Pacific City Joint Water-Sanitary Authority
2020 Water Master Plan

Prepared for
Pacific City Joint Water-Sanitary Authority

March 2022

Prepared by
Parametrix

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2020 Water Master Plan

Prepared for

Pacific City Joint Water-Sanitary Authority
34005 Cape Kiwanda Drive
PO Box 520
Pacific City, OR 97135

Prepared by

Parametrix
700 NE Multnomah, Suite 1000
Portland, OR 97232-4110
T. 503.233.2400 T. 360.694.5020 F. 1.855.542.6353
www.parametrix.com

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CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.

Elizabeth Goltiao

Prepared by Elizabeth Goltiao, EIT

Checked and approved by Matt Steiner, PE

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ACRONYMS AND ABBREVIATIONS

AC	asbestos cement
ADD	average daily demand
ALA	American Lifelines Alliance
ASCE	American Society of Civil Engineers
BPS	booster pump station
CMU	concrete masonry unit
CSZ	Cascadia Subduction Zone
DOGAMI	Oregon Department of Geology and Mineral Industries
FEMA	Federal Emergency Management Agency
gpd	gallons per day
gpm	gallons per minute
LF	linear feet
LOS	level of service
MDD	maximum daily demand
OAR	Oregon Administrative Rules
OHA	Oregon Health Authority
ORP	Oregon Resilience Plan
OSSPAC	Oregon Seismic Safety Policy Advisory Commission
PCJWSA	Pacific City Joint Water-Sanitary Authority
PHD	peak hourly demand
PRC	Population Research Center
PRV	pressure-regulating valves
RR	rates of repair
WTP	water treatment plant

EXECUTIVE SUMMARY

The Pacific City Joint Water-Sanitary Authority (PCJWSA) is a publicly owned water and sewer district located in Pacific City in southern Tillamook County, adjacent to the confluence of the Nestucca River with the Pacific Ocean. PCJWSA serves the unincorporated communities of Pacific City and Woods, approximately midway between Lincoln City and the City of Tillamook, Oregon. PCJWSA currently serves approximately 1,430 connections with significant seasonal demand variations.

All community water systems with 300 or more service connections are required by Oregon law to maintain a current water master plan evaluating system needs over a 20-year period. The plan includes water quality and service goals and identifies system deficiencies and future needs. The plan also includes recommended alternatives for achieving goals and correcting deficiencies, a recommended implementation schedule, and a financing program.

System Description

The PCJWSA water system includes an 864,000-gallons-per-day (gpd) water treatment plant on Horn Creek and six groundwater wells yielding approximately 144,000 gpd each, for a total delivery capacity of 1.7 million gallons per day from the Horn Creek Water Treatment Plant and the wells. PCJWSA has certified water rights or State of Oregon Department of Water Resources water use permits for these sources. Horn Creek serves the system via a transmission line, approximately 1,730 feet long and 12 inches in diameter. The remaining distribution network consists of approximately 25 miles of piping ranging from 2 to 12 inches in diameter. There are also three reservoirs within the system, and two (the 100,000-gallon [K] and 300K reservoirs) have adjacent pump stations.

Water Demand

Water demands for the average day, maximum day, maximum month, and peak hour were estimated and are presented in the text of this plan. These were used to make future water demand projections. A 0.8 percent growth rate was used to estimate the year 2040 future number of connections at 1,677. The buildout population would be achieved in nearly 100 years at this growth rate.

There is a large discrepancy between the water use measured at service meters and that read at the meters at the wells. This discrepancy points to the need to systematically replace the older meters at the service connections on a continuing basis.

Water Sources and Treatment

The PCJWSA water system currently has six individual groundwater wells. The three Dune Wells (Wells 1, 2, and 3) are located to the immediate north of the Authority office just east of Cape Kiwanda Drive. The three Spit Wells (Wells 4, 5, and 6) are located in Bob Straub State Park at the southern end of Sunset Avenue. All wells have an hour meter and a flow meter and an approximate yield of 100 gallons per minute (gpm) each. Therefore, the current wellfield capacity is 600 gpm. Treatment of water is by disinfection with sodium hypochlorite at all wells.

The PCJWSA water system also includes the Horn Creek Water Treatment Plant (WTP) with a surface water intake. The facility uses membrane microfiltration to treat 600 gpm currently, expandable to 1,200 gpm. Two chemical feed systems are available: sodium hypochlorite for disinfection and soda ash for pH control. Backwash and microfilter residuals are treated for surface water discharge in

below-grade neutralization and settling tanks. Finished water is chlorinated and stored for required disinfection contact in a baffled 83,000-gallon below-grade concrete tank. High-pressure vertical turbine pumps deliver water at 600 gpm each through a transmission pipeline to the 300K Reservoir.

Water Storage and Pumping

Storage volume is needed to equalize daily peak demands, provide sufficient volume for firefighting, and provide an emergency reserve should the water source, a major transmission line, or the treatment facilities become inoperative.

The water system stores water in three reservoirs which are named according to their volumes: the 100K, the 300K, and the 600K reservoirs. There are two booster pump stations adjacent to the 100K and 300K reservoirs. The 100K booster pump station and its hydropneumatic tank are independent of the rest of the system and limited to supplying Pine Road, Terrace View, North Cape Kiwanda Drive, and Ridge Road. The 100K reservoir booster pump does not have sufficient fire flow capacity or sufficient pressure. New construction along Ridge Road is required to provide a sprinkler system in the homes because a fire truck cannot access the homes. Not all residents along Ridge Road have sprinkler systems. Other residents that rely on the 100K booster pump station are not required to install sprinkler systems.

The booster pump station adjacent to the 300K reservoir pumps water to the 600K reservoir. The 300K reservoir is filled by the six wells during off-peak use or when the Horn Creek WTP is shut down. It is kept full by float switches within at the 600K reservoir during peak water demands. During off-peak times, the 300K reservoir and booster pump station refill the 600K reservoir.

To accommodate the 20-year projected demands, over 30,000 gallons of storage will be needed. After discussions with PCJWSA, it was determined that the new tank should hold the new required storage and replace the 100K reservoir – creating a new 150K reservoir.

Distribution System

The water distribution system consists of approximately 25 miles of pipeline ranging in diameter from 2 to 12 inches. Portions are constructed of non-complying glued joints, asbestos cement pipe, or have improperly restrained joints. Over 30 percent of the piping is 2-inch diameter, which severely reduces available pressure and restricts fire flows. The 2-inch pipeline should be replaced wherever it serves more than one neighborhood. Because of the quantity of small-diameter piping, large amounts of the system need to be replaced to provide adequate flows for service and to provide sufficient capacity for firefighting.

There are also areas of the distribution system that are not looped which is needed to maintain disinfectant concentrations. Portions of the system do not have hydrants and are thus unprotected in the event of a fire. The areas that are unlooped and without hydrants need to have pipelines and/or hydrants installed.

Water Quality and Regulatory Requirements

Water quality monitoring of the water from the wellfields and Horn Creek is conducted by PCJWSA in accordance with state and federal regulations, based on data provided by PCJWSA and a review of state records available on the internet. Testing is conducted for numerous contaminants.

Since 2005, PCJWSA had a total of 11 exceedances in disinfectant byproduct haloacetic acids (HAA5), lead, and total coliform. Refer to the 2005 Water Master Plan for exceedances prior to 2005.

Seismic Assessment

In accordance with Oregon Administrative Rules 333-061 and the Oregon Health Authority, a seismic risk assessment was conducted to assess potential damage following an earthquake or tsunami resulting from a Cascadia Subduction Zone (CSZ) earthquake. Working with PCJWSA, the backbone supply and distribution system was identified, and its performance during a CSZ seismic event was evaluated within the resiliency framework and level of service goals as developed by the Oregon Resilience Plan.

Geotechnical hazards resulting from a CSZ seismic event including liquefaction, lateral spreading, landslides, and tsunami inundation were evaluated for impacts to the backbone system. Additionally, structural design requirements, material properties, and facility conditions were analyzed to determine deficiencies within system components and potential mitigation measures.

In its current condition, the backbone system will likely experience severe damage from a CSZ seismic event, resulting in a prolonged loss of service. Recommendations to increase resiliency within the backbone system are listed in Section 5.4 and include seismic upgrades to the Horn Creek Water Treatment Plant; 100K, 300K, and 600K reservoirs; and the 300K booster pump station. Recommendations are also included for the replacement of most of the backbone pipeline with earthquake-resistant pipe and fittings.

Recommended Improvements

A prioritized listing of recommended improvements to the water system was developed through 2040. The objective was to first replace system components that were undersized or needed replacing and to provide new components to better accommodate future demand. Recommended improvements were identified based upon deficiencies identified by PCJWSA staff, engineering analysis of the water system, and system needs to accommodate future demand. The improvements were tabulated over the planning period of this Water Master Plan, and an opinion of capital and operational costs was estimated. The list and costs are in Table 6-1.

1. INTRODUCTION

1.1 General

Oregon Administrative Rule (OAR) 333-061-0060, Plan Submission and Review Requirements, paragraph (5) requires all community water systems with 300 or more service connections or serving more than 1,000 people to maintain a master plan. The master plan shall be prepared by a professional engineer, evaluating needs over a 20-year period, and include water quality and service goals, present and future system deficiencies, the engineer's recommended alternative for achieving goals and correcting deficiencies, a recommended implementation schedule, and a financing program.

1.2 Scope of Plan

The following summarize the scope of work for this master plan:

1. Review regulatory requirements and the water use permit to confirm compliance with Oregon Administrative Rules.
2. Develop 20-year service connection and water demand projections.
3. Evaluate the existing water system components: source, treatment, storage, and distribution system. Estimate the adequacy of the system to meet future needs and regulatory requirements. Conduct hydraulic modeling of the water system and evaluate the ability of the system to meet fire flow requirements.
4. Identify any observed water quality trends, water quality problems, and potential future water quality impacts.
5. Assess systems' seismic risk and develop a mitigation plan.
6. Identify and recommend capital improvements to correct identified deficiencies. Summarize needed improvements for source, storage, transmission, water quality, water rights, electrical systems, and operations program.
7. Develop a prioritized implementation schedule of improvements. Prepare planning-level opinion of probable cost on recommended improvements.
8. Review financing options to fund the improvements. Project the likely impact on water rates and identify the need to update water systems development charges.
9. Prepare a water master plan summarizing the findings.

1.3 System Background

PCJWSA is a publicly owned water and sewer district located in Pacific City in southern Tillamook County, adjacent to the confluence of the Nestucca River with the Pacific Ocean. PCJWSA serves the unincorporated communities of Pacific City and Woods approximately midway between Lincoln City and Tillamook, Oregon. The Pacific City Water District was organized in 1959. The Pacific City Sanitary District was organized in 1974. The two organizations shared offices and were joined into one agency in 1998 forming the Pacific City Joint Water-Sanitary Authority. PCJWSA is controlled by a five-member board of directors. PCJWSA currently serves approximately 1,430 water service connections as of June 2020.

The Pacific City area is recognized as the home of the scenic Cape Kiwanda and has become a recreational area that is well known for its dory boat fishing fleet. It is growing because of increased summertime tourism and a growing interest in vacation home developments. The area also includes dairy farming as an important agricultural business.

1.4 Previous Reports

The following previous reports have been prepared for PCJWSA related to the potable water system. These were reviewed during preparation of this Water Master Plan:

- PCJWSA Water Master Plan. March 2005. Prepared by Parametrix.
- Pacific City Water Master Plan 2009 Update. February 2010. Prepared by Parametrix.
- Water Management and Conservation Plan, Pacific City, Oregon. July 2012. Prepared by Parametrix.

Appendix A contains a list of references used to prepare this plan.

1.5 Overview of Regulatory Requirements

1.5.1 Master Plans

As mentioned previously, OAR 333-061-0060, Plan Submission and Review Requirements, paragraph (5) requires all community water systems with 300 or more service connections or serving more than 1,000 people to maintain a master plan. As of June 2020, PCJWSA has 1,430 water service connections. The plan should evaluate needs over a 20-year period and include water quality and service goals, present and future system deficiencies, the engineer's recommended alternative for achieving goals and correcting deficiencies, a recommended implementation schedule, and a financing program.

1.5.2 System Classification

The PCJWSA water system is classified by the Oregon Health Authority (OHA) as a "Community Water System" which is defined as a water system that has 15 or more service connections used by year-round residents or that regularly supplies drinking water to 25 or more year-round residents.

From OAR 333-061-0220, Classification of Water Treatment Plants and Water Distribution Systems, the classification of the water distribution system and treatment plan is determined. The introduction to the table makes the following statement:

> **Water treatment plants and distribution systems at community and non-transient non-community public water systems are classified based on the size and complexity of the water system facility. Classification of a water system or water system facility determines the level of certification required for operators in direct responsible charge of a water system or water system facility as prescribed by OAR 333-061-0225.**

Division 061 has a small water classification for some treatment and distribution systems. It defines a small water system as a system serving 150 service connections or fewer and uses only groundwater as its source, or it purchases finished water from another public water system. None of these criteria apply

to the PCJWSA system. It serves 1,430 connections, uses groundwater and surface water as its sources, and does not purchase finished water from another public water system.

Because PCJWSA is not considered a small water system, the distribution classification and treatment classification must be determined individually.

Water distribution classification is determined based on population served by the water system and included as follows:

Table 1-1. Water Distribution Classification

Population Served	Classification
1 to 1,500	Water Distribution 1
1,501 to 15,000	Water Distribution 2
15,001 to 50,000	Water Distribution 3
50,001 or more	Water Distribution 4

PCJWSA currently reports to OHA a population served of 1,000. It is therefore classified as a Water Distribution 1 system.

Water treatment plant classification is based on a point system assigned to reflect the complexity of treatment (population served or flow), and it is calculated using OAR 333-061-0220. Based on this classification, PCJWSA treatment plant is a Water Plant 1.

1.5.3 Drinking Water Quality and Compliance with Regulatory Standards

The Oregon Drinking Water Quality Act of 1981 (Chapter 448 of the Oregon Revised Statutes), was established to ensure all Oregonians have safe drinking water, provide an effective regulatory program, and to provide a means to improve inadequate drinking water systems. The Act is implemented through OAR Chapter 333, Division 061 (OAR 333-061). The Oregon State Legislature agreed to assume primary enforcement responsibility for the Federal Safe Drinking Water Act and adopt the National Primary Drinking Water Standards. OHA is the agency responsible for compliance and enforcement.
OAR 333-061 has numerous requirements for maintaining a safe drinking water system. In general, the regulations establish requirements for potable water systems that span subjects including design, operation, maintenance, treatment requirements, monitoring of water quality, record-keeping, operator certification, violations and fines, public notification, land use compatibility, emergency planning, environmental review for state-funded projects, plan submittal/review, and construction standards.

2. EXISTING WATER SYSTEM

2.1 Service Area Description

The PCJWSA service area includes the communities of Pacific City and Woods. The service area is approximately 1.7 square miles in size. The properties within the service area are zoned as residential, commercial, planned development, or air-park land use types. There is currently one dairy farm located within the service area, and PCJWSA supplies water to this site.

Figure 2-1 shows an aerial map of the PCJWSA service area and indicates the major streets, water distribution pipelines, and drinking water facilities in the service area. The following sections describe the existing drinking water system in greater detail.

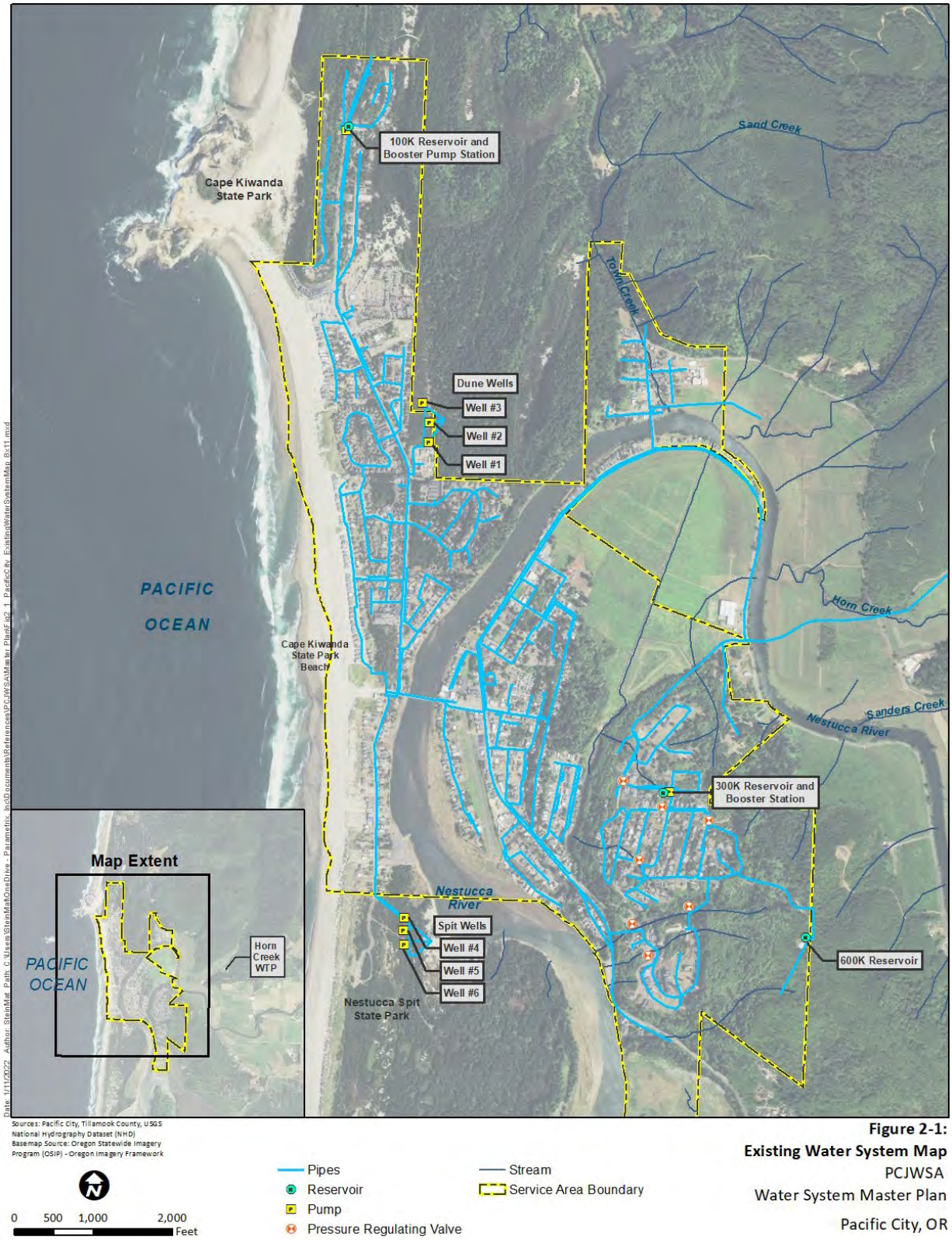
2.2 Distribution System

The water distribution system is composed of approximately 25 miles of pipeline ranging in diameter from 2 to 12 inches. Pipe materials include both C-900 and Schedule 40/80 polyvinyl chloride (PVC), steel, galvanized, polyethylene, asbestos-cement, and ductile iron. A map of the Pacific City Water System is shown in Figure 2-1, and a summary of pipe diameters, lengths, and material types is shown in Table 2-1.

The preferred materials for new water pipelines are C 900 PVC Class 150, or Class 200 for areas with pressures over 100 pounds per square inch (psi). On bridge crossings, ductile iron pipe is preferred. For valves, resilient seated gate valves are preferred. For hydrants, PCJWSA prefers 5-1/4-inch main valve openings, rated at 250 psi, with a coefficient of 0.9.

2.3 Dune and Spit Wells

The PCJWSA water system currently has six individual groundwater wells. The three Dune Wells (Wells 1, 2, and 3) are located to the immediate north of the PCJWSA office just east of Cape Kiwanda Drive. Wells 1 and 2 were developed in 1980 and 1984, respectively, while Well 3 was installed in 1996, replacing an old Well 3. The Dune Wells are located on Bureau of Land Management (BLM)–owned property that is currently leased to PCJWSA through a Recreation and Public lease agreement. PCJWSA maintains an easement agreement for access to the wells. The Dune Wells have a north-south alignment with about a 100-yard spacing between them. They feed into a southbound header, with Well 3 being the farthest north. Water from Wells 2 and 3 flows past Well 1. There is a mechanical water meter on each well and a fourth meter on the main header. Tillamook Public Utility District provides power from an overhead line that serves these wells. Standby power is available from a portable generator, manual transfer switches, and underground cables. The generator is housed in a shed at Well 2. The generator can be used to serve other facilities in town.



Sources: Pacific City, Tillamook County, USGS National Hydrography Dataset (NHD) Basemap Source: Oregon Statewide Imagery Program (OSIP) - Oregon Imagery Framework

0 500 1,000 2,000 Feet

Pipes
Reservoir
Pump
Pressure Regulating Valve
Stream
Service Area Boundary

Figure 2-1:
Existing Water System Map
PCJWSA
Water System Master Plan
Pacific City, OR

Figure 2-1. Existing Water System Map

Table 2-1. Summary of Distribution System Piping

	Pipe Diameter								Length by Material	
	1-inch (feet)	**2-inch (feet)**	**3-inch (feet)**	**4-inch (feet)**	**6-inch (feet)**	**8-inch (feet)**	**10-inch (feet)**	**12-inch (feet)**	**Linear Feet**	**Percent**
PVC	0	37,648	1,173	9,450	24,523	19,624	0	11,689	104,107	82.6
Polyethylene	100	2,151	0	0	0	0	0	0	2,251	1.8
Galvanized steel	0	987	0	0	0	0	0	0	987	0.8
Steel	0	0	0	0	0	1,442	0	0	1,442	1.1
Asbestos cement	0	0	0	4,036	5,718	2,452	1,329	0	13,535	10.7
Ductile iron	0	0	0	0	1,563	2,176	0	0	3,739	3.0
Length by diameter	100	40,786	1,173	13,486	31,804	25,694	1,329	11,689		
Percent	0.1%	32.4%	0.9%	10.7%	25.2%	20.4%	1.1%	9.3%		
Total									**126,061**	

Wells 4, 5, and 6 are referred to as the Spit Wells and are located in Bob Straub State Park at the southern end of Sunset Avenue. These wells were drilled in 1988. The Spit Wells have a north-south alignment. They feed into a northbound header. Well 4 has a 45-kVA three-phase pad-mounted transformer. There is a manual transfer switch and a receptacle at Well 5 to accept the portable generator; this feeds all three wells. All the wells have an hour meter and a flow meter.

All six wells have an approximate yield of 100 gallons per minute (gpm) each. Therefore, the current wellfield capacity is 600 gpm. Appendix C, Table C-1, contains more detailed information on all the wells.

A review of water right records indicated that three water right permits (G-10798, G-9388, and G-10392) are associated with the PCJWSA water supply wells. The three water right permits have been certified (certificates 93770, 80488, and 80489). Appendix C contains water rights documents for all the wells, and Table C-2 of Appendix C contains a summary of the water rights associated with the six water supply wells and identifies the points of diversion, the diversion rates, use, and application areas. The certified rights allow for well rotation to obtain the granted rates of diversion.

2.4 Horn Creek Water Treatment Plant

2.4.1 Background

Horn Creek is a tributary that flows into the Nestucca River approximately 1.5 miles upstream from Pacific City, Oregon. Approximately 90 percent of the watershed is located within the Siuslaw National Forest, with the remaining 10 percent held by the Stimson Timber Company (Stimson) and other private landowners. PCJWSA has three intakes on Horn Creek: an intake at the Horn Creek Water Treatment Plant and two smaller diversions farther upstream. The intake at the treatment plant is the only one currently in use.

PCJWSA had a “revocable” easement with the Stimson. It was for a 10-foot-wide approximately 20,800-foot-long easement over the existing roadway that connects the Horn Creek Pump Station to its intakes. Selected provisions of the easement agreement allowed Stimson to construct structures within the easements if they do not unreasonably interfere with PCJWSA use. Stimson may also install gates within the easement. PCJWSA is to clearly mark the pipeline at all times. Stimson is not responsible for damages to the pipeline caused by normal logging activities. This easement expired in 2017, and PCJWSA should begin the process to reestablish it.

To supply potable water to its customers, PCJWSA constructed a surface water intake and the Horn Creek WTP along Horn Creek, a tidally influenced tributary to the Nestucca River that supports federally listed salmon. The raw water intake has a microscreen housed in a concrete structure at the edge of Horn Creek. Adequate depth and channel flows are managed in the creek using two V-shaped rock weirs. Raw water is stored and pumped from a 37,000-gallon below-grade concrete tank. The facility uses membrane microfiltration to treat 600 gpm currently, expandable to 1,200 gpm. Sodium hypochlorite is used for disinfection. Backwash and microfilter residuals are treated for surface water discharge in below-grade neutralization and settling tanks. Finished water is chlorinated and stored for required disinfection contact in a baffled 83,000-gallon below-grade concrete tank. High-pressure vertical turbine pumps discharge at 600 gpm each through a new transmission pipeline to the 300K reservoir. Two hydropneumatic tanks protect the pipeline from water hammer. The pipeline was installed using shallow directional drilling to cross active dairy pastures, wetlands, and the Nestucca River. Shallow borings were used to allow easier access for maintenance. The pumping, microfiltration,

residuals, creek levels, and chemical feed systems are monitored and controlled through a centralized SCADA system.

There are finished water pumps at the Horn Creek WTP consisting of two vertical turbine pumps, each rated at 600 gpm and 210 feet of total head. PCJWSA will need to either certify the permit S-54783 by October 1, 2025 or file an extension. Because of the significant effort required to file an extension and risk associated with additional extensions, it is recommended by PCJWSA expand the capacity at Horn Creek WTP to demonstrate beneficial use and certify its water right.

2.4.2 Surface Water Rights

PCJWSA owns the water rights for three Horn Creek sources and manages water use and the infrastructure (e.g., intakes, pipelines, pumps). The water source diversion system consists of three diversion points:

- Upper Diversion #1 – Water right certificate number 86807 for diversion of 0.01 cubic feet per second (cfs). Located in Township 04 south, Range 10 west, Section 8, southwest 1/4 of the southwest 1/4. This source was developed in 1959.
- Upper Diversion #2 – Water right certificate number 86808 for diversion of 0.01 cfs. Located in Township 04 south, Range 10 west, Section 16, southwest 1/4 of the northwest 1/4. This source was developed in 1965.
- At Horn Creek Water Treatment Plant – Water right permit number S-54783 for diversion of 2.0 cfs, and water right certificates 91174 for 0.19 cfs and 91175 for 0.49 cfs. Note that according to permit S-54783, withdrawal of surface water from Horn Creek will not be allowed when stream flow is less than 2.0 cfs. Located in Township 04 south, Range 10 west, Section 20, southwest 1/4 of the northeast 1/4. This source was developed in 2010.

Actual construction dates for the upper diversion intake structures are unknown. The water rights give a general indication of when the intakes may have been constructed and the earliest date at which diversion operations may have commenced.

PCJWSA also has a Special-Use Permit (SUP) issued by the U.S. Forest Service (USFS). It covers the Upper Diversion Intakes. In the SUP, the Upper Diversion #1 is described as a 3-foot diversion dam, 200 feet of pipeline, and a 1,200-foot-long access road. The Upper Diversion #2 is described as being undeveloped.

USFS retains the right of entry and inspection of the facility and may amend in whole or in part the permit at its discretion. USFS can also prescribe new terms upon renewal. The SUP does not allow for maintenance or construction of future improvements or structures. The SUP requires the use or occupancy of the facility at least one day each year. The SUP states that the permit holder shall maintain the improvements to standards of repair, etc., acceptable to USFS.

The SUP was recently renewed and now expires on December 31, 2022. This SUP has a provision that should the facilities be abandoned or removed, an abandonment plan needs to be submitted to USFS for the removal of the facilities and area restoration. The work needed to remove these facilities would trigger numerous natural resource permits including the National Environmental Policy Act, Sections 401 and 404 of the Clean Water Act, National Pollution Discharge Elimination System Phase II, biological assessments, water rights validation, and a fish passage variance. Based on the significant permitting effort, PCJWSA should continue to maintain this SUP agreement and the existing intakes indefinitely.

Photograph 2-1. Horn Creek Water Treatment Plant

Photograph 2-2. Horn Creek Intake

Photograph 2-3. Horn Creek Raw Water Pumps

Photograph 2-4. Horn Creek Microfiltration System

Photograph 2-5. Horn Creek Finished Water Pumps

Photograph 2-6. Horn Creek Hydropneumatic Tanks

2.5 Reservoir and Booster Pump Stations

2.5.1 Reservoirs

The water system includes three reservoirs which are named according to their approximate capacity: 100K, the 300K, and the 600K reservoirs. The locations within the service area are shown in Figure 2-1. Elevation, capacity, and material of construction for the reservoirs are shown in Table 2-2. Combined, the existing reservoirs have 880,461 gallons of available storage.

Table 2-2. Reservoir Data

Reservoir Name	Capacity (gallons)	Diameter (feet)	Max Water Surface (feet)	Height (feet)	Base Elevation (feet)	Top Elevation (feet)	Material
100K	95,867	38	11.3	12	155.8	167.8	Concrete
300K	271,918	55	15.3	16	190.88	206.88	Concrete
600K	512,676	81	13.3	14	504	518	Bolted Steel

Photograph 2-7. 100K Reservoir

Photograph 2-8. 300K Reservoir

Photograph 2-9. 600K Reservoir

2.5.2 Booster Pump Stations

There are two booster pump stations in operation. One is adjacent to the 100K reservoir, which serves the north end of the service area. The 100K booster pump station and hydropneumatic tank are independent of the rest of the system and are limited to supplying Ridge Road, Pine Road, Terrace View, and North Cape Kiwanda Drive. The booster pump does not have fire flow capacity or sufficient pressure to supply Ridge Road adequately.

The other booster pump station is adjacent to the 300K reservoir, which has a base elevation of 190.88 feet. It pumps water to the 600K reservoir, which has a base elevation of 504 feet. The booster pumps keep the 600K reservoir full based on float switch settings. Photograph 2-14 shows the 300K booster pump station.

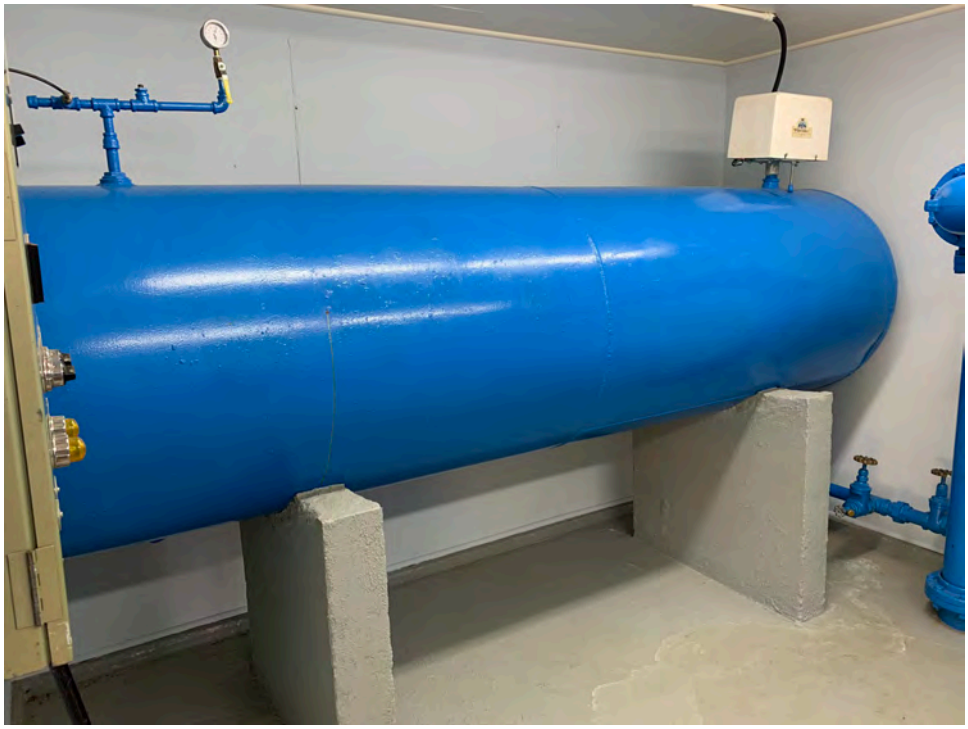
2.5.2.1 100K Booster Pump Station

The 100K reservoir is kept full with water pressure from the 300K reservoir. A booster pump station and hydropneumatic tank adjacent to the 100K reservoir pressurize water for distribution to Ridge Road, Pine Road, Terrace View, and North Cape Kiwanda Drive. The hydropneumatic system is necessary because the 100K reservoir is not high enough above the surrounding area. It must be boosted and held at a higher pressure by the hydropneumatic tank.

There are two pumps, each rated at 85 gpm and 140 feet of total head. This booster pump station does not have the capacity to adequately provide fire flow and pressure needs. There are also low-pressure issues at higher elevations along Ridge Road in the pump station's service area.

There is one fire hydrant in this part of the system. Because of the size of the hydropneumatics tank and pumps, adequate fire flows and fire flow durations are not achieved here.

Photograph 2-10. 100K Booster Pump Station



Photograph 2-11. 100K Hydropneumatic Tank

Photograph 2-12. 100K Booster Pumps

Photograph 2-13. 100K Booster Pump Piping

2.5.2.2 300K Booster Pump Station

The other booster pump station is adjacent to the 300K reservoir which pumps water to the 600K reservoir. There are two submersible pumps, each rated at 150 gpm and 296 feet of total head. The booster pumps keep the 600K reservoir full based on float switch settings. The 300K reservoir is the main storage workhorse of the PCJWSA system. It is filled by the Horn Creek WTP and/or the Wells whenever levels drop below designated levels. It can be kept full by the 600K reservoir through an altitude valve if levels drop too low. The 300K reservoir and its associated booster pump station refill the 600K reservoir whenever levels dictate.

Photograph 2-14. 300K Booster Pump Station

Photograph 2-15. 300K Booster Pumps

Photograph 2-16. 300K Booster Pump Piping

2.5.2.3 Horn Creek Finished Water Pump Station

There are finished water pumps at the Horn Creek WTP consisting of two vertical turbine pumps, each rated at 600 gpm and 210 feet of total head. There are open spaces to install a second membrane microfiltration skid with additional pumping capacity to provide redundancy and meet future water demands. See Section 2.4, Horn Creek Water Treatment Plant, for additional details.

2.6 Altitude and Pressure-Regulating Valves

2.6.1 Altitude Valves

There are two altitude valves in the system. The first altitude valve is located next to the 300K reservoir. This valve works in conjunction with the booster pump station adjacent to the 300K reservoir, because they share the same pipeline between the 300K and the 600K reservoirs.

There is a solenoid valve in the 100K booster pump station. This valve keeps the 100K reservoir filled. The booster pump and hydropneumatic tank at the 100K reservoir site supply pressurized water to customers at the north end of the service area.

2.6.2 Pressure-Regulating Valves

The water service area includes a hilly area known as Pacific City Heights where the 600K reservoir and the 300K reservoir are located. The water system has seven PRVs. These are used to reduce pressures in zones served by the 600K tank. These PRVs are listed below in Table 2-3, and their corresponding locations within the system are shown in Figure 2-2.

Table 2-3. PRV Summary

PRV Name	Size (inches)	Open Setting (psi)
River & Elderberry	2	45
Simmons & Topping	2	44
	6	38
River & Fisher	2	51
	6	40
Solita	2	45
	6	40
	Relief Valve	65
Kingfisher & Solita	2	54
	6	48
	Relief Valve	75
Heron Way	2	90
	6	84
	Relief Valve	100
Reddekopp & Dana	2	58
	6	52
	Relief Valve	78

psi = pounds per square inch

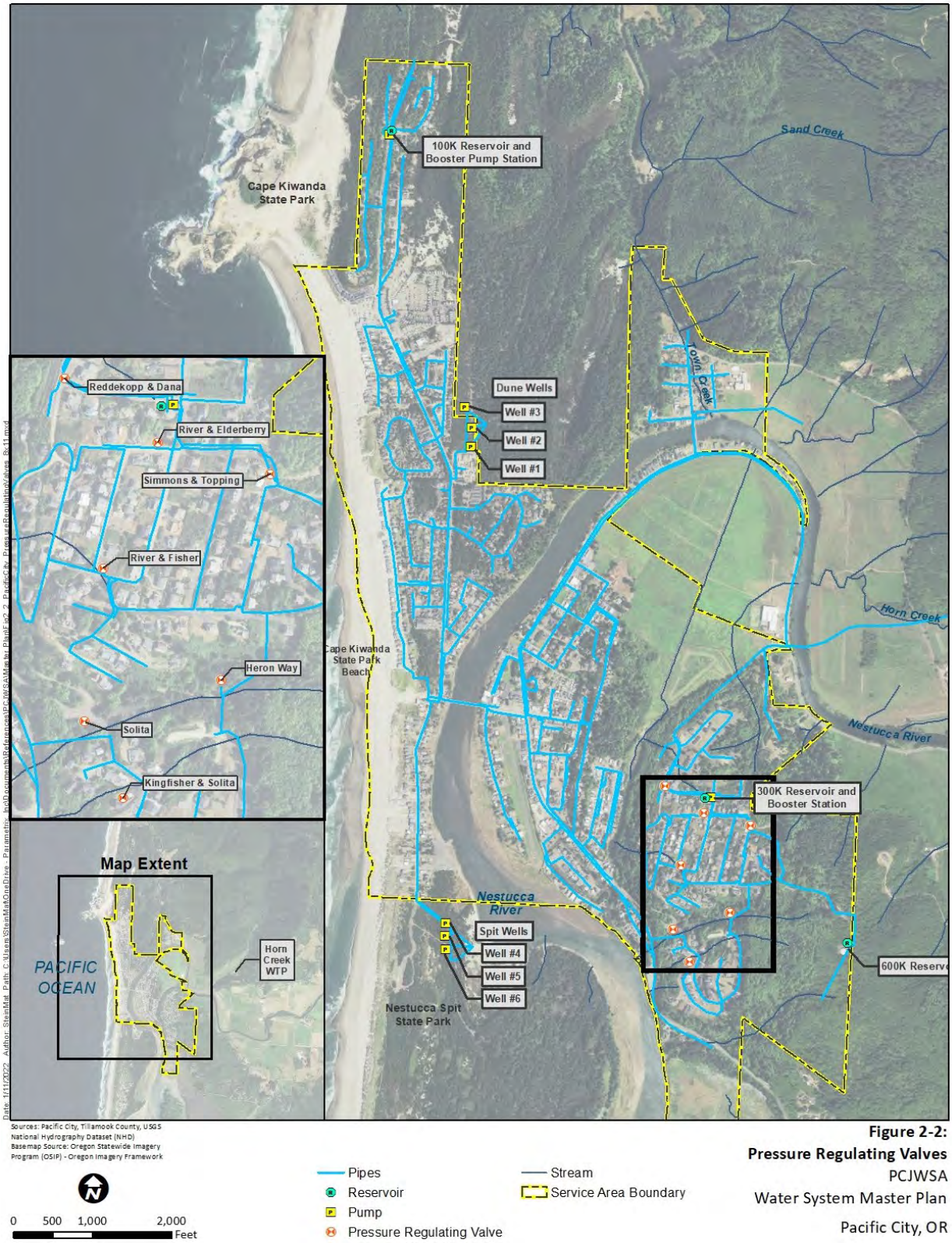


Figure 2-2. Pressure-Regulating Valves

2.7 Electrical and Controls Systems

2.7.1 Power

The water system is, in general, a gravity system where customers receive drinking water from the reservoirs. These same reservoirs also supply the fire hydrants. The electrical power is typically 220-volt, 3-phase. The loads connected at the time of this report are described below.

