PUBLIC HEALTH DIVISION
Drinking Water Services
Kate Brown, Governor

Oregon Health Authority

800 NE Oregon Street, #640
Portland, OR 97232-2162
Phone: 971-673-0191
Fax: 971-673-0694
www.healthoregon.org/DWP

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.

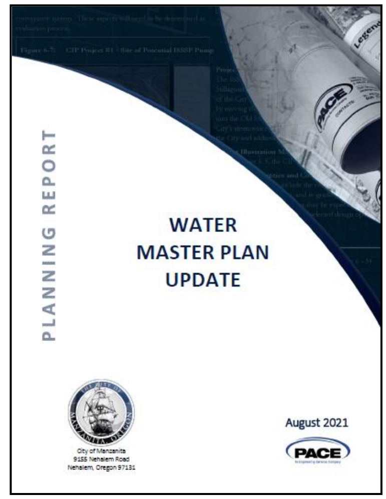
Thank you for your efforts in developing the Master Plan and if you have any questions, please feel free to call me at (971) 200-0288 or e-mail me at evan.e.hofeld@dhsoha.state.or.us.

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

Master Plan Overview:



The *August 2021 Water Master Plan Update* ("Master Plan") completed by PACE Engineers covers a 20-year planning horizon to the year 2040 for most facilities and a 50-year horizon for seismic planning. The Master Plan includes a system description, condition assessment, demand estimates, *InfoWare* hydraulic model results (see inset), and a seismic risk assessment (see the January 2019 *Water System Resilience Study* completed by BergerABAM included in Appendix A of the Master Plan). The Master Plan also identifies improvements and a prioritized (high-2021-2025, medium-2026-2030, and low-2031-2040) list of capital improvement plan (CIP) projects to address deficiencies and meet specified levels of service, asset management, and seismic mitigation goals. Planning-level construction cost estimates are also provided and are indexed to Engineering News Record (ENR) Construction Cost Index (CCI) for the June 2021, ENR CCI of 12112 (costs in the Plan can be updated in the future by multiplying the Master Plan cost by the current index value and dividing by 12112, which is an approach generally valid for a 2 to 3-year period, after which the costs should be updated by an engineer). Estimated project costs add 20% for contingencies (e.g. 0.2 x construction cost), 20-25% for design, and 5% for legal/administration costs. An analysis of existing revenue streams and potential funding options are provided in Section 8.

***Hydraulic Model Results** were inconclusive due to potential inaccurate flow test data needed to calibrate the model. 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.*

Water System Overview:

The City of Manzanita is a coastal community located in Tillamook County approximately 26 highway miles north of the City of Tillamook. Manzanita (PWS ID #41-00505) 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 (PWS ID #41-00952); 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.

Currently there are 1,761 metered connections of which 1,673 are active residential service connections in the City of Manzanita. 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. Demand estimates are shown in Table ES-1.

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 also included new pumps to deliver the finished water to the City.

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

Major Water Facility Findings/Recommendations:

(Identified as an independent reviewer and not necessarily inclusive of all recommendations in the Master Plan)

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 by enhanced erosion associated with higher wave action. Of greater concern is the **potential for lower stream flows associated with hotter, drier summers. 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 as a result of seismic events.

Manzanita is located near the Cascadia Subduction Zone (CSZ) and could potentially sustain a magnitude 9 earthquake and related tsunami. Recurrence interval on very large quakes along the Oregon coast is approximately 300 – 800 years. 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. The yellow shaded areas in the latest [DOGAMI Tsunami inundation map]() from 7/12/12 shows the tsunami inundation zone based on the largest CSZ event. The purple shaded areas represent smaller seismic events. Although many of the water assets are buried underground, ground subsidence is anticipated to occur in the 3 to 5-ft range, which can cause pipelines to shift and shear. Portions of the system that are aboveground will likely be destroyed and the debris and damage left behind will make access and repair very challenging.

