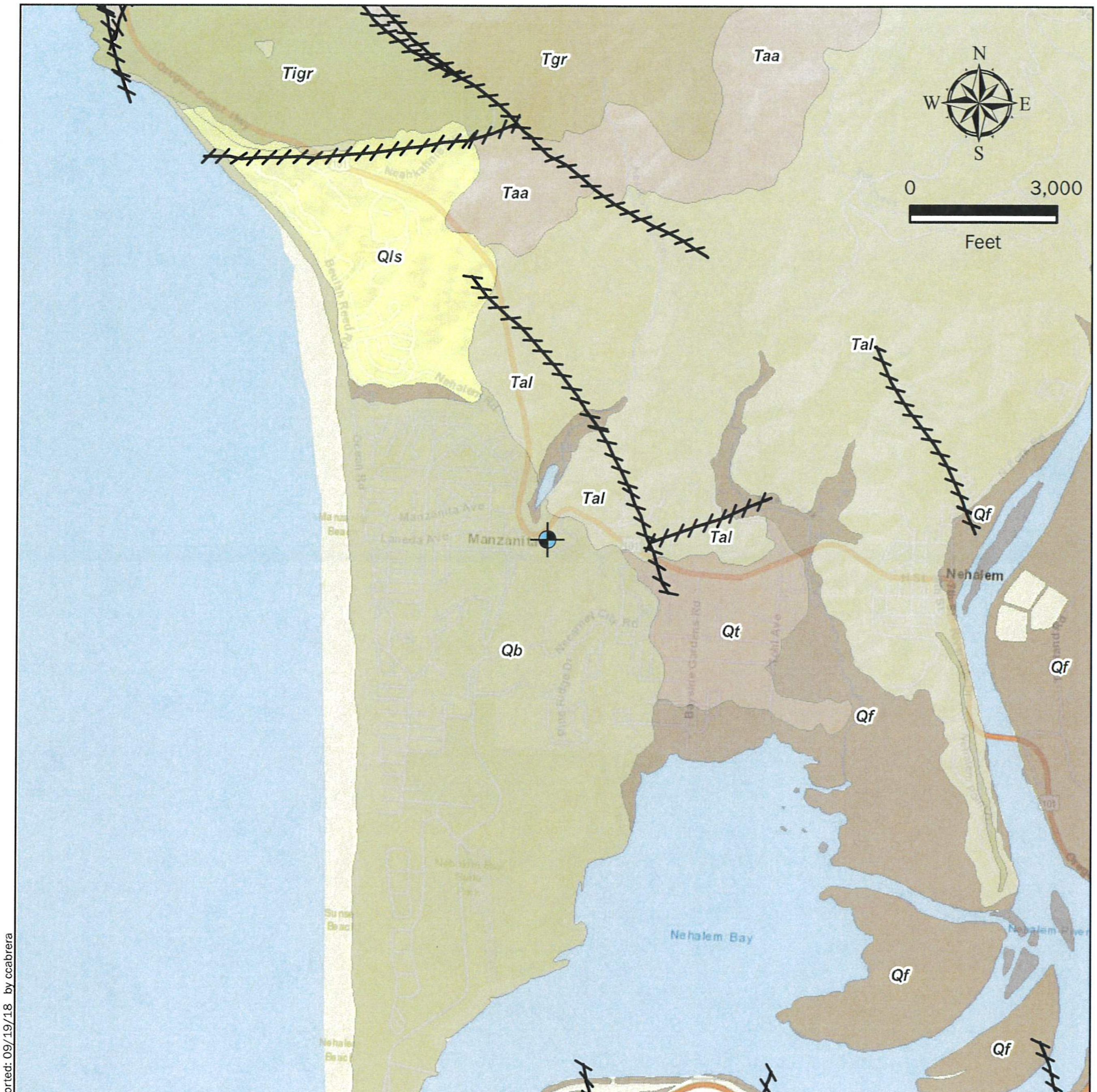
Projection: NAD 1983 StatePlane Oregon North FIPS 3601 Feet

Well Location Map

City of Manzanita Emergency Water Supply Well
Manzanita, Oregon

GeoEngineers

Figure 2



Legend

Approximate Planned Emergency Water Supply Well Location

Faults

Geology (DOGAMI)

- Qb: Beach/dune deposit
- Qf: Fluvial/estuarine deposits
- Qls: Landslide deposits
- Qt: Fluvial/estuarine deposits
- Taa: Angora Peak member
- Tal: Alsea Formation
- Tgr: Grande Ronde Basalt
- Tigr: Grande Ronde Basalt

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Oregon Geology, OGDC-6, from DOGAMI, https://www.oregongeology.org/.

Projection: NAD 1983 StatePlane Oregon North FIPS 3601 Feet

Surficial Geologic Map

City of Manzanita Emergency Water Supply Well
Manzanita, Oregon

GEOENGINEERS

Figure 3

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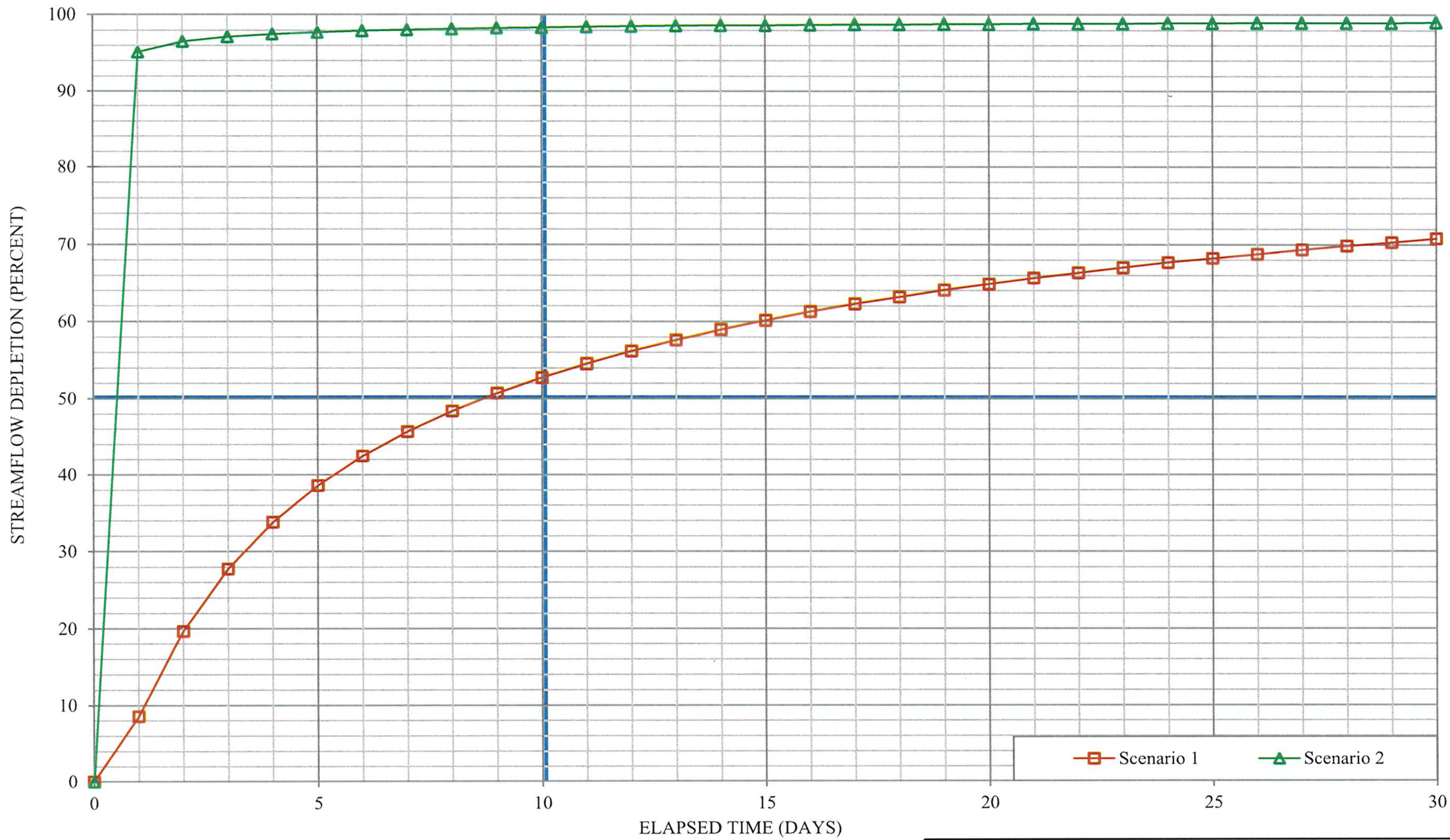

Notes:

1. Streamflow depletion rate was calculated using the US Geological Survey code STRMDEPL08 (Reeves, 2008) based on the method introduced by Hunt (1999) for a partially penetrating stream with streambed resistance.
2. Scenario 1 refers to an unconfined medium-grained sand aquifer.
3. Scenario 2 refers to a confined sandstone aquifer.

Streamflow Depletion Percentage	
City of Manzanita Emergency Water Supply Well Manzanita, Oregon	
GeoEngineers	Figure 4

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix R

Hydrant Flow Data

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Nehalem Bay Fire & Rescue

Nehalem, OR

This report was generated on 1/5/2021 10:12:24 AM

Hydrants Flow Tested for Date Range

Start Date: 01/01/2015 | End Date: 01/01/2021

HYD. ID	ADDRESS	LOCATION	TEST DATE	START TIME	END TIME	STATIC	RESIDUAL	DOWNSTREAM (HYD. ID)	FLOW @ DES. PRESS	PITOT PRESSURE	DISTRICT
Zone Unknown											
1	894 Madrona ST Manzanita, OR 97130	Poysky & Nutmeg	08/09/2015	10:41	10:43	43 PSI	12 PSI	156 GPM (Unnamed)	132 @ 20 PSI	1	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
1	894 Madrona ST Manzanita, OR 97130	Poysky & Nutmeg	08/04/2020	11:29	11:35	44 PSI	12 PSI	292 GPM (Unnamed)	249 @ 20 PSI	3.5	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
10	742 Cherry ST Manzanita, OR 97130	Cherry St & Cherry Lp	08/09/2015	16:22	16:22	91 PSI	43 PSI	494 GPM (Unnamed)	610 @ 20 PSI	10	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
11	108 College ST Manzanita, OR 97130	Cherry & College	08/09/2015	16:22	16:23	90 PSI	45 PSI	518 GPM (Unnamed)	657 @ 20 PSI	11	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
11	108 College ST Manzanita, OR 97130	Cherry & College	08/18/2020	14:40	14:47	93 PSI	22 PSI	936 GPM (Unnamed)	950 @ 20 PSI	8	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
12	College ST Manzanita, OR 97130	College St west end	08/09/2015	16:23	16:24	100 PSI	19 PSI	110 GPM (Unnamed)	109 @ 20 PSI	0.5	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
13	Cherry ST Manzanita, OR 97130	Cherry St dead end N	08/09/2015	16:24	16:25	94 PSI	5 PSI	156 GPM (Unnamed)	141 @ 20 PSI	1	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
14	484 Ocean AVE Manzanita, OR 97130	Poplar & Ocean	08/09/2015	16:25	16:26	37 PSI	35 PSI	270 GPM (Unnamed)	857 @ 20 PSI	3	Manzanita
Flow Test Results: Pass		Remarks: Single port						**TESTED BY:** Walsh , Jesse H			
15	775 Larch ST Manzanita, OR 97130	3rd & Ocean	08/09/2015	16:26	16:27	58 PSI	53 PSI	644 GPM (Unnamed)	1925 @ 20 PSI	17	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
15	775 Larch ST Manzanita, OR 97130	3rd & Ocean	08/04/2020	11:47	11:51	58 PSI	42 PSI	1234 GPM (Unnamed)	1968 @ 20 PSI	13.9	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
16	401 North AVE Manzanita, OR 97130	Nth 4th st &North Ave	08/09/2015	16:27	16:27	58 PSI	55 PSI	644 GPM (Unnamed)	2537 @ 20 PSI	17	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			

HYD. ID column sorts alphanumerically rather than strictly numerically because the Hydrant ID field can also contain letters and certain characters at the discretion of the Department entering the data.