2.7.1.1 Dunes Wellfield, Wells 1, 2 and 3

Utility power runs the pump motors and the chlorine system. Standby power is available from a portable generator which is housed at Well 2. Underground cables and a manual transfer switch run to each well. At times, this generator can be used elsewhere in the water or wastewater system. The generator is diesel-fired and is rated as 50 kW, 62.5 kVA, with multi-tap output voltages.

2.7.1.2 Spit Wellfield, Wells 4, 5 and 6

Utility power runs the pump motors and the chlorine system. Standby power is available via a receptacle at Well 5. Underground cables and manual transfer switches run to each well. Present operation is to use the generator now housed at the Dunes Wellfield to feed the Spit Wells.

The generator can only serve one wellfield at a time.

2.7.1.3 300K Reservoir and Booster Pump Station

Utility power runs the two transfer pumps that lift water from the 300K reservoir to the new 600K reservoir. A receptacle and manual transfer switch have been installed for standby power from a portable generator. Two trailer-mounted generators are available that are capable of running these pumps.

2.7.1.4 600K Reservoir

There is no electrical power on this site. The float switches, which call for water from the 300K reservoir, are powered from a telemetry line connected to the 300K reservoir site.

2.7.1.5 100K Reservoir and Booster Pump Station

Utility power runs the two 5-hp booster pumps at this site. A manual transfer switch is installed at the pump station and a trailer mounted generator is dedicated to this site.

2.7.1.6 Horn Creek

Utility power runs to the site. A 750-kW standby generator and automatic transfer switch provide backup power.

2.8 Control

Control of the water system is by float switches in the three reservoirs.

There are three main control loops:

1. When the water level in the 100K reservoir drops to a preset level, probes in the tank cause the control valve to open and water from the system flows to refill the reservoir. When the level in the 100K reservoir reaches the upper probe, it causes the control valve to close.
2. When the water level in the 300K reservoir drops to its setpoint, the continuity probe signals the Horn Creek WTP or Dune Wells, followed by the Spit Wells, to come on. Water is pumped from the WTP or wells to the reservoirs until the upper level is reached, commanding the well pumps to turn off.
3. When the water level in the 600K reservoir drops below the setpoint, a signal calls for water from the 300K reservoir. Water is then pumped by the 300K reservoir booster pumps until the upper level is reached, commanding the booster pumps to turn off.

2.9 Water Quality and Compliance

The Oregon Drinking Water Quality Act of 1981 (Chapter 448 of the Oregon Revised Statutes, Water Systems, 1999), was established to ensure all Oregonians safe drinking water, provide an effective regulatory program, and to provide a means to improve inadequate drinking water systems. The act is implemented through the Oregon Administrative Rules, Chapter 333, Division 061 (OAR 333-061). The Oregon State Legislature agreed to assume primary enforcement responsibility for the Federal Safe Drinking Water Act and adoption of the National Primary Drinking Water Standards. OHA is responsible for compliance and enforcement. OAR 333-061 includes requirements for maintaining a safe drinking water system. In general, the regulations establish requirements for potable water systems that span subjects including design, operation, maintenance, treatment requirements, monitoring of water quality, record keeping, operator certification, violations and fines, public notification, land use compatibility, emergency planning, environmental review for State-funded projects, plan submittal/review, and construction standards. The key sections are listed and briefly described in Appendix B.

2.9.1 Monitoring

Water quality monitoring of the water from the wellfields and Horn Creek is conducted by PCJWSA in accordance with state and federal regulations, based on data provided by PCJWSA and a review of state records available on the internet.

Testing is conducted for numerous contaminants. The following provides an overview of the parameters tested:

- Coliform bacteria – these are microbiological indicators, naturally occurring bacteria, that when present, indicate disinfection was not effective and the potential for the presence of pathogens.
- Chlorine residual – this is disinfectant in the system and it is tested daily and concurrently when coliform samples are collected.
- Inorganic compounds – e.g., metals, asbestos, nitrates.
- Organic compounds – solvents, pesticides, PCBs.

- Radioactive substances.
- Secondary contaminants – those compounds that are typically not harmful, but by their presence makes the water less palatable. Examples include iron or hardness.

Table 2-4 contains a summary of water quality monitoring for PCJWSA compared to the regulatory standard maximum contaminant level (MCL). The table includes each instance since 2005 where PCJWSA exceeded the established MCL. Since 2005, PCJWSA had exceedances in disinfectant byproduct HAA5, lead, and total coliform. Refer to the 2005 Water Master Plan for exceedances prior to 2005.

According to the OHA web site, PCJWSA has been granted a reduction in monitoring frequency for nitrite, inorganics, and arsenic.

Table 2-4. Regulatory Summary

Parameter	Monitoring Frequency	Current Sampling Location	MCL	MCL Exceeded	Exceedance Location
Arsenic	9 years	Horn Creek, Wells	0.010 mg/L	None	N/A
Asbestos	9 years	Distribution System	7 MFL	N/A	N/A
DBP2 HAA5	Quarterly	35530 Salal	0.060 mg/L	Q1 2012: 0.0739 mg/L	35560 Salal
				Q1 2012: 0.0744 mg/L	35530 Salal
				Q4 2018: 0.1470 mg/L	35530 Salal
				Q4 2020: 0.0660 mg/L	35530 Salal
DBP2 TTHM	Quarterly	35560 Salal	0.080 mg/L	None	N/A
E. coli	2 weeks	Horn Creek	N/A	N/A	N/A
IOC	9 years	Horn Creek, Wells	Varies	None	N/A
Lead & Copper	3 years	10 Locations	Lead: 0.015 mg/L Copper: 1.3 mg/L	2014 Lead: 0.260 mg/L	N/A
Nitrate	Yearly	Horn Creek, Wells	10 mg/L	None	N/A
Nitrite	9 years	Horn Creek, Wells	1 mg/L	None	N/A
Radionuclides – Gross Alpha	Wells: 9 years HC: 6 years	Horn Creek, Wells	15 pCi/L	None	N/A
Radionuclides – Radium 226/228	Wells: 9 years HC: 6 years	Horn Creek, Wells	5 pCi/L	None	N/A
Radionuclides – Uranium	9 years	Horn Creek, Wells	0.03 mg/L	None	N/A
SOC	3 years	Horn Creek, Wells	Varies	None	N/A
Total Coliform	Monthly	Distribution System	0	None	N/A
	Annually[1]	Wells		2/11/2010	Well #4
				3/1/2010	Well #4
				4/6/2010	Well #4
				5/3/2010	Well #4
				2/1/2011	Well #6
				1/26/2016	Wells #4 and #5

Parameter	Monitoring Frequency	Current Sampling Location	MCL	MCL Exceeded	Exceedance Location
TOC	Quarterly	Raw Water at Horn Creek	N/A	N/A	N/A
Turbidity	Max Daily	Horn Creek	1 NTU	None	N/A
Volatile Organics	Wells: 3 years HC: Annually	Horn Creek, Wells	Varies	None	N/A

1 = Beginning January 1, 2012, samples taken at the wellfields were modified to one assessment sample per year.

DBP2 = Stage 2 Disinfectants and Disinfection Byproducts Rule; HAA5 = haloacetic acids; HC = Horn Creek; IOC = inorganic chemicals; MCL = maximum contaminant level; MFL = million fibers per liter; N/A = not applicable; NTU = nephelometric turbidity unit; Q = quarter; SOC = synthetic organic chemicals; TTHM = trihalomethanes; TOC = total organic carbon

2.9.2 Water Quality

Table 2-5 summarizes and compares the water quality from the Dune and Spit Wells and the Horn Creek WTP from water quality samples taken from 2008, 2011, and 2014. In general, the water is fairly soft, based on a hardness of less than 100 mg/L as $CaCO_3$, and has a moderate buffering capacity at the wells and a low buffering capacity at Horn Creek, based on the alkalinity. The pH is more acidic in the Dune Wells and Horn Creek, typically being below 7.0, which is of concern because of the potential for leaching lead and copper from old piping or joints. The pH of the Spit Wells is above 7.0. Manganese is typically not detected and iron is low, only being an occasional problem when iron bacteria accumulate in the well casings. This can be remedied by routine cleaning with sodium hypochlorite. Sulfate is low, being well below the secondary standard of 250 mg/L. If sulfates were higher, this might result in a salty taste to the water. Both color and odor are well below their associated secondary MCLs – resulting in an aesthetically pleasing water.

One concern regarding water quality is the potential for saltwater intrusion into the wells caused by continuous drawdown or additional drawdown from the wells. According to the previous master plan, water samples have indicated elevated levels in total dissolved solids (TDS) and chloride. At that time, the average TDS concentrations at the Dune and Spit Wells were 184 and 188 mg/L, respectively, and the average chloride concentrations were 67 and 55 mg/L, respectively. Water quality analyses from this master plan indicate slightly elevated concentrations of these parameters, and they should be continually monitored to provide information on the potential of seawater intrusion.

Table 2-5. Water Quality Summary

Parameter	Units	Dune Wells	Spit Wells	Horn Creek WTP
pH	pH Units	6.8	7.47	6.87
Specific Conductance	uhos/cm	343	352	95.8
Alkalinity	mg/L $CaCO_3$	44	91	17
Aluminum	mg/L	ND	ND	ND
Calcium	mg/L	4.32	5.3	2.42
Chloride	mg/L	83.9	59	12.3
Color	Color Units	ND	ND	ND
Copper	mg/L	ND	ND	ND

Parameter	Units	Dune Wells	Spit Wells	Horn Creek WTP
Fluoride	mg/L	ND	ND	ND
Hardness as $CaCO_3$	mg/L $CaCO_3$	70	75	26
Iron	mg/L	ND	0.164	ND
Manganese	mg/L	ND	ND	ND
Odor	Threshold #	0	0.3	1
Silver	mg/L	ND	ND	ND
Sodium	mg/L	27.97	37.97	9.8
Sulfate	mg/L	8.02	4.83	2.58
Total Solids, Dissolved	mg/L	198	243	66
Zinc	mg/L	ND	ND	ND

ND = not detected at method reporting limit; WTP = water treatment plant

3. WATER USE

3.1 Existing Water Demand

The existing demand placed on the PCJWSA system is primarily classified as domestic and seasonal use with a smaller portion used for commercial consumption. From 2017 to 2018, water use by commercial establishments accounted for typically between 10 and 14 percent, averaging about 12 percent of the total water produced by PCJWSA. Because commercial use varies by month and tracks with total water demand, and is expected to grow proportionally with the population, it is incorporated into the per connection water use. Water demands vary considerably based on seasonal and weekend population influx due to tourists and vacation home users.

PCJWSA has few industrial customers, currently consisting of one dairy and one microbrew pub. Over recent years, production at the brewpub has shifted to another facility outside of the PCJWSA service area, and very little production continues within the service area. Future growth potential of industrial customers is expected to be small.

Water production is metered at the WTP and each of the six wells, and each service connection (residential, commercial, and industrial) also has a water meter. When the water use, as measured from the service connection meters, is totaled, the result is typically lower than the water supply meter total from 24 to 30 percent. A similar trend was identified in the previous master plan. During that plan development process, the PCJWSA staff analyzed this difference and concluded that the service meters are generally recording lower water use than actual. The staff found that replacing the meters with more reliable meters increased recorded water use at some of the services that have been converted. Based on this analysis of the water meters, the WTP and well meters were used as the basis of water use for the service area in preparing this Water Master Plan. PCJWSA should replace all meters in the distribution system. When updating the Water Management and Conservation Plan, PCJWSA should assess if the new flow meters were able to reduce water loss in the system. Other sources of the discrepancy between water production and water use may include the following:

- Leakage and waterline breaks can account for 2 to 5 percent of water loss, and in systems with older pipes, up to 10 percent.
- Unmetered water use can include water system flushing, hydrant testing, and unauthorized connections.

The record of water supplied for the period from 2017 to 2019 is presented in Table 3-1. The average water use in 2019 was 237,241 gallons per day (gpd).

Table 3-1. PCJWSA Monthly Horn Creek WTP and Well Production

Month	2017 (gallons)	2018 (gallons)	2019 (gallons)
January	9,020,970	5,571,321	6,159,140
February	5,316,030	5,242,600	4,976,190
March	5,910,870	5,737,846	6,823,000
April	5,851,500	6,059,430	6,442,110
May	7,082,100	6,584,140	7,857,480
June	7,471,590	8,235,100	8,346,060
July	10,610,900	11,109,790	10,461,790
August	10,218,330	10,574,120	10,448,350
September	8,151,981	8,137,300	6,923,630
October	6,698,620	7,539,450	5,928,510
November	6,158,510	6,455,290	5,726,450
December	7,944,628	6,400,060	5,243,145
Total for Year	**90,436,029**	**87,646,447**	**85,335,855**
Max. Month Use	**10,610,900**	**11,109,790**	**10,461,790**
Min. Month Use	**5,316,030**	**5,242,600**	**4,976,190**
Avg. Month Use	**7,536,336**	**7,303,871**	**7,111,321**
Max. Day Use (gpd)	**504,000**	**499,000**	**545,320**
Avg. Annual Daily Use (gpd)	**247,770**	**240,127**	**233,797**

gpd = gallons per day

3.1.1 Seasonal Difference in Water Use

Water use in winter was slightly more than half that of July to August, likely caused by the significant population increase from summer tourism. The summertime water use over the 3-year period has remained mostly steady, peaking in 2018.The wintertime water use has been more variable, peaking in early and late 2017. Over the last 3 years, the minimum water use was in February in 2017, February in 2018, and December in 2019. Maximum water use was in July for all 3 years.

3.1.2 Water Use per Connection

The average water demand per service connection was 178 gallons per day per connection, averaged for 2017 and 2018, based on the total annual water production and average number of connections served during 2017 and 2018.

3.1.3 Maximum Daily Demand and Peak Hour Demand

Based on daily production records from all wells and the WTP for 2019, the maximum daily demand (MDD) was 545,320 gallons. The annual average daily production for 2019 was 233,797 gpd. The resulting maximum day factor from average daily demand (ADD) to MDD was 2.3, which is within the range of typical design values (Dewberry 2002; Mays 1999).

Another peak demand is the peak hourly demand (PHD). The peak hourly demand was estimated by applying a peaking factor to the ADD. A peaking factor of 3.5 was selected for the PCJWSA system which is consistent with the previous master plan (PCJWSA 2005). These values for the ratio of MDD to ADD and for PHD to ADD are within typical ranges for water systems (Dewberry 2002; Mays 1999).

3.2 Projected Development and Future Water Use

3.2.1 Projected Development

3.2.1.1 Buildout Development

There were several approaches considered to estimate future populations. To estimate buildout population, the ultimate population that could potentially be within the PCJWSA boundary, a listing of all available lots was examined. This listing included lot zoning, size, and whether occupied or not.

There are generally three types of zones available that could support growth having potential demands on the infrastructure: residential, commercial, and overlay zones. The residential zones are R1, R2, and R3, which are for low, medium, and high-density housing (single, one- or two-family, or multiple family dwellings, respectively). The fourth residential zone is RR, Rural Residential that allows single-family dwellings on larger lots.

The two commercial zones, C1 and C2, are generally for low and medium density commercial activities. Zone C1 is typically mixed in with residential areas, while zone C2 is more dedicated to commercial. In PCJWSA, there are two C2 zones: one at the downtown area on the west side of Brooten Road, north and south of Pacific Avenue, the second on Cape Kiwanda Drive near the dory launch.

The first overlay zone includes the Airpark Overlay Zone, which allows one- or two-family residential dwellings, aircraft hangers, and aircraft-related businesses. The second overlay zone is PD or Planned Development. Its purpose is to allow greater flexibility and to promote development of areas with attractive features such as views or natural amenities. It can be used in any of the planned or conditional uses for all of the other zones. For purposes of estimating populations, all overlay zones were assumed to be developable as if they were zoned R2 – one- or two-family dwellings. This assumption allows for a reasonable growth and thus should provide for adequate future infrastructure.

To estimate future population at buildout, the PCJWSA service area was divided into two categories: developed lots and undeveloped lots.

All zoned areas are allowed increased density of use with conditional approval. For example, R1 is typically for single-family homes, but conditionally may have two-family homes. Conditional changes could potentially increase water/sewer use in all areas. To simplify the myriad possibilities for this evaluation, all areas were assumed to be used only for their designated zoning purpose. All developed lots were assumed to retain their existing development and not to subdivide.

Undeveloped lots were assumed to be subdivided based on lot size limitations set in the zoning code to achieve the maximum number of homes for the primary allowed zone. The area available for an undeveloped lot was assumed to have an effective area of 80 percent available, to allow for public right of way, setbacks, driveways, access between lots, steep slopes, etc. For example, an undeveloped parcel of 1.2 acres or 52,272 square feet would be developable as follows for the different residential zones:

- The lot has an effective area of 41,818 square feet.
- If zoned R1, it can be subdivided into five 7,500-square-foot single-family lots, or five new connections.
- If zoned R2, it can be subdivided into five 7,500-square-foot lots, with a two-family dwelling per lot, or 10 new connections. Note that if the option for 5,000 square feet per single family home were used, only 8 new connections would be built. This would be less advantageous to the developer, so the greater density would be assumed.
- If zoned R3, it can be divided into 10 lots of 5,000 square feet each, with a four-family dwelling per lot, for a total of 40 households. Note that this zoning allows one-, two-, and three-family dwellings. These would be less advantageous to a developer, so the greater density would be assumed.
- If zoned RR, it is limited to a minimum lot size of 20,000 square feet, for a total of one household.

The two overlay zones were assumed to be treated the same as R2 residential and included in the estimate of total households.

Using the total number of existing lots (which equals existing connections) plus the future connections, leads to the total potential number of residential households that PCJWSA serves at buildout. The estimated number of connections at buildout is approximately 2,500.

Determining the population potential does not address the question of the rate of growth needed to estimate the population in the 20-year planning horizon. This is discussed in the following section.

3.2.1.2 Development Estimate for 2040

The conventional approach to forecasting flows and loads is based on population trends. In Oregon, communities outside the Metro boundary must apply the most recent final forecast issued by the Portland State University Population Research Center (PRC) to develop population projections per OAR 660-032-0020. The most recent population forecast for Tillamook County was published in 2017 and did not include a forecast for PCJWSA. It is worth noting that the PRC did forecast an average annual growth rate of 0.6 percent for Tillamook County as a whole and 0.3 percent for areas outside the urban growth boundaries between 2017 and 2035.

Because a population forecast for Pacific City is not available, the number of service connections added per year was evaluated to help predict growth and forecast future demand. Between 1996 and 2019, the growth rate per connection per ranged from 0.3 to just under 8 percent. Table 3-2 summarizes the number of connections from 1996 to present. PCJWSA experienced a growth rate per connection of 0.8 percent over the past 5 years, 0.63 percent over the past 10 years, and 1.61 percent over the past 15 years. The past 5-year period is considered to be the expected projected future for Pacific City, and 0.8 percent is in line with the population forecasts provided by the PRC for Tillamook County. As such, 0.8 percent annual increase in service connections is used as part of this master plan.

Table 3-2. Historical Water Connections

Fiscal Year Ending[1]	New Connections	Total Connections[2]
1996	35	919
1997	25	944
1998	24	968
1999	25	993
2000	22	1015
2001	23	1038
2002	17	1055
2003	33	1088
2004	38	1126
2005	88	1214
2006	32	1246
2007	50	1296
2008	31	1327
2009	9	1336
2010	10	1346
2011	4	1350
2012	5	1355
2013	5	1360
2014	6	1366
2015	6	1372
2016	11	1383
2017	5	1388
2018	21	1409
2019	12	1421
2020	9	1430

1 = PCJWSA Fiscal Year is July 1 – June 30

2 = As of June 30, 2020, PCJWSA had 1433 connections – 3 of which have

only sewer service (15 have only water service)

As of June 30, 2020, there were 1,430 water connections within the service area. Based on a starting point of 1,430 service connections in 2020, an additional 247 service connections are expected to be added by 2040. The total number of expected connections in 2040 is 1,677.

3.2.2 Future Water Demands

Projected service connection estimates and the existing ADD were used to determine future water demands. Peaking factors discussed previously were used to estimate the MDD and the PHD. Table 3-3 presents these projected flows by year from 2020 through 2040. These demands will be used to estimate future water system requirements.

Table 3-3. Projected Water Demands

Year	Connections	Average Daily Demand (gpd)	Maximum Daily Demand (gpd)	Peak Hourly Demand (gpd)	Maximum Daily Demand (gpm)	Peak Hourly Demand (gpm)
2020	1,430	255,089	586,704	892,811	407	620
2021	1,441	257,129	591,398	899,953	411	625
2022	1,453	259,186	596,129	907,153	414	630
2023	1,465	261,260	600,898	914,410	417	635
2024	1,476	263,350	605,705	921,725	421	640
2025	1,488	265,457	610,551	929,099	424	645
2026	1,500	267,581	615,435	936,532	427	650

Year	Connections	Average Daily Demand (gpd)	Maximum Daily Demand (gpd)	Peak Hourly Demand (gpd)	Maximum Daily Demand (gpm)	Peak Hourly Demand (gpm)
2027	1,512	269,721	620,359	944,024	431	656
2028	1,524	271,879	625,322	951,576	434	661
2029	1,536	274,054	630,324	959,189	438	666
2030	1,549	276,246	635,367	966,862	441	671
2031	1,561	278,456	640,450	974,597	445	677
2032	1,573	280,684	645,573	982,394	448	682
2033	1,586	282,929	650,738	990,253	452	688
2034	1,599	285,193	655,944	998,175	456	693
2035	1,612	287,474	661,191	1,006,161	459	699
2036	1,624	289,774	666,481	1,014,210	463	704
2037	1,637	292,092	671,813	1,022,324	467	710
2038	1,651	294,429	677,187	1,030,502	470	716
2039	1,664	296,785	682,605	1,038,746	474	721
2040	1,677	299,159	688,065	1,047,056	478	727

gpd = gallons per day; gpm = gallons per minute

Average demand per connection is 178 gpd

Average daily demand (ADD) = Connections x 178 gpd; Maximum daily demand = ADD x 2.3; Peak hourly demand = ADD x 3.5

4. WATER SYSTEM ANALYSIS

4.1 Storage Analysis

4.1.1 Storage Volume Requirements

There are numerous methods of determining appropriate storage for a water system. The goal is to provide sufficient storage to equalize daily peak demands, provide sufficient volume for firefighting, and to provide an emergency reserve should the water source, a major transmission line, or the treatment facilities become inoperative. The typical water system storage needs to account for the following five types of storage:

1. Operational Storage: Volume between the pump off and on points
2. Equalization Storage: Used to equalize daily peak demands
3. Emergency Storage: Used if a water source, a major transmission line, or the treatment facilities become inoperative
4. Fire Storage: Used for fire suppression
5. Dead Storage: The unusable water at the bottom of the reservoirs

4.1.1.1 Operational Storage

Operational storage provides water to users while the system pumps are off. This allows the water provider to meet the constantly changing water demand needs without having excessive pump cycling which would increase wear on the pumps. Table 4-1 summarizes the reservoir level operating ranges.

Table 4-1. Reservoir Level Operating Range Summary

Reservoir Name	Low Level[a]	High Level[a]
100K	10	11.3
300K	14.3[b]/13.3[c]	15.3[b]/15[c]
600K	10.3	13.3

a = Levels are provided in feet above finished floor at each reservoir

b = Horn Creek is operating

c = Spit or Dune Wells are operating

4.1.1.2 Equalization Storage

Equalization storage provides water to meet the difference between the MDD and the PHD. PCJWSA must provide equalization storage to compensate for the difference between the pumping capacity at Horn Creek or at the well fields and peak hour demand. There are numerous ways of calculating the required equalization storage. Because Oregon does not provide specific guidelines for equalization storage calculation, it is recommended that PCJWSA uses the following equation from the *Water System Design Manual* from the Washington State Department of Health (DOH 2020).

Equalization Storage (in gallons) = (PHD – Qs)*(150 minutes)

PHD = peak hour demand in gpm

Qs = active supply source capacities. Because the Horn Creek and the well fields do not operate at the same time, only the flow from Horn Creek was uses in the calculations.

4.1.1.3 Emergency Storage

Emergency storage is used in the event that a water source, a major transmission line, or the treatment facilities become inoperative. To calculate the reserve supply, we use the ADD. The reason that an average demand is used for emergencies is because in an emergency, the public would be asked to implement conservation measures. For this master plan, 2 days of ADD were allocated for emergency storage.

4.1.1.4 Fire Storage

Fire storage is used to suppress any fires in the service area. Based on conversations with the fire marshal, the fire flow required is 1,000 gpm with a fire duration of 2 hours.

4.1.1.5 Dead Storage

Dead storage is the water at the bottom of the tank that is unavailable to the system's users. In gravity reservoirs, dead storage is the water below the top of the outlet pipe silt stop. In reservoirs with a pumped outlet, dead storage is the volume of water that cannot be pumped because of insufficient net positive suction head. Because the as-built drawings for outlet pipes of the existing reservoirs are not available, it was assumed that the dead storage would be equal to a 6-inch depth.

4.1.2 Storage Volume Analysis

A breakdown of the required storage is shown in Table 4-2. Currently, PCJWSA has sufficient storage to meet the system requirements; however, the system will need over 30,000 gallons of storage by 2040.

Table 4-2. Reservoir Storage Summary

Storage	2020 (gallons)	2040 (gallons)
Operational	144,433	144,433
Equalization	3,001	19,068
Fire	120,000	120,000
Emergency	510,177	598,318
Dead	32,399	32,399
Total Required Storage	934,554	1,048,729
Total Available Storage[1]	880,461	880,461
Excess Storage	70,451	(33,757)

1 = See Section 2.5.1.

Because additional system storage is required, it is recommended that PCJWSA construct a new reservoir designed to provide the necessary future storage and replace the storage currently provided by the 100K reservoir – making the new reservoir the 150K reservoir. It is recommended to replace the 100K reservoir storage because of the facility's age and inability to provide fire flows. Currently, the only fire hydrant in the north end of the service area is fed from the 100K booster pump and hydropneumatic tank – which are not sized to provide adequate fire flows and duration.

This approach provides the necessary future storage, replaces the aging 100K reservoir, and provides fire flow to the north end of the service area. The new 150K reservoir would be able to provide the necessary fire flows to the north end with the exception of Ridge Road where developments are already required to provide onsite fire mitigation. The 100K reservoir itself would be decommissioned, but the booster pump station and hydropneumatic tank would likely remain to provide necessary pressures to Ridge Road.

The new 150K reservoir would likely be southeast of the existing 100K reservoir. There is land owned by the BLM east of Cape Kiwanda Drive where the reservoir could be sited. The south end of this land is designated for public purposes, and the reservoir could be sited there. The north end is designated for recreational purposes. Based on preliminary research, the reservoir would be located at an elevation such that its high-water level would be equal to that of the 300K reservoir. This would allow the new reservoir to work with the existing 300K reservoir without creating additional pressure zones. This would also provide the necessary fire flows and storage needed for the north end of the service area.

4.2 Hydraulic Analysis

4.2.1 Model Development and Updating

The PCJWSA water system components were analyzed by developing a computer model of the physical sources, treatment plant, pipes, pumps, valves, and reservoirs. The previous master plans used a WaterCAD model to simulate the distribution system. That model was converted from WaterCAD to an Innovyze InfoWater model. InfoWater is a commonly used software for modeling water distribution networks. It operates within ESRI's ArcMap, allowing ArcGIS layers to be used within the model.

The majority of the pipeline and system node information imported from the previous WaterCAD model was unchanged. Some system nodes were near the northern end of Cape Kiwanda Drive were modified to match the approximate ground elevations from Google Earth. The pipeline configurations and sizing were updated using the ArcGIS map prepared for the Water Management and Conservation Plan (PCJWSA 2012). Additional pipelines were added to or modified in the InfoWater model based on interviews and sketches provided from PCJWSA.

No individual service lines were included in this model. Instead, historical and future demands were assigned to the nearest system node.

4.2.2 Fire Flows

Based on discussions with the Nestucca Rural Fire Protection District, the existing PCJWSA should be able to provide 500 gpm to all hydrants with a 20-psi residual pressure. New parts of the system will need to be capable of providing 1,000 gpm to all hydrants with a 20-psi residual pressure.

A major deficiency is the extent of 2-inch-diameter pipelines in the water distribution system. The available water for fire flows and water pressures are very low in the 2-inch piping at current and future

water demands. The 2-inch pipeline should be replaced wherever it serves more than one neighborhood. Because of the large quantity of small-diameter piping, much of the system needs to be replaced to provide adequate flows for service and to provide sufficient capacity for firefighting.

The 100K reservoir and booster pump station are not currently able to provide sufficient fire flow to the area they serve. There is one hydrant that is served from the 100K reservoir. The 100K booster pump station has two pumps rated at 85 gpm at 140 feet of total dynamic head that feed a hydropneumatic tank. In order to meet fire flow needs, it is recommended that PCJWSA construct a new fire flow pump station at the 100K reservoir site. That building will house a new diesel fire pump and all associated equipment. Valving and piping will be provided that allow the fire pump station to pump around the 100K booster pump station and the hydropneumatic tank. During a fire event in that area, it is anticipated that pressure will drop quickly in the system. Once pressure has dropped below a certain setpoint in the system, the fire pump will automatically start and provide the needed flow. This fire pump will provide the necessary fire flows until the future 150K tank can be constructed.

4.3 Future System Requirements

4.3.1 SCADA Improvements

Currently, there are no alarms within the SCADA system that alerts PCJWSA that doors at the booster pump station or hatches at the reservoirs are open. The SCADA system should be upgraded to include general SCADA upgrades to the distribution system and to install door and hatch alarms at all the pump station and reservoir sites.

4.3.2 Site Security

4.3.2.1 Reservoir and Booster Pump Station Security

Based on conversations with PCJWSA, the fencing around all the reservoir and booster pump station sites need to be replaced. The new fencing should be at least 6 feet tall and have barbed wire at the top and a 20-foot-wide gate for access.

4.3.2.2 Wellhead Protection

The Dune wells are located on BLM-owned property. PCJWSA maintains an easement agreement for access to the wells. As part of the lease with BLM, PCJWSA needs to delineate a 100-foot setback around each wellhead with an additional fence. The new fencing should be 3 to 4 feet tall and include a gate for access.

4.3.3 Reservoir Rehabilitation

In 2020, the 100K, 300K, and 600K reservoirs were inspected by divers. The following details out the deficiencies found from that investigation:

100K Reservoir

- Hairline crack along entire interior circumference near the top of the tank above water level.
- Hairline crack at 3:00 position with possibly some sediment flowing through

- Minor hairline cracks at various locations.
- Significant ladder corrosion.
- Float guide bolts rusted away.
- Note – as part of this master plan, a project to replace the 100K reservoir is included. Because a new reservoir has been included to account for the storage in the 100K reservoir and the additional required storage, a capital improvement project was not included to address these deficiencies.

300K Reservoir

- Overflow pipe corrosion at bottom of tank where it penetrates the floor may need repairs.
- Significant ladder corrosion.
- Float bracket bolts completely corroded.
- Some manway corrosion, not serious.
- Two significant vertical cracks will need repair.

600K Reservoir

- Bolts throughout the tank will need replaced at some point.
- Hardware (flange couplings) on inlet pipe needs replaced. Inlet pipe appears to come all the way up to the top of the tank near the ladder.
- Other miscellaneous hardware will need bolt replacements.
- The float guide wire anchors have rusted away and will need replaced.
- Exterior access hatch rusting and needs re-coated.

These deficiencies are significant enough that each reservoir should be rehabilitated as part of this planning process.

4.3.4 Well Improvements

The PCJWSA water system currently has six individual ground water wells. The three Dune Wells (Wells 1, 2, and 3) are located to the immediate north of the PCJWSA office just east of Cape Kiwanda Drive. Wells 1 and 2 were developed in 1980 and 1984, respectively, while Well 3 was installed in 1996, replacing an old Well 3. Wells 4, 5, and 6 are referred to as the Spit Wells and are located in Bob Straub State Park at the southern end of Sunset Avenue. These wells were drilled in 1988.

Based on conversations with PCJWSA, these wells may need to be replaced in the future or have additional treatment at each location to meet water quality requirements.

4.3.5 Horn Creek Expansion

PCJWSA has five surface water rights permits (four of which have been certified) on Horn Creek, all of which have been transferred to a single point of withdraw at the intake at the Horn Creek WTP. In order to certify the final water right, PCJWSA must show beneficial use of the entire right. The Horn Creek facility currently uses membrane microfiltration to treat 600 gpm. To demonstrate beneficial use of the

full water right, the Horn Creek facility should be increased to 1,200 gpm by adding an additional membrane microfiltration skid, raw water pump, finished water pump, and associated systems.

4.3.6 Standby Power

Utility power runs the two booster pumps that lift water from the 300K reservoir to the new 600K reservoir. A receptacle and manual transfer switch have been installed for standby power from a portable generator. This is the same generator used for the Spit wellfields. To provide improved resiliency during a power outage, the 300K booster pumps station and the Spit Wells should each have a generator, muffler, and an automatic transfer switch. This will allow these two facilities to switch over to standby power automatically when it is needed.

4.3.7 300K Booster Pump Station

The 600K reservoir was limited to how quickly it can be refilled. Currently, it is filled from the 300K booster pump station, which has 150 gpm pumps. Based on conversations with PCJWSA, it would be preferred that the 600K reservoir could be filled twice as quickly. It is recommended that the two 150-gpm pumps be replaced with two 300-gpm pumps.

4.3.8 Water Meters

Water production is metered at the WTP and each of the six wells, and each service connection (residential, commercial, and industrial) also has a water meter. When the water use, as measured from the service connection meters, is totaled, the result is typically lower than the water supply meter total by 24 to 30 percent. A similar trend was identified in the previous master plan. PCJWSA is currently replacing all its water meters with new radio-read water meters so automated meter reading can be used. This should improve the accuracy of the meters used for billing purposes. Eventually, this system can be upgraded to an advanced metering infrastructure system where daily produced water flows can be compared with revenue meter flows. This system would also help staff detect leaks in the distribution system more quickly. During the writing of this master plan, the water meters were being installed into the distribution system. As part of the Water Management and Conversation Plan, PCJWSA should assess if these meter replacements reduced the amount of nonrevenue water.

5. SEISMIC RESILIENCY ANALYSIS

5.1 Introduction, Backbone System, and Seismic Hazards

5.1.1 Introduction

In accordance with Oregon Administrative Rules (OAR) 333-061, OHA requires a seismic risk assessment and mitigation plan to be included with the water master plan for water systems located in areas prone to moderate or heavy potential damage following an earthquake or tsunami resulting from a Cascadia Subduction Zone (CSZ) earthquake. Pacific City is within the identified area, and as part of the current Water Master Plan a seismic risk assessment was performed.

The risk from a CSZ earthquake in the Pacific Northwest is significant enough that the Oregon Seismic Safety Policy Advisory Commission (OSSPAC) developed the Oregon Resilience Plan (ORP). The ORP outlines systematic vulnerability assessments to determine risk and subsequent measures to bring the state closer to resilient performance following a CSZ event. The target goals for water service restoration are as noted in Figure 5-1 on the following page.

The ORP lists target level of service (LOS) goals for water systems assuming resilience enhancements are implemented over time. The targets were set for three LOSs:

- Minimal LOS restored for the use of emergency response.
- Functional LOS up to 50 percent of capacity that is sufficient to get the economy moving again.
- Operational LOS where restoration is up to 90 percent of capacity (which may still rely on temporary fixes).

Typically following a major disaster businesses and population will migrate out of the area, resulting in long-term economic damage. In order to stop this migration, the resilience of the water system is essential.

The seismic risk assessment and mitigation plan prepared for PCJWSA primarily focuses on minimal LOS for emergency response to a seismic event and functionality of the backbone system. Recommendations are also provided for the backbone system for long-term resilience planning.

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

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

Source: OSSPAC 2018

Figure 5-1. Oregon Resilience Plan Water System Recovery Goals for Coast

5.1.2 Backbone System

During development of the water master plan PCJWSA worked with Parametrix to develop the list of critical facilities to be evaluated during the seismic risk assessment based on OHA criteria.

The OHA guidelines for risk of failure are based on the following:

- The seismic risk assessment must identify critical facilities capable of supplying key community needs, including fire suppression, health and emergency response and community drinking water supply points.
- The seismic risk assessment must identify and evaluate the likelihood and consequences of seismic failures for each critical facility.
- The mitigation plan may encompass a 50-year planning horizon and include recommendations to minimize water loss from each critical facility, capital improvements or recommendations for further study or analysis.

The system components selected form the backbone system intended to meet the minimal LOS goal for post-event service and are listed in Table 5-1 and shown in Figure 5-2.