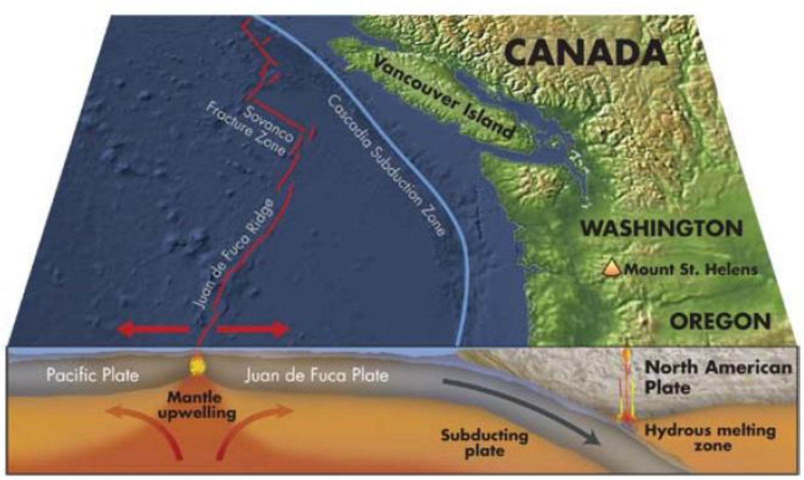
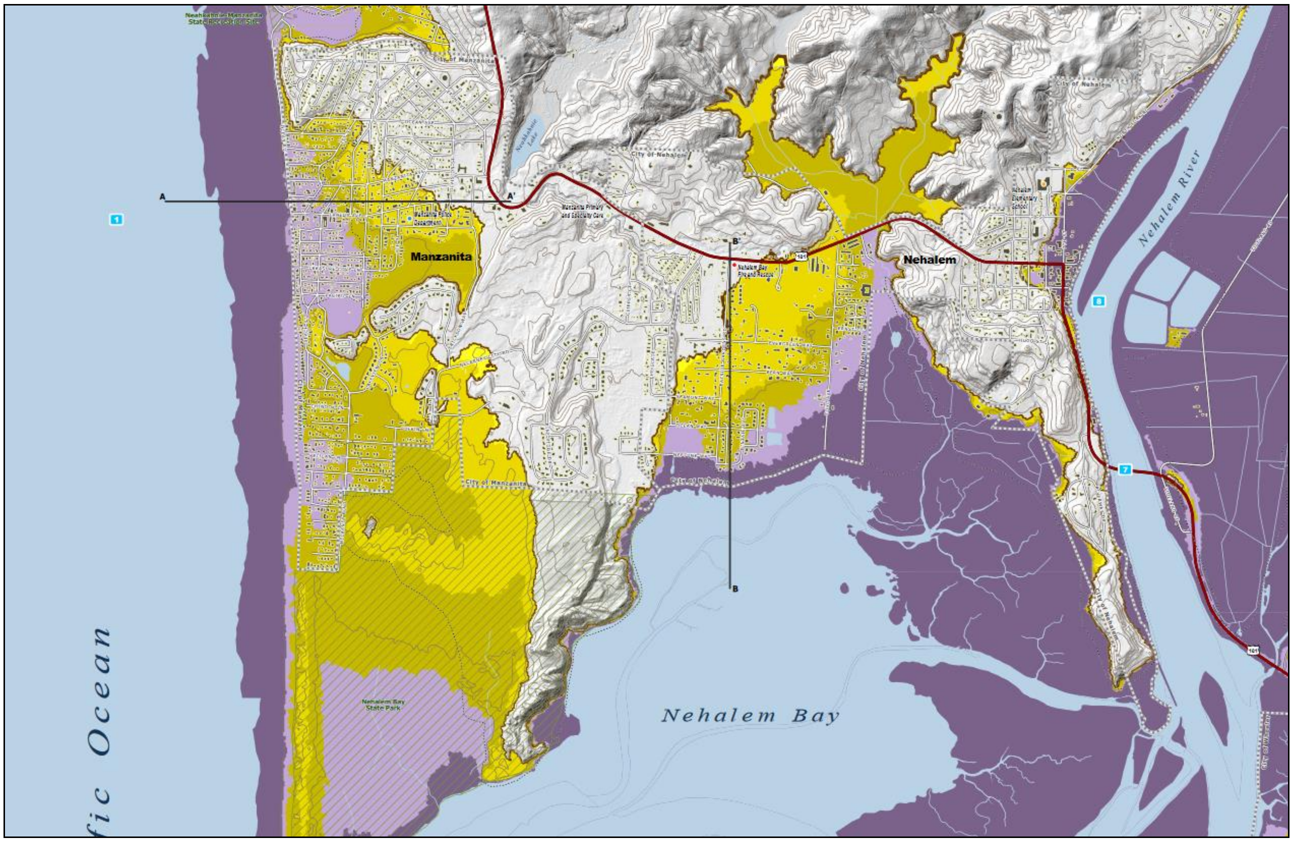
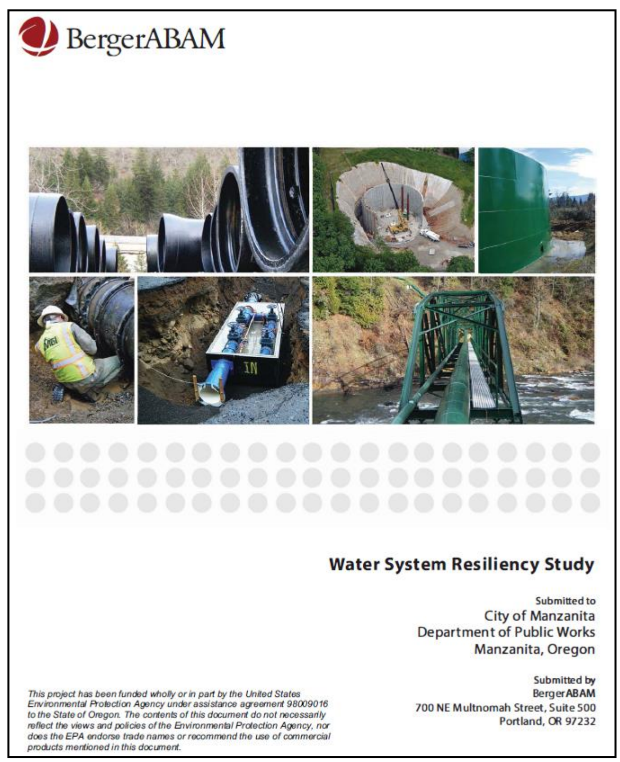