HYD. ID	ADDRESS	LOCATION	TEST DATE	START TIME	END TIME	STATIC	RESIDUAL	DOWNSTREAM (HYD. ID)	FLOW @ DES. PRESS	PITOT PRESSURE	DISTRICT
16	401 North AVE Manzanita, OR 97130	Nth 4th st &North Ave	08/04/2020	14:29	14:31	58 PSI	48 PSI	1408 GPM (Unnamed)	2895 @ 20 PSI	18.1	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
17	364 Fourth ST Manzanita, OR 97130	Manzanita & 4th	09/29/2015	8:46	8:52	72 PSI	68 PSI	842 GPM (Unnamed)	3363 @ 20 PSI	29	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
18	542 N 1st ST Manzanita, OR 97130	1st & North	08/10/2015	16:52	16:52	88 PSI	73 PSI	733 GPM (Unnamed)	1657 @ 20 PSI	22	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
19	490 Manzanita AVE Manzanita, OR 97130	Manzanita & Pine	08/10/2015	16:57	16:57	62 PSI	55 PSI	681 GPM (Unnamed)	1792 @ 20 PSI	19	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
-2	Tohl RD Manzanita, OR 97130	Tohl Rd. & Easement	09/08/2015	13:16	13:16	99 PSI	76 PSI	884 GPM (Unnamed)	1721 @ 20 PSI	32	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
20	15 Washington AVE Manzanita, OR 97130	Ocean Rd & Washington	08/10/2015	10:46	0:00	88 PSI	80 PSI	766 GPM (Unnamed)	2432 @ 20 PSI	24	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
21	585 Manzanita AVE Manzanita, OR 97130	Manzanita & Division	08/11/2015	10:47	10:47	56 PSI	54 PSI	681 GPM (Unnamed)	3243 @ 20 PSI	19	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
21	585 Manzanita AVE Manzanita, OR 97130	Manzanita & Division	08/04/2020	14:57	15:05	56 PSI	40 PSI	1234 GPM (Unnamed)	1912 @ 20 PSI	13.9	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
22	85 Manzanita AVE Manzanita, OR 97130	Manzanita & 1st	08/11/2015	10:47	10:48	85 PSI	76 PSI	749 GPM (Unnamed)	2178 @ 20 PSI	23	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
23	686 Manzanita AVE Manzanita, OR 97130	Manzanita & Classic	08/11/2015	10:48	10:48	56 PSI	50 PSI	663 GPM (Unnamed)	1744 @ 20 PSI	18	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
23	686 Manzanita AVE Manzanita, OR 97130	Manzanita & Classic	08/30/2020	7:44	7:44	56 PSI	48 PSI	663 GPM (Unnamed)	1493 @ 20 PSI	18	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
24	Laurel AVE Manzanita, OR 97130	Laurel & 5th St	09/29/2015	8:37	8:43	70 PSI	64 PSI	766 GPM (Unnamed)	2406 @ 20 PSI	24	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
25	594 North AVE Manzanita, OR 97130	North St & Division	08/11/2015	10:50	10:50	42 PSI	38 PSI	518 GPM (Unnamed)	1300 @ 20 PSI	11	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
26	730 Classic ST Manzanita, OR 97130	North St & County Rd	08/11/2015	10:51	10:51	92 PSI	53 PSI	663 GPM (Unnamed)	923 @ 20 PSI	18	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			

HYD. ID column sorts alphanumerically rather than strictly numerically because the Hydrant ID field can also contain letters and certain characters at the discretion of the Department entering the data.

HYD. ID	ADDRESS	LOCATION	TEST DATE	START TIME	END TIME	STATIC	RESIDUAL	DOWNSTREAM (HYD. ID)	FLOW @ DES. PRESS	PITOT PRESSURE	DISTRICT
26	730 Classic ST Manzanita, OR 97130	North St & County Rd	08/04/2020	14:46	14:49	90 PSI	28 PSI	1036 GPM (Unnamed)	1106 @ 20 PSI	9.8	Manzanita
Flow Test Results: No Data Provided		Remarks:						TESTED BY: Hill , Jeff			
27	267 Second ST Manzanita, OR 97130	Manzanita & 2nd	08/11/2015	10:52	10:52	80 PSI	73 PSI	733 GPM (Unnamed)	2338 @ 20 PSI	22	Manzanita
Flow Test Results: Pass		Remarks:						TESTED BY: Walsh , Jesse H			
27	267 Second ST Manzanita, OR 97130	Manzanita & 2nd	08/25/2020	10:57	11:09	80 PSI	42 PSI	1282 GPM (Unnamed)	1640 @ 20 PSI	15	Manzanita
Flow Test Results: Pass		Remarks:						TESTED BY: Testby not Assigned			
27	267 Second ST Manzanita, OR 97130	Manzanita & 2nd	08/25/2020	10:57	11:09	80 PSI	42 PSI	1282 GPM (Unnamed)	1640 @ 20 PSI	15	Manzanita
Flow Test Results: Pass		Remarks:						TESTED BY: Hill , Jeff			
28	128 Division ST Manzanita, OR 97130	Laneda & Division	08/11/2015	10:52	10:54	65 PSI	57 PSI	699 GPM (Unnamed)	1776 @ 20 PSI	20	Manzanita
Flow Test Results: Pass		Remarks:						TESTED BY: Walsh , Jesse H			
29	472 Laneda AVE Manzanita, OR 97130	Laneda & N 5th	08/11/2015	10:54	10:55	72 PSI	65 PSI	716 GPM (Unnamed)	2114 @ 20 PSI	21	Manzanita
Flow Test Results: Pass		Remarks:						TESTED BY: Walsh , Jesse H			
-3	34890 53 HWY Manzanita, OR 97130	Hwy 53 & Mohler Store	09/08/2015	13:16	13:18	102 PSI	78 PSI	884 GPM (Unnamed)	1716 @ 20 PSI	32	Manzanita
Flow Test Results: Pass		Remarks: During pump engagement						TESTED BY: Walsh , Jesse H			
30	75 Carmel AVE Manzanita, OR 97130	Laneda & N Carmel	08/11/2015	10:55	10:56	86 PSI	80 PSI	766 GPM (Unnamed)	2796 @ 20 PSI	24	Manzanita
Flow Test Results: Pass		Remarks:						TESTED BY: Walsh , Jesse H			
31	773 Laneda AVE Manzanita, OR 97130	Laneda & 101	08/11/2015	10:56	10:56	56 PSI	49 PSI	663 GPM (Unnamed)	1605 @ 20 PSI	18	Manzanita
Flow Test Results: Pass		Remarks:						TESTED BY: Walsh , Jesse H			
32	110 Ocean RD Manzanita, OR 97130	Laneda & Ocean Rd	08/11/2015	10:57	10:57	89 PSI	82 PSI	749 GPM (Unnamed)	2576 @ 20 PSI	23	Manzanita
Flow Test Results: Pass		Remarks:						TESTED BY: Walsh , Jesse H			
34	31 Laneda AVE Manzanita, OR 97130	Laneda & 1st	09/29/2015	13:50	14:01	90 PSI	84 PSI	842 GPM (Unnamed)	3172 @ 20 PSI	29	Manzanita
Flow Test Results: Pass		Remarks: Tight ports, stuck steamer.						TESTED BY: Walsh , Jesse H			
34	31 Laneda AVE Manzanita, OR 97130	Laneda & 1st	08/30/2020	6:50	6:51	89 PSI	80 PSI	884 GPM (Unnamed)	2655 @ 20 PSI	32	Manzanita
Flow Test Results: Pass		Remarks:						TESTED BY: Hill , Jeff			
35	364 N Fourth ST Manzanita, OR 97130	Laneda & 4th	08/17/2015	10:49	11:03	75 PSI	71 PSI	766 GPM (Unnamed)	3154 @ 20 PSI	24	Manzanita
Flow Test Results: Pass		Remarks:						TESTED BY: Walsh , Jesse H			
35	364 N Fourth ST Manzanita, OR 97130	Laneda & 4th	08/30/2020	7:19	7:19	78 PSI	68 PSI	827 GPM (Unnamed)	2136 @ 20 PSI	28	Manzanita
Flow Test Results: Pass		Remarks:						TESTED BY: Hill , Jeff			

HYD. ID column sorts alphanumerically rather than strictly numerically because the Hydrant ID field can also contain letters and certain characters at the discretion of the Department entering the data.