Table 5-1. Critical System Components

Facility	Component	Type	Year of Construction
Horn Creek WTP	Intake structure	Concrete vault	2010
	37,000 gal below-grade storage tank	Concrete	2010
	Filtration	Membrane microfiltration	2010
	Disinfection	Sodium hypochlorite	2010
	Backup generator	500-kW diesel generator	2010
Distribution System	Horn Creek WTP to reservoirs	Various size PVC, asbestos concrete, steel, ductile iron	1990–2010
100K Reservoir	Above-ground reservoir	Prestressed concrete	1972
300K Reservoir	Above-ground reservoir	Prestressed concrete	1972
	Booster pump station	Two 150 gpm submersible pumps	1999
600K Reservoir	Above-ground reservoir	Bolted steel	1999
Fire Suppression	Horn Creek WTP hydrant		2010
	Resort Drive hydrant		2010

gal = gallon; gpm = gallons per minute; WTP = water treatment plant

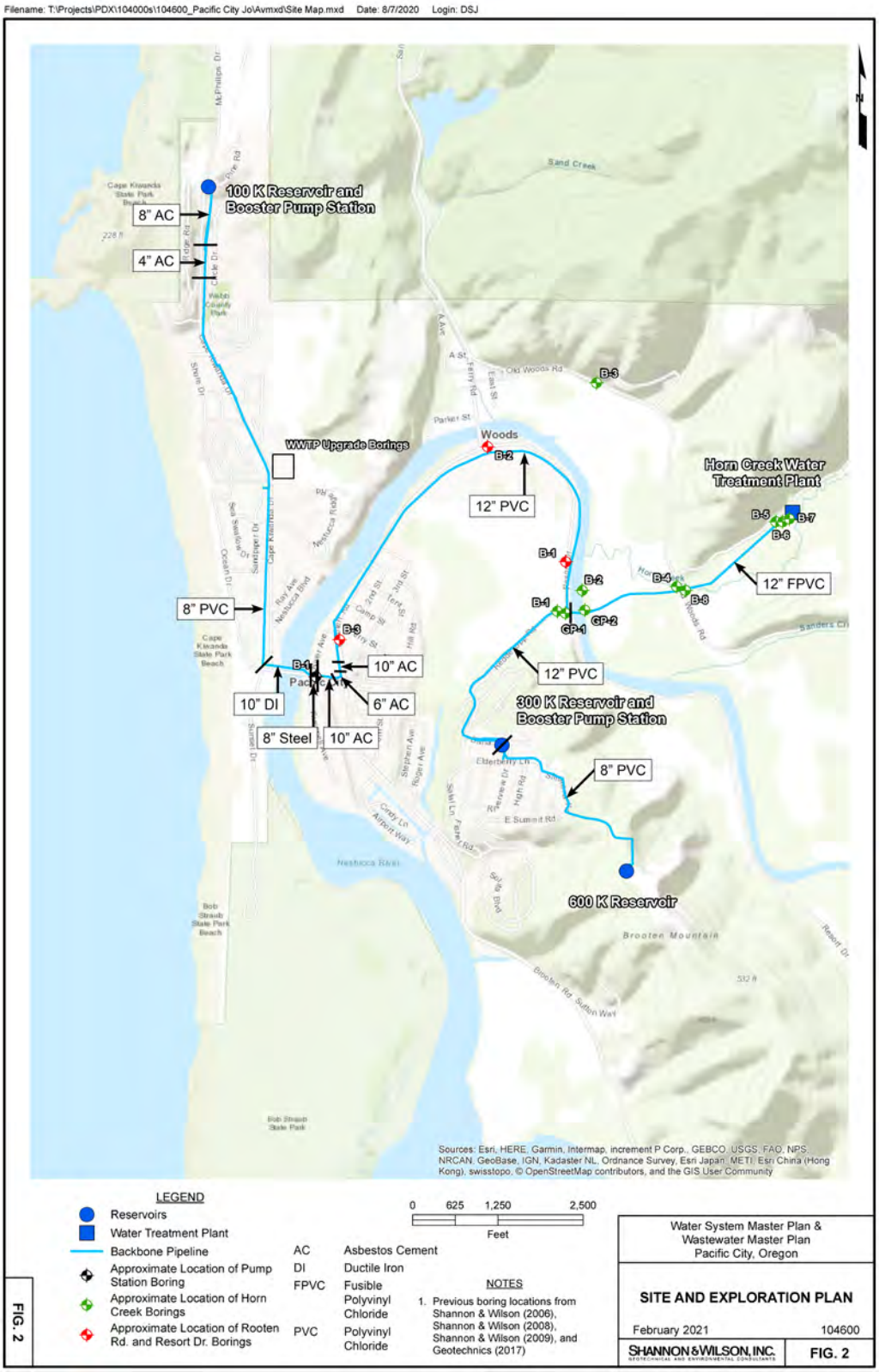


Figure 5-2. Backbone System Map

5.1.3 Seismic Hazards Assessment

A seismic hazards assessment was performed by Shannon & Wilson, Inc. for the PCJWSA service area as summarized in this section. The report includes the results of desktop research in addition to review of several borings that were performed for previous PCJWSA projects including the Horn Creek Treatment Plant (Horn Creek WTP). Detailed hazard mapping performed by the Oregon Department of Geology and Mineral Industries (DOGAMI) was also utilized to identify hazards resulting from a M9.0 CSZ event. The full report is available in Appendix D.

Pacific City is in the Coast Range along the western edge of Oregon and lies along an active tectonic plate boundary, where oceanic crust is subducting beneath the North American continental crust. Mapped site geology is comprised of Quaternary dune sand and alluvial deposits at the 100K reservoir and Horn Creek WTP sites. Portions of the backbone pipeline and the 300K and 600K reservoir sites are underlain by Tertiary basalt and basaltic sandstone.

5.1.3.1 Liquefaction

Liquefaction is when saturated soils undergo a reduction in shear strength during seismic ground shaking, essentially causing the soil to turn into a liquid. The extent of the liquefaction is determined by the soil properties and the magnitude of the seismic event. Consequences to structures and utilities from seismic liquefaction include:

- Uneven and non-uniform settlement of buildings and structures
- Loss of foundation bearing support
- Flotation of water and sewer lines, tanks, pipes, and other buried structures
- Lateral ground movement

Liquefaction susceptibility mapping from DOGAMI indicates that several areas of Pacific City are susceptible to seismic induced liquefaction. Figure 5-3 shows the areas that are susceptible to liquefaction. Estimated settlement from liquefaction can be seen in Table 5-2.

As noted in Figure 5-3, the 100K reservoir is in an area with high susceptibility to liquefaction, along with approximately 2 miles of backbone pipeline to the intersection of Brooten and Spring Street. Eastern portions of the backbone pipeline are mapped as moderate susceptibility to liquefaction. The Pacific City Heights area with the 300K and 600K reservoirs are on terrain underlain with shallow rock and are not considered to be susceptible to liquefaction.

A liquefaction analysis was performed during design of the Horn Creek WTP which concluded approximately 6 to 8 inches of seismic induced settlement may occur following a M9.0 CSZ event. To mitigate the potential differential settlement, the Horn Creek WTP and adjacent standby generator were constructed on deep foundation elements that extend through the liquefiable layers.

Table 5-2. Estimated Liquefaction-Induced Vertical Settlement

Source	Boring	Boring Depth (feet)	Estimated Settlement (inches)
Shannon & Wilson 2006	B-1	11.5	<1.6[1]
	B-2	11.5	<1.7[1]
	B-3	10.0	0.3
Shannon & Wilson 2008	B-1	51.0	3.3
	B-2	46.5	24.8[1]
	B-5	36.5	10.8
	B-6	58.0	1.3
Shannon & Wilson 2011	B-1	81.5	12.9
Geotechnics 2017	CPT-2	42.5	0.8

1 = Boring terminated before reaching the bottom of the liquefiable layer. Liquefaction-induced settlement at these locations may be greater than reported.

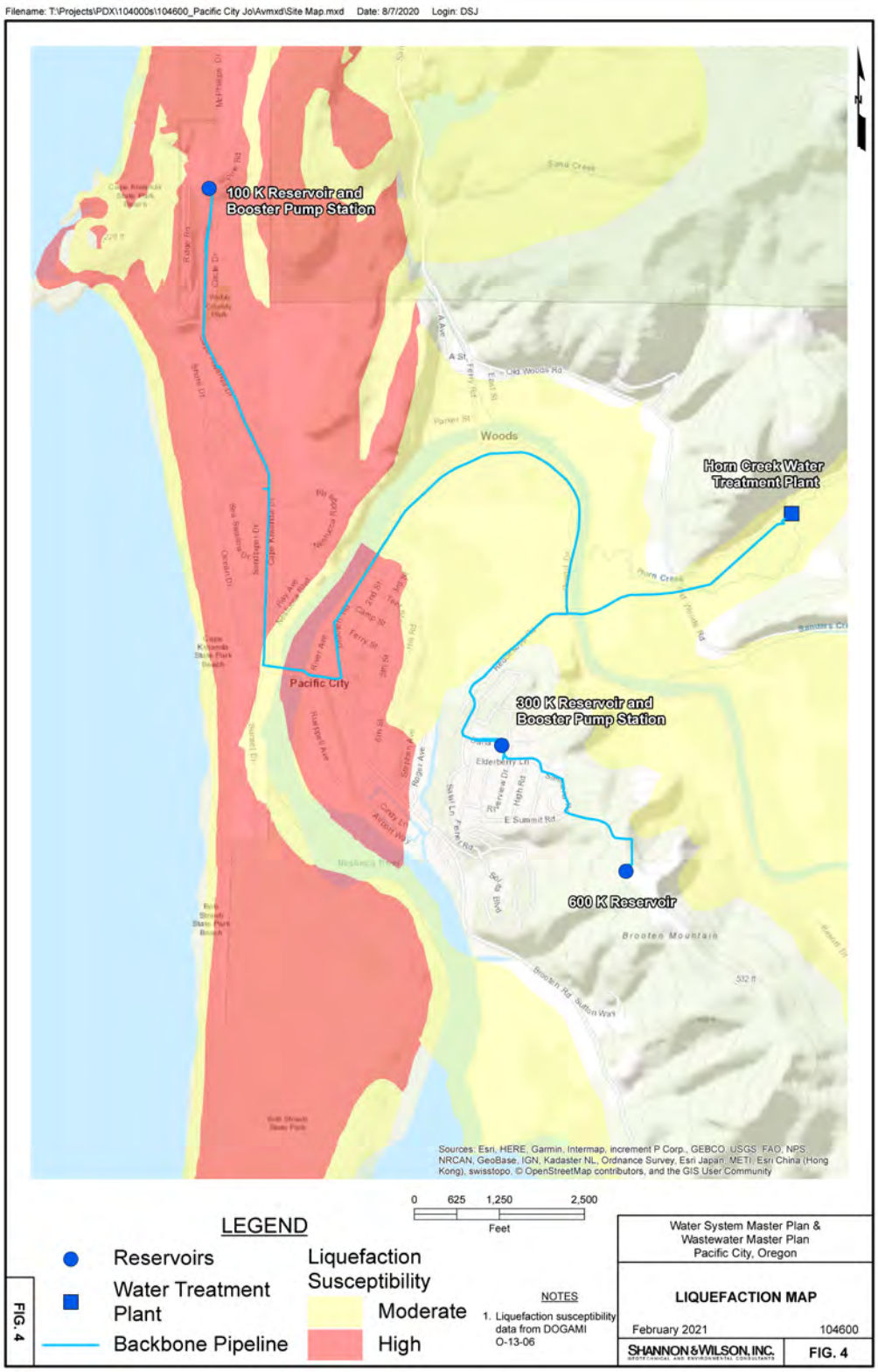


Figure 5-3. Liquefaction Susceptibility

5.1.3.2 Lateral Spreading

Lateral spreading is the movement of liquefied soils that are located in areas with mild slopes adjacent to steep slopes or a vertical face. The movement can occur when the soil becomes liquefied during a seismic event and ground acceleration surpasses the strength of the soil to remain in place. Consequences to utilities and infrastructure from lateral spreading are very similar to those for liquefaction. Lateral spreading can be especially severe near rivers due to the sloping nature of the adjacent banks.

The backbone pipeline crosses the Nestucca river at two locations; on the east side underneath the riverbed, and on the west side attached to the Pacific Avenue Bridge. At the east crossing the lateral spreading is not expected to have an impact on the pipeline. Lateral spreading adjacent to the Pacific Avenue Bridge is expected to exceed 2 feet during a M9.0 CSZ event which would impact the pipelines on either ends of the bridge, and likely the bridge itself. Estimated lateral spreading at the river crossings can be found in Table 5-3. Lateral spreading is likely to occur along other portions of the backbone pipeline where there are liquefiable soils, especially along the Nestucca River.

Table 5-3. Estimated Lateral Spread Displacement

Location	Distance from Slope (feet)	Lateral Spread (inches)
Nestucca River HDD Crossing at Reddekopp Road (east side)	100	23
	200	14
Nestucca River HDD Crossing at Reddekopp Road (west side)	100	2.4
	200	1.6
Airport Pump Station East of Nestucca River	200	29
	300	23

Source: Shannon & Wilson 2021.

HDD = horizontal directional drilled

5.1.3.3 Landslide Hazard

DOGAMI has prepared statewide landslide susceptibility mapping that classifies slopes on a scale of Low, Moderate, High, or Very High based on the presence and number of historical landslides near a given site, and the likelihood of sliding based on statistical analysis of the surrounding slope geometry. Figure 5-4 shows the DOGAMI Landslide Hazard Map overlain with Pacific City and the backbone facilities.

The majority of the backbone pipeline and the Horn Creek WTP are in the Low-susceptibility zones. The 100K reservoir is situated in sloping terrain which is mapped as Moderate to High susceptibility. Approximately 2,000 feet of the backbone pipeline feeding the reservoir from the south are also in the Moderate to High susceptibility zone. The 300K and 600K reservoirs, and backbone pipeline from the east river crossing up to the 600K reservoir are all in Moderate to High susceptibility zones.

In addition to the DOGAMI-mapped landslides there are steep slopes adjacent to both the 300K and 600K reservoirs that could become active during a M9.0 CSZ event.

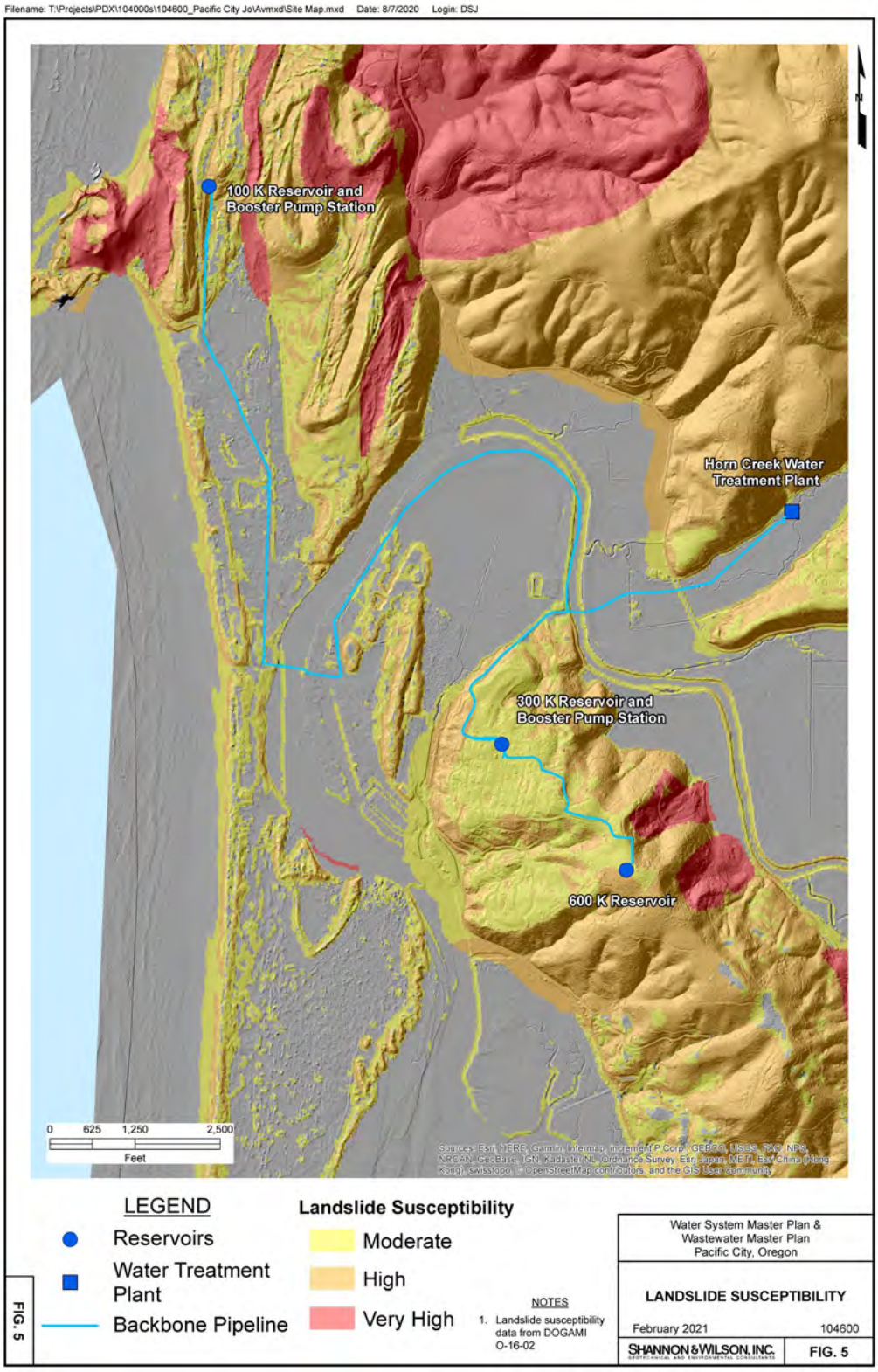


Figure 5-4. Landslide Susceptibility

5.1.3.4 Tsunami Hazard

Figure 5-5 shows the tsunami inundation limits as determined by DOGAMI for a CSZ-level event. Relative heights are based on model time intervals between earthquakes and range from SM = 300 years, M = 425 to 525 years, L = 650 to 800 years, XL = 1,050 to 1,200 years, and XXL = 1,200 years. None of the reservoirs are expected to be inundated by any range events since they are all outside of the mapped tsunami zones. Horn Creek WTP is within the tsunami zone and is only expected to be inundated at the XL- and XXL-level events.

The west crossing of the backbone pipeline located on the Pacific Avenue Bridge is located within the tsunami zone and is expected to be inundated for all range events.

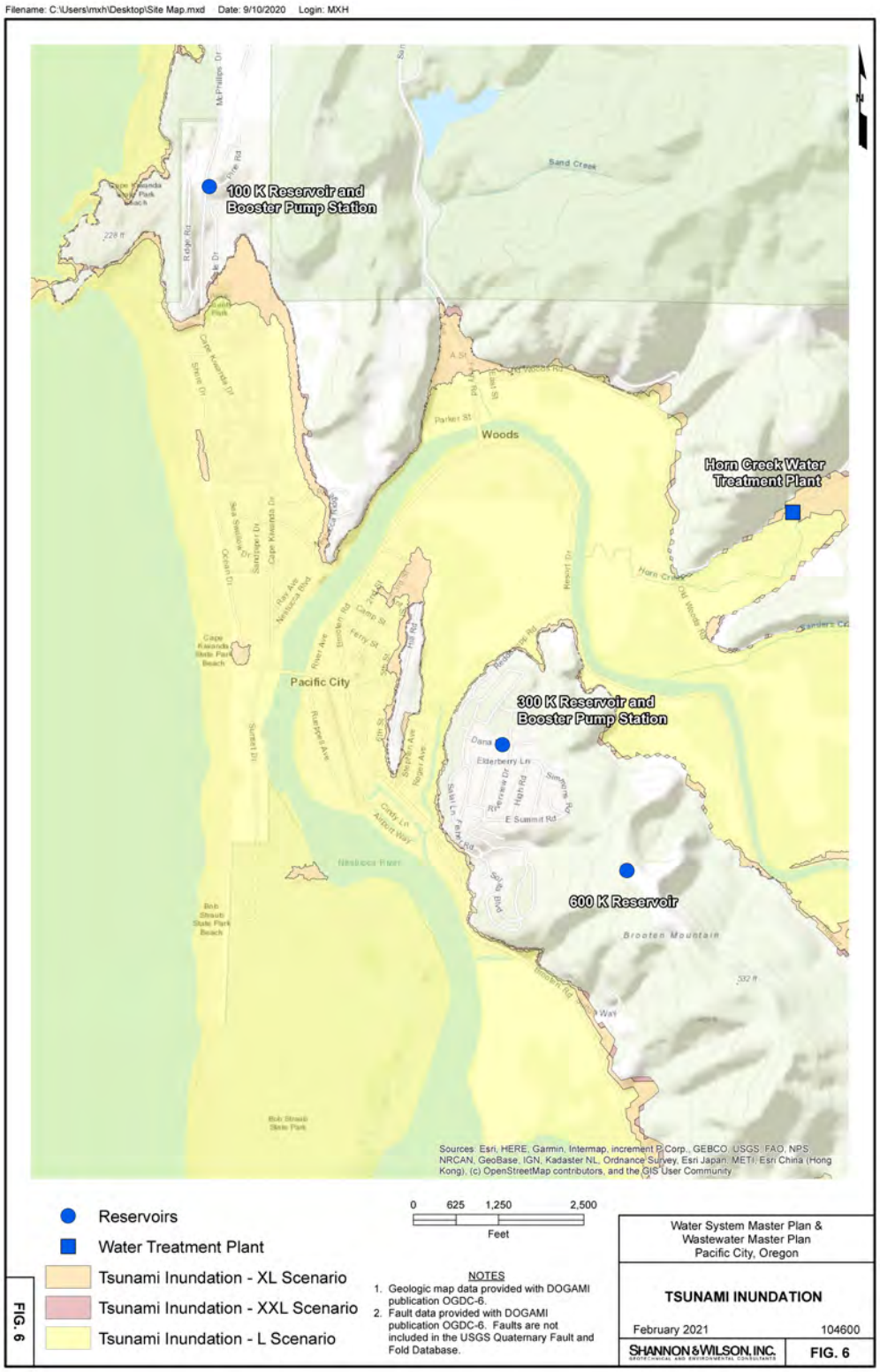


Figure 5-5. Tsunami Inundation Zone

5.2 Evaluation Methodology and Seismic Performance Objectives

5.2.1 Treatment Plant, Reservoirs, and Pump Stations

The performance of the PCJWSA water treatment plant, reservoirs, booster station, and backbone pipeline was evaluated for a CSZ seismic event. The evaluation was based on:

- Geotechnical seismic hazard assessment data provided by Shannon & Wilson (see Appendix D for full report).
- Comparison of the seismic design parameters where available as specified for original construction with current design parameters for a CSZ event.
- Review of available construction documents to identify potential deficiencies.
- Site visit to confirm conditions and determine any site-specific hazards.

Pump stations and water storage facilities that are required to maintain water pressure for fire suppression are designated and essential facilities noted as Risk Category IV. Systems and components that are not required to maintain water pressure for fire suppression are designated as Risk Category III, which represents a substantial hazard to human life at a level lower than Category IV.

To meet the target LOS goals established by OHA, water systems and structures need to meet and or exceed defined levels of nonstructural and structural levels of performance. These include expectations on continued operations and the ability to repair earthquake damage for the performance objectives as described in Table 5-4 and Figure 5-6.

Table 5-4. Comparison of Risk Categories with Seismic Performance Objectives

	Performance Objective	
Risk Category	**Structural**	**Nonstructural**
IV	Immediate Occupancy	Operational
III	Damage Control	Position Retention
I & II	Life Safety	Position Retention

As defined by ASCE 41-13

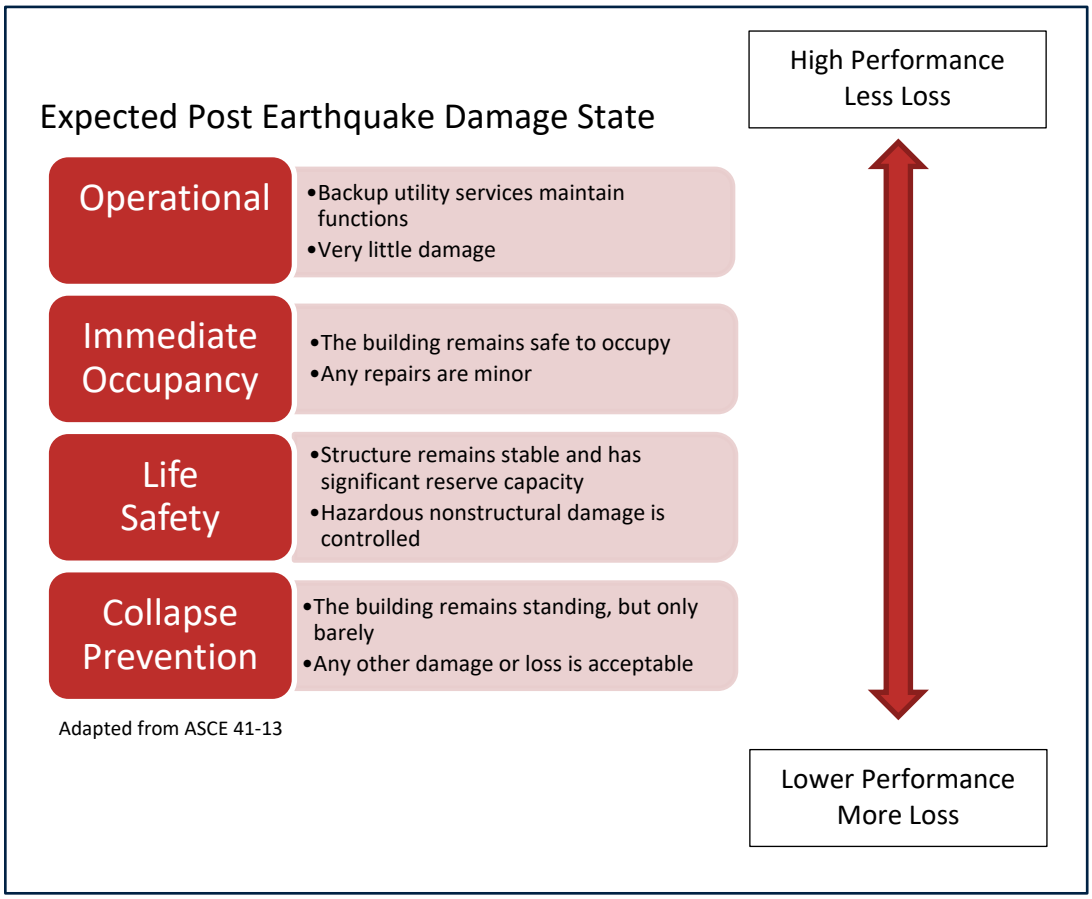


Figure 5-6. Building Performance Objectives

5.2.2 Pipeline Fragility

Pipeline fragility is the potential for damage to a pipeline by estimating the rate of repair per 1,000 linear feet (LF) of transmission main following a seismic event. The estimated rate of repairs is based on the material and physical makeup of the pipeline and the surrounding ground conditions. Where actual pipeline damage is difficult to predict, pipeline fragility analysis can provide an assessment of expected damage to the backbone system and potentially identify higher risk pipelines or critical areas where mitigation efforts should be focused first.

Factors that contribute to the damage of buried pipelines include surrounding ground conditions and physical features such as the following:

- Liquefaction and lateral spreading
- Landslides and settlement
- Continuous or segmented pipelines
- Appurtenances and branches
- Pipe material, age, and corrosion

Fragility of the backbone pipeline was evaluated using information on the pipes provided by PCJWSA, seismic guidelines, and the American Lifelines Alliance (ALA) guideline. The ALA is a partnership between the Federal Emergency Management Agency (FEMA) and the American Society of Civil Engineers (ASCE).

The analysis focused on the backbone system shown in Figure 5-2 to estimate rates of repair (RR). Data provided by PCJWSA included pipe length, operational date, diameter, and material of construction.

The ALA guideline recommends a general approach using two pipe vulnerability functions as shown in Table 5-5 to determine the repair rates of a large inventory of pipelines. The wave propagation function estimates RR per 1,000 LF of pipe due to ground shaking or seismic wave propagation. The permanent ground deformation function estimates RR per 1,000 LF of pipe due to ground deformation resulting from landslides, liquefaction, or lateral spreading as the result of a seismic event.

Table 5-5. Buried Pipe Vulnerability Functions

Hazard	Vulnerability Function	Lognormal Standard Deviation, β
Wave propagation	RR = K1 x 0.00187 x PGV	1.15
Permanent ground deformation	RR = K2 x 1.06 x $PGD^{0.319}$	0.74

PGD = permanent ground deformation; PGV = peak ground velocity; RR = rates of repair

In Table 5-5 the fragility constants K1 and K2 are used to scale the repair rates for different pipe diameters, materials, and joint types. K1 represents the pipe material's ability to withstand ground shaking. K2 represents the pipe joint's ability resist separation during ground deformation. The ALA guideline provides a range of K values scalable for different pipe materials and joint types. A higher K value means the pipe or joint has less ability to withstand damage. Lower K values indicate the pipe or joint has more resistance to withstand damage from ground movement. K values are summarized in Table 5-6 and were selected based on review of as-built plans provided by PCJWSA.

Table 5-6. Pipe Fragility K Values

Pipe Material Abbreviation	Pipe Material Description	Assumed Joint Type	Diameter (inches)	K1	K2
DI	Ductile iron	Cement	4–12	1.0	1.0
DI	Ductile iron	Rubber gasket	4–12	0.8	0.8
AC	Asbestos cement	Rubber gasket	4–12	0.5	0.8
AC	Asbestos cement	Cement	4–12	1.0	1.0
PVC	Polyvinyl chloride	Rubber gasket	4–12	0.5	0.8

5.2.3 Seismic Performance Objectives

5.2.3.1 Structural Performance Objective

Immediate Occupancy: "Immediate Occupancy" refers to the post-earthquake damage state in which only very limited structural damage has occurred. The main lateral-and-vertical-force-resisting systems

of the building retain most of their pre-earthquake design strength and stiffness. The risk of life-threatening injury from structural damage is very low. Some minor structural repairs will be required, but the building could be occupied prior to completing the repairs. The building is available for continued use and is not limited by its structural condition. Damage or disruption to nonstructural elements may limit occupancy including the availability of external utility services.

5.2.3.2 Nonstructural Performance Objectives

Operational: "Operational" refers to the performance level where most nonstructural systems that are required for normal use of the building or facility are functional. Minor cleanup and the repair of some items may be required. Operational nonstructural performance includes consideration of elements that are typically beyond the structural engineers' responsibilities. This includes nonstructural equipment that is properly mounted and braced to withstand ground motion. Quite often it is necessary to include emergency power generation to provide utility services that may be disrupted during an event due to loss from external sources. Qualification testing may also be necessary to ensure that equipment will function adequately during or after ground shaking.

5.3 Evaluation Results

5.3.1 Horn Creek WTP

Constructed new in 2010, the Horn Creek WTP uses membrane microfiltration to treat 600 gpm. Raw water is stored and pumped from a 37,000-gallon below-grade concrete tank. Finished water is chlorinated and stored for required disinfection contact in a baffled 83,000-gallon below-grade concrete tank. Two high-pressure vertical turbine pumps discharge at 600 gpm each through a new transmission pipeline to the 300K reservoir.

Horn Creek WTP was designed to a Risk Category III and the foundations for both the treatment plant and the standby generator are founded on concrete piles that extend below the liquefiable soil present at this location. Table 5-7 presents observations from a review of the original construction drawings and a site observation.

Table 5-7. Horn Creek WTP Evaluation Summary

Potential Deficiencies	Description
Condition assessment	• Exterior slabs at the entry doors show signs of post-construction settlement. • Visible cracks were observed in the floor of the treatment plant.
Seismic Structural	• Per Shannon & Wilson Report: 6 to 8 inches of post-liquefaction settlement, 3 to 4 inches of differential settlement. • Water intake structure supported on precast mat foundation over compacted aggregate base. • Metal building frame connections are undersized to resist lateral seismic forces.

Potential Deficiencies	Description
Seismic Nonstructural	• Per Shannon & Wilson Report: susceptible to tsunami inundation. • The standby generator needs to be verified that it is seismically certified to remain operational and can sustain shaking during a CSZ-level event. • Vertical components of the microfiltration system are unrestrained. • Rigid transmission pipe connections likely to fail during a seismic event. • Relative movement between the intake structure and the adjacent soil may damage the intake pipe. • The hydropneumatic tanks are insufficient to resist lateral seismic forces. • Non-seismic anchors on backup generator fuel tank base connection. • Sodium hypochlorite drums are unrestrained. • Chlorine tank is unrestrained. • HVAC ducting restraint is undersized. • Equipment, tables, and materials in the office are unrestrained.

CSZ = Cascadia Subduction Zone

5.3.2 100K Reservoir

The 100K reservoir is a ground supported prestressed concrete tank with a capacity of 95,867 gallons. The tank was constructed in 1972 and is 38 feet in diameter by 12 feet tall with a domed concrete roof. Shop drawings for this reservoir were unavailable from the tank manufacturer. Shear capacity at the connection of the tank to the base was estimated using code required minimums in place at the time of tank construction. Table 5-8 presents observations from the site visit.

Table 5-8. 100K Reservoir Evaluation Summary

Potential Deficiencies	Description
Condition Assessment	• Staining, efflorescence, and minor surface cracking noted on the exterior walls. • Horizontal hairline crack around the perimeter of the tank just below the roof to wall transition. • Some minor concrete loss and exposed rebar at multiple locations near the wall to roof transition. • Moss growth around the base.
Seismic Structural	• Per Shannon & Wilson Report: Reservoir is located in an area mapped as high susceptibility to liquefaction. • Per Shannon & Wilson Report: Reservoir is located in an area mapped as moderate to high susceptibility for landslides. • Unable to verify the shear capacity at tank wall to base connection.
Seismic Nonstructural	• The inlet and outlet piping connections to the tank are rigid connections that are likely to fail during a seismic event.

5.3.3 300K Reservoir

The 300K reservoir is a ground supported prestressed concrete tank with a capacity of 271,918 gallons. The tank was constructed in 1972 and is approximately 55 feet in diameter by 16 feet tall with a domed concrete roof. Shop drawings for this reservoir were unavailable from the tank manufacturer. Shear capacity at the connection of the tank to the base was estimated using code required minimums in place at the time of tank construction. Table 5-9 presents observations from the site visit.

Table 5-9. 300K Reservoir Evaluation Summary

Potential Deficiencies	Description
Condition Assessment	• Staining, efflorescence, and minor surface cracking noted on the exterior walls. • Vertical cracking with efflorescence at multiple wall locations. • Some minor concrete loss and exposed rebar at multiple locations near the wall to roof transition. • Moss growth around the base with areas of loose grout.
Seismic Structural	• Per Shannon & Wilson Report: Reservoir is not located in an area mapped as susceptible to liquefaction. • Per Shannon & Wilson Report: Reservoir is located in an area mapped as moderate to high susceptibility for landslides. • Unable to verify the shear capacity at tank wall to base connection.
Seismic Nonstructural	• The inlet and outlet piping connections to the tank are rigid connections that are likely to fail during a seismic event. • The south side of the site is a large cut slope with the toe of the slope approximately 4 feet from the base of the tank.

5.3.4 600K Reservoir

The 600K reservoir is a ground supported bolted steel tank with a capacity of 512,676 gallons. The tank was constructed in 1999 and is approximately 81 feet in diameter by 14 feet tall with an aluminum domed roof. Table 5-10 presents observations from a review of the original construction drawings, site observation, and underwater inspection performed by MIT Diving and Coating.

Table 5-10. 600K Reservoir Evaluation Summary

Potential Deficiencies	Description
Condition Assessment	• Coating on the northern inspection hatch has deteriorated, extensive surface rust on steel hatch base and opening. • Mild surface rust present on the southern inspection hatch. • Noticeable moisture in two locations on top of footing at base of tank ring. • Interior bolted seams exhibiting signs of universal surface corrosion and staining. Gasket material is flaking onto the tank bottom. • Interior hardware plastic nut caps are cracking, surface rust present on the bolts.

Potential Deficiencies	Description
Seismic Structural	• Per Shannon & Wilson Report: Reservoir is not located in an area mapped as susceptible to liquefaction. • Per Shannon & Wilson Report: Reservoir is located in an area mapped as moderate to high susceptibility for landslides.
Seismic Nonstructural	• The inlet and outlet piping connections to the tank are rigid connections that are likely to fail during a seismic event. • The north and east side of the site is a large cut slope with the toe of the slope approximately 2 feet from the base of the tank.

5.3.5 300K Booster Station

The 300K booster pump station is a 16-foot by 12-foot combination concrete masonry unit (CMU) and wood-framed building on a concrete slab foundation. Two 150 gpm submersible pumps controlled by float switches pump water from the 300K reservoir up to the 600K reservoir. The building was constructed in 1999 as a Risk Category III structure. Table 5-11 presents observations from a review of the original construction drawings and site observation.

Table 5-11. 300K Booster Station Evaluation Summary

Potential Deficiencies	Description
Condition Assessment	• Minor rust staining around the flanged fittings and restained joint and on the concrete floor where the transmission pipe exits the building. • Minor efflorescence on the south side of the CMU block wall.
Seismic Structural	• Per Shannon & Wilson Report: Reservoir is not located in an area mapped as susceptible to liquefaction. • Per Shannon & Wilson Report: Reservoir is located in an area mapped as moderate to high susceptibility for landslides. • Roof to wall connections are not designed to resist lateral forces from a CSZ event.
Seismic Non-Structural	• The inlet and outlet piping connections to the tank are rigid connections that are likely to fail during a seismic event. • Pump and piping appurtenances are not full restrained. • Electrical controls attached to the building walls were not designed for a CSZ-level event. • The partial height CMU wall on the east side of the building is retaining fill from a cut slope up to the adjacent road. • Standby power is provided by a portable generator that is not stored onsite.

5.3.6 Pipeline Fragility

The seismic hazard was calculated for all pipe and joint types present in the backbone system. Table 5-12 lists the repair rate by pipe and joint for moderate or high liquefaction susceptibility. Repair rates that are less than 1.0 indicate a very low chance for pipeline damage. For ground shaking, the greatest repair rate is 0.10, indicating the potential for little or no repair.

The repair rates for liquefaction range from 3.64 to 5.41, indicating a high potential for repair across all types of pipes and joints. Based on the low range of 3.64, there is the potential for a pipe repair approximately every 275 feet.

Table 5-12. Repair Rate (Number of Repairs per 1,000 LF of Pipe)

			Liquefaction Susceptibility	
Pipe Material	**Joint Type**	**Seismic Hazard**	**Moderate**	**High**
Ductile iron	Cement	Ground shaking	0.10	0.10
		Liquefaction	4.55	5.41
Ductile iron	Rubber gasket	Ground shaking	0.08	0.08
		Liquefaction	3.64	4.33
Asbestos cement	Rubber gasket	Ground shaking	0.05	0.05
		Liquefaction	3.64	4.33
Asbestos cement	Cement	Ground Shaking	0.10	0.10
		Liquefaction	4.55	5.41
Polyvinyl chloride	Rubber gasket	Ground shaking	0.05	0.05
		Liquefaction	3.64	4.33

5.4 Recommendations

5.4.1 General Recommendations

To achieve the seismic resilience goals as set forth in the ORP, it is recommended that PCJWSA develop its own seismic resilience design guide. The design guide should include a process for incorporating seismic resilience considerations into capital improvement projects, beginning with project planning and life-cycle cost assessment through design and construction. For new structures, the design and construction cost to build to Risk Category IV is typically relatively minor compared to the minimum standards for Risk Category III structures. Any project beyond minor equipment upgrades should be evaluated through the design guide to determine opportunities for seismic retrofits. Design standard recommendations include, but are not limited to the following:

- Geotechnical Hazards – Site-specific geotechnical hazards including but not limited to liquefaction, lateral spreading, and landslides should be considered in both design of new and retrofit of existing structures. Design elements such as deep foundations or soil improvements should be included as measures to mitigate impacts from a seismic event.
- New Construction – All new water system structures should be built and designed to Risk Category IV standards as specified in the Oregon Structural Specialty Code.
- Retrofit Construction – Existing water system structures should be seismically retrofitted to meet the performance objectives for Risk Category IV structures as noted in Table 5-4.
- Equipment – Equipment within water system structures required to be operational following a seismic event should be seismically certified. To remain operational, equipment should be

attached and braced per the requirements of the current edition of ASCE 7, *Minimum Design loads and Associated Criteria for Buildings and Other Structures*.