Figure 1-1. Cascadia Subduction Zone (CSZ)



DOGAMI Tsunami inundation map from 7/12/12

The City helped prepare a Water System Resiliency Study in 2018 by BergerABAM. A copy of the study is included in Appendix A. Exhibits in the study include earthquake, landslide impacts, and other hazard maps for the City. 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 (Figure 4-2) associated with a moderate seismic event and Tsunami inundation is a concern in the lower elevations in the City. **Refer to the Tillamook County Multi-Jurisdiction Natural Hazards Mitigation Plan adopted Sept. 2017, which addresses all significant natural hazards (not just a CSZ event) and contains hazard assessments specifically for the City of Manzanita and surrounding areas. Also refer to the Oregon Resilience Plan (ORP), which is a statewide assessment and planning guide focused solely on the impacts and planning needed for a CSZ event.**



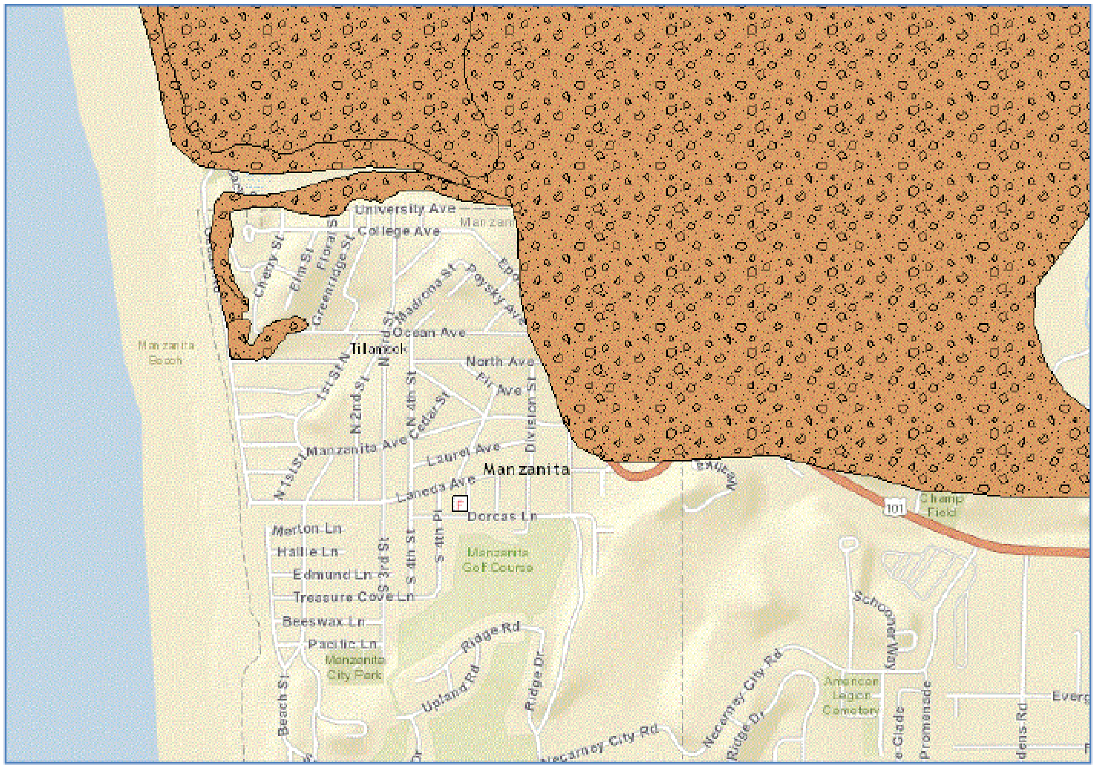


Figure 4-2. Landslide risk areas to the north

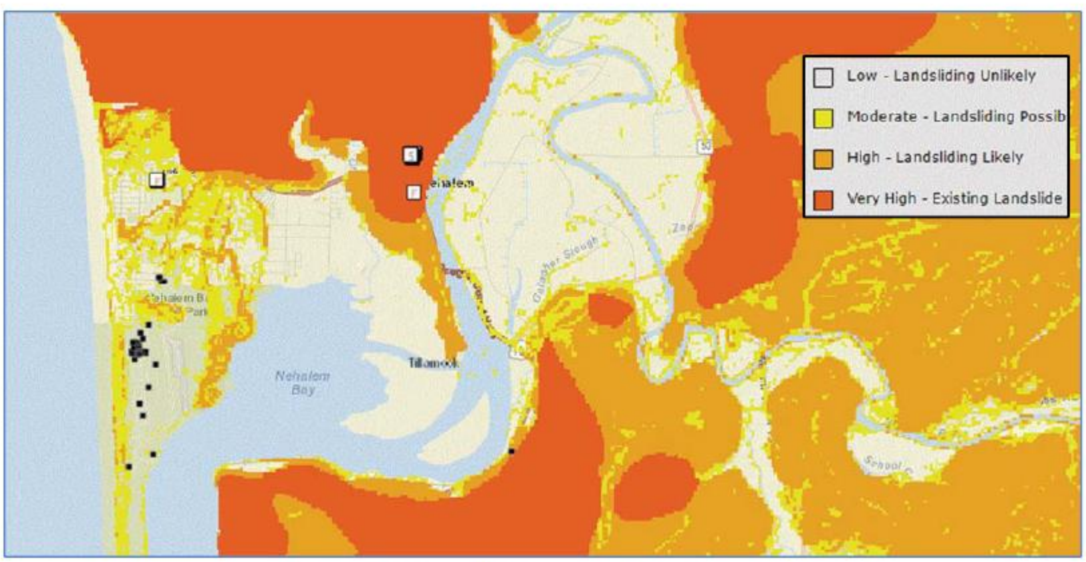


Figure 5-1 Landslide risk areas (broader area)