HYD. ID	ADDRESS	LOCATION	TEST DATE	START TIME	END TIME	STATIC	RESIDUAL	DOWNSTREAM (HYD. ID)	FLOW @ DES. PRESS	PITOT PRESSURE	DISTRICT
36	120 N Third ST Manzanita, OR 97130	Laneda & 3rd	08/17/2015	11:04	11:14	78 PSI	71 PSI	797 GPM (Unnamed)	2496 @ 20 PSI	26	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
36	120 N Third ST Manzanita, OR 97130	Laneda & 3rd	08/30/2020	7:30	7:31	80 PSI	72 PSI	856 GPM (Unnamed)	2541 @ 20 PSI	30	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
38	131 Classic ST Manzanita, OR 97130	Classic & Dorcas 100' N	08/17/2015	11:22	11:35	66 PSI	59 PSI	733 GPM (Unnamed)	2026 @ 20 PSI	22	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
38	131 Classic ST Manzanita, OR 97130	Classic & Dorcas 100' N	08/25/2020	11:13	11:25	68 PSI	40 PSI	1238 GPM (Unnamed)	1656 @ 20 PSI	14	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
39	795 S Carmel AVE Manzanita, OR 97130	S Carmel & Bonny Ln	08/17/2015	14:18	14:31	74 PSI	60 PSI	699 GPM (Unnamed)	1448 @ 20 PSI	20	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
4	37190 21st ST Manzanita, OR 97130	Epoh & Ocean	08/09/2015	16:16	16:16	73 PSI	38 PSI	518 GPM (Unnamed)	648 @ 20 PSI	11	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
4	37190 21st ST Manzanita, OR 97130	Epoh & Ocean	08/04/2020	12:03	12:07	72 PSI	26 PSI	965 GPM (Unnamed)	1031 @ 20 PSI	8.5	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
-4	18005 Foss RD at Miami River RD Manzanita, OR 97130	Foss Rd & Miami Riv. Rd.	09/08/2015	13:18	13:18	99 PSI	65 PSI	856 GPM (Unnamed)	1349 @ 20 PSI	30	Manzanita
Flow Test Results: Pass		Remarks: During pump operation						**TESTED BY:** Walsh , Jesse H			
40	454 Dorcas LN Manzanita, OR 97130	Dorcas & 5th	08/17/2015	14:36	14:47	72 PSI	45 PSI	681 GPM (Unnamed)	970 @ 20 PSI	19	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
41	165 S 5th ST Manzanita, OR 97130	Fire Station Blow Off	08/17/2015	14:49	15:03	66 PSI	4 PSI	156 GPM (Unnamed)	132 @ 20 PSI	1	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
42	514 S 3rd ST Manzanita, OR 97130	3rd & Treasure Cove	08/17/2015	15:06	15:15	84 PSI	79 PSI	766 GPM (Unnamed)	3034 @ 20 PSI	24	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
43	195 Beach ST Manzanita, OR 97130	Beach & Merton	08/24/2015	9:08	9:25	88 PSI	73 PSI	733 GPM (Unnamed)	1657 @ 20 PSI	22	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
44	495 Beach ST Manzanita, OR 97130	Beach & Treasure Cove	08/24/2015	9:27	9:43	92 PSI	70 PSI	856 GPM (Unnamed)	1623 @ 20 PSI	30	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Testby not Assigned			
46	75 Pacific LN at S Carmel Manzanita, OR 97130	Pacific & S Carmel	08/24/2015	9:53	10:08	89 PSI	76 PSI	870 GPM (Unnamed)	2142 @ 20 PSI	31	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			

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46	75 Pacific LN at S Carmel Manzanita, OR 97130	Pacific & S Carmel	12/09/2017	13:52	14:02	90 PSI	42 PSI	1359 GPM (Unnamed)	1666 @ 20 PSI	16	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
48	10435 Neahkahnie Creek RD Manzanita, OR 97130	101 & Neahkahnie Creek Rd	08/24/2015	10:34	10:49	70 PSI	45 PSI	699 GPM (Unnamed)	1016 @ 20 PSI	20	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
49	36490 101 HWY N Manzanita, OR 97130	101 @ Church	08/24/2015	11:01	11:02	77 PSI	51 PSI	716 GPM (Unnamed)	1093 @ 20 PSI	21	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
5	290 College ST Manzanita, OR 97130	3rd & College	08/09/2015	16:17	16:17	74 PSI	30 PSI	518 GPM (Unnamed)	578 @ 20 PSI	11	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
-5	Foss RD Manzanita, OR 97130	Foss Rd & Well Site	09/08/2015	13:19	13:19	79 PSI	45 PSI	663 GPM (Unnamed)	892 @ 20 PSI	18	Manzanita
Flow Test Results: Pass		Remarks: During pump operation						**TESTED BY:** Walsh , Jesse H			
50	10890 North ST Manzanita, OR 97130	North & The Promenade	08/24/2015	11:07	11:22	64 PSI	40 PSI	663 GPM (Unnamed)	919 @ 20 PSI	18	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
52	Schooner WAY Manzanita, OR 97130	Schooner Way & NCCR	08/25/2015	9:19	9:32	67 PSI	42 PSI	663 GPM (Unnamed)	932 @ 20 PSI	18	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
53	35640 Clipper CT Manzanita, OR 97130	Clipper Ct & Schooner Way	08/25/2015	9:34		56 PSI	30 PSI	518 GPM (Unnamed)	617 @ 20 PSI	11	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
53	35640 Clipper CT Manzanita, OR 97130	Clipper Ct & Schooner Way	08/25/2020	16:05	16:06	56 PSI	36 PSI	585 GPM (Unnamed)	803 @ 20 PSI	14	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
54	10355 Pine Ridge DR Manzanita, OR 97130	Pine Ridge 1 (NE)	08/25/2015	15:48	15:48	72 PSI	40 PSI	663 GPM (Unnamed)	861 @ 20 PSI	18	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
55	10475 Pine Ridge Manzanita, OR 97130	Pine Ridge 2 (SE)	08/25/2015	15:49	15:49	82 PSI	50 PSI	699 GPM (Unnamed)	999 @ 20 PSI	20	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
56	10195 Pine Ridge Manzanita, OR 97130	Pine Ridge 3 (NW)	08/25/2015	15:50	15:50	58 PSI	35 PSI	541 GPM (Unnamed)	709 @ 20 PSI	12	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
57	10130 Pine Ridge Manzanita, OR 97130	Pine Ridge 4 (SW)	08/25/2015	15:50	15:51	50 PSI	35 PSI	518 GPM (Unnamed)	753 @ 20 PSI	11	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
58	10000 Pine Ridge Manzanita, OR 97130	Pinyon (N) & Pine Ridge	08/25/2015	15:51	15:51	50 PSI	27 PSI	494 GPM (Unnamed)	570 @ 20 PSI	10	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			

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HYD. ID	ADDRESS	LOCATION	TEST DATE	START TIME	END TIME	STATIC	RESIDUAL	DOWNSTREAM (HYD. ID)	FLOW @ DES. PRESS	PITOT PRESSURE	DISTRICT
59	34540 Pinyon DR Manzanita, OR 97130	Pinyon Dr (S)	08/25/2015	15:52	15:52	50 PSI	30 PSI	518 GPM (Unnamed)	644 @ 20 PSI	11	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
59	34540 Pinyon DR Manzanita, OR 97130	Pinyon Dr (S)	08/18/2020	16:05	16:08	58 PSI	22 PSI	573 GPM (Unnamed)	589 @ 20 PSI	3	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
6	386 University AVE Manzanita, OR 97130	University & Juniper	08/09/2015	13:19	13:23	70 PSI	40 PSI	494 GPM (Unnamed)	650 @ 20 PSI	10	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
6	386 University AVE Manzanita, OR 97130	University & Juniper	08/25/2020	10:26	10:36	76 PSI	40 PSI	518 GPM (Unnamed)	657 @ 20 PSI	11	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
60	9965 Lodgepole Manzanita, OR 97130	Lodgepole N & Shore Pine N	08/25/2015	15:53	15:55	45 PSI	25 PSI	312 GPM (Unnamed)	351 @ 20 PSI	4	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
61	34575 Lodgepole DR Manzanita, OR 97130	Lodgepole S & Pine Ridge S	08/25/2015	15:55	15:56	57 PSI	29 PSI	349 GPM (Unnamed)	405 @ 20 PSI	5	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
62	9890 Shore Pine LN Manzanita, OR 97130	Shore Pine S & Lodgepole S	08/25/2015	15:56	15:57	53 PSI	28 PSI	349 GPM (Unnamed)	405 @ 20 PSI	5	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
63	65 Beach DR Manzanita, OR 97130	Beach Cir & Tobin Ln	08/25/2015	15:57	15:57	83 PSI	62 PSI	733 GPM (Unnamed)	1326 @ 20 PSI	22	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
65	909 Lakeview DR Manzanita, OR 97130	Lakeview & Beach Pine	08/25/2015	15:58	15:59	78 PSI	53 PSI	699 GPM (Unnamed)	1101 @ 20 PSI	20	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
67	447 Upland LN Manzanita, OR 97130	Ridge Ln & Upland	08/25/2015	15:59	16:00	65 PSI	44 PSI	663 GPM (Unnamed)	1000 @ 20 PSI	18	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
68	500 Ridge RD Manzanita, OR 97130	Ridge Rd & Upland	08/25/2015	16:00	16:00	56 PSI	35 PSI	699 GPM (Unnamed)	935 @ 20 PSI	20	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
7	815 Elm ST Manzanita, OR 97130	High & Elm	08/09/2015	16:18	16:18	67 PSI	27 PSI	270 GPM (Unnamed)	294 @ 20 PSI	3	Manzanita
Flow Test Results: Pass		Remarks: Drain not working/seat gasket worn						**TESTED BY:** Walsh , Jesse H			
72	940 Fairway CT Manzanita, OR 97130	Fairway Ct & Gary	08/25/2015	16:01	16:02	70 PSI	54 PSI	699 GPM (Unnamed)	1293 @ 20 PSI	20	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
73	34995 Necarney City RD Manzanita, OR 97130	County Rd @ CARTM	08/25/2015	16:02	16:02	70 PSI	39 PSI	663 GPM (Unnamed)	858 @ 20 PSI	18	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			

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HYD. ID	ADDRESS	LOCATION	TEST DATE	START TIME	END TIME	STATIC	RESIDUAL	DOWNSTREAM (HYD. ID)	FLOW @ DES. PRESS	PITOT PRESSURE	DISTRICT
73	34995 Necarney City RD Manzanita, OR 97130	County Rd @ CARTM	08/18/2020	15:47	15:48	70 PSI	22 PSI	662 GPM (Unnamed)	676 @ 20 PSI	4	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
74	8970 Chinook LN Manzanita, OR 97130	Necarney & Chinook	09/01/2015	13:31	13:46	79 PSI	59 PSI	766 GPM (Unnamed)	1373 @ 20 PSI	24	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
75	34807 Necarney RD Manzanita, OR 97130	Necarney & Puffin	09/01/2015	13:48	14:00	78 PSI	59 PSI	766 GPM (Unnamed)	1399 @ 20 PSI	24	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
76	8995 Sandpiper LN Manzanita, OR 97130	Necarney & Sandpiper	09/01/2015	14:01	14:14	86 PSI	64 PSI	827 GPM (Unnamed)	1496 @ 20 PSI	28	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
78	8985 Pelican LN Manzanita, OR 97130	Necarney & Pelican	09/01/2015	14:22	14:36	87 PSI	64 PSI	827 GPM (Unnamed)	1473 @ 20 PSI	28	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
79	34360 Necarney RD Manzanita, OR 97130	Necarney & Sitka	09/01/2015	14:39	14:51	89 PSI	65 PSI	827 GPM (Unnamed)	1462 @ 20 PSI	28	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
79	34360 Necarney RD Manzanita, OR 97130	Necarney & Sitka	08/25/2020	14:08	14:10	89 PSI	37 PSI	1238 GPM (Unnamed)	1442 @ 20 PSI	14	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
80	8990 Spindrift LN Manzanita, OR 97130	Necarney & Spindrift	09/01/2015	14:52	15:04	82 PSI	56 PSI	766 GPM (Unnamed)	1224 @ 20 PSI	24	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
82	8984 Horizon LN Manzanita, OR 97130	Necarney & Horizon	09/08/2015	11:39	11:39	85 PSI	50 PSI	716 GPM (Unnamed)	1000 @ 20 PSI	21	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
82	8984 Horizon LN Manzanita, OR 97130	Necarney & Horizon	08/25/2020	13:53	13:56	86 PSI	20 PSI	662 GPM (Unnamed)	662 @ 20 PSI	4	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Hill , Jeff			
84	Dorcus Manzanita, OR 97130	Dorcus & Jackson	09/08/2015	13:13	13:13	62 PSI	55 PSI	699 GPM (Unnamed)	1839 @ 20 PSI	20	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
87	34690 Nehalem AVE Manzanita, OR 97130	Nehalem & Sandpiper	09/08/2015	13:15	13:15	84 PSI	60 PSI	766 GPM (Unnamed)	1300 @ 20 PSI	24	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
89	595 S Carmel AVE Manzanita, OR 97130	Carmel & Beeswax	12/09/2017	14:04	14:14	90 PSI	40 PSI	1462 GPM (Unnamed)	1753 @ 20 PSI	18.5	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			
9	807 Hemlock ST Manzanita, OR 97130	Hemlock	08/09/2015	16:21	16:21	95 PSI	53 PSI	663 GPM (Unnamed)	906 @ 20 PSI	18	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:** Walsh , Jesse H			