- Pipe Connections – Transmission mains and other similar conveyance pipes attached to water system structures need to be able to accommodate differential movement between the pipe, structure, and surrounding soil. Flexible connections that accommodate three-dimensional movement are recommended.

5.4.2 Horn Creek WTP

To increase the resiliency of the Horn Creek WTP following a seismic event, it is recommended to perform seismic retrofits to bring the plant up to the performance requirements of a Risk Category IV structure. Improvements include but are not limited to:

- Retrofit the intake structure and piping from the structure into the plant to mitigate the effects of liquefaction-induced differential settlement.
- Retrofit the metal building system and connections to the CMU shear walls to resist lateral movement due to seismic forces.
- Install flexible connections for the transmission main and fire hydrant to mitigate the effects of liquefaction-induced differential settlement.
- Restrain all tanks, equipment, pumps, HVAC ducting, and electrical equipment to prevent damage and ensure operation post seismic event.
- Construct an earthen berm around the site perimeter of the plant to mitigate the effects of tsunami inundation.

5.4.3 100K Reservoir

The 100K reservoir has been identified for replacement with a new 150K reservoir to be constructed at a relatively higher elevation to increase hydraulic performance and overall system resilience. The 100K reservoir is highly susceptible to damage resulting from landslides and liquefaction, both of which have high costs for mitigation. It is recommended that any seismic performance improvements to the 100K be minimal in nature, allowing funds to be better utilized for the new 150K reservoir. Minimum retrofit measures include but are not limited to the installation of flexible transmission main connections and an automatic closing valve.

5.4.4 300K Reservoir and Booster Pump Station

To increase the resiliency of the 300K reservoir and booster pump station following a seismic event, it is recommended to perform seismic retrofits to bring them both up to the performance requirements of a Risk Category IV structure. Improvements include but are not limited to:

- Perform a site-specific geotechnical investigation to determine landslide hazards and potential mitigation measures.
- Perform a detailed structural inspection of the concrete tank and base slab to determine cause and extents of surface cracking on the tank walls and suggested repairs.

- Perform radar inspection of the tank wall to base connection to verify existing reinforcement has the capacity to resist seismic forces for the design event.
- Evaluate the structural detailing of the roof-to-wall and the wall-to-floor connections in the booster station for capacity to resist seismic forces for the design event.
- Install flexible connections for the transmission main at the tank and the booster pump station to mitigate the effects of liquefaction-induced differential settlement.
- Restrain all instrumentation, pumps, and electrical equipment to prevent damage and ensure operation post event.

5.4.5 600K Reservoir

To increase the resiliency of the 600K reservoir following a seismic event, it is recommended to perform seismic retrofits to bring the reservoir up to the performance requirements of a Risk Category IV structure. Improvements include but are not limited to:

- Perform a site-specific geotechnical investigation to determine landslide hazards and potential mitigation measures.
- Install flexible connections for the transmission main to mitigate the effects of liquefaction-induced differential settlement.
- Repair the surface corrosion on the inspection hatches and interior bolts.

5.4.6 Backbone Pipeline

To increase resiliency of the backbone pipeline, segments identified in Section 5.3.6 should be replaced with new pipe and seismic-resistant flexible joints. Replacement segments are as follows:

- From the intersection of Resort Drive and Reddekopp Road (end of Horn Creek transmission main) to the 300K reservoir.
- From the east end of the Pacific Avenue Bridge to the end of the Horn Creek transmission main.
- Pacific Avenue Bridge – Horizontal directional-drilled pipe installed under the Nestucca River.
- From the west end of the Pacific Avenue Bridge to the 100K reservoir (or new 150K reservoir).
- From the 300K reservoir up to the 600K reservoir.

6. CAPITAL IMPROVEMENT PLAN

This section presents recommended improvements based upon deficiencies identified by PCJWSA staff, engineering analysis of the water system, and system needs to accommodate future demands. The first section of this chapter describes recommended improvements and the priority of making the improvement. The second section of this chapter tabulates the improvements over the planning period of this Water Master Plan and provides an opinion of capital costs. The third section lists operational costs.

6.1 Descriptions of Recommended Improvements

The following prioritized listing contains recommended improvements to the water system through the year 2040. The objective is to first replace system components that are undersized or need replacing, and to provide new components to better accommodate future demands. Figure 6-1 shows the locations of the proposed facility and pipeline improvements. For clarity, the seismic upgrades are shown on Figure 6-2.

6.1.1 Facility Upgrades

F-01. Standby Power for 300k booster pump station (BPS) and Spit Wells. Install a 150-kW generator at the 300K reservoir booster pump station, including a muffler, an auto-transfer switch and a building. Install a 50-kW generator at the Spit Wells, including a muffler, an auto-transfer switch, and a building.

F-02. 300K Tank Rehabilitation. Repair crack and ladders at the 300K reservoir.

F-03. 600K Tank Rehabilitation. Rehabilitate coating on failing bolts at the 600K reservoir.

F-04. 100K Reservoir Security Upgrade. Replace existing fence with 6-foot-tall fence, add barbed wire above fence, and include 20-foot swing gate entrance at the 100K reservoir.

F-05. SCADA Upgrades. Improve the water distribution SCADA system, install door alarms, install reservoir hatch alarms.

F-06. Upgrade 300k BPS. Install two 300-gpm pumps and upgrade electrical and control systems. Dune Wells. Install a new fence around the Dune Wellhead site.

F-07. Upgrade Horn Creek WTP to 1200 gpm. Install additional microfiltration skid, raw water pump, and finished water pump to match existing. Include a 750-kW generator.

F-08. 100K Fire Pump. Add a 500 gpm fire pump system (skid-mounted, diesel-powered) at the 100K reservoir site to provide fire flow to the north end area. Install 8-inch C900 PVC piping to connect to the distribution system.

F-09. 300K Reservoir Security Upgrade. Replace existing fence with a 6-foot-tall fence, add barbed wire above fence, and include 20-foot swing gate entrance at the 300K reservoir.

F-10. 600K Reservoir Security Upgrade. Replace existing fence with a 6-foot-taall fence, add barbed wire above fence, and include 20-foot swing gate entrance at the 600K reservoir.

F-11. Well Upgrades. Based on the condition of the wells, rehabilitate or drill new wells. Include treatment enhancements.

F-12. Wells Security Upgrades. Install fences around wells to delineate 100-foot setback around each wellhead.

F-13. Dune Wellhead Protection. Install a new fence around the Dune Wellhead site.

F-14. Wells Evacuation Area. Construct an evacuation area with radio tower.

F-15. 150K-gallon Reservoir. Decommission the existing 100,000-gallon reservoir and install a new 150,000-gallon reservoir (welded steel with epoxy coating) at a higher-elevation location, include telemetry. Install 10-inch-diameter C900 to connect to distribution system.

6.1.2 Pipe Upgrades

P-01. Water Meter Replacement. Reconcile the discrepancy between water production and water meter usage readings at services by replacing old water meters at each service connection.

P-02. Rueppell Avenue. Replace 2-inch polyethylene and galvanized piping with 6-inch C900 PVC. Install a fire hydrant.

P-03. Ferry Street in PC. Replace 2-inch pipe with 8-inch C900 PVC from Brooten Road to Hillcrest Road. Install a fire hydrant.

P-04. Roger Avenue and Jumper Lane. Install 8-inch C900 PVC od HDPE through Roger Avenue and Jumper Lane by boring under Brooten Road and up Roger Avenue. Install a hydrant.

P-05. Stephens Avenue, Wonder Lane, and Roger Avenue. Replace the 2-inch PVC piping with 6-inch C900 PVC. Install a fire hydrant.

P-06. Sunset Drive. Replace glued 6-inch PVC with 8-inch C900 PVC along Sunset Drive.

P-07. Pacific Avenue. Replace 10-inch asbestos-cement (AC) pipe with 10-inch C900 PVC along Pacific Avenue, between Brooten Road and Hill Road. Install a fire hydrant at Brooten Road and Hill Road intersection.

P-08. Pacific Avenue. Replace 10-inch AC with 10-inch C900 PVC along Pacific Avenue, between Brooten Road and Beachy Bridge.

P-09. Brooten Road. Replace roughly 100 feet of 6-inch AC piping with 10-inch C900 along Brooten Road. Install a hydrant just north of the intersection of Brooten Road and Pacific Avenue.

P-10. 4th Street South. Replace 2-inch PVC with 6-inch C900 PVC along 4th Street between Haystack Drive and Brooten Road.

P-11. 4th Street North. Replace 2-inch PVC with 6-inch C900 PVC along 4th Street between Haystack Drive and Pacific Avenue. Replace 2-inch PVC in Fisher Avenue with 4-inch C900 PVC. Install a fire hydrant at the intersection of 4th Street and Pacific Avenue.

P-12. 6th Street. Replace 2-inch PVC with 6-inch C900 PVC along 6th Street, between Pacific Avenue and Haystack Drive.

P-13. Hill Road. Replace 2-inch PVC with 8-inch or 12-inch C900 PVC along Hill Road (to be interconnected/looped).

P-14. Brooten Road. Replace 4-inch AC along Brooten Road south of the Slough Bridge to the south end of Nestucca Manor and 2-inch galvanized steel pipe through Nestucca Manor with 8-inch C900 PVC. Install a fire hydrant.

P-15. 3rd Street. Replace 2-inch PVC with 6-inch C900 along 3rd Street.

P-16. Tent Street. Replace 4-inch PVC with 6-inch C900 PVC along Tent Street.

P-17. 2nd Street and Shade Street. Replace 2-inch PVC with 6-inch C900 PVC through 2nd Street and Shade Street.

P-18. Brooten Road and Pacific Downtown Loop. Install 6-inch C900 PVC to connect River Avenue to Pacific Avenue.

P-19. Woods Bridge. Replace 6-inch ductile iron with 12-inch ductile iron. Include an air release valve and seismic-rated joints.

P-20. Cape Kiwanda Drive South End. Replace 2-inch galvanized steel with 6-inch C900 PVC along Cape Kiwanda Drive, connecting Pacific Avenue and Nestucca Boulevard.

P-21. Ella Avenue, Ray Avenue, Spike Avenue, Williams Avenue, Nestucca Boulevard. Replace 2-inch and 4-inch PVC with 6-inch C900 PVC through Ella Avenue, Ray Avenue, Spike Avenue, Williams Avenue, and Nestucca Boulevard. Install a fire hydrant along Williams Avenue and Spike Avenue.

P-22. Pine Street and Madrona Drive. Replace 2-inch PVC with 6-inch C900 PVC along Pine Street and Madrona Drive.

P-23. Shore Drive. Replace 2-inch PVC with 6-inch C900 PVC along Shore Drive.

P-24. Ridge Road, Pine Road, and Hilltop Road. Replace 2-inch PVC with 6-inch C900 PVC along Ridge Road, Pine Road, and Hilltop Road.

P-25. Cape Kiwanda Drive – South of Ridge Connector. Replace 4-inch AC with 8-inch C900 PVC along Cape Kiwanda Drive, south of Ridge Road connector.

P-26. Cape Kiwanda Drive – North of Ridge Connector. Replace 4-inch AC with 8-inch C900 PVC along Cape Kiwanda Drive, north of Ridge Road connector.

P-27. Pacific City Heights. Replace 2-inch PVC with 6-inch C900 PVC through Elderberry Lane, Salal Lane, Lower Loop Road, Upper Loop Road, Riverview Drive, Saghalie Lane, and South Circle Drive. Connect loop along Fisher Road with 6-inch C900 PVC.

P-28. Brooten Road. Replace 8-inch AC from Slough Bridge to Airport Way with 8-inch C900 PVC. Include an air release valves and seismic-rated joints at Slough Bridge.

P-29. Brooten Road. Replace 4-inch AC with 8-inch C900 PVC along Brooten Road south of Nestucca Manor.

P-30. Brooten Road. Replace 8-inch AC with 12-inch C900 from Pacific Avenue to Airport Way.

P-31. Ferry Street. Replace 6-inch ductile iron piping with 8-inch C900 PVC.

P-32. Old Woods Road. Connect Horn Creek WTP pipeline along Old Woods Road to Ferry Street with 8-inch C900 PVC.

P-33. Resort Drive. Connect 4-inch PVC to parallel 12-inch PVC in Resort Drive (north of the dairy), Install a fire hydrant.

P-34. Hillcrest Road. Install new 4-inch C900 PVC through Hillcrest Road.

6.1.3 Seismic Upgrades

S-01. Upgrade Reservoirs. Replace transmission connections with seismic, flexible fittings at the 300K and 600K Reservoirs. At the 300K Reservoir, replace booster pump station piping and fittings with earthquake-resistant ductile iron pipe. Provide landslide mitigation at the 600K Reservoir.

S-02. Upgrade Backbone Pipe from the Pacific Ave Bridge to the Horn Creek Transmission Pipe. Replace existing 8-, 10-, and 12-in with earthquake-resistant ductile iron pipe.

S-03. Upgrade Pacific Ave. Bridge Water Line. Replace 10-in DIP with 10-inch fusible PVC installed by HDD under Nestucca River.

S-04. Upgrade Backbone Pipe from the Horn Creek Transmission Pipe to the 300K Reservoir. Replace 12-in pipe with 12-in earthquake-resistant ductile iron pipe.

S-05. Upgrade Backbone Pipe from 300K Reservoir to the 600K Reservoir. Replace 8-in pipe with 8-in with earthquake-resistant ductile iron pipe.

S-06. Upgrade Horn Creek Water Treatment Plant. Provide a new seismic resilient intake with flexible connections. Incorporate improvements to the equipment anchorage and the metal building.

S-07. Upgrade Backbone Pipe from 100K or 150K Reservoir to the Pacific Ave Bridge. Place 4-, 8-, and 10-in pipe with earthquake-resistant ductile iron pipe.

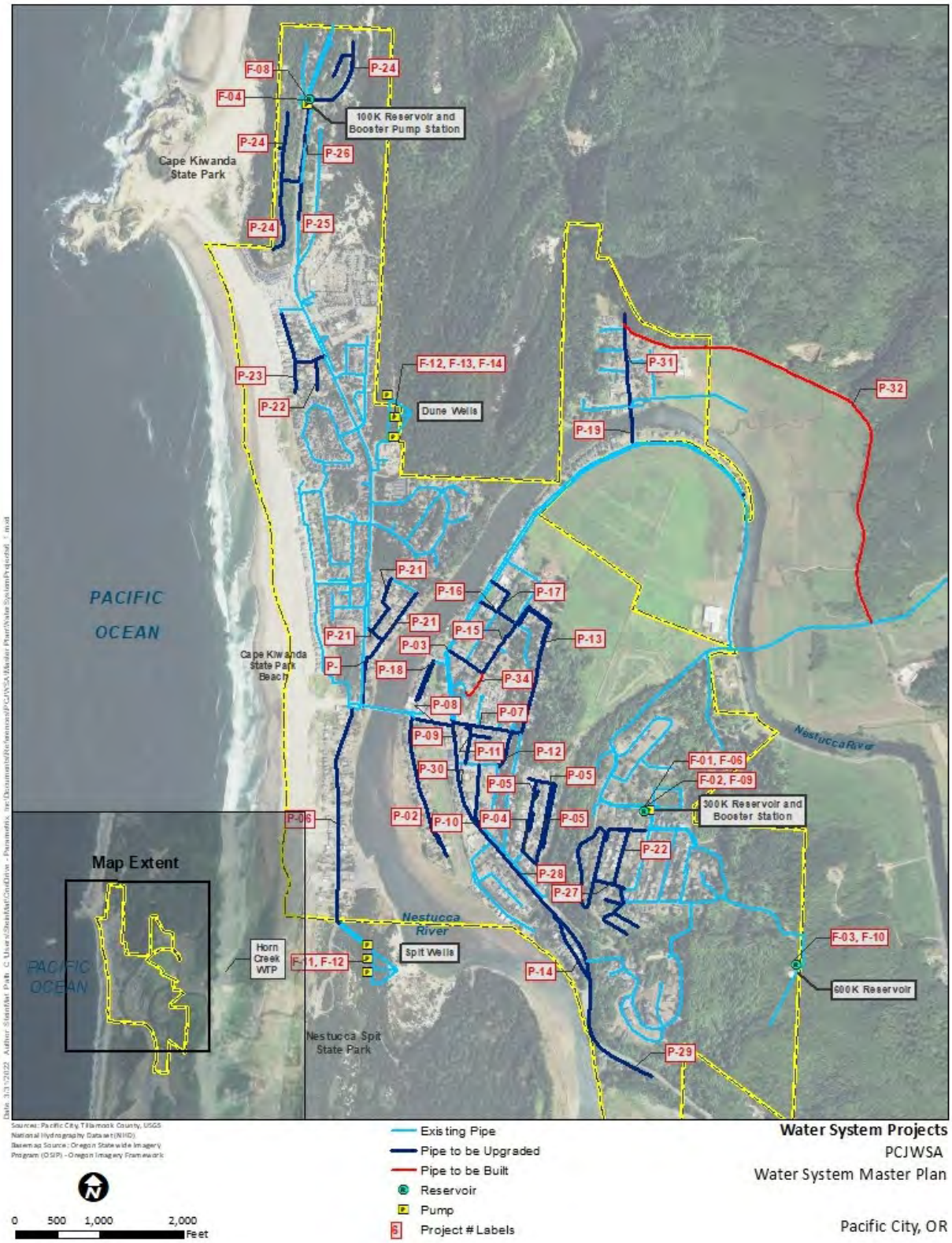


Figure 6-1. Water System Projects

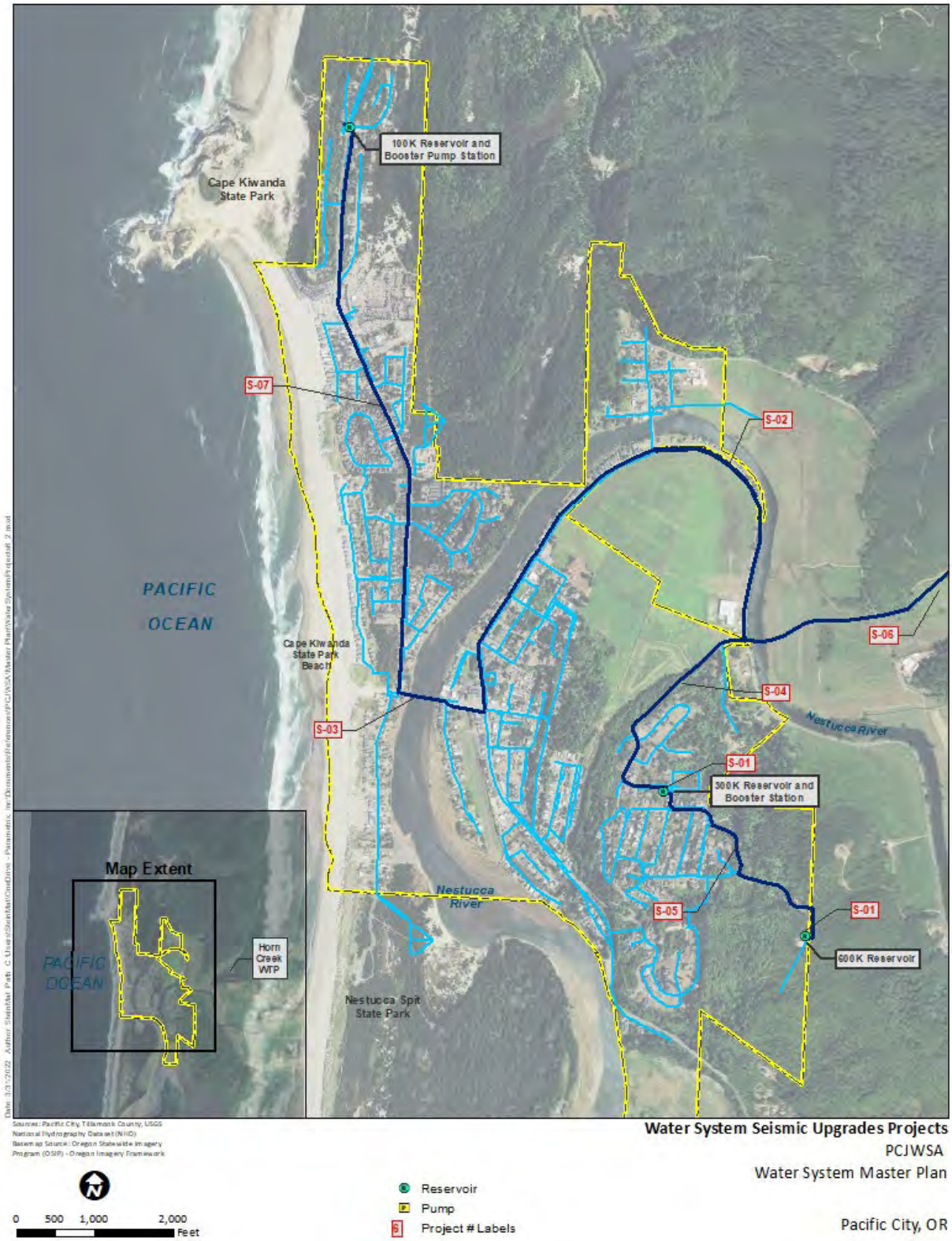


Figure 6-2. Water System Upgrade Projects

6.2 Implementation Schedule and Capital Cost Opinions for Recommended Improvements

The schedule of improvements was based upon priority as indicated by PCJWSA staff and results of this study. Table 6-1 lists the improvements and proposed schedule for implementation, as well as an opinion of the total project cost. The cost opinion includes construction cost, surveying, engineering, a contingency, and PCJWSA administrative costs. PCJWSA administrative costs were assumed to be 10 percent of the total to cover project management, coordination, administrative, and legal review costs. Costs for property purchase or easements are not included. Actual costs may vary with market conditions, contractor desire for work, subsurface conditions, and other factors not known at this time. The costs shown are in 2020 dollars, and inflation should be considered at time of construction.

Table 6-1. 2020 CIP Costs

	Project Name	Year	Cost
	Facility Improvements		
F-01	Standby Power for 300k BPS and Spit Wells	2021	$ 105,000
F-02	300k Tank Rehabilitation	2021	$ 25,000
F-03	600k Tank Rehabilitation	2021	$ 150,000
F-04	100K Reservoir Security Upgrade	2022	$ 50,000
F-05	SCADA Upgrades	2023	$ 50,000
F-06	Upgrade 300K Booster PS	2025	$ 66,000
F-07	Upgrade Horn Creek WTP to 1200 gpm	2025	$ 1,358,000
F-08	100K Fire Pump	2025	$ 1,439,000
F-09	300K Reservoir Security Upgrade	2025	$ 50,000
F-10	600K Reservoir Security Upgrade	2026	$ 50,000
F-11	Well Upgrades	2026	$ 1,000,000
F-12	Wells Security Upgrades	2026	$ 100,000
F-13	Dune Wellhead Protection	2030	$ 40,000
F-14	Wells Evacuation Area	2031	$ 100,000
F-15	150K-gal Reservoir	2032	$ 1,068,000
	Pipe Upgrades		
P-01	Water Meter Replacement	2021	$ 400,000
P-02	Rueppell Avenue	2021	$ 588,000
P-03	Ferry Street in Pacific City	2021	$ 166,000
P-04	Roger Avenue and Jumper Lane	2022	$ 311,000
P-05	Stephens Avenue, Wonder Lane, and Roger Avenue	2022	$ 646,000
P-06	Sunset Drive	2022	$ 746,000
P-07	Pacific Avenue (from Brooten Road to Hill)	2023	$ 261,000
P-08	Pacific Ave (from Brooten Road to bridge)	2024	$ 205,000
P-09	Brooten Road	2024	$ 47,000
P-10	4th Street South	2025	$ 231,000

	Project Name	Year	Cost
P-11	4th Street North	2025	$ 185,000
P-12	6th Street	2026	$ 128,000
P-13	Hill Road	2026	$ 1,183,000
P-14	Brooten Road & Nestucca Manor	2027	$ 668,000
P-15	3rd Street	2027	$ 203,000
P-16	Tent Street	2027	$ 156,000
P-17	2nd Street and Shade	2028	$ 145,000
P-18	Brooten and Pacific Downtown Loop	2028	$ 434,000
P-19	Woods Bridge	2029	$ 321,000
P-20	Cape Kiwanda Drive South End	2030	$ 174,000
P-21	Ella, Ray, Spike, Williams, and Nestucca Blvd	2030	$ 566,000
P-22	Pine Street and Madrona	2030	$ 231,000
P-23	Shore Drive	2030	$ 289,000
P-24	Ridge Road, Pine Road, and Hilltop Road	2030	$ 1,444,000
P-25	Cape Kiwanda Drive - South of Ridge Connector	2032	$ 280,000
P-26	Cape Kiwanda Drive - North of Ridge Connector	2032	$ 516,000
P-27	Pacific City Heights	2032	$ 1,134,000
P-28	Brooten Road	2034	$ 407,000
P-29	Brooten Road (south of Nestucca Manor)	2034	$ 474,000
P-30	Brooten Road (from Pacific to Airport Way)	2035	$ 587,000
P-31	Ferry Street	2035	$ 462,000
P-32	Old Woods Road	2035	$ 1,739,000
P-33	Resort Drive	2037	$ 152,000
P-34	Hillcrest Road	2039	$ 139,000
	Seismic Upgrades		
S-01	Upgrade Reservoirs	2022	$ 540,000
S-02	Upgrade Backbone Pipe from the Pacific Ave Bridge to the HC Transmission Pipe	2030	$ 6,156,000
S-03	Upgrade Pacific Ave Bridge Water line	2032	$ 530,000
S-04	Upgrade Backbone Pipe from the HC Transmission Pipe to the 300k Reservoir	2034	$ 2,460,000
S-05	Upgrade Backbone Pipe from the 300k Reservoir to the 600k Reservoir	2036	$ 1,846,000
S-06	Upgrade Horn Creek Water Treatment Plant	2038	$ 90,000
S-07	Upgrade Backbone Pipe from 100k or 150k Reservoir to the Pacific Ave Bridge	2040	$ 4,234,000
	Total		**$ 37,075,000**

The majority of the work is for pipeline-type construction. The following general assumptions apply to the cost opinions for pipeline work:

- All AC pipe to be replaced will be abandoned in place and not removed.
- Pipeline project costs were based on construction and equipment estimated from the Cost Works software. Pipe was assumed to be C900 PVC for all pipeline projects except project P-23 which was assumed to be ductile iron and the pipelines noted in the seismic upgrades which were assumed to be earthquake-resistant ductile iron pipe.
- It was assumed there would be five joint restraints, two bends, and one tee per 100 feet of pipeline.
- Restoration costs include backfill, compaction, and pavement restoration.
- A 10 percent markup was added for contractor mobilization, overhead, and profit.
- Surveying would be needed for all pipeline work. A rate of $3.00 per linear foot of pipe was used to estimate surveying costs.
- Engineering costs were estimated to be 25 percent of the construction costs.

The 150K reservoir project cost was based on a quote for a similar tank installed in La Push, Washington in 2020, plus the additional costs listed above. It was assumed that the new reservoir will require 2,000 linear feet of pipe to connect to the distribution system. The length of pipe required and the overall project cost are likely to change once the new reservoir location has been finalized.

The cost of boring for project P-03 was estimated based on a recent project in Washington. Note that costs of pipe installation by boring can vary significantly with site conditions and length of pipe to be installed. If possible, open cut construction is recommended to reduce cost.

6.3 Operation and Maintenance Costs

PCJWSA does not anticipate needing to hire additional staff as part of the identified improvements. The only hiring will be to replace personnel. Additionally, these system upgrades should not require any additional operation and maintenance costs to maintain the improvements.

7. FINANCE

7.1 Overview

PCJWSA operates both the water and sewer systems within the community of Pacific City. Since 1998, when the former Pacific City Water District and the former Pacific City Sanitary District merged to form PCJWSA, the financials have been reported as a single consolidated company. To fund water projects, PCJWSA can issue debt either to another federal, state, or local agency pledging gross revenues from only water rates and charges, or from water and sewer rates and charges. Also, PCJWSA can legally issue voter-approved general obligation (GO) bonds and assess property taxes to pay annual debt service (principal and interest) until the bonds are fully repaid. PCJWSA also qualifies for some federal and state grant and lending programs. In this chapter, we review the methods of borrowing, sources of revenues to repay the loans, the possible lenders, and current financial conditions.

7.2 Finance Methods and Sources

7.2.1 Methods of Borrowing

7.2.1.1 Direct State Loans

PCJWSA has three means of borrowing money. The first and easiest is to borrow from the State of Oregon via programs the State offers. These loans are state-to-municipal loans for water and sewer that do not require PCJWSA to issue bonds. Only administrative action by the PCJWSA Board of Directors is required to obligate PCJWSA to accept the loan and to repay it. It is not subject to voter referral to an election. PCJWSA can refer this loan to a vote of the people to secure a GO taxing authority. If it is successful, then PCJWSA can assess property taxes to repay this loan. Otherwise, PCJWSA has to pledge to increase its user fees sufficient to pay all operating costs and annual debt service.

7.2.1.2 Revenue Bonds

PCJWSA has the power to issue revenue bonds under the authority of ORS 287A.150. The PCJWSA Board of Directors would adopt a resolution of intent to issue a revenue bond. The resolution spells out the purpose(s) and amount(s) of the bond(s). The resolution and notice of the resolution have to be published in at least one newspaper or comparable method of notification, and then wait 60 days during which time voters may sign petitions of 5 percent of the electorate to refer the bonds to a vote. If a referral is not undertaken or successful, then the PCJWSA Board of Directors has the authority to negotiate and sell revenue bonds.

Revenue bond advantages include increased flexibility since bonds are not typically restricted by debt limitation statutes, and voter approval is not typically required (unless 5 percent of the electorate signs a petition). Disadvantages of the revenue bonds are that they are more complex financial arrangements and that these are used to finance revenue-producing projects.

7.2.1.3 General Obligation Bonds

PCJWSA has the power to issue GO bonds through Tillamook County by the authority of ORS 297A.100, but only upon voter approval. PCJWSA would draft and adopt a bond resolution and submit the

resolution and a bond title to the Tillamook County elections officer to place on the ballot for a general election. In an even-numbered year, voters would approve (or disapprove) the bonds by a simple majority of those who vote at the election. In an odd-numbered year, voters would approve the bonds only if more than 50 percent of the voters cast ballots and more than 50 percent of the votes cast were in favor of the bonds (double majority). Once voters approve issuing GO bonds, then PCJWSA has the power to negotiate the sale of the bonds and to assess property taxes at a rate that will generate up to an amount equal to total annual debt service. Because GO bonds are a full faith and credit pledge of PCJWSA, they get a lower interest rate on the municipal bond market than comparably sized revenue bonds. Federal and state lenders do not differentiate the interest rate between revenue and GO bonds. Also, annually the PCJWSA Board of Directors, through the budgeting process, can decide to pay the next year's debt service partially from user fee revenues, system development charge (SDC) revenues, or property tax assessments. This flexibility allows the PCJWSA Board of Directors to more equitably allocate the cost of debt service to its rate and taxpayers.

Water (or sewer) rates use a "pay-for-services-rendered" notion of equity. The more water a customer uses, the more it pays in debt service (and of the operating costs). Property taxes use an "ability-to-pay" notion of equity. That is, the more valuable a taxpayer's property (a surrogate measure of wealth) the more the taxpayer pays in debt service. By adjusting the percentage of total annual debt service paid from SDCs and the percentage paid from taxes, the PCJWSA Board of Directors can adjust its own notions of equity.

Because these bonds are tax exempt, the interest portion of the tax payments on these bonds is deductible from Oregon and federal income taxes.

7.2.2 Sources of Financing

PCJWSA has three separate sources of financing for water improvement projects:

- Municipal bond market
- The U.S. Department of Agriculture (USDA) Rural Development Water and Environmental Programs
- Oregon Business Development Department

7.2.2.1 The Municipal Bond Market

This source of financing is 100 percent loan – no grants. These loans are placed through financial institutions that require that an official statement of offering be prepared that clearly demonstrates the municipality's legal and financial ability to borrow and repay the loan. Typical closing costs to prepare the bonds ranges from 1.5 percent to over 2.0 percent of the amount of the bonds being issued.

7.2.2.2 USDA Rural Development Water and Environmental Programs

USDA provides financing resources through the Rural Utilities Service Water and Environmental Programs (WEP). WEP focuses specifically on rural communities with populations of 10,000 or less and aims to develop drinking water and wastewater systems. PCJWSA is eligible for this program and used this program for upgrades to its wastewater treatment plant. PCJWSA applied and received a $30,000 grant from the Special Evaluation Assistance for Rural Communities and Households (SEARCH) Program to conduct an environmental review and preliminary engineering report. It also received an $8.7 million

loan and $1.9 million grant through the Water and Wastewater Disposal program for the construction of the WWTP.

Applications are accepted electronically through the USDA Rural Development RD Apply website or submitted through the local USDA Rural Development office. For more information, contact Jay DeLapp, the Community Programs Specialist for Tillamook County, jay.delapp@usda.gov or at (541) 801-2676.

The following programs administered through WEP may be applicable for PCJWSA:

- Emergency Community Water Assistance Grants
- SEARCH
- Water and Waste Disposal Loan and Grant Program

Emergency Community Water Assistance Grants

The Emergency Community Water Assistance Grant program aims to assist communities with less than 10,000 people prepare or recover from emergencies that impact safe drinking water. Of the listed qualified emergency events, an earthquake is of most concern for PCJWSA. See Chapter 5 of this master plan. Grants can be for as much as $150,000 and can be used for construction of water system extensions, repairing breaks in the existing water distribution system, or related maintenance. Grants are also available for up to $1,000,000 to construct a water source, intake, or treatment facility. Applications are open year-round.

Special Evaluation Assistance for Rural Communities and Households

The SEARCH program serves rural communities with a population of 2,500 or less and where median household income is below the poverty line. The program is intended to help small, financially distressed rural communities. Funds can be used for feasibility studies, preliminary design, and technical assistance to develop applications for financial assistance. PCJWSA applied and received a $30,000 grant from this program on the wastewater side to conduct an environmental review and preliminary engineering report for upgrades at its WWTP. Applications are open year-round.

Water and Waste Disposal Loan and Grant Program

This program provides funding for clean drinking water, sanitary sewer, and stormwater systems. Areas with less than 10,000 people are eligible. The program provides long-term, low-interest loans to finance construction or improvements. Terms for the loans are up to 40 years, based on the expected life of the systems. The fixed, low interest rates are based on the median household income of the area. For some, the program will also provide a grant to keep costs lower for the users. PCJWSA received an $8.7 million loan and $1.9 million grant through this program for the construction of the WWTP. Applications are open year-round.

7.2.2.3 Oregon Business Development Department

The Oregon Business Development Department (OBDD) came from what was previously the Oregon Economic and Community Development Department. The Infrastructure Finance Authority (IFA) administers resources for development activities in the water and wastewater industry. The regional development officer for Tillamook County is Melanie Olson who can be contacted at melanie.olson@oregon.gov or 503-801-7155 for more information.

The following programs administered through IFA may be applicable to PCJWSA:

- Community Development Block Grants (CDBG)
- Safe Drinking Water Revolving Loan Fund (SDWRLF)
- Special Public Works Funds (SPWF)
- Water/Wastewater Financing Program (WWF)

Community Development Block Grants

CDBG funds public works infrastructure including water and wastewater treatment plants, public water and sewer pipe, and water reservoirs. Funds can only be applied to final design or construction. No funding for planning activities is provided. PCJWSA is eligible for this program. All non-metropolitan cities and counties in rural Oregon are eligible for grants. In order for PCJWSA to receive one of these grants, the project must demonstrate the benefit to low- and moderate-income families.

CDBG will fund up to $2,500,000 for public water works projects. Applications are accepted in spring and summer of each year.

Safe Drinking Water Revolving Loan Fund

The SDWRLF provides funds for engineering, design, upgrade, construction, or installation of system improvements and equipment for water intake, filtration, treatment, storage, and transmissions. Funds can also be used towards acquisitions of property or easements, improvements to physical security, and legal or technical help. Funds are strictly prohibited from being used on ongoing operations, fire suppression projects, projects that do not directly address the most severe noncompliance and health risks, and growth beyond industry-standard 20-year projections. PCJWSA is eligible for this program. To be eligible, a water system must service at 25 or more year-round residents or systems that have 15 or more connections, and systems cannot be federally owned or operated.

SDWRLF provides up to $6 million per project with possible subsidized interest rates and principal forgiveness. Loans tend to be 30 years or the useful life of the project asset, whichever is less. Drinking water providers must submit their proposed drinking water project information on a Letter of Interest (LOI) form found on the OBDD website. LOIs are due each quarter on March 15, June 15, September 15, and December 15. LOIs are rated and ranked to create a project priority list (PPL). Funding is available only for those projects listed on the PPL

Part of the SDWRLF is the Sustainable Infrastructure Planning Projects (SIPP) for projects that promote sustainability in the drinking water industry. These projects receive a 100 percent forgivable loan that funds up to $20,000. PCJWSA is likely not to receive any funding through SIPP, as priority for these projects is given to water systems with fewer than 300 connections.

Special Public Works Funds

SPWF is geared primarily for developing industrial and commercial lands – which likely does not impact PCJWSA in the near future but could be a possibility in the future; however, it can be applied to projects as a result of a natural disaster. For emergency projects, the fund provides a 25 percent match (up to 500,000). Grants are also available for projects with a business commitment to create or retain traded-sector jobs up to $5,000 per job – not to exceed 85 percent of the project cost or $500,000 per project. The application process is open year-round.

Water/Wastewater Financing Program

WWFP provides low-cost financing for planning, design, and construction of water and wastewater infrastructure. PCJWSA is eligible for this program – as are most public entities. Applications are accepted year-round and require submission of a Project Notification and Intake form. Contact the Regional Development Officer (Melanie Olson) for additional information.

Loans are limited to $10,000,000 per project with up to 25 years of repayment. Loans are typically repaid with utility revenues or voter-approved bonds.

Grants may be awarded where the annual median household income is less than the state average. Grants may be as much as $750,000.