Overall reliability and resiliency issues associated with the water system are discussed in Appendix A. Appendix A also details recommended improvements associated with the transmission main from the wells to Manzanita, which are also summarized in section 6.7.1.1 of the Master Plan. These measures are intended to improve the resiliency of the backbone water system that conveys water from the wells to Manzanita's reservoirs. The following passages are excerpts from the 2018 BergerABAM report in Appendix A.

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.

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 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.

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.

Section 7.0 of the BergerABAM report lists recommended improvements to mitigate seismic impacts.

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.

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.

Referring back to the main body of the Master Plan…

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 regarding water quality other than diligence in meeting all applicable regulatory requirements. There are several theories regarding the source of excess air causing white or cloudy water** - 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. A **follow-up study of the whitewater issue is recommended and should be pursued with a qualified engineer on a time and materials basis**. 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 whitewater problem and the relatively low hydrant flows.

From an infrastructure standpoint, capacity of the water supply system is generally adequate for Manzanita and the Joint Water System during the planning period.

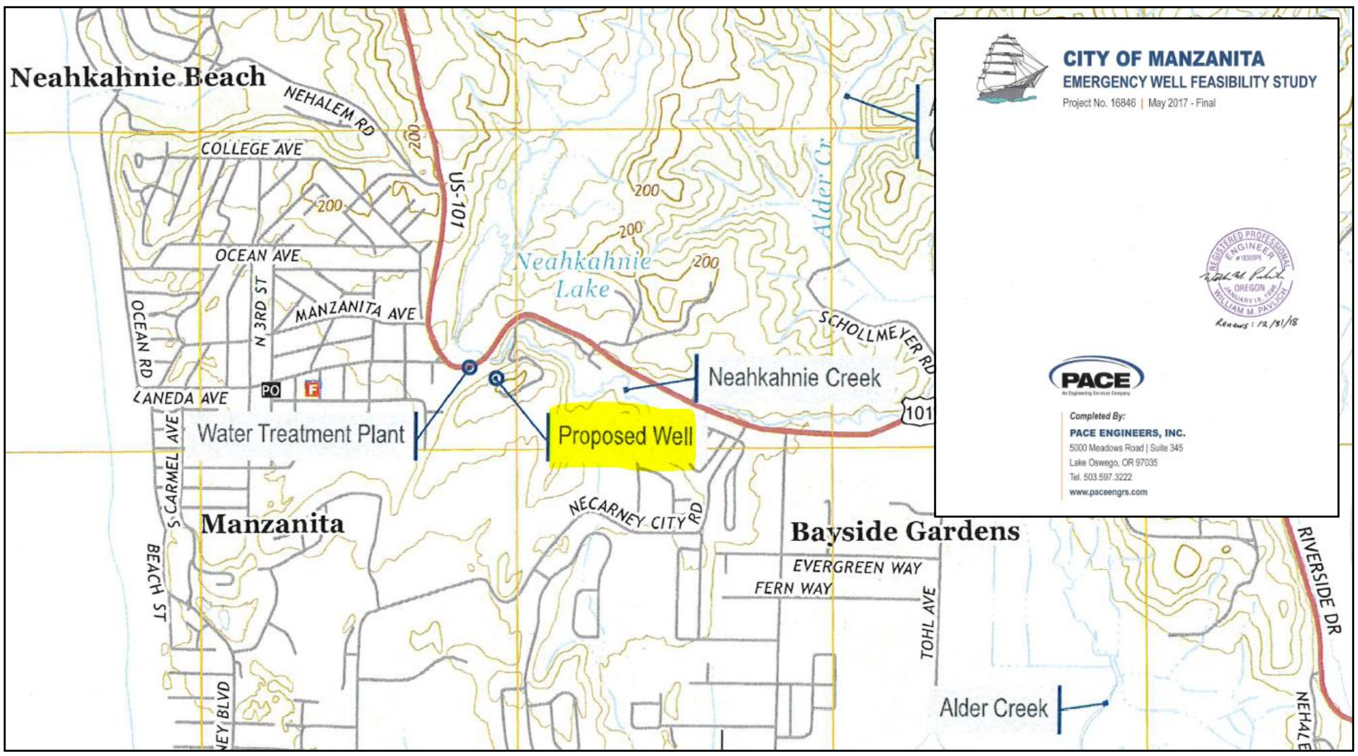
Although the City historically relied on surface water sources, the City currently relies on water supplied by two wells, constructed in 2003, that also provide water for the City of Wheeler. Well No. 1 and Well No. 2 are currently the only sources utilized for Manzanita's water supply and will likely be the primary source through the planning period. **Recent upgrades to the wells, treatment, and supply capabilities included a 50 percent increase in capacity and 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 water right permit extension process.