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HYD. ID	ADDRESS	LOCATION	TEST DATE	START TIME	END TIME	STATIC	RESIDUAL	DOWNSTREAM (HYD. ID)	FLOW @ DES. PRESS	PITOT PRESSURE	DISTRICT
90	95 Edmund ST at S Carmel AVE Manzanita, OR 97130	Edmund & S Carmel	12/09/2017	11:40	11:44	900 PSI	44 PSI	1462 GPM (Unnamed)	1483 @ 20 PSI	18.5	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:**	Walsh , Jesse H		
91	165 S Carmel AVE at Merton LN Manzanita, OR 97130	S Carmel & Merton Ln	12/09/2017	11:26	11:38	88 PSI	46 PSI	1462 GPM (Unnamed)	1896 @ 20 PSI	18.5	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:**	Walsh , Jesse H		
92	901 Beach ST at Sunset Maznanita, OR 97130		12/09/2017	13:38		88 PSI	42 PSI	1462 GPM (Unnamed)	1805 @ 20 PSI	18.5	Manzanita
Flow Test Results: Pass		Remarks:						**TESTED BY:**	Walsh , Jesse H		
B1	Brighton BLVD Brighton, OR 97136	Brighton Blvd N	10/22/2015	8:35	8:48	20 PSI	18 PSI	383 GPM (Unnamed)	913 @ 10 PSI	6	Private
Flow Test Results: Pass		Remarks:						**TESTED BY:**	Walsh , Jesse H		
B2	Brighton BLVD Brighton, OR 97136	Brighton Blvd above Kenton ave.	10/22/2015	9:06	9:23	56 PSI	46 PSI	625 GPM (Unnamed)	1248 @ 20 PSI	16	Private
Flow Test Results: Pass		Remarks: Stem stiff, caps rusted						**TESTED BY:**	Walsh , Jesse H		
B3	Brighton BLVD at Ridge WAY Brighton, OR 97136	Brighton Blvd & Ridge Way	10/22/2015	8:54	9:05	23 PSI	18 PSI	383 GPM (Unnamed)	600 @ 11.5 PSI	6	Private
Flow Test Results: Pass		Remarks:						**TESTED BY:**	Walsh , Jesse H		
B4	Brighton BLVD at Cliff DR Brighton, OR 97136	Brighton Blvd & Cliff Dr	10/22/2015	9:39	9:50	45 PSI	32 PSI	585 GPM (Unnamed)	832 @ 20 PSI	14	Private
Flow Test Results: Pass		Remarks:						**TESTED BY:**	Walsh , Jesse H		
B5	Cliff DR Brighton, OR 97136	Cliff Dr S	10/22/2015	9:27	9:38	42 PSI	26 PSI	494 GPM (Unnamed)	586 @ 20 PSI	10	Private
Flow Test Results: Pass		Remarks:						**TESTED BY:**	Walsh , Jesse H		
B6	Brighton BLVD Brighton, OR 97136	Bright Blvd	10/22/2015	9:52	10:01	100 PSI	69 PSI	812 GPM (Unnamed)	1354 @ 20 PSI	27	Private
Flow Test Results: Pass		Remarks:						**TESTED BY:**	Walsh , Jesse H		
N-84	36115 Underhill LN Nehalem, OR 97131	Underhill & 101	11/09/2015	16:19	0:00	82 PSI	62 PSI	781 GPM (Unnamed)	1438 @ 20 PSI	25	Nehalem
Flow Test Results: Pass		Remarks:						**TESTED BY:**	Walsh , Jesse H		
N-85	36315 101 HWY N Nehalem, OR 97131	Across from Bunkhouse	11/03/2015	16:23	0:00	76 PSI	60 PSI	781 GPM (Unnamed)	1536 @ 20 PSI	25	Nehalem
Flow Test Results: Pass		Remarks:						**TESTED BY:**	Walsh , Jesse H		
N-86	36445 Necarney city RD Nehalem, OR 97131	Across from Shell Station	11/03/2015	16:26	0:00	72 PSI	60 PSI	681 GPM (Unnamed)	1503 @ 20 PSI	19	Nehalem
Flow Test Results: Pass		Remarks:						**TESTED BY:**	Walsh , Jesse H		
N-86	36445 Necarney city RD Nehalem, OR 97131	Across from Shell Station	03/16/2020	14:07		75 PSI	6 PSI	1480 GPM (Unnamed)	1309 @ 20 PSI	20	Nehalem
Flow Test Results: Pass		Remarks:						**TESTED BY:**	Knight III , Frankie		
N-87	12500 Thols ST Nehalem, OR 97131	13th & Tohls	11/03/2015	16:29	0:00	86 PSI	24 PSI	494 GPM (Unnamed)	510 @ 20 PSI	10	Nehalem
Flow Test Results: Pass		Remarks:						**TESTED BY:**	Walsh , Jesse H		

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City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix S

Opinions of Probable Cost for Emergency Well, Recommended Resiliency Improvements and Miscellaneous Projects

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Appendix S: Opinions of Probable Project Costs (OPCs)

City of Manzanita Water Master Plan Update 2021
(Basis: ENR CCI June 2021: 12112)

1. Emergency Well (see Appendix P for a copy of the referenced study.)
Update to costs presented in the Emergency Well Feasibility Study, PACE Engineers, Inc., May 2017.
(See Appendix P for a copy of the referenced study.)

Task	Budget
1. Feasibility Review/Engineering Contract	NA[1]
2. OHA Plan Review	$5,500
3. Easement Acquisition	$2,300
4. Hydrogeological Tech Memo	NA[1]
5. Water Right Transfer	$10,000
6. Funding Application[2]	-
7. Well design/Bid/Construct/Test	$185,000
8. Connect to WTP	$150,000
9. Finalize Water Right	$5,000
Task Subtotal	**$357,800**
Recommended allowance for legal and administrative costs.	$5,500
Project Total	**$363,300**
Recommended Budget for Planning Purposes	**$400,000**

1. Project has been Implemented.
2. The City intends to self-fund the project; no budget is included for funding applications.

2. Recommended Resiliency Improvements
Updates to selected costs presented in the Water System Resiliency Study, BergerABAM, January 2018.
For general planning purposes associated with the Manzanita Water Master Plan Update 2021.
(See Appendix A for a copy of the referenced study.)

Project	Budget
Water Transmission/Distribution Seismic Improvements	
Bleed out control vault at City limits	$110,000
Bypass and flow control at WTP	$170,000
Reservoir bypass connection and water main	$110,000
Emergency connection to Fire and Rescue facility	$55,000
Bleed out control at RT 53 Water, Inc. (Zaddock Cr.)	$60,000
Bleed out control at Tidelands Services Coop	$110,000
Replace connection with City of Nehalem	$110,000
Bury transmission main at pedestrian bridge crossing	$230,000
Bury transmission main at bridge crossing (Hwy 101 and 53)	$280,000
Water Transmission/Distribution Total	**$1,235,000**
Reservoir Storage	
Build two 1-million gallon reservoirs	$4,000,000
Reservoir Storage Total	**$4,000,000**

Water System Information Management System

Build GIS System for water infrastructure NA[1]

1. Project has been Implemented.

Water Supply Improvements

Emergency well[1].

1. See "1. Emergency Well" above.

3. Miscellaneous Projects

Project	Budget	
Preliminary Design of Recommended Storage Improvements (Preliminary survey, geotechnical, siting, connections, materials, maintenance of service during construction plan, etc. as needed for preparation of funding applications)	$100,000	(Obtained from FEMA)
New Water Meters (Continuous read)	$500/meter; 100 meters per year	
Water Management and Conservation Plan	$80,000	
Water Right Partial Perfection	$15,000	
Water Master Plan Update	$100,000	
White Water Investigation	$50,000	

1. This is a budget figure but the project should be conducted on a time and materials basis.

Leak Detection	$10,000
Water Rate Study	$25,000
SDC Study	$20,000

City of Manzanita
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Appendix T

Manzanita Water Funds Budgets for FY 2021-2022

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BUDGET NOTES - ENTERPRISE FUNDS

WATER OPERATING FUND

REVENUES

The Water Operating Fund accounts for the day-to-day operations of the water system including meter installation and repair, water system maintenance, billing, and water quality control. The revenues from Water Sales and Collections reflect the rates implemented in October 2014. The current residential in-city base rate is $39.50 per month. Water revenue is the second largest revenue source in the City's budget, although all monies must be used for the water utility. The revenue from Wholesale Water Sales is the payment from the City of Wheeler for its share of the operational expenses for the well, as well as payments from Tideland and Zaddach Creek Water Co-ops for bulk water only.

The 2014 study which recommended the current rates also recommended an annual rate adjustment. This was not implemented as revenues appeared to be keeping up with expenses. However, the inability in the last years to provide sufficient revenues to finance needed system improvements and major maintenance activities suggest that a water rate increase needs to be considered in the next fiscal year. Funds for a new water rate study are included in this budget.

EXPENDITURES

The Water Operating Fund expenditures are formatted to reflect the water filtration plant and the well system built in 2003. The expenses of the filtration plant and the distribution system are reflected in the Water System Department of the Fund. The well and associated transmission line expenses are reflected in the Well Field and Transmission Lines Department of the Fund. The expenses in the Well Field and Transmission Lines Department are shared with the City of Wheeler using a formula established in an intergovernmental agreement. Debt Service was refinanced with lower interest bonds in 2018.

The operation of the well system and the surface water system must be closely coordinated to meet health requirements and water demands. In 2006, it was decided that a Manzanita employee should oversee the system as any changes at the well site affect what needs to happen at the water treatment plant. Wheeler pays its share of the personnel services for the staff member designated as being in "Direct Responsible Charge" (DRC) as defined by State regulations. That staff member is currently the Public Works Director.

This budget also includes a Public Works Utility Clerk position which is intended to move water billing and administration to the Public Works office to better coordinate with the field staff working on the water system. The position would also provide clerical and recordkeeping assistance to free up the Public Works Director for field supervisory duties. The position would be funded 75% from the Water Fund and 25% from the Road Fund.