Additionally, IFA offers grants up to $20,000 and loans up to $60,000 for water providers serving fewer than 15,000 people. These grants may be used towards preliminary planning, engineering studies, and economic investigations.

7.2.3 Sources of Revenue

PCJWSA has four basic sources of revenue to pay for capital projects or repay future loans:

1. Capital improvement charges
2. Interest from the local government investment pool (LGIP)
3. SDCs
4. Property taxes

Revenue is also generated by water usage per customer. This is PCJWSA's primary source to pay for all operating expenditures such as payroll and electricity, and the PCJWSA Board of Directors can increase the rates as needed to meet its financial obligations. Only those connected to the water system pay these rates.

7.2.3.1 Capital Improvement Charges

PCJWSA charges all users $3.00 per month for capital improvements.

7.2.3.2 Local Government Investment Pool

PCJWSA has investments in the LGIP which is included in the Oregon Short-Term Fund. Investments in the short-term fund are governed by ORS 294.135, the Oregon Investment Council, and portfolio guidelines issues by the Oregon Short-Term Fund Board. As of 2020, PCJWSA had nearly $5 million in investments in the LGIP. Interest from the investment funds are used to finance capital improvement projects.

7.2.3.3 SDCs

In the 1989 Oregon state legislative session, a bill was passed that created a uniform framework for the imposition of SDCs statewide. ORS 223.297-223.314, which became effective on July 1, 1991, (with subsequent amendments), authorizes local governments to assess SDCs for the following types of capital improvements:

- Drainage and flood control
- Water supply, treatment, and distribution
- Wastewater collection, transmission, treatment, and disposal
- Transportation
- Parks and recreation

SDCs can be developed around two concepts: (1) reimbursement fee, and (2) improvement fee, or a combination of the two.

The reimbursement fee is based on the costs of capital improvements *already constructed or under construction*. The legislation requires the reimbursement fee to be established or modified by an ordinance or resolution setting forth the methodology used to calculate the charge. This methodology must consider the cost of existing facilities, prior contributions by existing users, gifts or grants from federal or state government or private persons, the value of unused capacity available for future system users, rate-making principles employed to finance the capital improvements, and other relevant factors. The objective of the methodology must be that future system users contribute no more than an equitable share of the capital costs of *existing* facilities. Use of reimbursement fee revenues is restricted only to capital expenditures for the specific system for which they are assessed, including debt service.

The methodology for establishing or modifying an improvement fee must be specified in an ordinance or resolution that demonstrates consideration of the *projected costs of capital improvements identified in an adopted plan and list*, that are needed to increase capacity in the system to meet the demands of new or expanded development. Use of revenues generated through improvement fees is dedicated to capacity-increasing capital improvements or the repayment of debt on such improvements. An increase in capacity is established if an improvement increases the level of service provided by existing facilities or provides new facilities.

In many systems, growth needs will be met through a combination of existing available capacity and future capacity-enhancing improvements. Therefore, the law provides for a combined fee (reimbursement plus improvement component).

As part of this master plan, the SDC methodology and rates were revisited. In general, it was determined that the SDC rates developed as part of this master plan are in line with what PCJWSA already uses. The full report can be found in Appendix E.

The following table outlines the current SDC schedule.

Table 7-1. Current SDC Schedule

Meter Size	SDC
5/8 x 3/4 inches	$ 17,483
1 inch	$ 46,625
1-1/2 inches	$ 58,280
2 inches	$ 116,560
3 inches	$ 174,480
4 inches	$ 233,119

Meter Size	SDC
6 inches	$ 582,800
5/8 x 3/4 inches – Duplex/Fourplex, per unit	$ 17,483
5/8 x 3/4 inches – Apartment, per unit	$ 12,415
5/8 x 3/4 inches – Lodging facility per unit	$ 13,813
5/8 x 3/4 inches – Space in a Recreational Vehicle Park	$ 9,726

7.2.3.4 Property Taxes

PCJWSA can collect property taxes to repay voter-approved GO bonds. The tax levy is calculated annually, and the revenues by state law are restricted to repayment of the specific debt authorized by voters. As soon as the bonds are repaid, PCJWSA must stop levying the tax. This source of revenue is the most secure for lenders, and lenders reward municipalities that issue GO bonds with lower interest rates than comparably sized revenue bonds.

7.3 Financial Analysis

A financial forecast provides PCJWSA with a snapshot of its current financial status and its ability to finance the projects listed in the CIP. These forecasts include numerous assumptions and can deviate from observed conditions in the future. As such, PCJWSA should review this forecast annually compared to observed conditions. The intent of this exercise is to determine the potential need to finance projects in the CIP outside of the current funding mechanisms.

Table 7-2 is a forecast into the next 10 years. Water Revenue includes the monthly Capital Improvement Charge, interest from the LGIP, and SDCs. It was assumed that the Capital Improvement Charge would stay constant throughout and that the interest acquired from the LGIP and the SDC rates would increase by 3 percent annually. In general, the SDC rates have typically increased 2 to 3 percent; however, there have been some years with no increases. PCJWSA uses economic indicators each year to determine the SDC increase annually, and 3 percent was selected based on historical information and anticipation of the future. Expenses in Table 7-2 were developed based on the previous 5 years and escalated 3 percent annually into the future.

Projects from the CIP were included in this table based on the year each appears in the CIP. Based on this high-level analysis, PCJWSA does not have the current funding mechanisms needed to finance the projects in the CIP. After the 2021 projects, PCJWSA will not have the ability to pay for all the projects in 2022 or any year after that. PCJWSA needs to pursue additional outside funding or alternative funding mechanisms to be able to finance all the necessary improvements.

Table 7-2. Projected Short Term Cash Flow

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Starting Balance	$ 1,643,000	$ 414,072	$ (1,599,832)	$ (1,674,998)	$ (1,703,328)	$ (4,411,405)	$ (6,565,120)	$ (7,327,251)	$ (7,633,572)	$ (7,719,846)
Water Revenue	$ 271,204	$ 297,213	$ 305,994	$ 295,935	$ 324,355	$ 333,951	$ 343,834	$ 354,014	$ 364,500	$ 376,800
Expenses	$ 66,132	$ 68,116	$ 70,160	$ 72,265	$ 74,433	$ 76,666	$ 78,966	$ 81,335	$ 83,775	$ 86,288
CIP Projects	$ 1,434,000	$ 2,243,000	$ 311,000	$ 252,000	$ 2,958,000	$ 2,411,000	$ 1,027,000	$ 579,000	$ 367,000	$ 8,900,000
Ending Balance	$ 414,072	$ (1,599,832)	$ (1,674,998)	$ (1,703,328)	$ (4,411,405)	$ (6,565,120)	$ (7,327,251)	$ (7,633,572)	$ (7,719,846)	$ (16,329,334)

7.4 Recommendations

This section included a discussion of current known funding mechanisms for capital improvement projects. Current revenues are able to provide sufficient funding for the current expenses and some capital projects. These revenues are not sufficient to pay for all the capital projects included in this plan.

PCJWSA should begin to look for outside or additional resources to fund the CIP. It should begin by requesting a one-stop financing roundtable with Business Oregon (also referred to as Oregon Business Development Department in this master plan). This will give PCJWSA the opportunity to review the CIP with Business Oregon, Rural Development, and OHA in one meeting. After the meeting, PCJWSA should have a better idea which projects may qualify for funding and through which state or federal program. A list of potential funding programs is provided earlier in this master plan; however, this meeting will help to focus PCJWSA on the most advantageous ones.

Depending on the level of funding that PCJWSA can obtain from state or federal programs, it should also evaluate increasing its monthly capital improvement rate or look to raise funds through bonds. GO bonds would enable PCJWSA to raise the necessary funds through property taxes instead of increasing the monthly capital improvement rate; however, the GO bonds will require voter approval to enact.

There is no guarantee that PCJWSA will be able to obtain state or federal funding or that the funding it receives will be sufficient. It is also possible that PCJWSA is unable or unwilling to increase rates or issue a GO bond. If PCJWSA is unable to obtain the full amount required for the CIP, it should look to prioritize the most critical projects to be completed to ensure that those projects can be completed

Appendix A

References

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Appendix B

Regulatory Summary

Appendix B
Regulatory Summary
Key Sections of Public Water System Regulations, Oregon Administrative Rules, Chapter 333, Division 061

333-061-025 Responsibilities of Water Suppliers. Establishes responsibilities of water suppliers to include collection of submitting water samples for analyses, taking action should results exceed the maximum contaminant level (MCL), report the results of testing, notify customers and the public of violations, maintain operating and monitoring records, maintaining system pressure at least 20 pounds per square inch (psi), control cross connections, and assure operators are certified.

333-061-0030 Maximum Contaminant Levels and Action Levels. Sets the maximum concentrations allowable for various contaminants in water to assure the water is safe and palatable.

333-061-0032 Treatment Requirements and Performance Standards for Surface Water, Groundwater under Direct Influence of Surface Water, and Groundwater

333-061-0034 Treatment Requirements and Performance Standards for Corrosion Control

333-061-0036 Sampling and Analytical Requirements. Establishes frequency of sampling and methods to be used.

333-061-0040 Reporting and Record Keeping. Requires reporting of violations and routine results of monitoring.

333-061-0042 Public Notice. Requires providing public notice to persons served by the water system for all violations.

333-061-0043 Consumer Confidence Reports. This rule establishes the minimum requirements for the content of annual reports that community water systems must deliver to their customers

333-061-0045 Variances. This allows for variances from the maximum contaminant levels and treatment requirements under certain circumstances.

333-061-0046 Permits. This establishes the circumstances and conditions under which permits are issued.

333-061-0050 Construction Standards. Sets standards for construction of new public water systems or major additions or modifications to existing public water systems.

333-061-0055 Waivers from Construction Standards. This establishes the circumstances and conditions under which waivers from the construction standards are granted.

333-061-0057 Voluntary Drinking Water Protection Program. A public water system may establish a state certified wellhead protection program that delineates the well protection area and establishes standards of practice to protect the groundwater in those areas. This rule also covers contingency planning to respond to potential loss or reduction of a drinking water source.

333-061-0060 Plan Submission and Review Requirements. Establishes standards and fees for engineering plan reviews and standards for water master plans.

333-061-0061 Capacity Requirements for Public Water Systems. Establishes definitions for water system capacity, to include the technical, managerial, and financial capability. Technical standards include complying with land use, plan review, water rights, and water quality testing requirements; having water meters at all service connections; and a master plan meeting requirements of 333-061-0061. Managerial requirements include having certified operators. For systems where sensitive, endangered, or threatened fish species are located, requires water management and conservation plans meeting Oregon Water Resources Department requirements in OAR 690-86-0010 through 0920. Financial capability requires having a rate structure and billings that assure funds are collected to meet system needs for operation, maintenance, and replacement costs.

333-061-0062 Land Use Coordination. This rule is to assure that Health actions comply with state land use requirements.

333-061-0063 Environmental Review Process for The Safe Drinking Water Revolving Loan Fund Program. Provides for environmental review of actions that are funded through the Safe Drinking Water Revolving Loan Fund.

333-061-0064 Emergency Response Plan. Requires all systems to maintain a current emergency operations plan.

333-061-0065 Operation and Maintenance. Establishes requirements to assure public water systems are operated and maintained to provide continuous production and delivery of potable water. Includes requirements for timely leak repair; personnel training, experience, and certification; and record retention to include as-builts, operating manuals, and a current master plan. Other records to be maintained current include the number of service connections, raw water quality, chemicals and dosage rates, maintenance work, sampling and analyses, residual disinfectant measurements, cross connection control provisions, backflow prevention device testing, and customer complaints.

333-061-0070 Cross Connection Control. Establishes requirements for developing a cross-connection control program including a written plan of facilities with cross connections and backflow prevention devices. Also requires ongoing inspections for cross-connections, maintenance of records of devices, inspections, and testing.

333-061-0071, -0072, -0073, -0074 These sections cover backflow prevention device installation and operating standards, tester certification, inspector certification, instructor and training requirements.

333-061-0075 Sanitary Surveys of Watersheds. This section covers content of annual sanitary surveys required by purveyors using surface water or groundwater under the direct influence of surface water that do not provide filtration treatment. This would apply to PCJWSA should Horn Creek have been continued to be used without filtration.

333-061-0080 Role of Counties. Establishes the authority of counties over the water systems.

333-061-0085 Supplemental Fluoridation. Sets standards for application of fluoride.

333-061-0087 Product Acceptability Criteria. Sets standards for pipe and solders and prohibits use of lead piping.

333-061-0089 Annual Water System Fee. Requires water suppliers to pay a fee to the Oregon Health Authority by July 1 of every year.

333-061-0090 Penalties. Establishes violations to be penalized and penalty rate based on service population.

333-061-0095 Severability. Establishes the severability of any rule or part thereof.

333-061-0097 Adverse Health Affects Language. Establishes required language for public release related to violations or variances.

333-061-0098 References. Lists standards and industry references applicable to drinking water systems. These include many engineering standards, and are of use in applying engineering judgment to obtain variances from overly strict interpretation of the rules. These include the American Society for Testing and Materials, American Water Works Association, University of Southern California Manual of Cross Connection Control, and Standard Methods for the Examination of Water and Wastewater, 19th Edition, 1996.

333-061-0205, -0210, -0215, -0220, -0225, -02, -0228, -0230, -0235, -0245 Cover various requirements for operator certification, examinations, and fees.

333-061-0305, -0310, -0324, -0325, -0330, -0335 Cover various requirements for well testing.

333-061-0400 Reducing Lead in School Drinking Water. Establishes testing and sampling requirements for lead in school drinking water.

333-061-0510, -0520, -0530, -0540, -0550, -0560, -0570, -0580 Cover various rules and regulations about cyanotoxins.

Appendix C

Water Rights Documents

Table C-1
Water Supply Well Summary Data
Pacific City Joint Water-Sanitary Authority

Water Supply Well Information

Water Resource Dept Records								Production Rate (gpm)		Construction Dates		Total	First Water	Static
County	Well ID	Owner	Current Well Identification	Well Identification Remarks	General Well Location	Well Type	Well Type Remarks	Standard Demand	Peak Demand	Start	Complete	Depth (feet bgs)	Depth (feet bgs)	Water Level (feet bgs)
TILL	115	Pacific City Joint Water-Sanitary Authority	# 1	always called #1	southern dune well	production	operating	< 100	not exceeding 100	12/4/1980	12/17/1980	125	20	7
TILL	907	Pacific City Joint Water-Sanitary Authority	#2	originally called #3 before 1984	middle dune well	production	operating	< 100	not exceeding 100	2/15/1984	3/1/1984	80	45	7
TILL	908	Pacific City Joint Water-Sanitary Authority	old well #3	originally called #2 before 1984	northern dune well area	abandoned (see TILL 501505)	exists as capped well.	0	0	1/6/1981	1/10/1981	75	45	5
TILL	909	Pacific City Joint Water-Sanitary Authority	#2	first attempt abandoned due to sand intrusion	northern dune well area	abandoned	no abandonment record. Actual location not known.	0	0	12/17/1980	1/6/1981	85	n/a	n/a
TILL	50105	Pacific City Joint Water-Sanitary Authority	old well #3	well TILL 908	northern dune well area	abandonment	exists as capped well.	< 100	0	8/1/1996	8/1/1996	n/a	n/a	n/a
TILL	50092	Pacific City Joint Water-Sanitary Authority	new well #3	replaced TILL 908	northern dune well area	production	operating	< 100	not exceeding 100	7/17/1996	8/13/1996	75	2	3.2
TILL	937	Pacific City Joint Water-Sanitary Authority	#4	always called #4	northern spit well area	production	operating	not exceeding 100	not exceeding 100	7/6/1988	7/16/1988	47	16	8
TILL	936	Pacific City Joint Water-Sanitary Authority	#5	always called #5	middle spit well area	production	operating	< 100	not exceeding 100	7/26/1988	8/9/1988	51	16	8
TILL	934	Pacific City Joint Water-Sanitary Authority	#6	always called #6	southern spit well	production	operating	< 100	not exceeding 100	8/9/1988	8/22/1988	48	32	8

Table C-2
Water Supply Well Summary Data
Pacific City Joint Water-Sanitary Authority

Water Rights Information

Groundwater Rights								
Application Number	Permit Number	Certificatate Number	Priority Date	Stated Point of Diversion	Diversion Rate	Use	Application Area	State Limitations or Constraints
G-10215	G-9388	93770	3/16/1981	Wells #1 and #3.	Total of 0.457 cfs (205.1 gpm). 0.279 cfs (125.2 gpm) from well #1 and 0.178 cfs (79.9 gpm) from well #3.	quasi-municipal	All or portions of Sections 19 and 30 of T4S/R10W and portions of Sections 13, 24, and 25 of T4S/R11W.	Certificate allows reasonable rotation of diversion rates from the two wells.
G-11260	G-10392	80488	4/11/1984	Well #2.	Total of 0.3 cfs (134.6 gpm) or its equivalent in case of rotation.	quasi-municipal	All or portions of Sections 19, 25, 29, and 30 of T4S/R10W and portions of Sections 13 and 25 of T4S/R11W. Possible error regarding Section 25 being associated with T4S/R11W.	Certificate allows for reasonable rotation of diversion rates between wells.
G-11754	G-10798	80489	11/27/1987	Wells #4, #5, and #6.	Total of 300 gpm or its equivalent in case of rotation.	quasi-municipal	All or portions of Sections 18,19, and 30 of T4S/R10W and portions of Sections 13, 24, and 25 of T4S/R11W.	Further appropriation of water limited to the extent that it does not interfere with prior surface and groundwater rights. Certificate allows for rotation of diversion rates between the three wells.
			Total Diversion Rate allowed under existing Permits and Certificates		639.6 gpm or 1.425 cfs			

Table C-3
Water Supply Well Summary Data
Pacific City Joint Water-Sanitary Authority

Water Rights Information

Surface Water Rights								
Application Number	Permit Number	Certificatate Number	Priority Date	Stated Point of Diversion	Current Intake Identification	Diversion Rate	Use	Application Area
S-33272	S-26793	91174	8/3/1959	4S-10W-20-NESW	Horn Creek Intake	0.19 cfs	Municipal	Most or portions of Sections 19, 30, and 31 of T4S/R10W and portions of Sections 13, 24, and 25 of T4S/R11W.
S-40432	S-30792	91175	7/8/1965	4S-10W-20-NESW	Horn Creek Intake	0.49 cfs	Municipal	Most or portions of Sections 19, 30, and 31 of T4S/R10W and portions of Sections 13, 24, and 25 of T4S/R11W.
S-33272	S-26793	86807	8/3/1959	4S-10W-8-SESE	Upper Diversion #1	0.01 cfs	Municipal	Portions of Sections 19 and 30 of T4S/R10W and portions of Sections 24 and 25 of T4S/R11W.
S-40432	S-30792	86808	7/8/1965	4S-10W-16-SWNW	Upper Diversion #2	0.01 cfs	Municipal	Portions of Sections 19 and 30 of T4S/R10W and portions of Sections 24 and 25 of T4S/R11W.
S-49201	S-54783	-	5/3/1972	4S-10W-20-NESW	Horn Creek Intake	2.0 cfs	Quasi-municipal	Portions of Section 30 of T4S/R10W and portions of Sections 13, 24, and 25 of T4S/R11W.
				Total Diversion Rate allowed under existing Permits and Certificates		2.7 cfs		

STATE OF OREGON

COUNTY OF TILLAMOOK

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

PACIFIC CITY JOINT WATER-SANITARY AUTHORITY
PO BOX 520
PACIFIC CITY OR 97135

confirms the right to use the waters of TWO WELLS, in the NESTUCCA RIVER BASIN, for QUASI-MUNICIPAL PURPOSES.

This right was perfected under Permit G-9388. The date of priority is MARCH 16, 1981. The amount of water to which this right is entitled is limited to an amount actually used beneficially, and shall not exceed 0.457 CUBIC FOOT PER SECOND (CFS); BEING 0.279 CFS FROM WELL 1 AND 0.178 CFS FROM WELL 3, or its equivalent in case of rotation, measured at the well.

The wells are located as follows:

Twp	Rng	Mer	Sec	Q-Q	GLot	Measured Distances
4 S	10 W	WM	19	NW NW	1	WELL 3 (NEW) - 1570 FEET NORTH AND 170 FEET EAST FROM THE W1/4 CORNER, SECTION 19
4 S	10 W	WM	19	SW NW		WELL 1 (ORIGINAL) - 850.7 FEET NORTH AND 255.7 FEET EAST FROM W1/4 CORNER, SECTION 19

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

A description of the place of use is as follows:

Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	19	NE NE
4 S	10 W	WM	19	NW NE
4 S	10 W	WM	19	SW NE
4 S	10 W	WM	19	SE NE
4 S	10 W	WM	19	NE NW
4 S	10 W	WM	19	NW NW
4 S	10 W	WM	19	SW NW
4 S	10 W	WM	19	SE NW
4 S	10 W	WM	19	NE SW
4 S	10 W	WM	19	NW SW
4 S	10 W	WM	19	SW SW
4 S	10 W	WM	19	SE SW

NOTICE OF RIGHT TO PETITION FOR RECONSIDERATION OR JUDICIAL REVIEW

This is an order in other than a contested case. This order is subject to judicial review under ORS 183.482. Any petition for judicial review must be filed within the 60-day time period specified by ORS 183.482. Pursuant to ORS 183.482, ORS 536.075 and OAR 137-003-0675, you may petition for judicial review and 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.

Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	19	NE SE
4 S	10 W	WM	19	NW SE
4 S	10 W	WM	19	SW SE
4 S	10 W	WM	19	SE SE
4 S	10 W	WM	30	NE NE
4 S	10 W	WM	30	NW NE
4 S	10 W	WM	30	SW NE
4 S	10 W	WM	30	SE NE
4 S	10 W	WM	30	NE NW
4 S	10 W	WM	30	NW NW
4 S	10 W	WM	30	SW NW
4 S	10 W	WM	30	SE NW
4 S	10 W	WM	30	NE SW
4 S	10 W	WM	30	NE SE
4 S	10 W	WM	30	NW SE
4 S	10 W	WM	30	SW SE
4 S	10 W	WM	30	SE SE
4 S	11 W	WM	13	NE SE
4 S	11 W	WM	13	NW SE
4 S	11 W	WM	13	SW SE
4 S	11 W	WM	13	SE SE
4 S	11 W	WM	24	NE NE
4 S	11 W	WM	24	NW NE
4 S	11 W	WM	24	SW NE
4 S	11 W	WM	24	SE NE
4 S	11 W	WM	24	NE SE
4 S	11 W	WM	24	SE SE
4 S	11 W	WM	25	NE NE
4 S	11 W	WM	25	SE NE

Water shall be acquired from the same aquifer (water source) as the original point of appropriation.

The quantity of water diverted at the new point of appropriation shall not exceed the quantity of water lawfully available at the original point of appropriation as follows:

Twp	Rng	Mer	Sec	Q-Q	Measured Distances
4 S	10 W	WM	19	NW NW	WELL 2 – 1465.2 FEET NORTH AND 167.4 FEET EAST FROM W1/4 CORNER, SECTION 19

The water user shall maintain an in-line flow meter or other suitable device for measuring and recording the quantity of water appropriated.

The right to use of the water is restricted to beneficial use at the place of use described, and is subject to all other conditions and limitations contained in Certificate 61546 and any related decree.

This certificate is issued to confirm a change in POINT OF APPROPRIATION OF WELL 2, approved by an order of the Water Resources Director entered JANUARY 13, 2005, at Special Order Volume 63, Page 76, approving Transfer Application 9607, supercedes Certificate 61546, State record of Water Right Certificates.

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; however, water may be applied to lands which are not specifically described above, provided the holder of this right complies with ORS 540.510(3).

Issued MAY 25 2018.

Dwight French
Water Right Services Division Administrator, for
Thomas M. Byler, Director
Oregon Water Resources Department

STATE OF OREGON

COUNTY OF TILLAMOOK

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

PACIFIC CITY JWSA
P.O. BOX 520
PACIFIC CITY, OREGON 97135-0520

confirms the right to use the waters of ONE WELL in the NESTUCCA RIVER BASIN for QUASI-MUNICIPAL USE.

This right was perfected under Permit G-10392. The date of priority is APRIL 11, 1984. This right is limited to 0.3 CUBIC FOOT PER SECOND or its equivalent in case of rotation, measured at the well.

The well is located as follows:

SW 1/4 NW 1/4, SECTION 19, TOWNSHIP 4 SOUTH, R 10 W, W.M.; BEING 1200.2 FEET NORTH 11 DEGREES 3 MINUTES 41 SECONDS EAST FROM THE WEST 1/4 CORNER OF SECTION 19.

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

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

SW 1/4 SE 1/4
SE 1/4 SW 1/4
SECTION 18

W 1/2 NE 1/4
SE 1/4 NE 1/4
E 1/2 NW 1/4
SW 1/4
W 1/2 SE 1/4
NE 1/4 SE 1/4
SECTION 19
TOWNSHIP 4 SOUTH, RANGE 10 WEST, W.M.

This is a final order in other than contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review of the order must be filed within the 60 days of the date of service.

G-11260.SB

Certificate Number 80488

NW 1/4 NE 1/4
S 1/2 NE 1/4
NW 1/4
NE 1/4 SW 1/4
W 1/2 SE 1/4
SECTION 30
TOWNSHIP 4 SOUTH, RANGE 10 WEST, W.M.

E 1/2 SE 1/4
SECTION 13

E 1/2 NE 1/4
E 1/2 SE 1/4
SECTION 24

E 1/2 NE 1/4
SECTION 25
TOWNSHIP 4 SOUTH, RANGE 11 WEST, W.M.

Water may be applied to lands which are not specifically described above, provided the holder of this right complies with ORS 540.510(3).

The well shall be maintained in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon.

Issued January 14, 2004.

Dwight Ford for

Paul R. Cleary, Director
Water Resources Department

Recorded in State Record of Water Right Certificates Number 80488.

G-11260

STATE OF OREGON

COUNTY OF TILLAMOOK

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

PACIFIC CITY JWSA
P.O. BOX 520
PACIFIC CITY, OREGON 97135-0520

confirms the right to use the waters of WELL NO.'S 4, 5 AND 6 in the NESTUCCA RIVER BASIN for QUASI-MUNICIPAL USE.

This right was perfected under Permit G-10798. The date of priority is NOVEMBER 27, 1987. This right is limited to 300 GALLONS PER MINUTE or its equivalent in case of rotation, measured at the wells.

The wells are located as follows:

WELL NO. 4 - SW 1/4 SW 1/4, SECTION 30, TOWNSHIP 4 SOUTH, RANGE 10 WEST, W.M.; 1000 FEET NORTH AND 590 FEET EAST FROM THE SW CORNER OF SECTION 30;

WELL NO. 5 - NW 1/4 SW 1/4, SECTION 30, TOWNSHIP 4 SOUTH, RANGE 10 WEST, W.M.; 1930 FEET NORTH AND 340 FEET EAST FROM THE SW CORNER OF SECTION 30; AND

WELL NO. 6 - NW 1/4 SW 1/4, SECTION 30, TOWNSHIP 4 SOUTH, RANGE 10 WEST, W.M.; 2280 FEET NORTH AND 2800 FEET EAST FROM THE SW CORNER OF SECTION 30.

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

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

SW 1/4 SE 1/4
SE 1/4 SW 1/4
SECTION 18
TOWNSHIP 4 SOUTH, RANGE 10 WEST, W.M.

This is a final order in other than contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review of the order must be filed within the 60 days of the date of service.

G-11754 Certificate Number 80489

W 1/2 NE 1/4
SE 1/4 NE 1/4
E 1/2 NW 1/4
SW 1/4
W 1/2 SE 1/4
NE 1/4 SE 1/4
SECTION 19

NW 1/4 NE 1/4
S 1/2 NE 1/4
NW 1/4
NE 1/4 SW 1/4
W 1/2 SE 1/4
SECTION 30
TOWNSHIP 4 SOUTH, RANGE 10 WEST, W.M.

E 1/2 SE 1/4
SECTION 13

E 1/2 NE 1/4
E 1/2 SE 1/4
SECTION 24

E 1/2 NE 1/4
SECTION 25
TOWNSHIP 4 SOUTH, RANGE 11 WEST, W.M.

Water may be applied to lands which are not specifically described above, provided the holder of this right complies with ORS 540.510(3).

The well shall be maintained in accordance with the General Standards for the Construction and Maintenance of Water Wells in Oregon.

Issued January 14, 2004.

Paul R. Cleary, Director
Water Resources Department

Recorded in State Record of Water Right Certificates Number 80489.

G-11754

STATE OF OREGON

COUNTY OF TILLAMOOK

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

PACIFIC CITY JOINT WATER SANITARY AUTHORITY
PO BOX 520
PACIFIC CITY OR 97135

confirms the right to use the waters of UNNAMED STREAM, a tributary of HORN CREEK, for MUNICIPAL USE.

This right was perfected under Permit S-30792. The date of priority is JULY 8, 1965. The amount of water to which this right is entitled is limited to an amount actually used beneficially, and shall not exceed 0.49 CUBIC FOOT PER SECOND, or its equivalent in case of rotation, measured at the point of diversion.

The point of diversion is located as follows:

Twp	Rng	Mer	Sec	Q-Q	Measured Distances
4 S	10 W	WM	20	NE SW	2200 FEET NORTH AND 2450 FEET EAST FROM SW CORNER, SECTION 20

A description of the place of use is as follows:

Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	18	SE SW
4 S	10 W	WM	19	NW NE
4 S	10 W	WM	19	SW NE
4 S	10 W	WM	19	SE NE
4 S	10 W	WM	19	NE NW
4 S	10 W	WM	19	SW NW
4 S	10 W	WM	19	SE NW
4 S	10 W	WM	19	NE SW
4 S	10 W	WM	19	NW SW
4 S	10 W	WM	19	SW SW
4 S	10 W	WM	19	SE SW
4 S	10 W	WM	19	NE SE
4 S	10 W	WM	19	NW SE
4 S	10 W	WM	19	SW SE
4 S	10 W	WM	19	SE SE
4 S	10 W	WM	30	NE NE
4 S	10 W	WM	30	NW NE
4 S	10 W	WM	30	SW NE
4 S	10 W	WM	30	SE NE
4 S	10 W	WM	30	NE NW
4 S	10 W	WM	30	NW NW
4 S	10 W	WM	30	SW NW
4 S	10 W	WM	30	SE NW

NOTICE OF RIGHT TO PETITION FOR RECONSIDERATION OR JUDICIAL REVIEW

This is an order in other than a contested case. This order is subject to judicial review under ORS 183.482. Any petition for judicial review must be filed within the 60-day time period specified by ORS 183.482. Pursuant to ORS 183.482, ORS 536.075 and OAR 137-003-0675, you may petition for judicial review and 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.

Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	30	NE SW
4 S	10 W	WM	30	NE SE
4 S	10 W	WM	30	NW SE
4 S	10 W	WM	30	SW SE
4 S	10 W	WM	30	SE SE
4 S	10 W	WM	31	NW NE
4 S	10 W	WM	31	SW NE
4 S	11 W	WM	13	NE SE
4 S	11 W	WM	13	SW SE
4 S	11 W	WM	13	SE SE
4 S	11 W	WM	24	NE NE
4 S	11 W	WM	24	NW NE
4 S	11 W	WM	24	SW NE
4 S	11 W	WM	24	SE NE
4 S	11 W	WM	24	NE SE
4 S	11 W	WM	24	NW SE
4 S	11 W	WM	24	SE SE
4 S	11 W	WM	25	NE NE
4 S	11 W	WM	25	SE NE

The quantity of water diverted at the new point of diversion shall not exceed the quantity of water available from the original point of diversion described as follows:

Twp	Rng	Mer	Sec	Q-Q	Measured Distances
4 S	10 W	WM	16	SW NW	330 FEET NORTH AND 50 FEET EAST FROM W1/4 CORNER, SECTION 16

The water user shall maintain and operate the existing measurement device and shall make such improvements as may be required by the Department.

The water user shall maintain the existing headgate and shall make such improvements as may be required by the Department.

The water user shall maintain and operate fish screening and by-pass device as required by the Oregon Department of Fish and Wildlife to prevent fish from entering the diversion.

The right to the use of the water is subject to the existing minimum flow policies established by the Water Policy Review Board.

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; however, water may be applied to lands which are not specifically described above, provided the holder of this right complies with ORS 540.510(3).

This certificate is issued to confirm changes in POINT OF DIVERSION AND PLACE OF USE approved by an order of the Water Resources Director entered JANUARY 31, 2011, at Special Order Volume 83, Page 461, approving Transfer Application 11126, and together with Certificate 86808, supersedes Certificate 44554, State record of Water Right Certificates.

Issued JAN 26 2016.

Dwight French
Water Right Services Division Administrator, for
Thomas M. Byler, Director
Oregon Water Resources Department

STATE OF OREGON

COUNTY OF TILLAMOOK

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

PACIFIC CITY JOINT WATER SANITARY AUTHORITY
PO BOX 520
PACIFIC CITY OR 97135

confirms the right to use the waters of HORN CREEK, a tributary of NESTUCCA RIVER, for MUNICIPAL USE.

This right was perfected under Permit S-26793. The date of priority is AUGUST 3, 1959. The amount of water to which this right is entitled is limited to an amount actually used beneficially, and shall not exceed 0.19 CUBIC FOOT PER SECOND, or its equivalent in case of rotation, measured at the point of diversion.

The point of diversion is located as follows:

Twp	Rng	Mer	Sec	Q-Q	Measured Distances
4 S	10 W	WM	20	NE SW	2200 FEET NORTH AND 2450 FEET EAST FROM SW CORNER, SECTION 20

A description of the place of use is as follows:

Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	18	SE SW
4 S	10 W	WM	19	NW NE
4 S	10 W	WM	19	SW NE
4 S	10 W	WM	19	SE NE
4 S	10 W	WM	19	NE NW
4 S	10 W	WM	19	SW NW
4 S	10 W	WM	19	SE NW
4 S	10 W	WM	19	NE SW
4 S	10 W	WM	19	NW SW
4 S	10 W	WM	19	SW SW
4 S	10 W	WM	19	SE SW
4 S	10 W	WM	19	NE SE
4 S	10 W	WM	19	NW SE
4 S	10 W	WM	19	SW SE
4 S	10 W	WM	19	SE SE
4 S	10 W	WM	30	NE NE
4 S	10 W	WM	30	NW NE
4 S	10 W	WM	30	SW NE
4 S	10 W	WM	30	SE NE
4 S	10 W	WM	30	NE NW
4 S	10 W	WM	30	NW NW
4 S	10 W	WM	30	SW NW
4 S	10 W	WM	30	SE NW
4 S	10 W	WM	30	NE SW
4 S	10 W	WM	30	NE SE

NOTICE OF RIGHT TO PETITION FOR RECONSIDERATION OR JUDICIAL REVIEW

This is an order in other than a contested case. This order is subject to judicial review under ORS 183.482. Any petition for judicial review must be filed within the 60-day time period specified by ORS 183.482. Pursuant to ORS 183.482, ORS 536.075 and OAR 137-003-0675, you may petition for judicial review and 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.

Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	30	NW SE
4 S	10 W	WM	30	SW SE
4 S	10 W	WM	30	SE SE
4 S	10 W	WM	31	NW NE
4 S	10 W	WM	31	SW NE
4 S	11 W	WM	13	NE SE
4 S	11 W	WM	13	SW SE
4 S	11 W	WM	13	SE SE
4 S	11 W	WM	24	NE NE
4 S	11 W	WM	24	NW NE
4 S	11 W	WM	24	SW NE
4 S	11 W	WM	24	SE NE
4 S	11 W	WM	24	NE SE
4 S	11 W	WM	24	NW SE
4 S	11 W	WM	24	SE SE
4 S	11 W	WM	25	NE NE
4 S	11 W	WM	25	SE NE

The quantity of water diverted at the new point of diversion shall not exceed the quantity of water available from the original point of diversion described as follows:

Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	8	SE SE

The water user shall maintain and operate the existing measurement device and shall make such improvements as may be required by the Department.

The water user shall maintain the existing headgate and shall make such improvements as may be required by the Department.

The water user shall maintain and operate fish screening and by-pass device as required by the Oregon Department of Fish and Wildlife to prevent fish from entering the diversion.

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; however, water may be applied to lands which are not specifically described above, provided the holder of this right complies with ORS 540.510(3).

This certificate is issued to confirm changes in POINT OF DIVERSION AND PLACE OF USE approved by an order of the Water Resources Director entered JANUARY 31, 2011, at Special Order Volume 83, Page 461, approving Transfer Application 11126, and together with Certificate 86807, supersedes Certificate 32238, State record of Water Right Certificates.

Issued JAN 26 2016

Dwight French
Water Right Services Division Administrator, for
Thomas M. Byler, Director
Oregon Water Resources Department

STATE OF OREGON

COUNTY OF TILLAMOOK

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

PACIFIC CITY JOINT WATER SANITARY AUTHORITY
PO BOX 520
PACIFIC CITY, OR 97135-0520

confirms the right to use the waters of HORN CREEK, a tributary to the NESTUCCA RIVER for MUNICIPAL USES.

This right was perfected under Permit S-26793. The date of priority is AUGUST 3, 1959. The amount of water to which this right is entitled is limited to an amount actually used beneficially, and shall not exceed 0.01 CUBIC FOOT PER SECOND, or its equivalent in case of rotation, measured at the point of diversion.

The point of diversion is located as follows:

Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	8	SE SE

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

MUNICIPAL USES					
Twp	Rng	Mer	Sec	Q-Q	GLot
4 S	10 W	WM	19	NE SW	
4 S	10 W	WM	19	NW SW	
4 S	10 W	WM	19	SW SW	
4 S	10 W	WM	19	SE SW	
4 S	10 W	WM	30	NE NW	
4 S	10 W	WM	30	NW NW	
4 S	10 W	WM	30	SW NW	
4 S	10 W	WM	30	SE NW	
4 S	11 W	WM	24	NE NE	1
4 S	11 W	WM	24	SE NE	2
4 S	11 W	WM	24	NE SE	3
4 S	11 W	WM	24	SE SE	4
4 S	11 W	WM	25	NE NE	1
4 S	11 W	WM	25	SE NE	2

This certificate describes that portion of the water right confirmed by Certificate 32238, State Record of Water Right Certificates, NOT modified by the provisions of an order of the Water Resources Director entered JAN 3 1 2011, approving Transfer Application T-11126.

The issuance of this superseding certificate does not confirm the status of the water right in regard to the provisions of ORS 540.610 pertaining to forfeiture or abandonment.

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.

WITNESS the signature of the Water Resources Director, affixed JAN 3 1 2011.

Dwight Frul

Phillip C. Ward, Director

STATE OF OREGON, |
County of Marion, |*ss.*

This superseding permit is issued to describe an amendment for a change in point of diversion proposed under Permit Amendment Application T-11450 and approved by Special Order Vol. 88, Page 144, entered Nov. 19, 2012, and to describe extensions of time for complete application of water approved May 24, 1978, August 27, 1981, March 21, 1986, and May 14, 2012, an assignment to a new permittee approved September 18, 1998, and a Water Management and Conservation Plan approved October 1, 2012. This permit supersedes Permit S-36881.