Treatment at the wells is currently limited to carbon dioxide removal, disinfection, and corrosion control. The City is installing a new hypochlorite disinfection system to replace the old MIOX onsite mixed oxidant disinfection system. **There are no water quality issues or treatment needs anticipated for the wells during the planning period.** The water rights 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). **The WMCP will need to be completed with information for the entire Joint Water System. WMCPs must be updated every five years**. **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.

The original Anderson Creek surface water source 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. **The high costs (estimated at roughly $5 million) and limited reliability are the basis for not recommending improvements for the Anderson Creek sources during this planning period.**

The City still maintains the 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 also maintained because the City intends to use it for emergency purposes using water from a future well. **There are no specific treatment related recommendations other than diligence in meeting all applicable regulatory requirements.**

An emergency water well was proposed. The proposed project consists of constructing an emergency water supply well near the City's Water Treatment Plant and in close proximity to Neahkahnie Creek, 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).



No other sources of water have been identified for development during the planning period.

Existing reservoir deficiencies are noted in Section 3.5 and in Appendix A.
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. All the reservoirs are subject to seismic-related damage. **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 shown in Fig 3-2. The project addresses the issues with the 1.6 MG reservoir while also addressing complexities and potential problems associated with the current reservoir field piping and operational configurations. The recent addition of duplex pumping for the well supply, may reduce or eliminate the need for additional storage capacity (to supplement well capacity) in the near future. However, **the potential for**

curtailment requirements associated with the anticipated well 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 and the **extra reservoir capacity could also 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 dry weather conditions

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.

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. However, Manzanita does include some undeveloped land at elevations that cannot be served by the existing system. Improvements that are coordinated and involve some cost sharing with the City and future developers may provide additional benefits to the City, such as increasing reservoir capacity beyond the needs of the development or upsizing and replacing old and/or undersized mains.

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).

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**. **Periodic leak detection surveys of the water system are recommended as general practice** to maintain or possibly reduce overall system water losses. **Customer water meters should be maintained and replaced periodically to ensure accurate readings** (the City plans to replace 100 meters per year on an approximate 20-year cycle. Budget $500 per meter ($50,000 per year)).

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.

The City has recently completed improvements that enhance the SCADA system and the ability to record and retain accurate water usage data.

Planning status/recommendations: 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. 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 **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. 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. **The EPA has free software (CUPSS) and materials available on its website to assist small communities with asset management**. 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.**

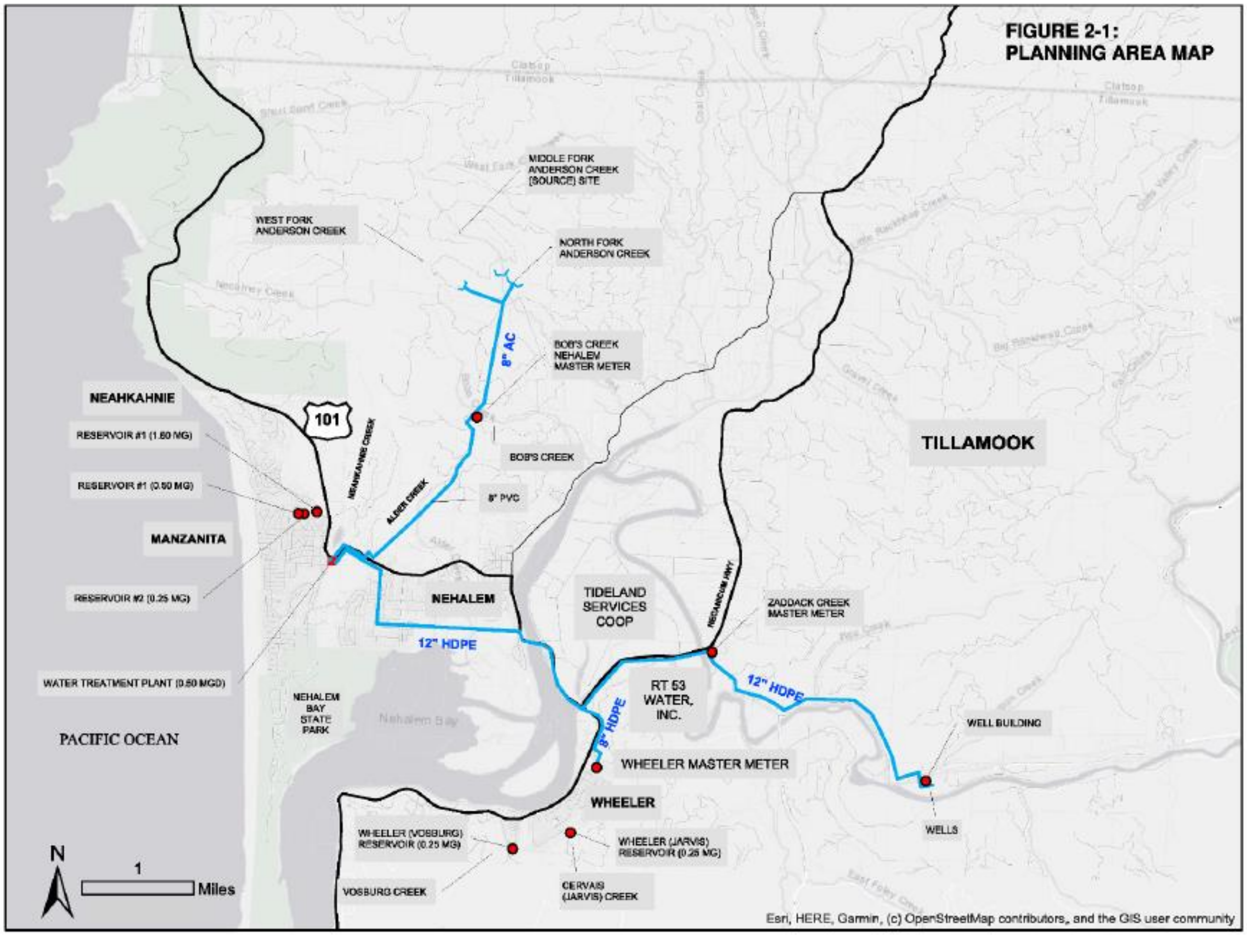
Because of the relatively high construction costs, funding agency participation may be needed or desired. If the City decides to pursue agency assistance, then once the City has determined which projects to include, **the City should contact Business Oregon's Infrastructure Finance Authority (IFA) to 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. To set up a One-Stop meeting, contact Melanie Olson who is IFA's Regional Development Officer serving Tillamook County: melanie.olson@oregon.gov, 503-801-7155.