The System Maintenance and Supplies line item reflects routine line and facility repair. This year, expenses include maintenance requirements to the treatment plant, distribution system, meter changeout and fire hydrant replacement. Professional Services include a $100,000 water reservoir design study funded 75% by a FEMA grant.

WATER CONSTRUCTION FUND

REVENUES

The Water Construction Fund accounts for major system expansion or improvement projects. The funding sources for the Water Construction Fund include system development charges and transfers from the Water Operating Fund. The large carryover amount reflects the reserve for future system replacement of around $2.4 million. The monies from System Development Charges are from the $6,900 per dwelling unit received at the time of construction of new homes and which by State law must be accounted for in a capital construction fund.

EXPENDITURES

The 2006 Water System Master Plan update has identified a priority list of projects to complete for the water system. The City has used the strategy of replacing water lines in coordination with upgrading the storm drainage and street surface for certain streets. The budget includes the Water Construction Fund's share of $405,000 for replacing the asbestos concrete and PVC water lines as part of the Dorcas and 4th Street improvement project.

WATER OPERATING FUND
FUND 40, DEPARTMENT 400

BUDGET FOR FISCAL YEAR 2021/2022

ACTUAL 18/19	ACTUAL 19/20	ADOPTED 20/21		RESOURCES	PROPOSED BY STAFF	PROPOSED BY BUDGET OFFICER	APPROVED BY BUDGET COMMITTEE	ADOPTED BY GOVERNING BODY
473,602	600,326	450,127	3900	**CARRYOVER BALANCE**	530,424	530,424	530,424	
				CHARGES FOR SERVICES				
1,003,508	996,861	960,000	4300	Water Sales and Collections	960,000	960,000	960,000	
0	0	30,000	4300	Wholesale Water Sales (Wheeler, Zaddach Creek, Tideland)	30,000	30,000	30,000	
8,242	6,376	13,650	4340	Meter Installations	9,100	9,100	9,100	
1,011,751	1,003,237	1,003,650		Total Charges for Services	999,100	999,100	999,100	0
				USE OF MONEY & PROPERTY				
31,771	27,695	14,000	4250	Earned Interest	10,000	10,000	10,000	
31,771	27,695	14,000		Total Use of Money & Property	10,000	10,000	10,000	0
				OTHER REVENUE				
2,822	599	100	4800	Miscellaneous	100	100	100	
			4080	Grants	83,650	83,650	83,650	
2,822	599	100		Total Other Revenue	83,750	83,750	83,750	0
1,519,945	1,631,857	1,467,877		**TOTAL WATER OP FUND RESOURCES**	1,623,274	1,623,274	1,623,274	0

WATER OPERATING FUND

FUND 40, DEPARTMENT 400

EXPENDITURES, PAGE 1

BUDGET FOR FISCAL YEAR 2021/2022

ACTUAL 18/19	ACTUAL 19/20	ADOPTED 20/21			PROPOSED BY STAFF	PROPOSED BY BUDGET OFFICER	APPROVED BY BUDGET COMMITTEE	ADOPTED BY GOVERNING BODY
				PERSONAL SERVICES				
218,771	202,735	153,680		Salaries and Wages **	187,696	187,696	187,696	
5,150	260	14,500		Oncall Time **	14,500	14,500	14,500	
0	4,288	10,500		Overtime	10,500	10,500	10,500	
131,135	142,535	121,633		Payroll Benefits and Expenses **	186,416	186,416	186,416	
355,056	349,818	300,313		Total Personal Services	399,112	399,112	399,112	0
				MATERIALS & SERVICES				
18,809	20,581	15,000	6020	Building Operations	14,600	14,600	14,600	
2,002	0	1,500	6040	Contract Services	1,800	1,800	1,800	
22,839	23,668	23,700	6050	Insurance	29,900	29,900	29,900	
525	1,115	1,500	6030	Office Supplies	2,500	2,500	2,500	
1,749	25	600	6060	Advertising	600	600	600	
1,996	1,369	4,675	6080	Building Maintenance	33,600	33,600	33,600	
25,245	72,593	71,000	6100	Professional Services **	131,000	131,000	131,000	
0	842	800	6120	Uniform or Clothing Allowance	1,200	1,200	1,200	
8,971	5,602	7,600	6180	Vehicle/Equipment Maint, Supplies, Repair	9,600	9,600	9,600	
1,613	2,930	4,500	6230	Travel and Training - Staff **	4,500	4,500	4,500	
2,155	4,830	7,472	6240	Dues & Subscriptions	3,500	3,500	3,500	
100,467	218,161	132,800	6450	System Maintenance and Supplies	210,700	210,700	210,700	
398	88	2,200	6470	Chemicals, Supplies, and Telemetry	2,200	2,200	2,200	
12,176	11,061	11,000	6500	Billing and Administration **	28,800	28,800	28,800	
387	358	500	6530	Fire Patrol	500	500	500	
1,140	1,745	2,200	6600	Testing (Federal and State)	2,200	2,200	2,200	
0	25	200	6800	Miscellaneous	200	200	200	
1,228	0	0	6540	Lease/Easement				
201,700	364,993	287,247		Total Materials & Services	477,400	477,400	477,400	0

** Denotes items shared with other funds/departments.

WATER OPERATING FUND
FUND 40, DEPARTMENT 400

EXPENDITURES, PAGE 2

BUDGET FOR FISCAL YEAR 2021/2022

ACTUAL 18/19	ACTUAL 19/20	ADOPTED 20/21			PROPOSED BY STAFF	PROPOSED BY BUDGET OFFICER	APPROVED BY BUDGET COMMITTEE	ADOPTED BY GOVERNING BODY
				CAPITAL OUTLAY				
0	0	0	7010	Office Equipment **				
0	0	5,000	7030	Vehicles and Equipment				
0	0	0		Vehicles				
0	0	0		Equipment				
	0	65,000		Buildings				
0	0	0	7200	Line Replacement				
0	0	0	7020	New Construction (Handicap Restrooms)				
0	677	0	7220	Storm Drainage				
0	677	70,000		Total Capital Outlay	0	0	0	0
				TRANSFER OUT				
14,300	14,300	14,300	8008	Public Works Equipment Reserve Fund	14,300	14,300	14,300	
0	113,675	113,675	8005	City Hall Expansion Fund	0	0	0	
75,000	0	75,000	8009	Water Construction Fund	200,000	200,000	200,000	
-	-	157,348		Indirect Overhead Payment to General Fund	157,348	157,348	157,348	
89,300	127,975	360,323		Total Transfer Out	371,648	371,648	371,648	0
				DEBT SERVICE				
178,345	172,931	172,256	8310	Loan Payment	172,981	172,981	172,981	
178,345	172,931	172,256		Total Debt Service	172,981	172,981	172,981	0
824,401	1,016,394	1,190,139		**TOTAL WATER SYSTEM DEPARTMENT**	1,421,141	1,421,141	1,421,141	0

** Denotes items shared with other funds/departments.

WATER OPERATING FUND
WELL FIELD & TRANSMISSION LINES
FUND 40, DEPARTMENT 410

EXPENDITURES, PAGE 3

BUDGET FOR FISCAL YEAR 2021/2022

ACTUAL 18/19	ADOPTED 19/20	ADOPTED 20/21			PROPOSED BY STAFF	PROPOSED BY BUDGET OFFICER	APPROVED BY BUDGET COMMITTEE	ADOPTED BY GOVERNING BODY
				PERSONAL SERVICES				
36,462	38,537	0		Salaries and Wages **	0			
21,772	23,067	0		Payroll Benefits and Expenses				
58,234	61,604	0		Total Personal Services	0	0	0	0
				MATERIALS & SERVICES				
14,701	15,010	22,400	6020	Building Operations	27,400	27,400	27,400	
0	336	400	6040	Contract Services	400	400	400	
3,540	3,757	4,000	6050	Insurance	4,800	4,800	4,800	
0	0	0	6080	Building Maintenance	0	0	0	
755	333	15,000	6100	Professional Services **	15,000	15,000	15,000	
0	468	450	6120	Uniform & Clothing Allowance	600	600	600	
1,056	840	2,200	6180	Vehicle/Equipment Maint, Supplies, Repair	3,900	3,900	3,900	
1,226	1,668	1,400	6230	Travel and Training - Staff	1,400	1,400	1,400	
14,147	34,014	8,000	6450	System Maintenance and Supplies	10,000	10,000	10,000	
999	0	10,550	6470	Chemicals, Supplies, and Telemetry	10,550	10,550	10,550	
	1,228	1,228	6540	Lease and Easements	1,228	1,228	1,228	
0	30	3,200	6600	Testing (Federal and State)	3,200	3,200	3,200	
0	0	100	6800	Miscellaneous	100	100	100	
36,425	57,684	68,928		Total Materials & Services	78,578	78,578	78,578	0
94,658	191,036	68,928		**TOTAL WELL FIELD & TRANSMISSION LINE DEPARTMENT**	78,578	78,578	78,578	0
0	0	0	8970	Reserve for Future Bond Payment				
0	0	9,060	8970	Council Designated Insurance Reserve	9,060	9,060	9,060	
0	0	199,750	8950	Contingency	114,495	114,495	114,495	
919,059	1,207,430	1,467,877		**TOTAL WATER OPERATING FUND EXPENDITURES**	1,623,274	1,623,274	1,623,274	0

** Denotes items shared with other funds/departments.

WATER CONSTRUCTION FUND
FUND 41, DEPARTMENT 810

BUDGET FOR FISCAL YEAR 2021/2022

ACTUAL 18/19	ACTUAL 19/20	ADOPTED 20/21		RESOURCES	PROPOSED BY STAFF	PROPOSED BY BUDGET OFFICER	APPROVED BY BUDGET COMMITTEE	ADOPTED BY GOVERNING BODY
2,575,338	2,441,568	2,444,367	3900	**CARRY OVER BALANCE**	2,495,462	2,495,462	2,495,462	
				CHARGES FOR SERVICES				
117,300	96,600	138,000	4200	System Development Charges	103,500	103,500	103,500	
0	0	1,000	4330	Service Extensions	1,000	1,000	1,000	
117,300	96,600	139,000		Total Charges fo Services	104,500	104,500	104,500	0
				USE OF MONEY & PROPERTY				
48,049	38,355	35,000	4250	Earned Interest	15,000	15,000	15,000	
				OTHER REVENUE				
0	0	0	4800	Miscellaneous				
				TRANSFER IN:				
75,000	0	75,000	4951	Water Operating Utility Fund	200,000	200,000	200,000	
30,000	1,800	1,800	4962	Puffin Lane LID Fund	45,300	45,300	45,300	
105,000	1,800	76,800		Total Transfers In	245,300	245,300	245,300	0
2,845,688	2,578,323	2,695,167		**TOTAL WATER CONSTRUCTION FUND RESOURCES**	2,860,262	2,860,262	2,860,262	0