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 2.0 *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* Horn Creek.....

The use to which water is to be applied is quasi-municipal.....

.....

Authorized Points of Diversion:

Twp	Rng	Mer	Sec	Q-Q	Measured Distances
4 S	10 W	WM	20	NE SW	2445 FEET NORTH AND 2514 FEET EAST FROM THE SE CORNER OF SECTION 19
4 S	10 W	WM	20	NE SW	2450 FEET NORTH AND 2575 FEET EAST FROM THE SW CORNER OF SECTION 20

Authorized Place of Use:

QUASI-MUNICIPAL USE				
Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	18	SE SW
4 S	10 W	WM	18	SW SE
4 S	10 W	WM	19	NW NE
4 S	10 W	WM	19	SW NE
4 S	10 W	WM	19	SE NE
4 S	10 W	WM	19	NE NW
4 S	10 W	WM	19	SW NW
4 S	10 W	WM	19	SE NW
4 S	10 W	WM	19	NE SW
4 S	10 W	WM	19	NW SW
4 S	10 W	WM	19	SW SW
4 S	10 W	WM	19	SE SW
4 S	10 W	WM	19	NE SE
4 S	10 W	WM	19	NW SE
4 S	10 W	WM	19	SW SE
4 S	10 W	WM	19	SE SE
4 S	10 W	WM	30	NE NE

QUASI-MUNICIPAL USE				
Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	30	NW NE
4 S	10 W	WM	30	SW NE
4 S	10 W	WM	30	SE NE
4 S	10 W	WM	30	NE NW
4 S	10 W	WM	30	NW NW
4 S	10 W	WM	30	SW NW
4 S	10 W	WM	30	SE NW
4 S	10 W	WM	30	NE SW
4 S	10 W	WM	30	NW SW
4 S	10 W	WM	30	NE SE
4 S	10 W	WM	30	NW SE
4 S	10 W	WM	30	SW SE
4 S	10 W	WM	30	SE SE
4 S	10 W	WM	31	NW NE
4 S	10 W	WM	31	SW NE
4 S	11 W	WM	13	NE SE
4 S	11 W	WM	13	SW SE
4 S	11 W	WM	13	SE SE
4 S	11 W	WM	24	NE NE
4 S	11 W	WM	24	NW NE
4 S	11 W	WM	24	SW NE
4 S	11 W	WM	24	SE NE
4 S	11 W	WM	24	NE SE
4 S	11 W	WM	24	NW SE
4 S	11 W	WM	24	SE SE
4 S	11 W	WM	25	NE NE
4 S	11 W	WM	25	SE NE
4 S	11 W	WM	25	NE SE

Permit Amendment T-11450 Conditions

The combined quantity of water diverted at the new additional point of diversion, together with that diverted at the old point of diversion, shall not exceed the quantity of water lawfully available at the original point of diversion.

The water user shall operate and maintain an approved fish screen at the new point of diversion. If Oregon Department of Fish and Wildlife (ODFW) determines the screen is not functioning properly, and is unsuccessful in working with the water user to meet ODFW standards, ODFW may request that OWRD regulate the use of water until OWRD receives notification from ODFW that the fish screen is functioning properly.

Water shall be acquired from the same surface water source (Horn Creek) as the original point of diversion.

Extension of Time Conditions

1. Development Limitations

Diversion of any water beyond 1.35 cfs under Permit S-36881 (superseded by Permit S-54783) shall only be authorized upon issuance of a final order approving a Water Management and Conservation Plan (WMCP) under OAR Chapter 690, Division 86. The required WMCP shall be submitted to the Department within 3 years of an approved extension of time application. Use of water under Permit S-54783 must be consistent with this and subsequent WMCP's approved under OAR Chapter 690, Division 86 on file with the Department.

The deadline established by the Extension of Time Final Order for submittal of a WMCP shall not relieve a permit holder of any existing or future requirement for submittal of a WMCP at an earlier date as established through other orders of the Department. A WMCP submitted to meet the requirements of the Extension of Time Final Order may also meet the WMCP requirements of other Department orders.

2. Settlement Conditions

The following three conditions are added pursuant to the Settlement Agreement:

2.a. Total surface water withdrawals from any of the points of diversion authorized under Certificates 86807 and 86808, under Transfer T-11126 and Permit S-54783 and any subsequent certificates issued thereunder, will be limited to a combined rate of 2.7 cfs.

2.b. Withdrawal of surface water from Horn Creek will not be allowed when stream flow is less than 2.0 cfs; however, for as long as Condition 3 of the Biological Opinion or the Corps Permit is in effect, the withdrawal of surface water will not be allowed when stream flow is less than 2.5 cfs. Condition 3 of Biological Opinion is copied below:

> 3. To implement reasonable and prudent #3 (instream flows) the Corps shall ensure that water withdrawals at the Horn Creek intake do not exceed 2.7 cfs, and minimum instream flows do not drop below 2.5 cfs.
>
> a. When water withdrawals on Horn Creek reach 2.0 cfs, instream flows shall be measure[d] concurrently at two locations until water withdrawals drop below 2.0 cfs. The first location shall be located approximately 250 feet from the confluence of Horn Creek and the Nestucca River. The second location shall be located approximately 250 feet above the head of tide.
>
> Biological Opinion, Attachment 1, p. 31.

For as long as the Biological Opinion is in effect, stream flow measurements will be taken in accordance with Paragraph 3.a. of Attachment 1 (as shown above), except that if the requirements of Paragraph 3.a. are amended by agreement of NOAA and Pacific City, requirements as amended shall apply. Thereafter, stream flow measurement for purposes of complying with Condition **2.b.** shall be taken below the lowest PCJSWA point of diversion on Horn Creek. The permit holder shall be responsible for maintaining and operating a stream gage at such location.

2.c. The water right permit holder will provide copies to Oregon Water Resources Department ("OWRD") of all reports prepared pursuant to Conditions 4(d)-(g) of the Biological Opinion for as long as such reports are required under the Corps Permit. At such time as reports are no longer required under the Corps Permit, the water right permit holder will provide annual reports to the OWRD, or more frequently if requested by OWRD, of daily stream flow measurements and daily surface water withdrawals. Conditions 4(d)-(g) of the Biological Opinion are copied below:

4. To implement reasonable and prudent #4 (monitoring) the Corps shall:

***

d. Annually, submit a report that details Pacific City's operation plan, including peak demand, Horn Creek withdrawals, and duration of peak withdrawals.

e. Annually, for a period of 5 years, submit a report to NMFS that summarizes the results of the post-construction instream temperature monitoring, low flow habitat analysis, and the effectiveness of the installation of the large wood debris structures in creating pools and providing habitat and riparian planting survival.

f. As required by term and condition #2[3], submit a monitoring report detailing instream flow measures collected during periods of peak withdrawals exceeding 2.0 cfs.

...

Biological Opinion, Attachment 1, p. 32

Water Management and Conservation Plan Conditions

The Pacific City Joint Water-Sanitary Authority Water Management and Conservation Plan shall remain in effect until October 1, 2022, unless approval is rescinded pursuant to OAR 690-086-0920.

The limitation of the diversion of water under Permit S-36881 (superseded by Permit S-54783) established in Condition #1 (Developmental Limitations) in the Final Order Incorporating Settlement Agreement (Page 6 of 9) issued by the Oregon Water Resources Department on May 14, 2012, approving an extension of time for Permit S-36881 (superseded by Permit S-54783) is removed.

Subject to other limitations and/or conditions of the permit, as well as the Settlement Conditions set forth in the Extension of Time Final Order Incorporating Settlement Agreement issued by the Oregon Water Resources Department on May 14, 2012, the Pacific City Joint Water-Sanitary Authority is authorized to divert up to 2.0 cfs under Permit S-54783.

The Pacific City Joint Water-Sanitary Authority shall submit an updated plan meeting the requirements of OAR Chapter 690, Division 086 within 10 years (of the plan approval date) and no later than April 1, 2022.

The Pacific City Joint Water-Sanitary Authority shall submit a progress report containing the information required under OAR 690-086-0120(4) by October 1, 2017.

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

The priority date of this permit is May 3, 1971.....

Actual construction work shall begin on or before July 27, 1974..... *and shall thereafter be prosecuted with reasonable diligence and be completed on or before* October 1, 2025.....

Complete application of the water to the proposed use shall be made on or before October 1, 2025.....

WITNESS my hand this.....19.....*day of* November, 2012.

.....

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

BEFORE THE WATER RESOURCES DEPARTMENT
OF THE
STATE OF OREGON

In the Matter of Permit Amendment T-11450, Tillamook County	))))	**FINAL ORDER** APPROVING AN ADDITIONAL POINT OF DIVERSION AND A CHANGE IN PLACE OF USE

Authority

ORS 537.211 establishes the process in which a water right permit holder may submit a request to change the point of diversion and/or place of use authorized under an existing water right permit.

Applicant

PACIFIC CITY JOINT WATER-SANITARY AUTHORITY
ATTN TONY OWEN
PO BOX 520
PACIFIC CITY OR 97135-0520

Findings of Fact

Background

1. On July 24, 2012, PACIFIC CITY JOINT WATER-SANITARY AUTHORITY filed an application for an additional point of diversion and to change in place of use under Permit S-36881. The Department assigned the application number T-11450.

2. On September 18, 1998, the Department approved an assignment of the permit to Pacific City Joint Water-Sanitary Authority.

3. On May 24, 1978, the Department approved an extension of time for complete application of water to October 1, 1980.

4. On August 27, 1981, the Department approved an extension of time for complete application of water to October 1, 1985.

5. On March 21, 1986, the Department approved an extension of time for complete application of water to October 1, 1990.

6. On May 14, 2012, the Department approved an extension of time for complete application of water to October 1, 2025.

This is a final order in other than 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 137-004-080 and OAR 690-01-005 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.

7. On October 1, 2012, the Department approved a Water Management and Conservation Plan submitted by the Pacific City Joint Water-Sanitary Authority. The approval order was entered at Volume 88, Page 595.

8. Permit Amendment Application T-11450 proposes an additional point of diversion approximately 60 feet upstream from the existing point of diversion to:

Twp	Rng	Mer	Sec	Q-Q	Measured Distances
4 S	10 W	WM	20	NE SW	2450 FEET NORTH AND 2575 FEET EAST FROM THE SW CORNER OF SECTION 20

9. Permit Amendment Application T-11450 proposes to change the place of use of the permit to:

QUASI-MUNICIPAL USES				
Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	18	SE SW
4 S	10 W	WM	18	SW SE
4 S	10 W	WM	19	NW NE
4 S	10 W	WM	19	SW NE
4 S	10 W	WM	19	SE NE
4 S	10 W	WM	19	NE NW
4 S	10 W	WM	19	SW NW
4 S	10 W	WM	19	SE NW
4 S	10 W	WM	19	NE SW
4 S	10 W	WM	19	NW SW
4 S	10 W	WM	19	SW SW
4 S	10 W	WM	19	SE SW
4 S	10 W	WM	19	NE SE
4 S	10 W	WM	19	NW SE
4 S	10 W	WM	19	SW SE
4 S	10 W	WM	19	SE SE
4 S	10 W	WM	30	NE NE
4 S	10 W	WM	30	NW NE
4 S	10 W	WM	30	SW NE
4 S	10 W	WM	30	SE NE
4 S	10 W	WM	30	NE NW
4 S	10 W	WM	30	NW NW
4 S	10 W	WM	30	SW NW
4 S	10 W	WM	30	SE NW
4 S	10 W	WM	30	NE SW
4 S	10 W	WM	30	NW SW
4 S	10 W	WM	30	NE SE
4 S	10 W	WM	30	NW SE
4 S	10 W	WM	30	SW SE
4 S	10 W	WM	30	SE SE
4 S	10 W	WM	31	NW NE
4 S	10 W	WM	31	SW NE
4 S	11 W	WM	13	NE SE
4 S	11 W	WM	13	SW SE
4 S	11 W	WM	13	SE SE
4 S	11 W	WM	24	NE NE

QUASI-MUNICIPAL USES				
Twp	Rng	Mer	Sec	Q-Q
4 S	11 W	WM	24	NW NE
4 S	11 W	WM	24	SW NE
4 S	11 W	WM	24	SE NE
4 S	11 W	WM	24	NE SE
4 S	11 W	WM	24	NW SE
4 S	11 W	WM	24	SE SE
4 S	11 W	WM	25	NE NE
4 S	11 W	WM	25	SE NE
4 S	11 W	WM	25	NE SE

10. Notice of the application for the permit amendment was published in the Department's weekly notice on July 31, 2012 pursuant to ORS 540.520(5). No comments were filed in response to the notice.

11. The Oregon Department of Fish and Wildlife has determined that a fish screen is necessary at the new point of diversion to prevent fish from entering the diversion and that the diversion is currently equipped with an appropriate fish screen.

Permit Amendment Review Criteria

12. The changes would not result in injury to other water rights.

13. The proposed place of use is controlled by the permit holder.

14. The changes do not enlarge the permit.

15. The changes do not alter any other terms of the permit.

16. The proposed place of use is contiguous to the authorized place of use.

Conclusions of Law

The additional point of diversion and change in place of use proposed by Permit Amendment Application T-11450 is consistent with the requirements of ORS 537.211.

Now, therefore, it is ORDERED:

1. The additional point of diversion and change in place of use proposed by Permit Amendment Application T-11450 are approved.

2. Permit S-54783, in the name of PACIFIC CITY JOINT WATER-SANITARY AUTHORITY, is issued to replace Permit S-36881, and incorporates the amendments approved by this order, the extensions of time, and the Water Management and Conservation Plan. Permit S-36881, in the name of PACIFIC CITY JOINT WATER-SANITARY AUTHORITY, is no longer of any force or effect.

3. The combined quantity of water diverted at the new additional point of diversion, together with that diverted at the old point of diversion, shall not exceed the quantity of water lawfully available at the original point of diversion.

4. The water user shall operate and maintain an approved fish screen at the new point of diversion. If Oregon Department of Fish and Wildlife (ODFW) determines the screen is not functioning properly, and is unsuccessful in working with the water user to meet ODFW standards, ODFW may request that OWRD regulate the use of water until OWRD receives notification from ODFW that the fish screen is functioning properly.

5. Water shall be acquired from the same surface water source as the original point of diversion.

6. All other terms and conditions of Permit S-54783 remain the same.

Dated at Salem, Oregon this 19 day of November, 2012.

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

Mailing Date: NOV 20 2012

STATE OF OREGON

COUNTY OF TILLAMOOK

CERTIFICATE OF WATER RIGHT

THIS CERTIFICATE ISSUED TO

PACIFIC CITY JOINT WATER SANITARY AUTHORITY
PO BOX 520
PACIFIC CITY, OR 97135-0520

confirms the right to use the waters of UNNAMED STREAM, a tributary to HORN CREEK for MUNICIPAL USES.

This right was perfected under Permit S-30792. The date of priority is JULY 8, 1965. The amount of water to which this right is entitled is limited to an amount actually used beneficially, and shall not exceed 0.01 CUBIC FOOT PER SECOND, or its equivalent in case of rotation, measured at the point of diversion.

The point of diversion is located as follows:

Twp	Rng	Mer	Sec	Q-Q	Measured Distances
4 S	10 W	WM	16	SW NW	330 FEET NORTH AND 50 FEET EAST FROM W1/4 CORNER, SECTION 16

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

MUNICIPAL USES				
Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	19	NE SW
4 S	10 W	WM	19	NW SW
4 S	10 W	WM	19	SW SW
4 S	10 W	WM	19	SE SW
4 S	10 W	WM	30	NE NW
4 S	10 W	WM	30	NW NW
4 S	10 W	WM	30	SW NW
4 S	10 W	WM	30	SE NW
4 S	11 W	WM	24	NE SE
4 S	11 W	WM	24	NW SE
4 S	11 W	WM	24	SW SE
4 S	11 W	WM	24	SE SE
4 S	11 W	WM	25	NE NE
4 S	11 W	WM	25	NW NE
4 S	11 W	WM	25	SW NE
4 S	11 W	WM	25	SE NE

This certificate describes that portion of the water right confirmed by Certificate 44554, State Record of Water Right Certificates, NOT modified by the provisions of an order of the Water Resources Director entered JAN 3 1 2011, approving Transfer Application T-11126.

The issuance of this superseding certificate does not confirm the status of the water right in regard to the provisions of ORS 540.610 pertaining to forfeiture or abandonment.

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 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 JAN 3 1 2011.

Phillip C. Ward, Director

BEFORE THE WATER RESOURCES DEPARTMENT
OF THE
STATE OF OREGON

In the Matter of Transfer Application T-11126, Tillamook County	)))	FINAL ORDER APPROVING A CHANGE IN POINT OF DIVERSION AND PLACE OF USE

Authority

ORS 540.505 to 540.580 establishes the process in which a water right holder may submit a request to transfer the point of diversion, place of use, or character of use authorized under an existing water right. OAR Chapter 690, Division 380 implements the statutes and provides the Department's procedures and criteria for evaluating transfer applications.

Applicant

PACIFIC CITY JOINT WATER SANITARY AUTHORITY
TONY OWEN
PO BOX 520
PACIFIC CITY, OR 97135-0520

Findings of Fact

Background

1. On September 1, 2010, PACIFIC CITY JOINT WATER SANITARY AUTHORITY filed an application for a change in point of diversion and to change the place of use under Certificates 32238 and 44554. The Department assigned the application number T-11126.

2. The portion of the first right to be transferred is as follows:

Certificate: 32238 in the name of PACIFIC CITY WATER DISTRICT (perfected under Permit S-26793)
Use: MUNICIPAL
Priority Date: AUGUST 3, 1959
Rate: 0.19 CUBIC FOOT PER SECOND
Source: HORN CREEK, tributary to the NESTUCCA RIVER

Authorized Point of Diversion:

Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	8	SE SE

This final order is subject to judicial review by the Court of Appeals under ORS 183.482. Any petition for judicial review must be filed within the 60-day time period specified by ORS 183.482(1). Pursuant to ORS 536.075 and OAR 137-003-0675, you may petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the Director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied.

Authorized Place of Use:

MUNICIPAL USES					
Twp	**Rng**	**Mer**	**Sec**	**Q-Q**	**GLot**
4 S	10 W	WM	19	NE SW	
4 S	10 W	WM	19	NW SW	
4 S	10 W	WM	19	SW SW	
4 S	10 W	WM	19	SE SW	
4 S	10 W	WM	30	NE NW	
4 S	10 W	WM	30	NW NW	
4 S	10 W	WM	30	SW NW	
4 S	10 W	WM	30	SE NW	
4 S	11 W	WM	24	NE NE	1
4 S	11 W	WM	24	SE NE	2
4 S	11 W	WM	24	NE SE	3
4 S	11 W	WM	24	SE SE	4
4 S	11 W	WM	25	NE NE	1
4 S	11 W	WM	25	SE NE	2

3. Transfer Application T-11126 proposes to move the authorized point of diversion approximately 1.8 miles downstream to:

Twp	Rng	Mer	Sec	Q-Q	Measured Distances
4 S	10 W	WM	20	NE SW	2450 FEET NORTH AND 2575 FEET EAST FROM THE SW CORNER OF SECTION 20

4. Transfer Application T-11126 also proposes to change the place of use of the right to:

MUNICIPAL USES				
Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	18	SE SW
4 S	10 W	WM	19	NW NE
4 S	10 W	WM	19	SW NE
4 S	10 W	WM	19	SE NE
4 S	10 W	WM	19	NE NW
4 S	10 W	WM	19	SE NW
4 S	10 W	WM	19	SW NW
4 S	10 W	WM	19	NE SW
4 S	10 W	WM	19	NW SW
4 S	10 W	WM	19	SW SW
4 S	10 W	WM	19	SE SW
4 S	10 W	WM	19	NE SE
4 S	10 W	WM	19	NW SE
4 S	10 W	WM	19	SW SE
4 S	10 W	WM	19	SE SE
4 S	10 W	WM	30	NE NE
4 S	10 W	WM	30	NWNE
4 S	10 W	WM	30	SW NE
4 S	10 W	WM	30	SE NE
4 S	10 W	WM	30	NE NW
4 S	10 W	WM	30	NW NW
4 S	10 W	WM	30	SW NW
4 S	10 W	WM	30	SE NW
4 S	10 W	WM	30	NE SW

MUNICIPAL USES				
Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	30	NW SW
4 S	10 W	WM	30	NE SE
4 S	10 W	WM	30	NW SE
4 S	10 W	WM	30	SW SE
4 S	10 W	WM	30	SE SE
4 S	10 W	WM	31	NW NE
4 S	10 W	WM	31	SW NE
4 S	11 W	WM	13	NE SE
4 S	11 W	WM	13	SE SE
4 S	11 W	WM	13	SW SE
4 S	11 W	WM	24	NE NE
4 S	11 W	WM	24	NW NE
4 S	11 W	WM	24	SW NE
4 S	11 W	WM	24	SE NE
4 S	11 W	WM	24	NW SE
4 S	11 W	WM	24	NE SE
4 S	11 W	WM	24	SE SE
4 S	11 W	WM	25	NE NE
4 S	11 W	WM	25	SE NE
4 S	11 W	WM	25	NE SE

5. The portion of the second right to be transferred is as follows:

Certificate: 44554 in the name of PACIFIC CITY WATER DISTRICT (perfected under Permit S-30792)
Use: MUNICIPAL USE
Priority Date: JULY 8, 1965
Rate: 0.49 CUBIC FOOT PER SECOND
Source: UNNAMED STREAM, tributary to the HORN CREEK

Authorized Point of Diversion:

Twp	Rng	Mer	Sec	Q-Q	Measured Distances
4 S	10 W	WM	16	SW NW	330 FEET NORTH AND 50 FEET EAST FROM THE W1/4 CORNER OF SECTION 16

Authorized Place of Use:

MUNICIPAL USES				
Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	19	NE SW
4 S	10 W	WM	19	NW SW
4 S	10 W	WM	19	SW SW
4 S	10 W	WM	19	SE SW
4 S	10 W	WM	30	NE NW
4 S	10 W	WM	30	NW NW
4 S	10 W	WM	30	SW NW
4 S	10 W	WM	30	SE NW
4 S	11 W	WM	24	NE SE
4 S	11 W	WM	24	NW SE
4 S	11 W	WM	24	SW SE
4 S	11 W	WM	24	SE SE

MUNICIPAL USES				
Twp	**Rng**	**Mer**	**Sec**	**Q-Q**
4 S	11 W	WM	25	NE NE
4 S	11 W	WM	25	NW NE
4 S	11 W	WM	25	SW NE
4 S	11 W	WM	25	SE NE

6. Transfer Application T-11126 proposes to move the authorized point of diversion approximately 1.25 miles downstream to:

Twp	Rng	Mer	Sec	Q-Q	Measured Distances
4 S	10 W	WM	20	NE SW	2450 FEET NORTH AND 2575 FEET EAST FROM THE SW CORNER OF SECTION 20

7. Transfer Application T-11126 also proposes to change the place of use of the right to:

MUNICIPAL USES				
Twp	Rng	Mer	Sec	Q-Q
4 S	10 W	WM	18	SE SW
4 S	10 W	WM	19	NW NE
4 S	10 W	WM	19	SW NE
4 S	10 W	WM	19	SE NE
4 S	10 W	WM	19	NE NW
4 S	10 W	WM	19	SE NW
4 S	10 W	WM	19	SW NW
4 S	10 W	WM	19	NE SW
4 S	10 W	WM	19	NW SW
4 S	10 W	WM	19	SW SW
4 S	10 W	WM	19	SE SW
4 S	10 W	WM	19	NE SE
4 S	10 W	WM	19	NW SE
4 S	10 W	WM	19	SW SE
4 S	10 W	WM	19	SE SE
4 S	10 W	WM	30	NE NE
4 S	10 W	WM	30	NW NE
4 S	10 W	WM	30	SW NE
4 S	10 W	WM	30	SE NE
4 S	10 W	WM	30	NE NW
4 S	10 W	WM	30	NW NW
4 S	10 W	WM	30	SW NW
4 S	10 W	WM	30	SE NW
4 S	10 W	WM	30	NE SW
4 S	10 W	WM	30	NW SW
4 S	10 W	WM	30	NE SE
4 S	10 W	WM	30	NW SE
4 S	10 W	WM	30	SW SE
4 S	10 W	WM	30	SE SE
4 S	10 W	WM	31	NW NE
4 S	10 W	WM	31	SW NE
4 S	11 W	WM	13	NE SE
4 S	11 W	WM	13	SE SE
4 S	11 W	WM	13	SW SE
4 S	11 W	WM	24	NE NE

MUNICIPAL USES				
Twp	Rng	Mer	Sec	Q-Q
4 S	11 W	WM	24	NW NE
4 S	11 W	WM	24	SW NE
4 S	11 W	WM	24	SE NE
4 S	11 W	WM	24	NW SE
4 S	11 W	WM	24	NE SE
4 S	11 W	WM	24	SE SE
4 S	11 W	WM	25	NE NE
4 S	11 W	WM	25	SE NE
4 S	11 W	WM	25	NE SE

8. Notice of the application for transfer was published on September 7, 2010, pursuant to OAR 690-380-4000. No comments were filed in response to the notice.

9. The Oregon Department of Fish and Wildlife (ODFW) has determined that a fish screening and/or by-pass device is necessary at the new point of diversion to prevent fish from entering the diversion and/or safely transport fish back to the body of water from which the fish were diverted and that the diversion is not currently equipped with an appropriate fish screening and/or by-pass device. This diversion may be eligible for screening cost share funds.

10. On November 22, 2010, the Department mailed a copy of the draft Preliminary Determination proposing to approve Transfer Application T-11126 to the applicant. The draft Preliminary Determination cover letter set forth a deadline of December 22, 2010, for the applicant to respond. The applicant requested that the Department make a few corrections, extend the completion date to allow for completion of the project, and proceed with issuance of a Preliminary Determination.

11. On December 6, 2011, the Department issued a Preliminary Determination proposing to approve Transfer T-11126 and mailed a copy to the applicants. Additionally, notice of the Preliminary Determination for the transfer application was published on the Department's weekly notice on December 7, 2010, and in the Headlight-Herald newspaper on December 15, 22, and 29, 2010, pursuant to ORS 540.520 and OAR 690-380-4020. No protests were filed in response to the notice.

Transfer Review Criteria [OAR 690-380-4010(2)]

12. Certificates 32238 and 44554 are for municipal use. Therefore, they are not subject to forfeiture under ORS 540.610.

13. A diversion structure and pipelines sufficient to use the full amount of water allowed under the existing rights were present within the five-year period prior to submittal of Transfer Application T-11126.

14. The proposed changes would not result in enlargement of the rights.

15. The proposed changes would not result in injury to other water rights.

Conclusions of Law

The change in point of diversion and change in place of use proposed in Transfer Application T-11126 are consistent with the requirements of ORS 540.505 to 540.580 and OAR 690-380-5000.

Now, therefore, it is ORDERED:

1. The change in point of diversion and change in place of use proposed in Transfer Application T-11126 are approved.

2. The right to the use of the water is restricted to beneficial use at the place of use described, and is subject to all other conditions and limitations contained in Certificates 32238 and 44554 any related decree.

3. Water right certificates 32238 and 44554 are cancelled. New certificates will be issued describing the portions of the rights not affected by this transfer.

4. The quantity of water diverted at the additional point of diversion, together with that diverted at the original point of diversion, shall not exceed the quantity of water lawfully available at the original point of diversion.

5. The water user shall maintain and operate the existing measurement device and shall make such improvements as may be required by the Department.

6. The water user shall maintain the existing headgate and shall make such improvements as may be required by the Department.

7. Prior to diverting water, the water user shall install a fish screening and/or by-pass device, as appropriate, at the new point of diversion consistent with the Oregon Department of Fish and Wildlife's (ODFW) design and construction standards. Prior to installation, the water user shall obtain written approval from ODFW that the required screen and/or by-pass device meets ODFW's criteria. Prior to submitting a Claim of Beneficial Use, the water user must obtain written approval from ODFW that the required screening and/or by-pass device was installed to the state's criteria. The water user shall maintain and operate the fish screen and/or by-pass device, as appropriate, at the point of diversion consistent with ODFW's operational and maintenance standards.

8. The approved changes shall be completed and full beneficial use of the water shall be made on or before **October 1, 2020**. A Claim of Beneficial Use prepared by a Certified Water Right Examiner shall be submitted by the applicant to the Department within one year after the deadline for completion of the changes and full beneficial use of the water.

9. When satisfactory proof of the completed changes is received, new certificates confirming the rights transferred will be issued.

Dated at Salem, Oregon this 31st day of January 2011.

Dwight French for
PHILLIP C. WARD, DIRECTOR

Mailing Date: FEB 02 2011

Appendix D

Geotechnical Memorandum, Pacific City Water System Seismic Resilience Study, Pacific City, Oregon

SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

February 5, 2021

Matt Steiner
Parametrix
700 NE Multnomah St #1000
Portland, OR 97232

RE: GEOTECHNICAL MEMORANDUM, PACIFIC CITY WATER SYSTEM SEISMIC RESILIENCE STUDY PACIFIC CITY, OREGON

Dear Mr. Steiner:

Shannon & Wilson, Inc. (Shannon & Wilson), is pleased to submit this technical memorandum documenting our geological and seismic hazards assessment for existing critical facilities and key infrastructure owned and operated by the Pacific City Joint Water-Sanitary Authority (PCJWSA). Parametrix is under contract to support the PCJWSA on preparation of a water and wastewater Master Plan, and Shannon & Wilson, as a subconsultant to Parametrix, is providing a geotechnical review of readily available geotechnical information in the project area. The project area is located on the Oregon Coast, as shown on Figure 1, Vicinity and Quaternary Fault Map.

SCOPE OF SERVICES

Shannon & Wilson prepared this technical memorandum in accordance with our scope of services, specified in the Geotechnical Subconsultant Agreement with Parametrix executed January 3, 2020. This memorandum presents results of our geotechnical desk study and a summary of geologic and seismic hazards at key PCJWSA facilities and pipeline alignments. The assessment was performed utilizing readily available geological data and findings from previous geotechnical explorations performed by Shannon & Wilson and others. The approximate locations of the available geotechnical borings are provided in Figure 2. Specifically, this study considered geotechnical data from the following documents, provided by Parametrix for review:

- Shannon & Wilson, 2006, Boring Logs for Brooten Rd. and Resort Dr. Waterline Design, Pacific City, Oregon, dated July 2006, Project No. 24-1-03383-001;
- Shannon & Wilson, 2008, Geotechnical Engineering Report, Horn Creek Water System Improvements, Pacific City Oregon, dated July 8, 2008, Project No. 24-1-03458;
- Shannon & Wilson, 2011, Geotechnical Engineering Evaluation, Airport Pump Station, Pacific City, Oregon, dated May 29, 2009, Project No. 24-1-03553. and

3990 Collins Way ▪ Suite 100 ▪ Lake Oswego, Oregon 97035-3437 ▪ 503 210-4750
▪ www.shannonwilson.com ▪

- Geotechnics, 2017, Geotechnical Engineering Report, Pacific City Wastewater Treatment Plant Upgrade, Pacific City, Oregon, dated April 3, 2017, Project No. 15-008-1.

The Brooten Rd and Resort Dr Waterline Design (Shannon & Wilson, 2006) and Horn Creek Water System Improvements (Shannon & Wilson, 2008) reports were prepared for sites directly on water system improvement facilities. The wastewater Airport Pump Station (Shannon & Wilson, 2011) and Pacific City Wastewater Treatment Plant Upgrade (Geotechnics, 2017) reports were not performed for sites directly along the water backbone pipeline but were performed near the alignment. The results of the seismic hazards analysis performed for adjacent facilities was included for reference; however, it is noted explorations performed directly along the alignment may yield different results.

The scope of services performed for this project consisted of the following:

- Review mapped site geology;
- Review existing and readily available geotechnical reports for the project area;
- Review mapped landslides included in Oregon Department of Geology and Mineral Industries' (DOGAMI's) landslide inventory (if any) along the pipeline alignment, at 3 reservoir sites, and at the treatment plant sites;
- Review mapped relative earthquake liquefaction hazards based on DOGAMI maps (High, Medium, Low, or no susceptibility);
- Review mapped relative landslide risk based on DOGAMI maps (Very High, High, Moderate, or Low susceptibility);
- Prepare this letter report presenting the geologic maps and a brief discussion summarizing our findings, conclusions, and the potential need for mitigation of seismic hazards.

PROJECT UNDERSTANDING

We understand that the PCJWSA is developing a water and wastewater Master Plan for several key facilities in Pacific City, Oregon. These key facilities defined by Parametrix include the Horn Creek Surface Water Treatment Plant (Horn Creek WTP) and three reservoirs, as well as a backbone pipeline connecting the Horn Creek WTP and reservoirs, as shown on Figure 2, Site Map. The Horn Creek WTP is located adjacent to Horn Creek in a valley east of Old Woods Road and east of the City limits. Two of the subject reservoirs, with capacities of 300K (thousand-gallons) and 600K are located to the west of the Horn Creek WTP, on the opposite side of the Nestucca River and within the Pacific City Heights neighborhood. The third reservoir has a capacity of just 100K and is located at the north end

of Pacific City, near the intersection of McPhillips Drive and Pine Road. The 100K and 300K reservoir sites are both equipped with booster pump stations.

The backbone pipeline begins at the 100K reservoir site following McPhillips Drive/Cape Kiwanda Drive, then crosses east over the Nestucca River at Pacific Avenue, finally heading north along Brooten Road/Resort Drive until reaching the intersection with Reddekopp Road. From this point, the pipeline heads west along Reddekopp Road into the Pacific City Heights neighborhood, then travels east on Elderberry Lane, connecting to the 300K Reservoir. The pipeline then continues southwest along Simmons Road until the intersection with Lo-Mar Lane, at which point the alignment turns east up an access road leading to the 600K Reservoir. An existing transmission pipeline runs in a west-southwesterly direction from the Horn Creek WTP site, across the Nestucca River, and ties into the backbone pipeline at the intersection of Resort Drive and Reddekopp Road.

Parametrix has been selected to develop the subject master plan for PCJWSA. The goal of this study is to identify high level issues that could affect City water and wastewater systems and facilities, including geological hazards and seismic hazards including landslide, liquefaction, lateral spread, and tsunami hazards. Geotechnical evaluations performed for this phase of work are to be based on existing geotechnical maps and readily available information; therefore, the current project does not include development of detailed, localized, site-specific subsurface characterizations and design recommendations.

GEOLOGIC SETTING

Pacific City is located in the Coast Range Physiographic province (Orr and Orr, 2012). The northwestern portion of the Oregon Coast Range has been mapped and described by several authors, including Schlicker and others (1972), Wells and others (1994), and Snavely and others (1996). A geologic map of Pacific City is presented in Figure 3 and is based on DOGAMI publication OGCD-6 (Smith and Row 2015).

The western edge of Oregon lies along an active tectonic plate boundary, where oceanic crust is subducting beneath North American continental crust. The project site lies along the northwestern margin of the Oregon Coast Range, which began to form more than 50 million years ago when an oceanic island chain slowly collided with the primitive Oregon coast (Orr and Orr, 2012). The Coast Range took shape as blocks of the volcanic island chain compressed together with marine sedimentary rocks, which formed in the temporary basin between the islands and the continent.

Mapped site geology is comprised of Quaternary dune sand and Quaternary alluvial deposits at the Horn Creek WTP and 100K reservoir sites, and along the majority of the backbone pipeline. The 300K and 600K reservoir sites and portions of the backbone pipeline connecting to these sites are reportedly underlain by Tertiary basalt and basaltic sandstone.

SUBSURFACE CONDITIONS

We reviewed subsurface data from several borings performed during the four referenced previous explorations in the area.

A total of three solid auger borings were performed along Brooten Road and Resort Drive in support of the 2006 Waterline Design project. These borings were advanced to a maximum depth of just 11.5 feet bgs. Materials encountered at these boring locations typically consisted of about 2 feet of Fill materials consisting of Silty Gravel, overlying Alluvium consisting of Clayey Sand, Silty Sand, Poorly Graded Sand, and Sandy Silt. In one boring, a layer of Dune Sand was encountered, consisting of dense Poorly Graded Sand.

A total of eight mud rotary borings and two geoprobe borings were performed for the Horn Creek WTP geotechnical exploration. Two borings were performed on opposite sides of the Nestucca River near the intersection of Reddekopp Road and Resort Drive to support design of an HDD crossing. The boring on the west side of the river encountered silt alluvium from the ground surface to a depth of 16 feet below ground surface (bgs). The silt was underlain by medium dense, weakly cemented sand from 16 feet to 25 feet bgs that was interpreted to be weathered sandstone, underlain by intact sandstone extending to the maximum explored depth of 51 feet bgs. On the east side of the Nestucca River, we encountered very loose, fine silty sand to a depth of 33 feet bgs. The silty sand was underlain by loose to medium dense sand with trace silt from 33 feet to the extent of our boring at 46.5 feet.

Three borings were drilled in the areas of the Horn Creek WTP facility. Fill soils ranging from 1 to 4.5 feet in thickness were underlain by very soft, wet, alluvium consisting of silt to clayey silt to depths ranging from 28 to 64 feet below the existing ground surface. SPT blow counts in the silt generally varied from zero to three blows per foot. The fine-grained silty alluvial deposit was found to contain some wood debris, and its plasticity ranged from low, near the ground surface portion, to medium or high in the lower soil profile. The fine-grained alluvial deposit was underlain by very dense sandy gravel with silt interpreted to be weathered sandstone. The depths of this weathered rock formation varied from 28 to 64 feet.

Soils at the Airport Pump Station site were explored with one mud rotary auger boring advanced to a total depth of 81.5 feet bgs. Subsurface conditions at this site primarily consisted of alternating layers of Nestucca River Alluvium and Dune Sands. Dune Sands typically consisted of dense to very dense Poorly Graded Sand. The Alluvium layers typically consisted of very loose to medium dense Poorly Graded Sand and Silty Sand, as well as stiff to very stiff Silt, Sandy Silt, and Organic Silt.

Based on our review of the 2017 Geotechnics report, soil conditions near the existing Wastewater Treatment Plant on Cape Kiwanda Drive consist of a thin layer of fill overlying medium dense to very dense Dune Sand to a depth of at least 42 feet bgs.

REGIONAL SEISMICITY

Earthquakes in the Pacific Northwest occur largely as a result of the subduction of the Juan de Fuca plate beneath the North American plate along the Cascadia Subduction Zone (CSZ). The CSZ is located approximately parallel to the coastline from northern California to southern British Columbia. The compressional forces that exist between these two colliding plates cause the oceanic Juan de Fuca plate to descend, or subduct, beneath the continental plate at a rate of about 1.5 inches per year. This process leads to volcanism in the North American plate and stresses and faulting in both plates throughout much of the western regions of southern British Columbia, Washington, Oregon, and northern California. Stress between the colliding plates is periodically relieved through great earthquakes at the CSZ plate interface.