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

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

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**.

The following information contains more detailed facility descriptions and generally follows the progression of sections in the Master Plan. Major water facilities and planning area are shown in Figure 2-1.



3.3.1 - 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). 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 which is also situated near Neahkahnie creek.

Water rights related to the Manzanita system are summarized in Table 3.1. 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. 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

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.

As previously mentioned, 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 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.

3.3.3 - Current Sources (2 wells):

The City's current water source consists of two wells (Table 3-2) 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.

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 repumped 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.)

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

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.

3.3.2 - Historical (Unused) Sources (Alder, Neahkahnie, and Anderson Creeks):

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. 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. 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.

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.

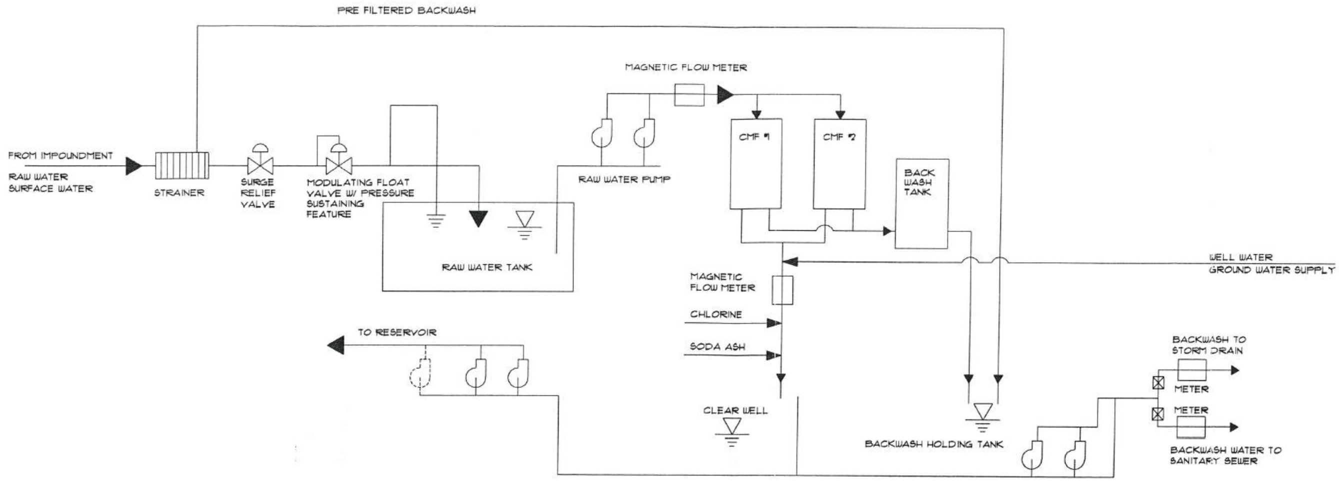
Flows from the Anderson Creek sources were sufficient to reliably supply the City year-round. Recent years have seen significantly reduced stream flows in the region during the Summer and early Fall, undoubtedly affecting availability of flows in Anderson Creek. City staff have noted the reductions as 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.

3.4.1 – Manzanita Membrane 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.

Costs associated with the well sources 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 membrane plant 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.