WATER CONSTRUCTION FUND
FUND 41, DEPARTMENT 810

BUDGET FOR FISCAL YEAR 2021/2022

EXPENDITURES

ACTUAL 18/19	ACTUAL 19/20	ADOPTED 20/21			PROPOSED BY STAFF	PROPOSED BY BUDGET OFFICER	APPROVED BY BUDGET COMMITTEE	ADOPTED BY GOVERNING BODY
				MATERIALS & SERVICES				
0	0	500	6040	Contract Services	0	0	0	
0	0	1,000	6060	Advertising	0	0	0	
0	0	1,000	6100	Professional Fees	0	0	0	
0	0	2,500		Total Materials & Services	0	0	0	0
				CAPITAL OUTLAY				
0	0	0	7020	New Construction				
404,120	179,742	235,000	7220	Water Construction Projects - Manzanita System Projects	425,000	425,000	425,000	
404,120	179,742	235,000		Total Capital Outlay	425,000	425,000	425,000	0
				TRANSFERS				
0	0	0	8014	Puffin Lane LID Fund				
0	0	2,431,432	8970	Reserve for Future	2,400,000	2,400,000	2,400,000	
0	0	26,235	8950	Contingency	35,262	35,262	35,262	
			8990	Unappropriated Ending Fund Balance				
404,120	179,742	2,695,167		**TOTAL WATER CONSTRUCTION FUND EXPENDITURES**	2,860,262	2,860,262	2,860,262	0

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix U

Water Rate Resolution and Rate Schedule

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RESOLUTION NO. 14-12

A RESOLUTION AMENDING THE MONTHLY WATER SERVICE RATE SCHEDULE

WHEREAS, the City of Manzanita operates a municipal water system which involves impoundment and treatment of raw surface water, pumping of subsurface water, storage, testing and distribution of finished water and all functions related to operation and maintenance of a public water system as governed by Federal, State and local law; and,

WHEREAS, the City desires to operate its water system as a self supporting activity in accordance with the requirements of the City Charter and City Comprehensive Plan; and,

WHEREAS, Section 17 of Ordinance No. 90-8 authorizes the City Council to adopt by resolution such water rates and service charges as the Council deems to be in the interest of operating and maintaining the City water system; and .

WHEREAS, the current monthly water service rate schedule adopted by Resolution 08-06 does not generate enough revenue to keep the water system self supporting; and

WHEREAS, a water rate study prepared by the Oregon Association of Water Utilities recommends adjusting the water service rate schedule; now, therefore,

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF MANZANITA AS FOLLOWS:

Section 1. Effective October 1, 2014, the monthly water service rate schedule contained in Resolution No. 08-06 is rescinded, and the water service rate schedule attached hereto as Exhibit A is hereby adopted.

PASSED by the City Council and signed by me in authentication of its passage this 9th day of July, 2014.

Garry R. Bullard, Mayor

ATTEST:

Jerald P. Taylor, City Manager/Recorder

EXHIBIT A
WATER SERVICE RATE SCHEDULE
Effective October 1, 2014

MONTHLY RATE SCHEDULE

Customer Type	Location	Meter Size	Minimum Monthly Rate	Gallons included in minimum monthly rate	Cost per 1000 gallons over minimum
Residential	Inside City	Per Unit	$39.50	4,000	$2.50
	Outside City	Per Unit	$49.25	4,000	$3.25
Commercial	Inside City	5/8 inch	39.50	-0-	$2.50
		¾ inch	$43.25	-0-	$2.50
		1 inch	$55.00	-0-	$2.50
		1 ½ inch	$70.75	-0-	$2.50
		2 inch	$114.00	-0-	$2.50
	Outside City	5/8 inch	$49.25	-0-	$3.25
		¾ inch	$54.00		$3.25
		1 inch	$68.75	-0-	$3.25
		1 ½ inch	$88.50		$3.25
		2 inch	$142.50	-0-	$3.25
Bulk		2 inch	$142.50	-0-	$2.75

SYSTEM CONNECTION FEES

Service Charge This charge provides for the cost of meter and/or water line installation at time of service connection.	Actual cost of materials and labor

OTHER FEES

Delinquent Charge		$20.00
Returned Check Charge		$35.00
Reconnection Charge after service has been disconnected by the City*	During working hours	$40.00
	After working hours	$80.00
Non-emergency Customer Requested Disconnect (includes reconnection during working hours*) *A surcharge of $160.00 will be assessed to reconnect service that has been voluntarily turned off by the owner.		$40.00

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix V

2015 Memorandum re: A Resolution Increasing Water System Development Charges

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MEMORANDUM

TO: HONORABLE MAYOR AND CITY COUNCIL

FROM: CITY MANAGER JERALD P. TAYLOR

RE: RESOLUTION INCREASING WATER SYSTEM DEVELOPMENT CHARGES

DATE: SEPTEMBER 2, 2015

RECOMMENDED ACTION:

Move to approve Resolution 15-___ (A Resolution Increasing Water System Development Charges) which will increase the water system development charges from the current rate of $6,600 to a rate of $6,900.

BACKGROUND INFORMATION:

In August of 2010, the City Council adopted Resolution 10-08 which adopted the Water System Capital Improvement Plan and System Development Charge Methodology Update as submitted by Curran-McLeod, Inc. This document identified a maximum system development charge (SDC) for water of $6,040 based on the projected number of new connections and the estimated costs of the water system improvements needed to serve these new connections. The Council set the SDC at $6,040.

The construction cost figures and thus the SDC were recommended in the Plan to be adjusted annually to reflect the increased cost of building these improvements. The Engineering News Record (ENR) Construction Cost Index was adopted in the report as the measure of these cost increases. The ENR Construction Cost Index is published monthly.

Since the time the SDC was last adjusted by Resolution 13-09 in October of 2013, the ENR Construction Cost Index has risen over 4.5 percent. Increasing the SDC strictly using the methodology of the Plan would raise the SDC to $6,990. Staff is recommending that the water SDC be raised to $6,900.

If questions are raised, please note that the methodology for setting the SDC is not being changed, but merely the cost figures used in the formula. Public comments on this increase should be solicited to avoid any challenge of the SDC. However, the way that the charge is calculated is not being changed, just the cost figures.

RESOLUTION NO. 15-______

A RESOLUTION INCREASING WATER SYSTEM DEVELOPMENT CHARGES

WHEREAS, the City desires to maintain System Development Charges which are adequate for new development to pay its share of needed future capital improvements; and,

WHEREAS, Resolution 10-08 adopted the Water System Capital Improvement Plan and System Development Charge Methodology Update as submitted by Curran-McLeod, Inc. dated June, 2010; and,

WHEREAS, the above mentioned report provides for periodic updates to account for actual inflation in the costs presented in the report as measured by the Engineering News Record (ENR) Construction Cost Index; and,

WHEREAS, Resolution 13-09 adopted October 9, 2013 adjusted the system development charges using this methodology; and

WHEREAS, the ENR Construction Cost Index has increased more than 4.5 percent since the adoption of Resolution 13-09; now, therefore,

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF MANZANITA:

<u>Section 1.</u> Effective September 10, 2015, Water System Development Charges for all areas served by the City of Manzanita shall be $6,900.00.

PASSED by the City Council and signed by me in authentication of its passage this 9th day of September, 2015.

____
Garry R. Bullard, Mayor

ATTEST:

____
Jerald P. Taylor, City Manager/Recorder

City of Manzanita
Water Master Plan Update
Manzanita, Oregon

Appendix W

Oregon Water & Wastewater Funding and Resource Guide
RCAC, 2016

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2016

OREGON WATER & WASTEWATER FUNDING AND RESOURCE GUIDE

Compiled by:

RCAC
www.rcac.org

Oregon Water & Wastewater Funding and Resource Guide
March 2016

Background and Purpose	Rural Community Assistance Corporation (RCAC), a private nonprofit organization serving 13 states in the West and the Pacific islands, provides training, technical and financial resources and advocacy so rural communities can achieve their goals and visions. RCAC works with funding and regulatory agencies and partners to address utility compliance issues for lower income rural communities. The RCAC Oregon Water Wastewater Funding and Resource Guide is an easy to use document that identifies water and wastewater funding programs, agencies and organizational resources. RCAC hopes that this guide will be used as a tool to help you move forward with water and wastewater infrastructure projects in your community**.**
Scope	The guide provides information on primary agency funding programs that support planning, predevelopment and construction of drinking water and wastewater infrastructure projects. It also includes information on resources available to help communities complete drinking water and wastewater projects, address regulatory compliance, protect drinking water, improve water quality and local public health. Additional resources may be available. Please contact RCAC to suggest a resource to include in this guide.
Contents	o Agencies serving water/wastewater needs for small Oregon communities o Funding programs for water and wastewater projects
Key Project Stages	➢ Planning ➢ Predevelopment ➢ Engineering and Design ➢ Construction

This publication was made possible by Grant Number 90EF0069-04-00 from Health and Human Services and Rural Community Development Activities Program. Rural Community Assistance Corporation (RCAC) compiled the information in this guide in partnership with other agencies and organizations. RCAC is the western Rural Community Assistance Partnership, Inc. (RCAP) affiliate.

For more information on RCAC, visit: www.rcac.org

RCAC
www.rcac.org

Agencies Serving Water/Wastewater Needs of Small Oregon Communities

U.S. Environmental Protection Agency EPA Region 10 Oregon Operations Office 805 SW Broadway, Suite 500 Portland, OR 97205 Joel Salter Oregon Water Programs Coordinator Phone: (503) 326-2653 Email: Salter.Joel@epa.gov **Drinking Water SRF Site:** http://yosemite.epa.gov/r10/water.nsf/Drinking+Water/State+Revolving+Fund **Clean Water SRF Site:** http://yosemite.epa.gov/R10/ecocomm.nsf/state+revolving+fund/cwsrf	**U.S Department of Agriculture Rural Development (USDA RD)** 1220 SW 3rd Avenue, Suite 1801 Portland, OR 97204 Sam Goldstein, Community Programs Director Phone: (503) 414-3362 Email: Sam.goldstein@or.usda.gov Website: http://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program/or
U.S. Department of Health and Human Services Portland Area Indian Health Service 1414 NW Northrup Street, Suite 800 Portland, OR 97209 Phone: (503) 414-5555 Website: www.ihs.gov	**U.S. Department of Commerce Economic Development Administration (EDA)** 121 SW Salmon Street, Suite 244 Portland, OR 97204 David Porter, Economic Development Representative Phone: (503) 326-3078 Email: dporter@eda.doc.gov
Oregon Health Authority (OHA) Drinking Water Services PO Box 14450 Portland, OR 97293-0450 Phone: (971) 673-0422 Website: http://healthoregon.org/dwp Dave Leland, Program Manager, (971) 673-0415 Adam DeSemple, Safe Drinking Water Revolving Loan Fund, (971) 673-0422 Tony Fields, Planning Protection & Certification Manager, (971) 673-2269 Debra Lambeth, Environmental Review Coordinator, (971) 673-0414 Tom Pattee, Groundwater Protection, (541) 726-2587 x 24 Kari Salis, Technical Services Region 1, (971) 673-0423 Casey Lyon, Technical Services Region 2, (541) 726-2587 x 31 Julie Wray, Plan Review, (971) 673-0408	**Oregon Business Development Department (OBDD)** Infrastructure Finance Authority (IFA) 775 Summer St. NE, Suite 200 Salem, OR 97301-1280 Phone: (503) 986-0123 Email: infrastruture.info@state.or.us Website: www.orinfrastructure.org