Within the regional tectonic framework and historical seismicity, three broad earthquake sources are identified:

- **Subduction Zone Interface Earthquakes** originate along the CSZ, which is located 25 miles beneath the coastline. Paleoseismic evidence and historic tsunami records from Japan indicate that the most recent subduction zone interface event was in 1700 AD and was an approximately magnitude 9 earthquake that likely ruptured the full length of the CSZ.
- **Deep-Focus, Intraplate Earthquakes** originate from within the subducting Juan de Fuca oceanic plate as a result of the downward bending and tension in the subducted plate. These earthquakes typically occur 28 to 38 miles beneath the surface. Such events on the CSZ are estimated to be as large as magnitude 7.5. Historic earthquakes include the 1949 magnitude 7.1 Olympia earthquake, the 1965 magnitude 6.5 earthquake between Tacoma and Seattle, and the magnitude 6.8 2001 Nisqually earthquake. The highest rate

of CSZ intraslab activity is beneath the Puget Sound area, with much lower rates observed beneath western Oregon.

- **Shallow-Focus Crustal Earthquakes** are typically located within the upper 12 miles of the earth's surface. The relative plate movements along the CSZ cause not only east-west compressive strain but dextral shear, clockwise rotation, and north-south compression of the leading edge of the North American Plate (Wells and others, 1998), which is the cause of much of the shallow crustal seismicity of engineering significance in the region. The largest known crustal earthquake in the Pacific Northwest is the 1872 North Cascades earthquake with an estimated magnitude of about 7. Other examples include the 1993 magnitude 5.6 Scotts Mill earthquake and magnitudes 5.9 and 6.0 Klamath Falls earthquakes.

SEISMIC HAZARDS

We have reviewed seismic hazard mapping of the project area performed by DOGAMI and published in the following Open-File Reports:

- Open-File Report O-13-06: Ground motion, ground deformation, tsunami inundation, coseismic subsidence, and damage potential maps for the 2012 Oregon Resilience Plan for Cascadia Subduction Zone Earthquakes, by Ian P. Madin and William J. Burns
- Open-File Report O-13-19: Tsunami inundation scenarios for Oregon, by George R. Priest, Robert C. Witter, Y. Joseph Zhang, Kelin Wang, Chris Goldfinger, Laura L. Stimely, John T. English, Sean G. Pickner, Kaleena L.B. Hughes, Taylore E. Wille, and Rachel L. Smith
- Open-File Report O-16-02: Open-File Report O-16-02, Landslide susceptibility overview map of Oregon, by William J. Burns, Katherine A. Mickelson, and Ian P. Madin.

These reports include GIS data of site conditions, ground motions, ground deformations, and other hazards associated with a deterministic evaluation of a magnitude Mw 9.0 event in the Cascadia Subduction Zone. The hazards evaluated in this letter do not consider any other deterministic events, nor do they consider probabilistic analyses that consider estimated seismic ground motions associated with specified return periods.

Seismic hazards, including liquefaction, lateral spreading, seismic-induced landslides, tsunami, and fault rupture hazards are discussed in the following sections.

Liquefaction Hazard

Liquefaction is a phenomenon in saturated soils in which pore water pressure in loose to medium dense, non-plastic to low plasticity silts and granular soils increases to nearly the

effective overburden pressure during seismic ground shaking. The increase in pore pressure results in a reduction of soil shear strength. Primary factors in determining the susceptibility of a soil to liquefaction include relative density, fines content (percent of soil by weight smaller than 0.075 millimeter, passing the No. 200 sieve), and the plasticity characteristics of the fines. Relative density can be estimated based on methods including Standard Penetration Test (SPT) N-values, CPT tip resistances, and shear wave velocity.

We have reviewed liquefaction-susceptibility mapping of the project area performed by DOGAMI and published in Open-File Report O-13-06. Liquefaction susceptibilities provided in report O-13-06 are based on application of mapped surface geology to the Youd and Perkins (1978) liquefaction susceptibility methodology, considering shaking from a Cascadia Subduction Zone event with modifications made by DOGAMI based their "understanding of Oregon Geology".

As shown on Figure 4, Liquefaction Map, the 100K reservoir site is located on lands mapped with high susceptibility to liquefaction. Approximately 2 miles of backbone pipeline are also within the high susceptibility zone, along an alignment extending from the 100K reservoir site to the intersection of Brooten Road and Spring Street. Eastern portions of the backbone alignment beyond this intersection are generally mapped with moderate susceptibility to liquefaction. The remaining portions of the backbone alignment, as well as the 300K and 600K reservoir sites, are located in the Pacific City Heights area on terrain underlain by shallow rock. These sites are not considered to be liquefaction-susceptible.

We previously performed liquefaction analyses for the Horn Creek WTP site, based on findings from three geotechnical borings within the plant limits (Shannon & Wilson, 2008). Based on the results of these analyses, we concluded in the referenced report that approximately 6 to 8 inches of total post-liquefaction settlement may occur at the site following a magnitude 9.0 seismic event on the Cascadia Subduction Zone. This may also result in 3 to 4 inches of differential settlement. Consequently, we understand that the treatment plant was supported on deep foundations extending through the liquefiable layers. DOGAMI has mapped this site in an area with Moderate susceptibility to liquefaction.

We also previously performed liquefaction analyses for a pump station near the intersection of Pacific Avenue and Brooten Road (Shannon & Wilson, 2011). These analyses were based on a mud rotary boring extended to 81.5 feet below the ground surface. The analyses predicted that up to 8 inches of total post-liquefaction settlement could occur at this site.

Liquefaction analysis was not included as part of the scope for previous pipeline explorations and several of the pipeline borings did not extend to the base of the liquefiable layer at their respective locations. For pipeline borings we estimated liquefaction-induced settlement for a magnitude 9.0 Cascadia Subduction Zone event using the peak ground accelerations estimated for a Cascadia Subduction Zone event by DOGAMI Open File Report O-13-06 using the available geotechnical boring data. A summary of liquefaction-induced settlement for the borings is presented as Exhibit 1. Borings in which the exploration did not extend to the base of the liquefiable layer are noted.

Exhibit 1: Estimated Liquefaction-Induced Vertical Settlement

Source	Boring	Boring Depth (feet)	Estimated Settlement (inches)
Shannon & Wilson (2006)	B-1	11.5	<1.6[1]
	B-2	11.5	<1.7[1]
	B-3	10.0	0.3[1]
Shannon & Wilson (2008)	B-1	51.0	3.3
	B-2	46.5	24.8[1]
	B-5	36.5	10.8
	B-6	58.0	1.3
Shannon & Wilson (2011)	B-1	81.5	12.9
Geotechnics (2017)	CPT-2	42.5	0.8

1 Boring terminated before reaching bottom of liquefiable layer. Liquefaction-induced settlement at these locations may be greater than reported.

Lateral Spreading Hazard

Lateral spreading hazards can exist in areas with mild slopes adjacent to a much steeper slope or vertical face. Lateral spreading failure can occur if soil liquefaction develops during a seismic event and the ground acceleration (inertial force) briefly surpasses the yield acceleration (shear strength) of the liquefied soil. This can cause both the liquefied soil and an overlying non-liquefied crust of soil to displace laterally down mild slopes or towards an embankment face.

The waterline backbone crosses the Nestucca River at two locations. The eastern crossing occurs near the intersection of Reddekopp Road and Resort Drive, where plans indicate the 16-inch HDPE pipeline goes 30 feet below the bottom of the river and the HDD curve begins approximately 200 feet from the river bank. For the purposes of this report we refer to the HDD crossing as “East Crossing”. We understand, the second crossing occurs at a bridge

over Nestucca River on Pacific Avenue, where the pipe is attached to the bridge. For the purposes of this report we refer to this crossing as "West Crossing".

We performed lateral spreading analyses to determine spread potential and displacements in accordance with the procedures by Youd et al. (2002) and considering later recommendations presented by Youd (2018). Estimated lateral spreading displacements were analyzed at boring locations B-1 and B-2, performed near Reddekopp Road as part of investigations for the Horn Creek Water Treatment Plant (East Crossing), and at boring B-1, performed in support of the Airport Pump Station improvements (West Crossing). The analyses were performed using a seismic source originating from the Cascadia Subduction Zone. The deterministic scenario used a magnitude (Mw) of 9.0, and site-to-source distances (R) of 105 to 109 km, which is the range of distances between each site and the event epicenter presented by the USGS Cascadia M9.0 Scenario.

The analyses indicate that lateral spreading will occur in the vicinity of the Nestucca River, at locations where granular or low-plasticity fine-grained soils are present along the riverbanks.

At the East Crossing, the expected level of lateral displacement on the east side of the river is expected to be on the order of approximately 23 inches at a distance of 100 feet from the riverbank, based on our analysis of Horn Creek WTP Boring B-2. Predicted lateral spreading displacement falls to approximately 14 inches at a distance of 200 feet from the eastern bank, which is approximately where pipe construction method transitioned from horizontal directional drilling to cut-and-cover construction. On the western side of the river, significantly less lateral spreading (on the order of 2 to 3 inches) is predicted within 100 to 200 feet of the western bank. This is due to the presence of relatively shallow non-liquefiable weathered sandstone and bedrock observed in Horn Creek WTP Boring B-1. Lateral displacements can be expected to be largest near the riverbank faces and will decrease with distance. At depths of 1H below the riverbank, where H is the height of the free face, lateral spread is not expected to have an impact on buried pipelines (Youd, 2018). The pipeline is approximately 1H, or 17 feet, below the ground surface within approximately 100 feet of the riverbank on the east side of the river. Additionally, where the pipeline is buried in the sandstone on the west side of the river (approximately 16 feet below ground surface and 180 feet from the west bank) lateral spread is not anticipated to occur at the depth of the pipe.

We previously performed lateral spreading analyses near the West Crossing, to support our geotechnical engineering report for the pump station near the intersection of Pacific Avenue

and Brooten Road. These analyses were based on a single mud rotary boring drilled to 81.5 feet below the ground surface. Potential lateral spread of 1 to 2 feet was previously predicted at the pump station site, which is located 300 feet east of the Nestucca River. We expanded on these analyses to estimate lateral spreading at distances closer to the river as part of this study. We estimate that as much as 2.5 feet of lateral spreading could occur within 200 feet of the Nestucca River at this location.

Estimated lateral spreading at the previously discussed locations where subsurface data is available is summarized in Exhibit 2.

Exhibit 2: Estimated Lateral Spread Displacement (Youd 2002)

Location	Distance from Slope (feet)	Lateral Spread (inches)
Nestucca River HDD Crossing at Reddekopp Road (East Side)	100	23
	200	14
Nestucca River HDD Crossing at Reddekopp Road (West Side)	100	2.4
	200	1.6
Airport Pump Station East of Nestucca River	200	29
	300	23

We note that the Youd method is an empirical model. At distances closer than approximately 100 feet, the ratio of the height of the free face to the distance from the edge of the slope is outside of the range of data that the model was calibrated to. As such there is additional uncertainty these values.

Lateral spreading is likely to occur along other portions of the backbone alignment where liquefiable soils are present near free faces, especially along the Nestucca River.

Landslide Hazard

We reviewed the statewide landslide susceptibility map prepared by DOGAMI and presented in Open-File Report O-16-02. The statewide landslide susceptibility map classifies slopes on a scale of Low, Moderate, High, or Very High landslide susceptibility based on the presence and abundance of historical landslides near a given site (i.e. landslide density) and the proneness to sliding based on a statistical analysis of slope geometry. Mapped zones with Low susceptibility have low landslide density and low proneness to landsliding. Zones mapped with Moderate susceptibility are in areas with moderate landslide density and/or moderate proneness to landsliding. High-susceptibility zones are

in areas with high landslide density and/or high proneness to landsliding. Very High-susceptibility zones are zones where mapped historical or ancient landslides are present.

The relative hazard risk was developed by DOGAMI by creating a generalized geology-landslide intersect map and a percent slope map. Spatial statistics were then used to determine the mean and standard deviation of slope angles within landslides per geologic unit. Thirty percent of the area within the statewide hazard map consists of High or Very High hazard slopes and 80 percent of the landslides are located within this area. The DOGAMI Landslide Hazard Map overlain with the backbone facilities is presented in Figure 5. Limitations of the input and modeling mean that the map should only be used for general planning purposes, and the map cannot be used as a substitute for geotechnical explorations and detailed site-specific analyses.

Based on our review of the statewide landslide susceptibility map, the majority of the backbone pipeline, as well as the Horn Creek WTP site, are in Low-susceptibility landslide zones. The 100K reservoir site is located in sloping terrain that has been mapped as Moderately to Highly susceptible to landslides. Approximately 2,000 feet of backbone pipeline to the south of the 100K reservoir is similarly mapped as Moderately to Highly landslide-susceptible, before the pipeline enters flatter terrain mapped with Low-susceptibility. The 300K and 600K reservoirs and connecting portions of the backbone pipeline located within the Pacific City Heights neighborhood are typically mapped in areas with Moderate to High landslide-susceptibility. Approximately 440 feet north of the 600K reservoir site, DOGAMI has mapped a Very High landslide susceptibility zone approximately 80 feet east of the pipeline alignment, indicating the presence of an ancient or historical landslide in this area.

Tsunami Hazard

The tsunami inundation limits shown in Figure 6 depict data from DOGAMI Publication O-13-19, Tsunami Inundation Scenarios for Oregon (DOGAMI, 2013). The scenario inundations shown on Figure 6 are based on Cascadia Subduction Zone earthquake events. Relative tsunami heights in this report scale directly to local peak fault slip calculated from model time intervals between earthquakes; specifically, the scenarios and time intervals are as follows: SM = 300 yrs, M = 425-525 yrs, L = 650–800 yrs, XL = 1,050–1,200 yrs, XXL = 1,200 yrs.

Each of the three reservoir sites is located outside of mapped tsunami zones and is not expected to experience inundation from Cascadia Subduction Zone tsunamis even at the

XXL scenario level. The Horn Creek WTP site is located outside of tsunami inundation zones for events up to and including the L scenario level, though the site is expected to experience inundation for events at the XL and XXL levels.

Fault Rupture Hazard

Shallow crustal faults and folds throughout Oregon have been located and characterized by the United States Geological Survey (USGS, 2019). Mapped fault locations and detailed descriptions can be found in the USGS Quaternary Fault and Fold Database (USGS, 2019). The database defines four categories of faults, Classes A through D, based on evidence of tectonic movement known or presumed to be associated with large earthquakes during the Quaternary (less than 1.8 million years ago). For Classes A and B, there is geologic evidence that demonstrates the existence of Quaternary deformation. However, for Class B faults, evidence of Quaternary faulting or slip is more equivocal, or the faults may not extend deep enough to be a source of significant earthquakes. According to the USGS Fault and Fold Database, there are no Class A or Class B faults that cross the pipeline. The nearest reported Class A Fault is the Cascadia fold and fault zone located in the Pacific Ocean approximately 4 miles from Pacific City.

CONCLUSIONS AND RECOMMENDATIONS

Based on our review of available geotechnical data discussed above, the three reservoirs, Horn Creek WTP, and backbone pipeline are susceptible to various geological and seismic hazards.

The 100K reservoir and Horn Creek WTP are in areas of mapped liquefaction susceptibility. The liquefaction hazard at the Horn Creek WTP site was investigated and addressed in our 2008 geotechnical report, and this report included recommendations for founding the WTP and intake structures on augercast piles to mitigate the hazard. Based on our review of construction documents for this facility, the plant and intake structures were founded on augercast piles as recommended, mitigating the liquefaction hazard. Foundation information for structures at the 100K reservoir site was not provided, nor did we have any existing site-specific subsurface information at this site.

Structures founded on liquefiable soils may experience adverse total and differential seismic settlement, permanent horizontal displacement and foundation distress resulting from lateral spreading, and surface manifestations including sand boils. Mitigation methods for these hazards may include designing buildings with stiffened shallow foundation systems or deep foundations, or by performing ground improvement to reduce or eliminate the

hazard. Liquefaction mitigation through ground improvement is typically achieved through mass-mixing, which is performed by blending soils with a cement binder material using a horizontal-axis rotating drum mounted on the boom of an excavator. The mixing drum is advanced into the native soils while pumping a cement slurry through the mixing drum and mixing the soil to the target depth. The mixing is performed in continuous rectangular cells, which contain liquefiable soils and mitigate the liquefaction hazard.

Portions of the backbone pipeline located in liquefiable soils may be subject to temporary and permanent lateral and horizontal displacements during and after a major seismic event. A large portion of the backbone pipeline runs adjacent to the Nestucca River, and liquefied soils in this area are likely susceptible to lateral spreading towards the river. Damage to the pipeline can be reduced through installation of seismic-resistant flex joints at locations where predicted liquefaction settlement exceeds the pipe's ability to structurally deform; however, ground displacements resulting from lateral spreading can often be measured in feet, which may exceed the limits of seismic joints. Mitigation of excessive liquefaction and lateral spread hazards can be achieved by performing ground improvement. In addition to hardening the pipeline, being prepared to pump-by-pass broken sections of pipeline after a seismic event may help satisfy certain demand requirements, such as fire flow, after a seismic event while more permanent repairs measures can be performed.

The backbone pipeline reportedly crosses the Nestucca River at the Pacific City Bridge. Distress to or failure of the bridge during a seismic event could also cause distress to the pipeline at this location.

The 300K and 600K reservoirs are mapped in areas with Moderate to High landslide susceptibility, and landslides have been mapped in the vicinity of these sites in Pacific City Heights. Site-specific landslide hazards could be further evaluated by a site reconnaissance by an engineering geologist as an addendum or part of additional scope. Site-specific investigation, including subsurface borings, may be required to determine if slope stability is a hazard and to develop appropriate mitigation methods for addressing the hazard. Such mitigation methods can include structure setbacks, ground improvement, mitigative site grading, use of soil nails or rock bolts, and other methods.

The Horn Creek WTP is susceptible to tsunami inundation resulting from a Cascadia Subduction Zone event meeting the XL or XXL criteria discussed previously in this letter. Tsunami mitigation for proposed developments often consists of siting structures at elevations above the expected inundation level. Mitigation of tsunami hazard at developed

sites can potentially be achieved through grading of an earthen berm around the site perimeter.

LIMITATIONS

This letter report was prepared for the exclusive use of Parametrix and PCJWSA and their representatives to support preparation of a water and wastewater master plan. The conclusions and recommendations contained in this letter are based on the information and data provided to us, and information that is publicly available. This letter report presents factual data only and should not be viewed as a warranty of conditions described in this report, such as those interpreted from published maps. We assume that this information is representative of the actual conditions in the project area. Our conclusions and recommendations are based on:

- The limitations of our approved scope, schedule and budget; and
- Our understanding of the project and information provided by PCJWSA.

For any site located on or near a slope, there are slope instability risks that present and future owners have to accept, including, but not limited to:

- Natural factors: soil and groundwater conditions, steep topography, heavy rainfall events, erosion, and vegetation conditions; and
- Human-related factors: water leaks, pipe breaks, improper drainage, lack of maintenance of vegetation or drainage facilities, fill or debris placement, excavation and/or removal of trees/vegetation.

Similar circumstances or other unknown conditions may also affect slope stability. Our evaluation and recommendations described herein are not a guarantee or warranty of slope stability.

Please note that our scope of services did not include any environmental assessment or evaluation regarding the presence or absence of hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below the site.

Shannon & Wilson has prepared the attached, "Important Information About Your Geotechnical/Environmental Report," to assist you and others in understanding the use and limitations of our reports.

SHANNON & WILSON

Sincerely,

SHANNON & WILSON

Micah Hintz
Senior Engineer

REGISTERED PROFESSIONAL ENGINEER
77330PE
OREGON
Jan. 10, 2006
ELLIOTT CARL MECHAM
EXPIRES: 12/31/22

Elliott Mecham, PE
Senior Associate

MXH:ECM:RPP

Enc. Figure 1 – Quaternary Fault and Vicinity Map
Figure 2 – Site Map
Figure 3 – Geologic Map
Figure 4 – Liquefaction Susceptibility
Figure 5 – Landslide Susceptibility
Figure 6 – Tsunami Inundation
Attachment A – Existing Information

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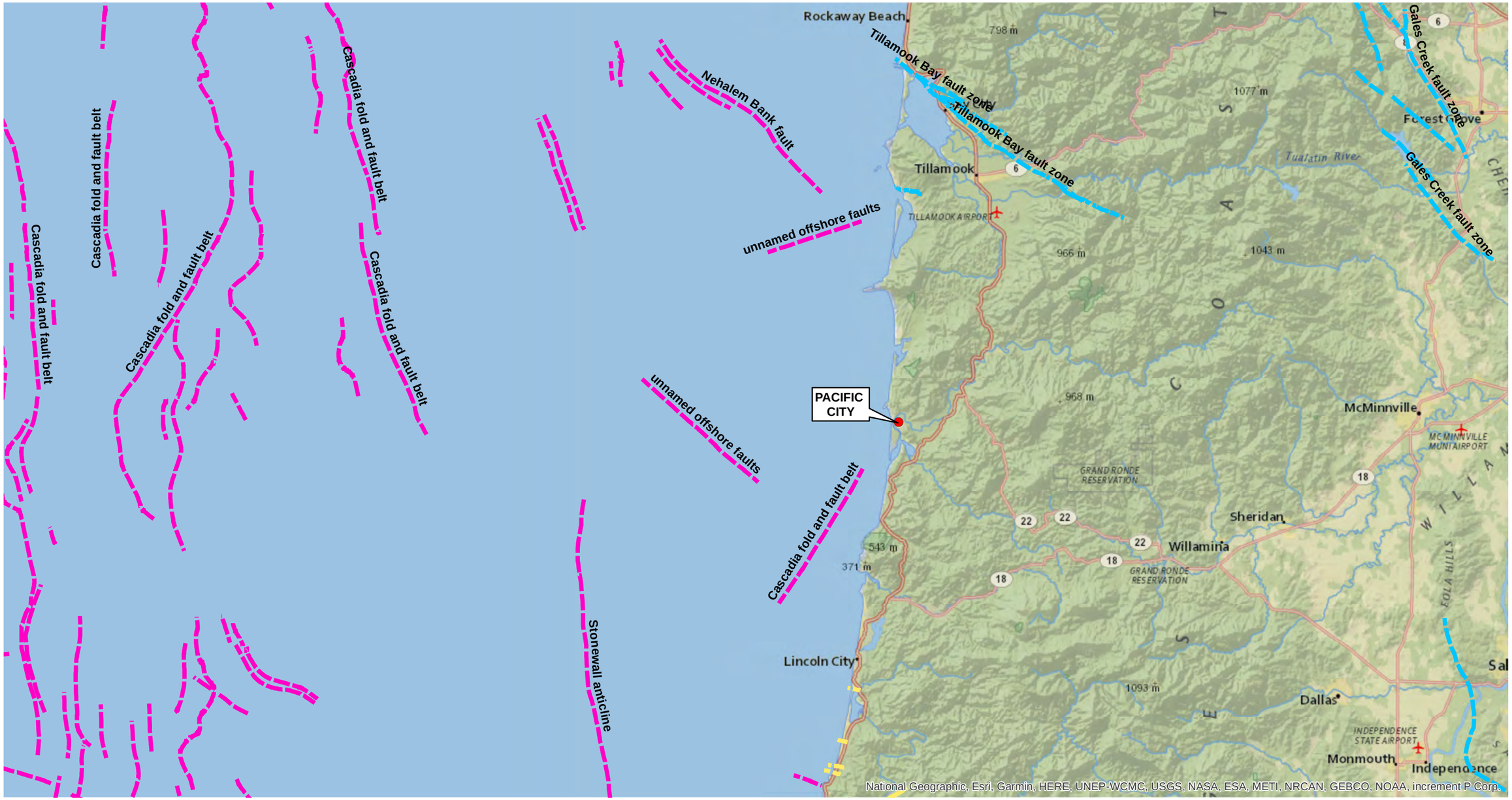
Youd, T.L., 2018, Application of MLR Procedure for Prediction of Liquefaction-Induced Later Spread Displacement, Journal of Geotechnical and Geoenvironmental Engineering, June 2018, Volume 144 Issue 6.



LEGEND

USGS Quaternary Faults - Age

- Latest Quaternary
- Late Quaternary
- Undifferentiated Quaternary

0 5 10 20

Scale in Miles

NOTES

1. Fault data provided with USGS Quaternary Fault and Fold Database, downloaded from USGS on September 3, 2019.

Water System Master Plan &
Wastewater Master Plan
Pacific City, Oregon

VICINITY AND QUATERNARY FAULT MAP

February 2020 104600

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 1

Filename: T:\Projects\PDX\104000s\104600_Pacific City JoVAvmxd\VicinityFault_10.6.mxd Date: 2/4/2020 Login: DSJ

Filename: T:\Projects\PDX\104000s\104600_Pacific City Jo\Avmxd\Site Map.mxd Date: 8/7/2020 Login: DSJ

LEGEND

- Reservoirs
- Water Treatment Plant
- Backbone Pipeline
- Approximate Location of Pump Station Boring
- Approximate Location of Horn Creek Borings
- Approximate Location of Rooten Rd. and Resort Dr. Borings

0 625 1,250 2,500
Feet

NOTES

1. Previous boring locations from Shannon & Wilson (2006), Shannon & Wilson (2008), Shannon & Wilson (2009), and Geotechnics (2017)

Water System Master Plan & Wastewater Master Plan
Pacific City, Oregon

SITE AND EXPLORATION PLAN

February 2021 104600

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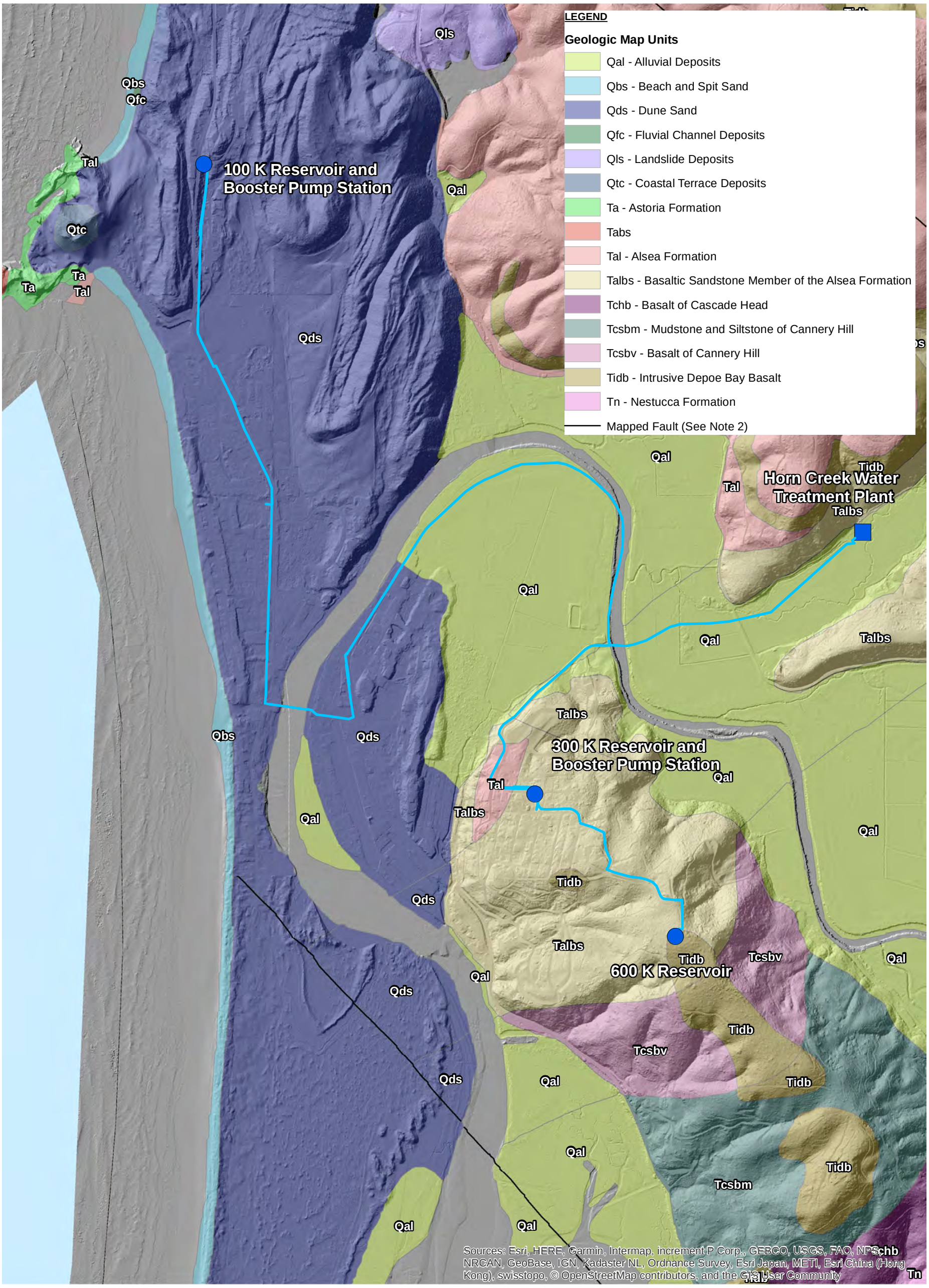
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2

FIG. 2

Filename: T:\Projects\PDX\104000s\104600_Pacific City Jo\Avmxd\Site Map.mxd Date: 8/7/2020 Login: DSJ



Reservoirs

Water Treatment Plant

Backbone Pipeline

0 625 1,250 2,500

Feet

NOTES

1. Geologic map data provided with DOGAMI publication OGDC-6.
2. Fault data provided with DOGAMI publication OGDC-6. Faults are not included in the USGS Quaternary Fault and Fold Database.

Water System Master Plan &
Wastewater Master Plan
Pacific City, Oregon

GEOLOGIC MAP

February 2021 104600

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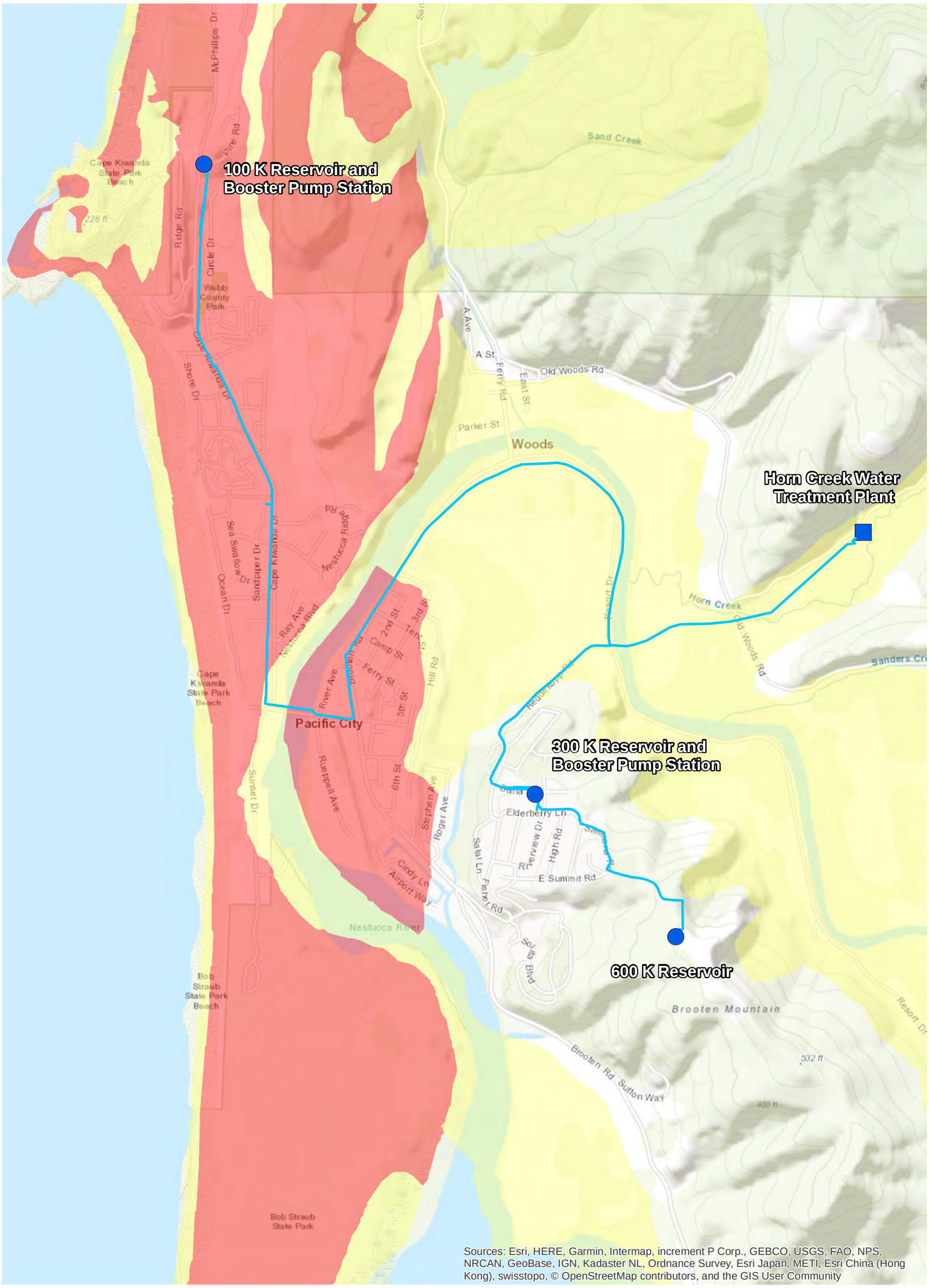
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 3

FIG. 3

Filename: T:\Projects\PDX\104000s\104600_Pacific City Jo\Avmxd\Site Map.mxd Date: 8/7/2020 Login: DSJ



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

0 625 1,250 2,500
Feet

LEGEND

- Reservoirs
- Water Treatment Plant
- Backbone Pipeline

Liquefaction Susceptibility

- Moderate
- High

NOTES

1. Liquefaction susceptibility data from DOGAMI O-13-06

Water System Master Plan &
Wastewater Master Plan
Pacific City, Oregon

LIQUEFACTION MAP

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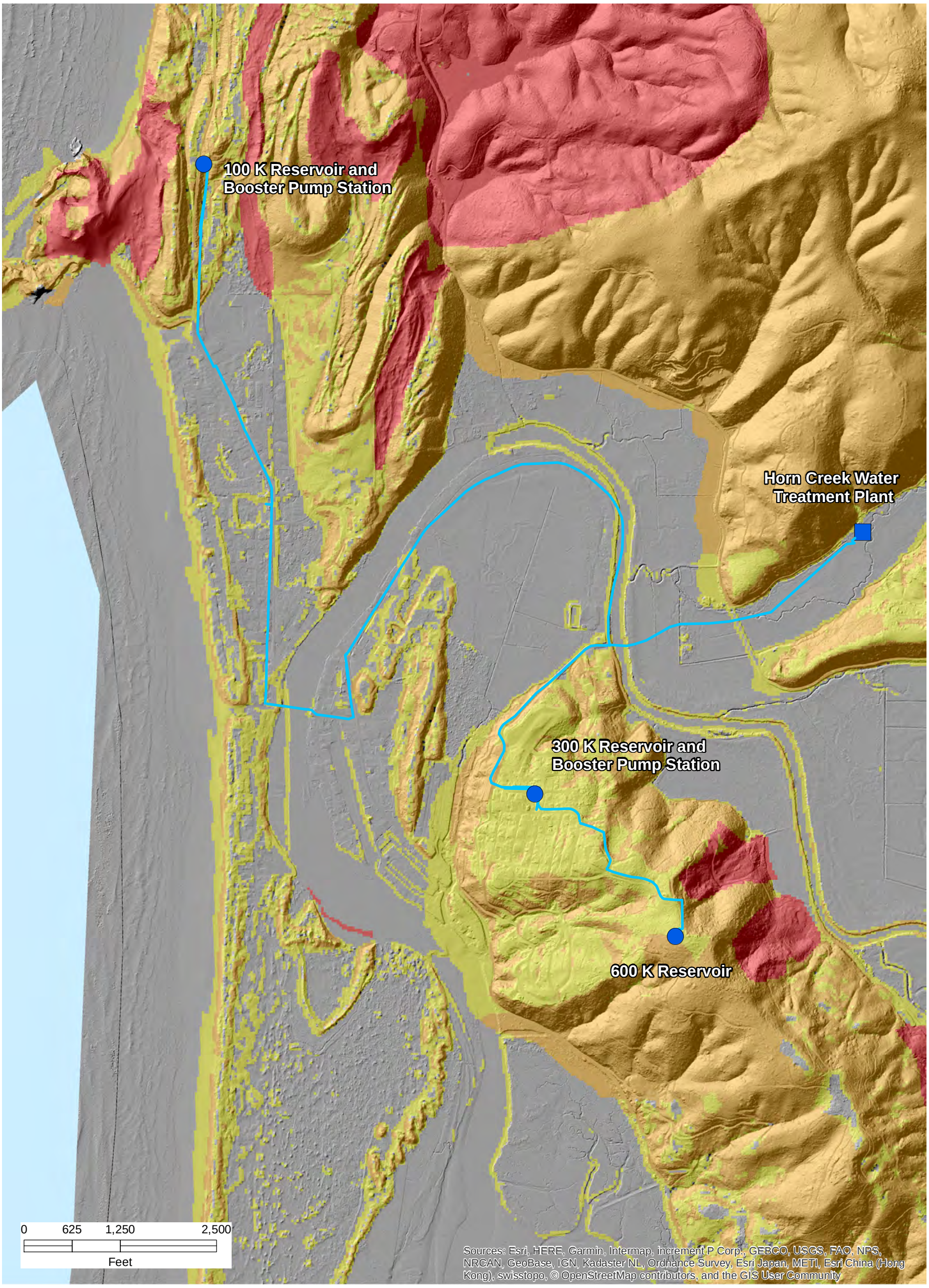
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 4

FIG. 4

Filename: T:\Projects\PDX\104000s\104600_Pacific City Jo\Avmxd\Site Map.mxd Date: 8/7/2020 Login: DSJ



LEGEND

- Reservoirs
- Water Treatment Plant
- Backbone Pipeline

Landslide Susceptibility

- Moderate
- High
- Very High

NOTES

1. Landslide susceptibility data from DOGAMI O-16-02

Water System Master Plan &
Wastewater Master Plan
Pacific City, Oregon

LANDSLIDE SUSCEPTIBILITY

February 2021 104600

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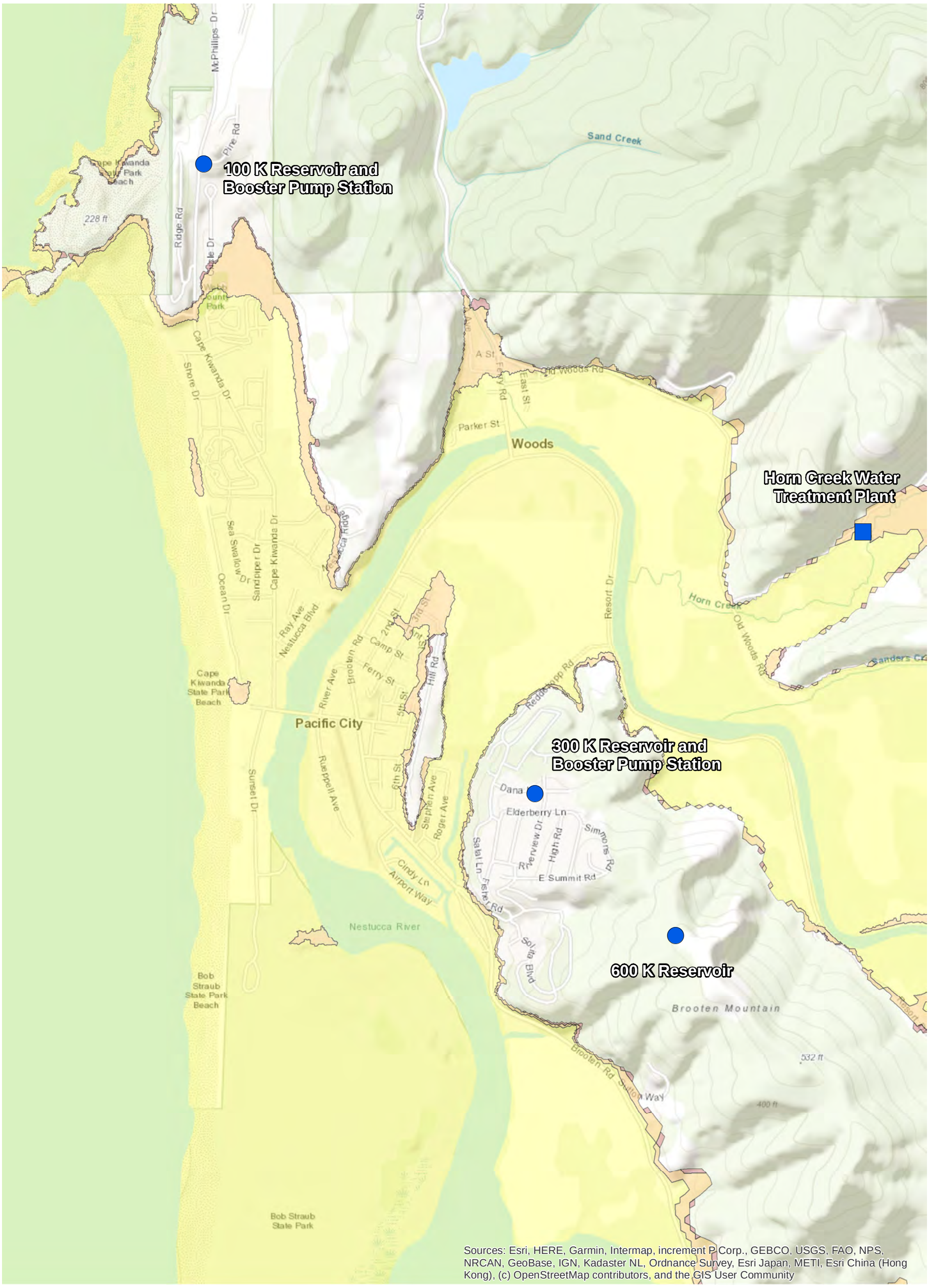
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 5

FIG. 5

Filename: C:\Users\mxh\Desktop\Site Map.mxd Date: 9/10/2020 Login: MXH



- Reservoirs
- Water Treatment Plant
- Tsunami Inundation - XL Scenario
- Tsunami Inundation - XXL Scenario
- Tsunami Inundation - L Scenario

0 625 1,250 2,500
Feet

NOTES
1. Geologic map data provided with DOGAMI publication OGDC-6.
2. Fault data provided with DOGAMI publication OGDC-6. Faults are not included in the USGS Quaternary Fault and Fold Database.