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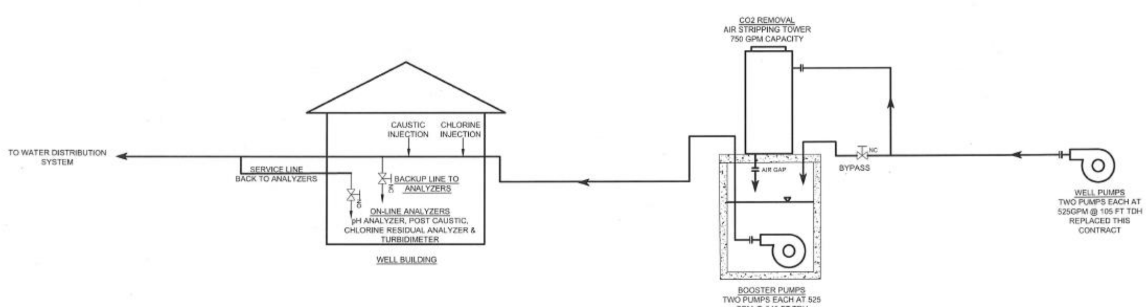
G4
TREATMENT PROCESS FLOW DIAGRAM
NTS

3.4.2 - Well Treatment

There are no water quality issues or treatment needs anticipated for the wells during the planning period.

<u>The well source has been classified as groundwater</u> 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. <u>The City is currently in the process of replacing the Miox system with a sodium hypochlorite system</u>. 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.

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



PROCESS FLOW

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

3.5 - Reservoirs:

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 shown in Fig 3-2. 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.

A recent study (included as Appendix A of the Master Plan) 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.

A summary of the reservoirs is tabulated on the following page.

Reservoir #	Location	Pressure Zone	Elevations	Operation
Clearwell – 2003 70,000-gallon Concrete	At the WTP South of Highway 101 and east of Laneda Avenue	N/A	Base Elev. = 94.41-ft (approx.) Ht. to Overflow = 105.71-ft	Chlorine is injected prior to the clearwell, which is used to provide contact time for disinfection **CT** (chlorine **C**oncentration x **T**ime) to meet 4.0-log viral inactivation and 0.5-log Giardia inactivation (0.5-log Giardia inactivation is required after filtration).
#1 – 1979 0.5 MG welded steel reservoir	North of Oak St between Poysky St and Ephoh St.	Base/Upper	Base Elev. = 231.89-ft Ht. to Overflow = 30.5-ft	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.
#2 – 1960 0.25 MG concrete reservoir	Same as Res #1	Base	Base Elev. = 224-ft (approx.) Ht. to Overflow = 15-ft	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. Reservoir No. 3 feeds the lower pressure zone and Reservoir No. 2.
#3 – 1997 1.6 MG glass-fused bolted steel tank	North Oak St. just east of Epoh St.	Base	Base Elev. = 206 (approx.) Ht. to Overflow = 33-ft	Water from Reservoir No. 1 fills the line that feeds Reservoir No. 3 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 of the master plan)

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

3.6 - Booster Pumping

<u>Manzanita has three booster pumping facilities</u> (locations are shown in Figure 3.2 and schematically in Fig 3.3):

1. at the well building (see Section 3.4.2),
2. at the water treatment plant (see Section 3.4.1), and
3. a booster pump station located at the reservoir field.

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 re-pressurize 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.