Agencies Serving Water/Wastewater Needs of Small Oregon Communities *Continued*	
Oregon Department of Environmental Quality (DEQ) 811 SW Sixth Avenue Portland, OR 97204-1390 *After October at:* 700 NE Multnomah Street, Suite #600 Portland, OR 97232 **Clean Water State Revolving Fund (CWSRF)** Phone: (503) 229-LOAN Email: CWSRFinfo@deq.state.or.us Website: www.deq.state.or.us/wq/loans/loans.htm	**Rural Community Assistance Corporation (RCAC)** 1020 S.W. Taylor Street Suite 450 Portland, OR 97205 Chris Marko, Rural Development Specialist (503) 228-1780 cmarko@rcac.org RosAnna Noval, Rural Development Specialist (503) 308-0207 rnoval@rcac.org Website: www.rcac.org

Additional Resources for Water and Wastewater Needs	
Association of Oregon Counties 1201 Court St NE Suite 300 Salem, OR 97301 Laura Cleland Phone: (503) 585-8351 Website: www.aocweb.org	**League of Oregon Cities** 1201 Court St. NE, Suite 200 Salem, OR 97301 Susan Muir Phone: (503) 588-6550 Website: www.orcities.org
Special Districts Association of Oregon PO Box 12613 Salem, OR 97309 Phone: (503) 371-8667 Website: www.sdao.com Luann Richey, (503) 371-8667 x 113	**Oregon Water Resources Department** 725 Summer Street NE, Suite A Salem, OR 97301 Phone: (503) 986-0900 Website: www.oregon.gov/owrd
Oregon Association of Water Utilities 935 N Main Street Independence, Oregon 97351 Phone: (503) 837-1212 Website: www.oawu.net	**Oregon Watershed Enhancement Board** 775 Summer St. NE Suite 360 Salem, OR 97301 Phone: (503) 986-0178 Website: www.oregon.gov/OWEB

Federal Regulatory Information:

Safe Drinking Water Act (SDWA): www.epa.gov/safewater/sdwa

Clean Water Act (CWA): http://www.epa.gov/oecaagct/lcwa.html

National Pollutant Discharge Elimination System (NPDES): http://cfpub.epa.gov/npdes/cwa.cfm?program_id=45

FUNDING PROGRAMS FOR WATER AND WASTEWATER PROJECTS IN OREGON

Planning and Predevelopment

Program	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
OBDD Infrastructure Finance Authority (IFA) **Community Development Block Grant (CDBG)**	Preliminary engineering and planning – water master plans, wastewater facilities plans, water conservation and management plans, capital improvement plans, inflow and infiltration studies. Final engineering – preliminary engineering reports, studies	Projects must principally benefit low to moderate income people in non-entitlement cities and counties. Projects must serve primarily residential needs, not primarily for capacity building.	• Grants up to $175,000 for preliminary engineering and planning • Grants up to $3,000,000 for final design engineering and construction	Competitive applications are accepted year-round and reviewed quarterly. All awards are subject to funding availability. Contact the Oregon Business Development Department (OBDD) at (503) 986-0123 and ask for your regional coordinator, or view program details at: www.orinfrastructure.org
OBDD IFA **Special Public Works Fund (SPWF)**	Preliminary engineering studies; and economic investigations related to municipal utility projects (water, wastewater, stormwater)	Cities, counties, county service districts (ORS Chapter 451), Tribes, ports, & districts (ORS 198.010)	• Grants up to $60,000 or 85% of project costs. • Loans available at reduced interest rates/7-year term.	Apply year-round based on funding availability. Contact OBDD at (503) 986-0123 and ask for your regional coordinator or view program details at: www.orinfrastructure.org
OBDD IFA **Water Wastewater (WWF)**	Preliminary planning, engineering studies and economic investigations in preparation for construction projects that address an existing or pending compliance issue.	Cities, counties, county service districts (ORS Chapter 451), tribes, ports and districts (ORS 198.010). For a population of less than 15,000 with a Notice of Non-compliance or potential notice.	• Grants up to $20,000 • Loans up to $20,000	Apply year-round based on funding availability. Contact OBDD at (503) 986-0123 and ask for the regional coordinator or view program details at: www.orinfrastructure.org
Oregon Association of Water Utilities (OAWU) **National Rural Water Association Revolving Loan Fund**	Financing for predevelopment costs associated with proposed water and wastewater projects. RLF funds can also be used with existing water/wastewater systems and the short term costs incurred for replacement equipment, small scale extension of services or other small capital projects that are not part the utility's regular operations and maintenance.	Public entities, including municipalities, counties, special purpose districts, Native American Tribes and nonprofit corporations, including cooperatives, with up to 10,000 population and rural areas with no population limits.	• Loans up to $100,000 or 75% of the total project costs, whichever is less. Maximum repayment period of 10 years. Fidelity bond insurance is required of all applicants. • 5 year, % only, pre-development loans are available. • 90 day, no %, disaster area	Contact OAWU at office@oawu.net or by phone at (503) 837-1212, or applications, information and forms are available for download at www.nrwa.org. Applications can be emailed to nrwarlf@nrwa.org or mailed to: NRWA-RLF, 2915 S. 13th, Duncan, OK 73533.

Program	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
			emergency loans with immediate turn around are also available. • Loans will be made at the lower of the poverty or market interest rate as published by RUS, with a minimum of 3% at the time of closing. Current RUS rates are available at www.usda.gov/rus/water/int-rate.htm • As a minimum, a promissory note or comparable document authorized by the governing body will be required.	
Oregon Water Resources Department (OWRD) **Feasibility Study Grants (Water Conservation, Reuse, and Storage Grant Program)**	Project planning studies performed to evaluate the feasibility of developing water conservation, reuse or storage projects. Eligible project elements include: • Water needs analyses; • Hydrological analyses; • Engineering and financial feasibility studies; • Geologic analyses; • Water exchange studies; • Analyses of by-pass, optimum peak, flushing and other ecological flows of the affected stream and the impact of a proposed project on those flows; • Analyses of environmental harm/impacts and/or public benefits	Persons, corporations, public and municipal corporations, political subdivisions, Indian tribes, and others as described in ORS 536.007.	• Grants up to $500,000 per project, depending on funding availability. • Grants require a dollar-for-dollar cost-match, which may include in-kind contributions.	Competitive applications accepted during open cycles announced at: http://www.oregon.gov/owrd/Pages/LAW/conservation_reuse_storage_grant_program.aspx All awards are subject to funding availability. OWRD contact: Jon Unger at (503) 986-0869 or email: fsgrants@wrd.state.or.us

Program	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
USDA-Rural Development Pre-development Planning Grant (PPG)	Water and/or wastewater planning; preliminary engineering reports, environmental reports, and other work to assist in developing a project that is expected to be funded by RD in the next 12 – 18 months.	Public bodies (such as municipality, county, district or authority); nonprofit organizations, and Indian tribes. Priority given to the smallest and poorest communities and systems with limited resources.	• Maximum $30,000 grant or 75% of project costs, whichever is less.	Apply year-round based on funding availability. Contact USDA-Rural Development Oregon State Office at (503) 414-3360 and ask for your regional loan specialist or view program details at: http://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program/or
USDA-Rural Development Special Evaluation Assistance for Rural Communities and Households **(SEARCH)**	Water and/or wastewater planning, preliminary engineering reports, environmental reports, and other work to assist in developing a project that is expected to be funded by RD in the next 12-18 months.	Public bodies (such as municipality, county, district, or authority); non-profit organizations and Indian tribes serving financially distressed communities with service area populations <2,500.	• Maximum $30,000 grant or 100% of project costs, whichever is less	Apply year-round based on funding availability. Contact USDA-Rural Development Oregon State Office at (503) 414-3360 and ask for your regional loan specialist or view program details at: www.cfda.gov (Number 10.759)
USDA-Rural Development Emergency and Imminent Community Water Assistance Grant (ECWAG) CFDA 10.763	Projects may include emergency and permanent repairs, replacement or significant maintenance to water systems resulting from a sudden and unexpected event such as an act of nature resulting in a significant decline in water quality or quantity.	Applicants may include Public bodies, non-profit organizations and Indian tribes serving populations < 10,000.	• 100% grant ranging from $150,000-$500,000 often with minimal predevelopment expense.	Contact USDA-Rural Development, Oregon State Office at (503) 414-3360 and ask for your regional loan specialist or view program details at: http://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program/or
Rural Community Assistance Corp. Loan Fund Feasibility and Predevelopment	Water and/or wastewater planning; environmental work; and other work to assist in developing an application for infrastructure improvements	Nonprofit organizations, public agencies and tribal governments serving rural areas with a population of 50,000 or less; or 10,000 if guaranteed by RD financing	• Max $50,000 for feasibility loan • Max $350,000 for predevelopment loan • 1 year term • Interest rate @ 5.5%	Applications accepted anytime Contact: Chuck Miller at (360) 253-7683 or cmiller@rcac.org. Applications available on-line at www.rcac.org

Program	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
EDA Technical Assistance Grants Feasibility Studies	EDA's mission is to help economically distressed communities in ways that help them build long-term economic development capacity. Projects must foster the creation or retention of higher-skilled, higher-wage employment opportunities for local displaced workers and attract private-sector capital investment.	Indian Tribes; state, county, city or other political subdivisions of a state; institutions of higher education; public or private non-profit organizations or associations	• $50,000 to $75,000 • Local match required • Grant funds received from other Federal Agencies may **not** be used to satisfy local share match.	Visit agency website at www.eda.gov and review latest "Federal Funds Announcement" (FFO). Submit application through www.grants.gov
Clean Water State Revolving Fund (CWSRF)	Loans are available for planning and design projects associated with: publicly owned wastewater treatment and stormwater facilities and systems, non-point source water quality improvement projects and estuary management projects.	Federally recognized tribal governments, cities, counties, sanitary districts, soil and water conservation districts, irrigation districts, various special districts and certain intergovernmental entities.	• Loan only • Up to 5 years • Substantially discounted interest rate • No annual fee	Applications accepted year round with scheduled review and ranking in February, June and October. Contact the Oregon Department of Environmental Quality (DEQ); call Katie Foreman at (503) 229-5622.