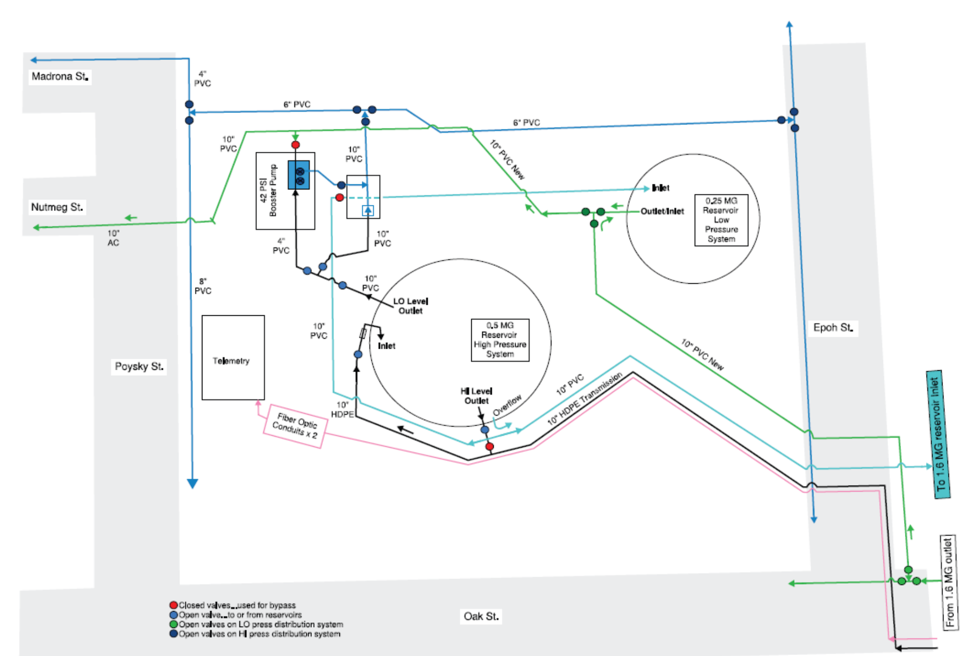
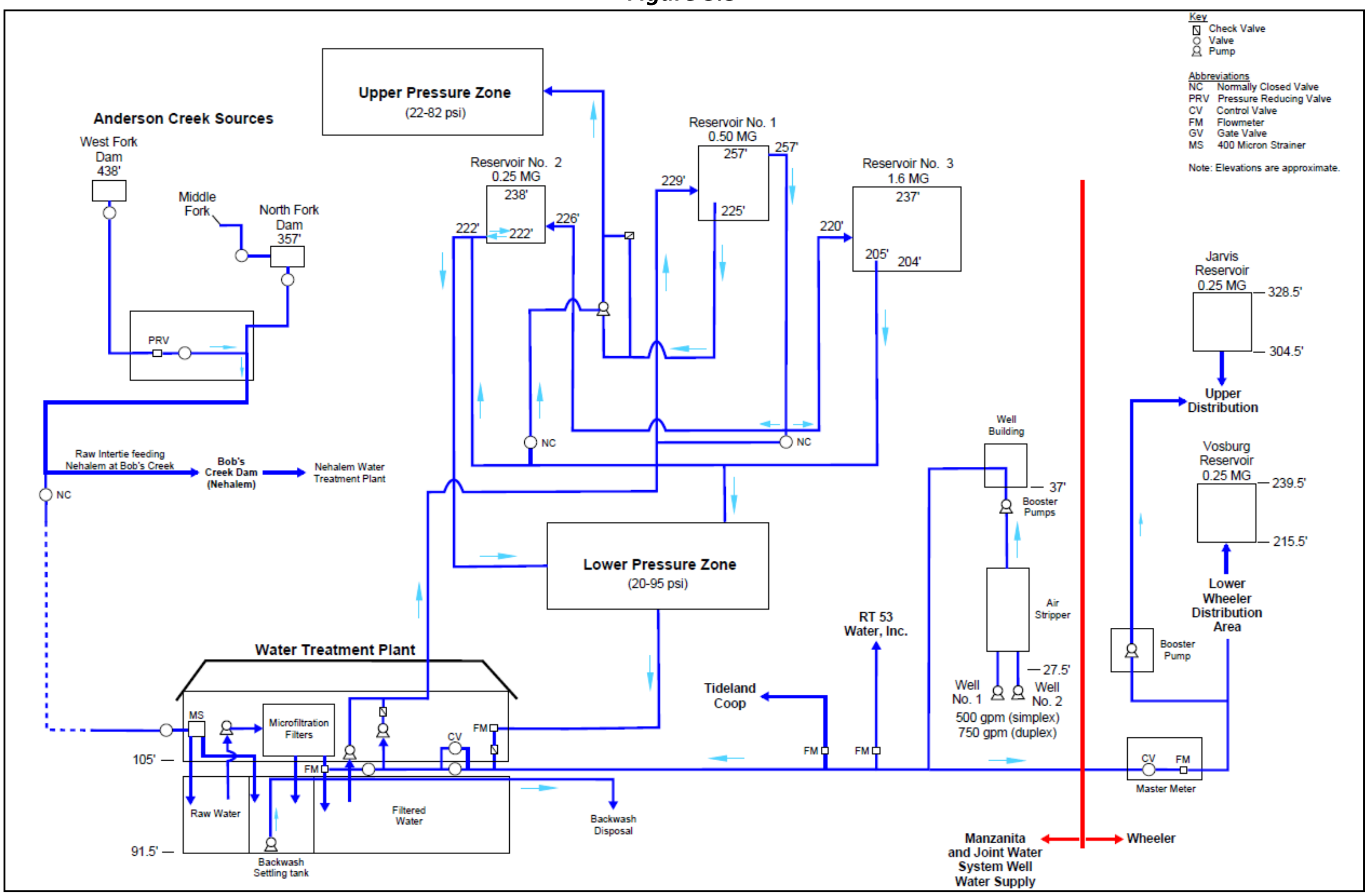


FIGURE 3-2:
RESERVOIR AREA DETAIL

3.7.1 - Transmission Mains

- Raw water transmission mains from the historic Anderson Creek sources are discussed in Section 3.2.2 of the Master Plan.
- Raw water transmission mains from the wells to the well building consist of approximately 8 miles of parallel 8-inch HDPE mains and 10-inch HDPE mains with many of the significant waterway crossings bored under the rivers.
- 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.

Figure 3.3



Distribution:

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.

Joint Water System Users:

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

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 (not included in Table 2.2) 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. (PWS ID #05200)*** was formerly known as Zaddack Creek and 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 (PWS ID #06154)*** is served by two 2" bulk meters. Tideland provides service to 17 residential connections and nine high-hazard connections.
- ***OPRD Nehalem Bay State Park (PWS ID #94192)*** 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.

Wheeler Water System (PWS ID #00952) - Population in Wheeler in 2013 was 415 persons and 241 service connections based on Wheeler's 2015 Master Plan; population in 2019 was 400 persons. Growth since that time has been nominal. The computed EDUs (for 2013) was 313 based on an average day demand of 195 gpd/EDU. (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.

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. Water rights for the wells are also owned by Wheeler.

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.

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.

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

5.8 - 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.

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.

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.