FUNDING PROGRAMS FOR WATER AND WASTEWATER PROJECTS IN OREGON

Construction

Program	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
OBDD IFA **Community Development Block Grant (CDBG)**	All projects must be in accordance with an approved water plan or wastewater plan. Eligible activities include: construction engineering; acquisition of property (including easements); grant administration; and audits. Projects addressing an existing or pending compliance issue will score higher.	Projects must principally benefit low to moderate income people in non-entitlement cities and counties. Projects must serve primarily residential needs and not be for capacity building.	• Maximum Grant of $3 million, subject to the maximum $3 million per project limitation during a five-year period. • Single grant may be awarded to cover final engineering and construction.	Competitive applications accepted year-round and reviewed quarterly. All awards are subject to funding availability. Contact OBDD at (503) 986-0123 and ask for your regional coordinator or view program information at www.orinfrastructure.org
OBDD IFA **Special Public Works Fund (SPWF)**	Planning for raising and managing funds, pre-construction and construction of water, wastewater, stormwater projects. Projects must be publically owned and support economic and community development in Oregon.	Cities, counties, county service districts (ORS Chapter 451), tribes, ports and districts (ORS 198.010)	• Primarily a loan program • Maximum $10 million loan • 25 year term maximum. • Grants based on retention or creation of jobs, up to max. of $5,000 per job • Grants cannot exceed $500,000 or 85% of the project cost, whichever is less	Apply year-round, based on funding availability. Contact OBDD at (503) 986-0123 and ask for your regional coordinator or view program details at www.orinfrastructure.org
OBDD IFA **Water Wastewater Financing (WWF)**	Planning, pre-construction, and construction improvements of drinking water, wastewater, or stormwater projects. Projects must be publically owned and address an existing or pending compliance issue.	Cities, counties, county service districts (ORS Chapter 451), tribes, ports, & districts (ORS 198.010)	• Maximum $10 million loan • 25 year term maximum • Grant eligibility based on median household income • Maximum $750,000 grant	Competitive applications are accepted year-round and reviewed quarterly. All awards are subject to funding availability. Contact OBDD at (503) 986-0123 and ask for your regional coordinator, or view program details at www.orinfrastructure.org

Program	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
Oregon Association of Water Utilities (OAWU) **National Rural Water Association Revolving Loan Fund**	Financing for predevelopment costs associated with proposed water and wastewater projects. RLF funds can also be used with existing water/wastewater systems and the short term costs incurred for replacement equipment, small scale extension of services or other small capital projects that are not part the utility's regular operations and maintenance.	Public entities, including municipalities, counties, special purpose districts, Native American Tribes and nonprofit corporations, including cooperatives, with up to 10,000 population and rural areas with no population limits.	• Loans up to $100,000 or 75% of the total project costs, whichever is less. Maximum repayment period of 10 years. Fidelity bond insurance is required of all applicants. • 5 year, % only, pre-development loans are available. • 90 day, no %, disaster area emergency loans with immediate turn around are also available. • Loans will be made at the lower of the poverty or market interest rate as published by RUS, with a minimum of 3% at the time of closing. Current RUS rates are available at www.usda.gov/rus/water/int-rate.htm • As a minimum, a promissory note or comparable document authorized by the governing body will be required. •	Contact OAWU at office@oawu.net or by phone at (503) 837-1212, or applications, information and forms are available for download at www.nrwa.org. Applications can be emailed to nrwarlf@nrwa.org or mailed to: NRWA-RLF, 2915 S. 13th, Duncan, OK 73533.

Program	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
Oregon Health Authority **Safe Drinking Water Revolving Loan Fund (SDWRLF)**	Drinking water system projects must resolve *existing* or *future* non-compliance with *current* or *future* state and federal drinking water standards, that addresses the most serious human health risks, or that is essential to create a new drinking water system improvement that will substantially benefit public health. *Eligible Activities:* Planning, engineering, design, water source construction, land or easement acquisition, treatment, storage, transmission/distribution, system purchase, system consolidation, system creation, system security, restructuring	Public and privately owned community and non-profit non-community public water systems. Federally owned systems are not eligible. *Ineligible Activities:* Dams or rehabilitation of dams, water rights, raw water reservoirs or rehab of raw water reservoirs, projects primarily needed to address fire protection, and projects primarily needed to serve future population growth.	• Projects requesting $3 million or more require additional review and approval from the Drinking Water Advisory Committee • Interest rate fluctuates quarterly (set at 80% of the previous quarters municipal bond rate) • 20-year term maximum • 30-year term maximum for disadvantaged communities • Principal Forgiveness • Green Project Reserve (GPR) financial incentive • Circuit Rider assistance for eligible systems under 10,000 in population	A Letter of Interest (LOI) may be submitted anytime to be eligible for funding consideration. Contact Oregon Health Authority's Drinking Water Services at (971) 673-0405 or go to the OHA website: http://healthoregon.org/srf You may also contact Business Oregon's Infrastructure Finance Authority (IFA) at (503) 986-0123 or visit their website at: http://www.orinfrastructure.org/LOI-Form/ to take you directly to the LOI.
Oregon Health Authority **Drinking Water Source Protection Fund (DWSPF)**	Drinking Water Source Protection projects that lead to risk reduction within a delineated source water area or that would contribute to a reduction in contaminant concentration within the drinking water source.	Any public and privately owned community and non-profit non-community water systems with a completed Source Water assessment. Federally owned systems are not eligible.	• Max $30,000 Grant • Max $100,000 loan • Interest rate fluctuates quarterly (set at 80% of previous quarter's municipal bond rate). • 20 year term • 30-year term maximum for disadvantaged communities	A letter of interest must be submitted to be eligible for funding consideration. Check with OHA on submittal schedule. Contact Oregon OHA Drinking Water Services at (971) 673-0405 or visit http://healthoregon.org/srf or contact OBDD at (503) 986-0123 or visit www.orinfrastructure.org
Oregon Health Authority (OHA) **Sustainable Infrastructure Planning Projects (SIPP)**	Drinking water system projects that include planning activities that promote sustainable water infrastructure. Priority will be given to those systems serving fewer than 300 service connections and/or are considered disadvantaged communities.	Public and privately owned community and non-profit non-community public water systems. Federally owned systems are not eligible.	• Funding up to $20,000 per project (above $20,000 is based on approval and availability of funds) • 100% Forgivable Loan • Total funds available for all projects $300,000 • No more than one award per	A letter of interest must be submitted to be eligible for funding consideration. Check with OHA on submittal schedule. Contact Oregon OHA Drinking Water Services at (971) 673-0405 or visit

Program	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
	Eligible Activities: Feasibility studies, asset management plans, system partnership studies, resilience plans, water rate analysis, leak detection studies, and water system master plans for for systems with fewer than 300 connections. *Ineligible Activities:* Construction or engineering/design.		community / water system • Water system must complete project within 1 year • 25% of the awarded funds can go towards the required community engagement & AM requirements set by IFA.	http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/SRF/Pages/index.aspx or contact Infrastructure Finance Authority (IFA) at (503) 986-0123 or visit http://www.orinfrastructure.org/
Oregon Water Resources Department (OWRD) **Water Projects Grants and Loans (Water Supply Development Account)**	Grants and loans to evaluate, plan, and develop water resource projects with economic, environmental, AND community (social/cultural) benefits. Eligible projects include but are not limited to those water resource projects that: • Increase water use efficiency • Develop new or expanded storage • Promote water reuse or conservation • Protect or restore stream flows • Determine seasonally varying flows	Persons, corporations, public and municipal corporations, political subdivisions, Indian tribes, nonprofit organizations and others as described in ORS 536.007.	• Applicants may apply for a grant or loan. • Grants require a minimum 25% cost-match, which may include cash or in-kind contributions. • Interest on loans shall be at reasonable rates as determined by the Water Resources Commission. Loan terms are a maximum of 50 years but cannot exceed the estimated life span of the project.	Competitive applications accepted year-round and reviewed annually. All awards are subject to funding availability. View program details at: http://www.oregon.gov/owrd/Pages/LAW/conservation_reuse_storage_grant_program.aspx OWRD contact: Jon Unger at (503) 986-0869 or email: Jon.J.Unger@wrd.state.or.us.
Clean Water State Revolving Fund (CWSRF)	Loans and bond purchase agreements are available for planning, design, and construction projects associated with: publicly owned wastewater treatment and stormwater facilities and systems, non-point source water quality improvement projects and estuary management projects. Interim financing is also available.	Indian tribal governments, cities, counties, sanitary districts, soil and water conservation districts, irrigation districts, various special districts and certain intergovernmental entities.	• Lower than market interest rates • Fixed interest rates • Terms up to 30 years • Up to 100% of eligible costs covered • No match required • Repayment begins after project is constructed • No pre-payment penalty • Additional financial incentives, including principle forgiveness	Applications accepted year round with scheduled review and ranking in the first week of January, May and September. Contact the Oregon Department of Environmental Quality (DEQ): call (503) 229-LOAN; email CWSRFinfo@deq.state.or.us or contact your local project officer http://www.deq.state.or.us/wq/loans/contacts.htm

Program	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
USDA-Rural Development Water Environmental Programs (WEP) Direct Loan & Grant Program	Pre-construction & construction associated with constructing, repairing, or improving water, sewer, solid waste or storm wastewater disposal facilities.	Public bodies (such as municipality, county, district, or authority); nonprofit organizations and Indian tribes serving communities with service area populations<10,000.	• Primarily loan program • Grants based on need • Interest rates track AA rated 20 yr. muni. bonds and fixed for life of loan • Lower income communities receive an interest rate subsidy • Up to 40-year loan term	Apply year-round based on funding availability. Contact USDA-Rural Development, Oregon State Office at (503) 414-3360 and ask for your regional loan specialist or view program details at: http://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program/or
RCAC Loan Fund **Construction**	Water, wastewater, solid waste and storm facilities that primarily serve low income rural communities. Includes predevelopment costs	Non-profit organizations, public agencies, and tribal governments rural areas with populations of 50,000 or less, or 10,000 if using RD financing as the takeout	• Max $2 million with commitment letter for permanent financing • Security in permanent loan letter of conditions • 1-3 year term • 1% loan fee • Interest rate 5.5%	Applications accepted anytime Contact: Chuck Miller at (360) 253-7683 or cmiller@rcac.org. Applications available on-line at www.rcac.org
RCAC Loan Fund **Intermediate Term Loans**	Water, wastewater, solid waste and storm facilities that primarily serve low income rural communities. Includes predevelopment costs	Non-profit organizations, public agencies, and tribal governments rural areas with populations of 50,000 or less; or 10,000 if using RD financing as the takeout	• For smaller capital needs projects • Normally not to exceed $100,000 • Up to 20 year term • Interest rate 5.0%	Applications accepted anytime Contact: Chuck Miller at (360) 253-7683 or cmiller@rcac.org. Applications available on-line at www.rcac.org
US Economic Development Administration **Public Works Grants**	EDA's mission is to help economically distressed communities in ways that help them build long-term economic development capacity. Projects must foster the creation or retention of higher-skilled, higher-wage employment opportunities for local displaced workers and attract private-sector capital investment.	Indian Tribes; state, county, city or other political subdivisions of a state; institutions of higher education; public or private non-profit organizations or associations	• Public Works grant awards are in the range of $500,000 – $2,500,000 with 50% local matching funds required. • Grant funds received from other Federal Agencies may not be used to satisfy local share match.	Visit agency website at www.eda.gov and review latest "Federal Funds Opportunities" (FFO). Submit application through www.grants.gov