Water System Master Plan &
Wastewater Master Plan
Pacific City, Oregon

TSUNAMI INUNDATION

February 2021 104600

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 6

FIG. 6

APPENDIX A: EXISTING INFORMATION

Appendix A

Existing Information

CONTENTS

Site Plans, Boring Logs, and Laboratory Data from the Following Sources:

- Shannon & Wilson, 2006, Brooten Rd. and Resort Dr. Waterline Design, Pacific City, Oregon, dated July 2006, Project No. 24-1-03383-001;
- Shannon & Wilson, 2008, Geotechnical Engineering Report, Horn Creek Water System Improvements, Pacific City Oregon, dated July 8, 2008, Project No. 24-1-03458;
- Shannon & Wilson, 2011, Geotechnical Engineering Evaluation, Airport Pump Station, Pacific City, Oregon, dated May 29, 2009, Project No. 24-1-03553. and
- Geotechnics, 2017, Geotechnical Engineering Report, Pacific City Wastewater Treatment Plant Upgrade, Pacific City, Oregon, dated April 3, 2017, Project No. 15-008-1.

Drawing From Parametrix, Inc. Drawing C-1, 3 of 4, Waterline Plan Phases I & II

BIG NESTUCCA RIVER

START
STA 0+00

RESORT DRIVE

B-1

STA 18+97 – NOTE 2
12"x6" TEE

CULVERT

CONNET TO
EXISTING 12"
MJ PLUG

PHASE I
Note 1

12" PVC WATERMAIN,

EXISTING 12" PVC

REDDEKOPP ROAD

WOODS
BRIDGE

CULVERT

B-2

STA 35+00 – NOTE 2
12"x12" TEE

PHASE II
Note 1

12" CULVERT

BROOTEN ROAD

STA 48+57 – NOTE 2
24" CULVERT WITH
CATCH BASIN

SPRING ST.

12"x6" TEE

12"x6" TEE

SHADE ST.

12"x6" TEE

TENT ST.

12"x6" TEE

CAMP ST.

12"x6" TEE

PACIFIC AVE

STA 75+87 END
CONNECT
NOTE 2

FERRY ST.

EXISTING
WATER

B-3

CULVERT

CULVERT

CULVERT

N

0 400 800

Scale in Feet

LEGEND

B-1 LOCATION AND NUMBER OF BORING

NOTES (PARAMETRIX, TSN, 7-10-06)
1. PHASES APPLIED TO A PREVIOUS ITERATION OF THE DESIGN AND NO LONGER APPLY.
2. STATIONING ON THIS FIGURE ARE APPROXIMATE. SEE JULY 2006 DRAWINGS.

Brooten Rd. and Resort Dr. Waterline Design
Pacific City, Oregon

PLAN OF EXPLORATIONS

July 2006 24-1-03383-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 2

Total Depth:	11.5 ft.	Northing:	45.20634 N	Drilling Method:	Solid Auger	Hole Diam.:	5 in.
Top Elevation:		Easting:	123.94788 W	Drilling Company:	Greg Vandehey	Rod Type:	
Vert. Datum:		Station:		Drill Rig Equipment:	Simco 2400	Hammer Type:	Cathead
Horiz. Datum:	NAD27	Offset:	-	Other Comments:	Bulk sample of drill cuttings taken from 2 to 6 feet		

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transition may be gradual.

Silty Sandy GRAVEL (GM), loose, gray and brown, dry, non-plastic.

(FILL)

2.0

Clayey SAND (SC), very loose, brown, moist becoming wet, medium to high plasticity, micaceous, sand is fine-grained, occasional fine organics.

(ALLUVIUM)

Sample 1 - Dry density 61.0 pcf, torvane 0.1 tsf, pocket pen. 0.5 tsf

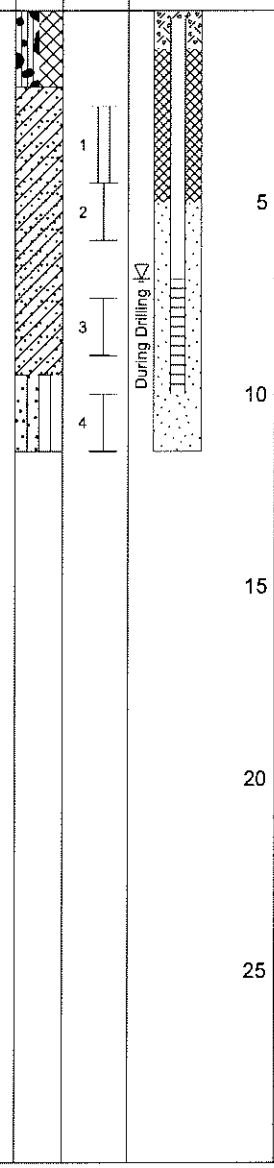
9.5

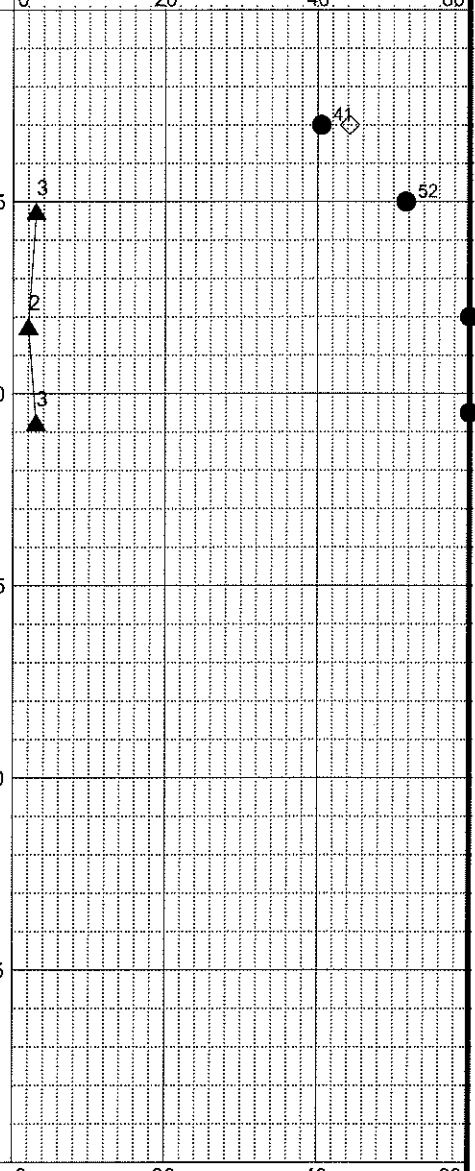
Stratified Clayey Sandy SILT and Silty SAND (ML/SM), soft/very loose, gray, wet, low to medium plasticity fines, micaceous, sand is fine-grained, occasional fine organics.

(ALLUVIUM)

11.5

Bottom of Boring Completed 6-28-06





LEGEND

- * Sample Not Recovered
- Thin Wall Sample
- Split Spoon
- Piezometer Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout
- Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Brooten Rd. and Resort Dr. Waterline Design
Pacific City, Oregon

LOG OF BORING B-1

July 2006 24-1-03383-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 4

Total Depth:	11.5 ft.	Northing:	45.21140 N	Drilling Method:	Solid Auger	Hole Diam.:	5 in.
Top Elevation:		Easting:	123.95258 W	Drilling Company:	Greg Vandehey	Rod Type:	
Vert. Datum:		Station:		Drill Rig Equipment:	Simco 2400	Hammer Type:	Cathead
Horiz. Datum:	NAD27	Offset:	-	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transition may be gradual.

Silty Sandy GRAVEL (GM), loose, gray and brown, dry, non-plastic.

(FILL)

Clayey SAND (SC), trace gravel, very loose to loose, brown, moist, medium to high plasticity, micaceous, sand is fine-grained, occasional fine organics.

(ALLUVIUM)

Clayey SAND (SC), very loose, brown with gray bands, wet, low to medium plasticity fines, micaceous, fine-grained, occasional fine organics.

(ALLUVIUM)

SAND (SP), loose, rust brown, wet, non-plastic, micaceous, fine-grained.

(ALLUVIUM)

Bottom of Boring Completed 6-28-06

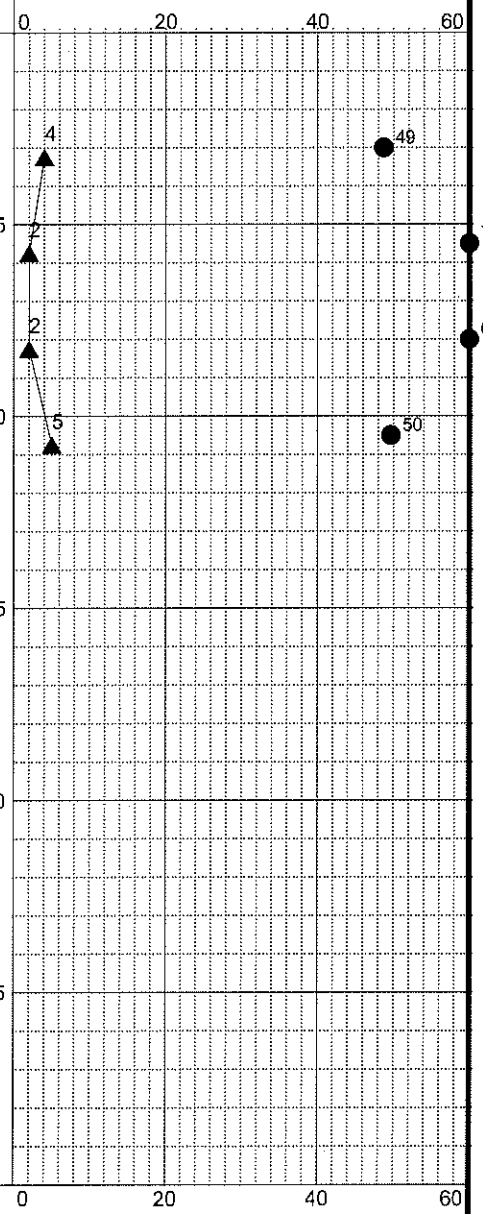
Depth, ft.: 2.0, 7.0, 11.0, 11.5

Samples: 1, 2, 3, 4

Ground Water: During Drilling

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

- * Sample Not Recovered
- Split Spoon
- Piezometer Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout
- Ground Water Level ATD

Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Brooten Rd. and Resort Dr. Waterline Design
Pacific City, Oregon

LOG OF BORING B-2

July 2006 | 24-1-03383-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 5

Total Depth:	9 ft.	Lat:	45.20361 N	Drilling Method:	Solid Auger	Hole Diam.:	5 in.
Top Elevation:		Long:	123.96074 W	Drilling Company:	Greg Vandehey	Rod Type:	
Vert. Datum:		Station:		Drill Rig Equipment:	Simco 2400	Hammer Type:	Cathead
Horiz. Datum:	NAD27	Offset:	-	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transition may be gradual.

Silty Sandy GRAVEL (GM), loose, gray and brown, dry, non-plastic.

(FILL)

Gravelly Sandy SILT (ML), soft to medium stiff, gray and brown, dry, low plasticity.

(FILL)

SAND (SP), trace of silt, medium dense to dense, gray-brown, moist becoming wet, non-plastic, micaceous, fine-grained, poorly graded.

(Dune Sand)

Bottom of Boring Completed 6-28-06

Note: Sand heaved (became quick) at 8 feet during drilling.

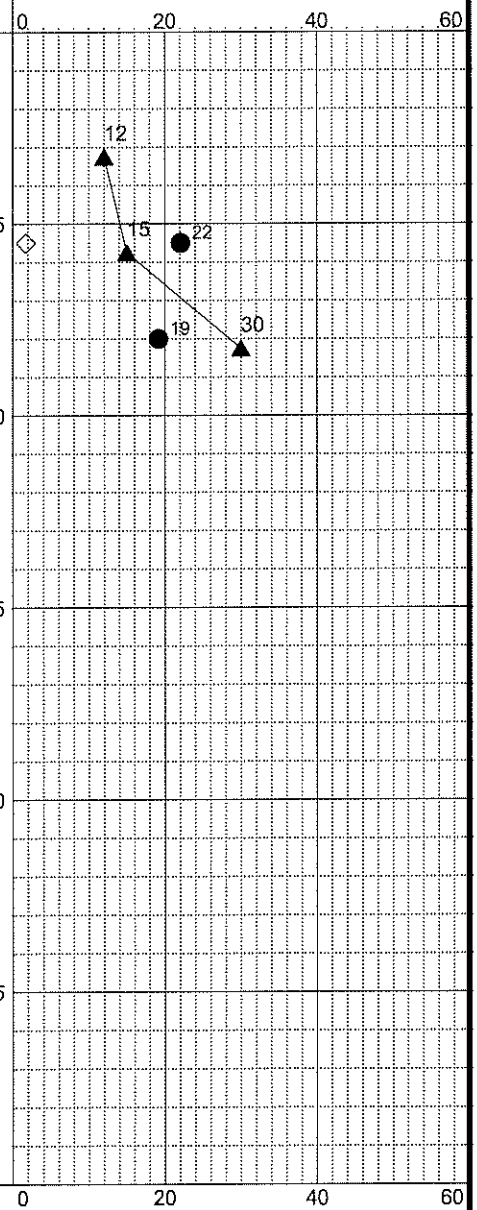
Depth, ft.: 2.0, 4.0, 10.0

Samples: 1 *, 2, 3

Ground Water: During Drilling

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

- * Sample Not Recovered
- Split Spoon
- Piezometer Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout
- Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Brooten Rd. and Resort Dr. Waterline Design
Pacific City, Oregon

LOG OF BORING B-3

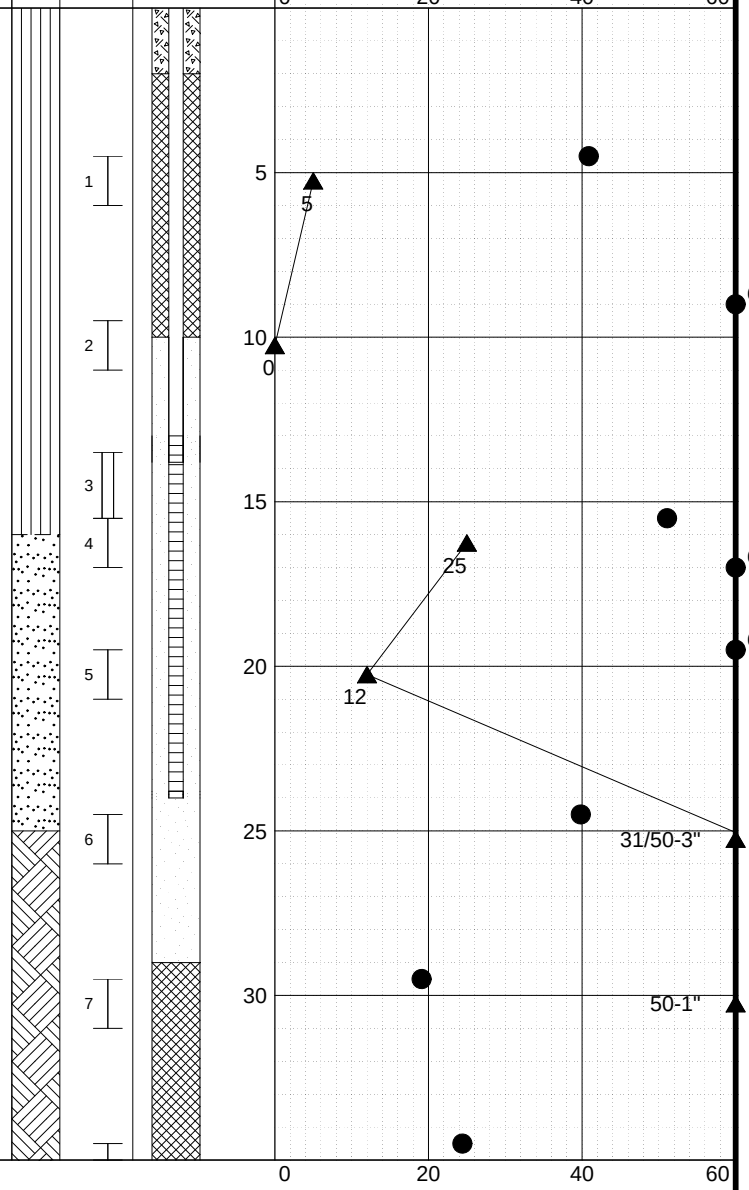
July 2006 | 24-1-03383-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 6

Total Depth:	51 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	4 in.
Top Elevation:		Easting:	~	Drilling Company:	Western States	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Track CME 55	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.*	*Elev.* Depth (ft.)
Medium stiff brown SILT with sand grades to sandy SILT, trace gravel; moist becoming wet, occasional fine organics. (ML) **Flood-Plain Alluvium**	
Medium dense brown weakly cemented SAND, trace sandstone gravel, wet. (weathered sandstone) (SP)	16.0
Sandstone, very low strength, gray, fine, strongly cemented, slightly weathered with thin seams of high plasticity gray clay. **Oligocene and Miocene Sedimentary Rocks**	25.0
CONTINUED NEXT SHEET	



LEGEND

- * Sample Not Recovered
- Standard Penetration Test
- 3" O.D. Shelby Tube
- Piezometer Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout

Plastic Limit ●—● Liquid Limit
Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Horn Creek Water System Improvement
Pacific City, Oregon

LOG OF BORING B-1

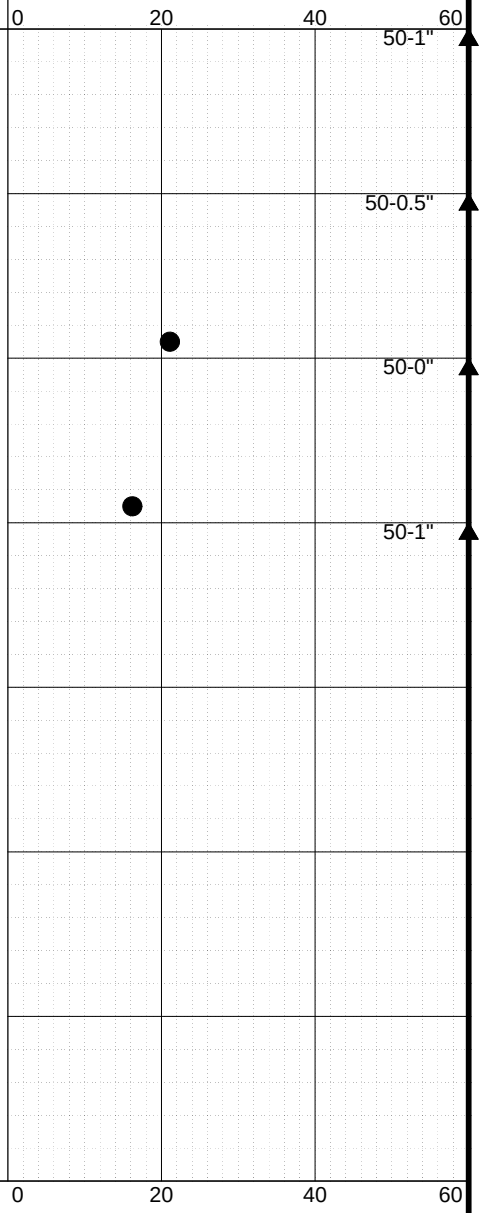
July 2008 24-1-03458-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A2
Sheet 1 of 2

Total Depth:	51 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	4 in.
Top Elevation:		Easting:	~	Drilling Company:	Western States	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Track CME 55	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.*	Elev. Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.	PENETRATION RESISTANCE, N (blows/ft.) ▲ Hammer Wt. & Drop: lbs / inches 140 lbs / 30 inches
Sandstone, very low strength, gray, fine, strongly cemented, slightly weathered with thin seams of high plasticity gray clay. **Oligocene and Miocene Sedimentary Rocks**			8 9 10 11		40 45 50	50-1" 50-0.5" 50-0" 50-1"
Completed on 09/26/2007.	51.0				55 60 65	



LEGEND

- * Sample Not Recovered
- Standard Penetration Test
- 3" O.D. Shelby Tube
- Piezometer Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout

Plastic Limit ●—● Liquid Limit
Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Horn Creek Water System Improvement
Pacific City, Oregon

LOG OF BORING B-1

July 2008 24-1-03458-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

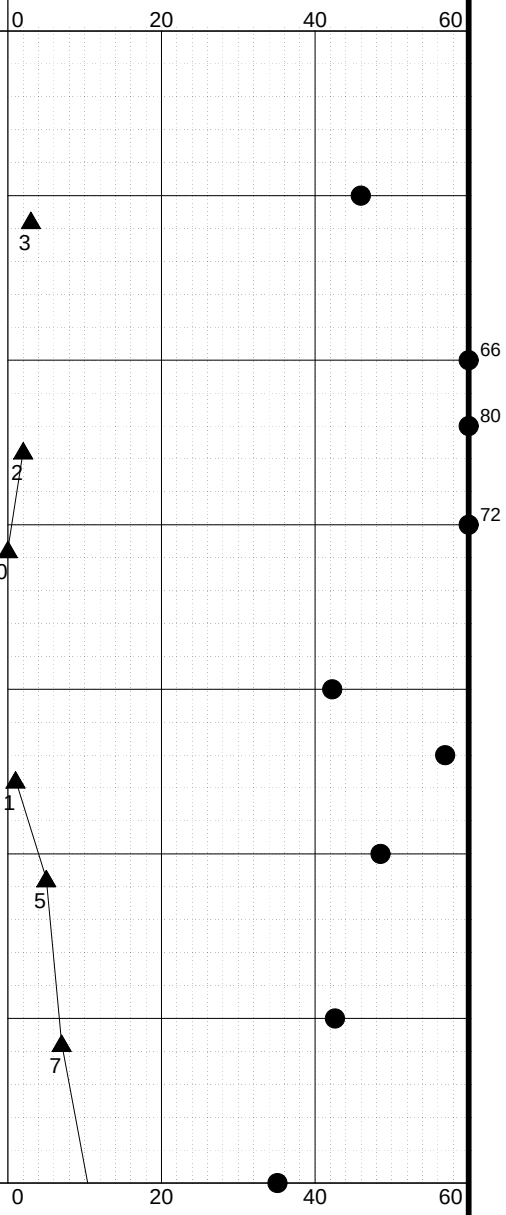
FIG. A2
Sheet 2 of 2

Total Depth:	46.5 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	4 in.
Top Elevation:		Easting:	~	Drilling Company:	Western States	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Track CME 55	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.*	Elev. Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.
Very loose brown fine silty SAND; moist. (SM) **Flood-Plain Alluvium**			1	During Drilling	5
Very loose dark gray fine silty SAND with silt lenses; wet, scattered fine organics. (SM) Dry Unit Weight = 97 pcf	9.0		2 3 4		10 15
Dry Unit Weight = 81 pcf			5 6 7 8		20 25 30
CONTINUED NEXT SHEET	33.0				

PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: *lbs / inches*
140 lbs / 30 inches



LEGEND

* Sample Not Recovered
Standard Penetration Test
3" O.D. Shelby Tube
Ground Water Level

Plastic Limit ●—● Liquid Limit
Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Horn Creek Water System Improvement
Pacific City, Oregon

LOG OF BORING B-2

July 2008 | 24-1-03458-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

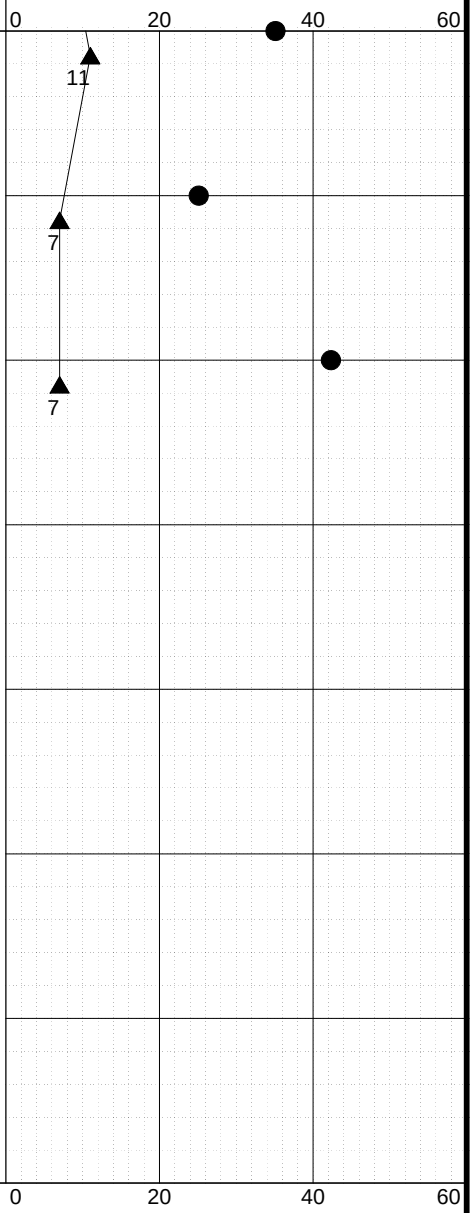
FIG. A3
Sheet 1 of 2

Total Depth:	46.5 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	4 in.
Top Elevation:		Easting:	~	Drilling Company:	Western States	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Track CME 55	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.*	Elev. Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.
Loose to medium dense grey fine to coarse SAND with trace silt and scattered organics (wood fiber particles), wet. (SP) With fine to medium subangular to subrounded gravel from 40 feet.			9 10 11		40 45
Boring Completed on 09/25/2007.	46.5				

PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: *lbs / inches*
140 lbs / 30 inches



LEGEND

* Sample Not Recovered
Standard Penetration Test
3" O.D. Shelby Tube
Ground Water Level

Plastic Limit ⊢●⊣ Liquid Limit
Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Horn Creek Water System Improvement
Pacific City, Oregon

LOG OF BORING B-2

July 2008 24-1-03458-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

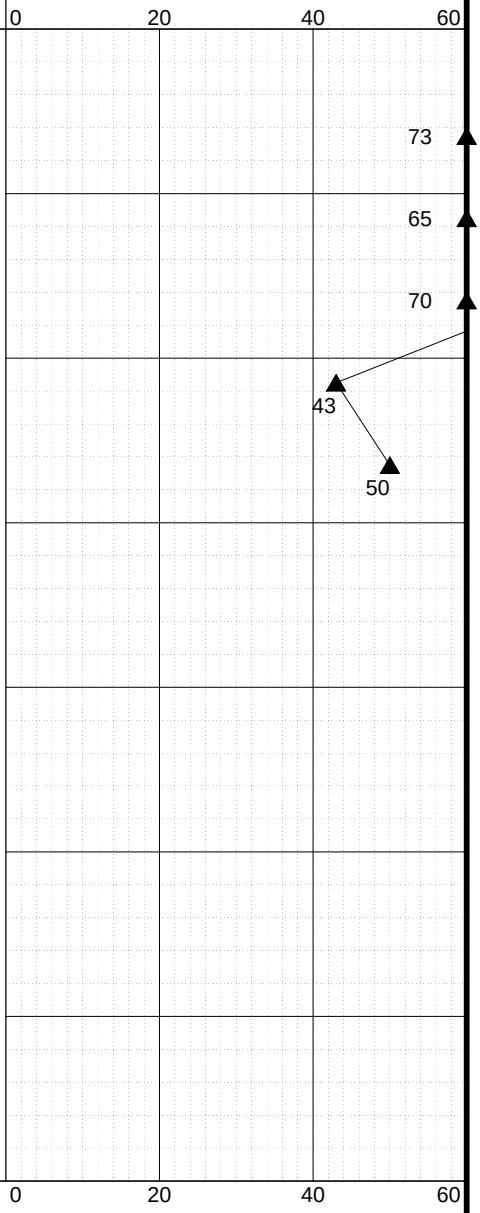
FIG. A3
Sheet 2 of 2

Total Depth:	14 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	4 in.
Top Elevation:		Easting:	~	Drilling Company:	Western States	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Track CME 55	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.*	Elev. Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.
Very dense brown silty GRAVEL with sand and cobbles; dry, angular fine to coarse sand and gravel; moist. (GM) **ROADWAY EMBANKMENT FILL** Becomes wet at 5 feet.			1, 2		5
Very dense brown silty GRAVEL with sand and cobbles; moist to wet; angular fine to coarse sand, fine gravel. (GM)	7.0		3, 4, 5		10
Boring Completed on 09/26/2007.	14.0				15, 20, 25, 30

PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

Standard Penetration Test

Plastic Limit ●—● Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Horn Creek Water System Improvement
Pacific City, Oregon

LOG OF BORING B-3

July 2008 24-1-03458-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

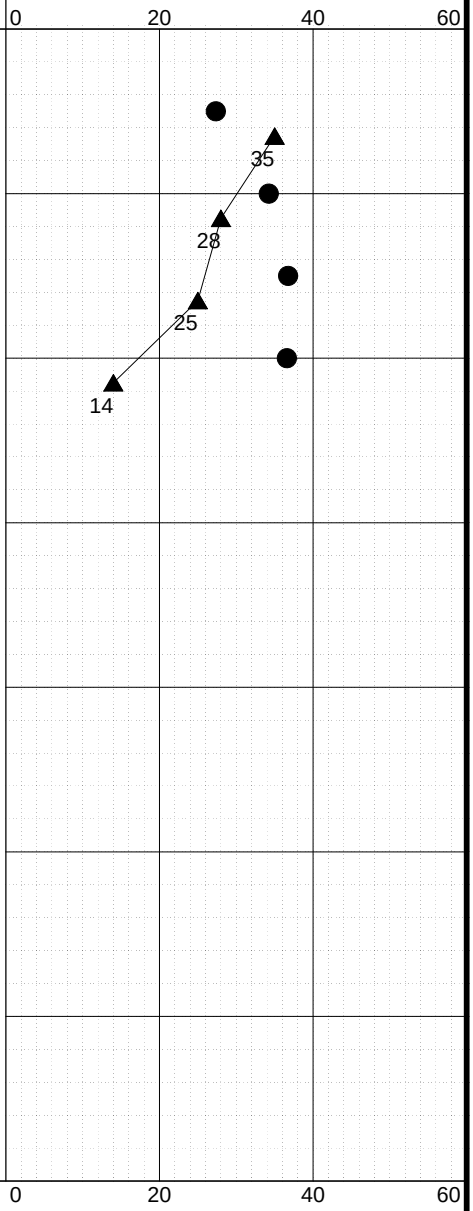
FIG. A4

Total Depth:	11.5 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	4 in.
Top Elevation:		Easting:	~	Drilling Company:	Western States	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Track CME 55	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.*	Elev. Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.
Dense to medium dense brown fine SAND with trace silt; moist. (SP) **ROADWAY EMBANKMENT FILL**			1, 2, 3, 4		
Boring Completed on 09/25/2007.	11.5				

PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

Standard Penetration Test

Plastic Limit ●—● Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Horn Creek Water System Improvement
Pacific City, Oregon

LOG OF BORING B-4

July 2008 24-1-03458-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

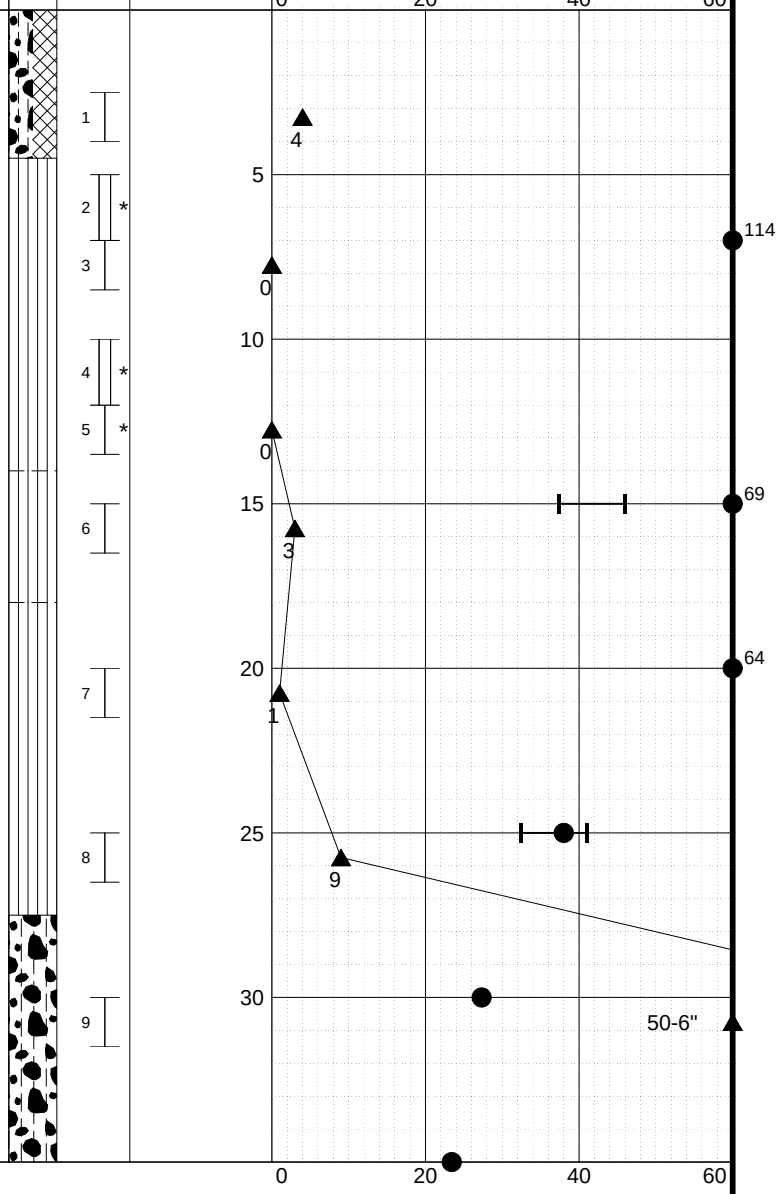
FIG. A5

Total Depth:	36.5 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	4 in.
Top Elevation:		Easting:	~	Drilling Company:	Western States	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Track CME 55	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION	Elev. Depth (ft.)
Loose grey slightly silty GRAVEL with sand; sub-angular sand and gravel; moist. (GW) **MAN-MADE FILL**	
Very soft gray SILT with fine sand; moist to wet, low plasticity. (ML)	4.5
With weakly cemented sand and abundant fine organics (wood fibers and particles) at 14 feet.	14.0
Very soft gray sandy SILT with fine to medium subrounded gravel and organics; wet, fine to coarse sand. (ML) **Flood-Plain Alluvium**	18.0
Very dense brown sandy GRAVEL with silt; wet. (weathered sandstone) (GM) **Oligocene and Miocene Sedimentary Rocks**	27.5

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.

CONTINUED NEXT SHEET



LEGEND

* Sample Not Recovered

Standard Penetration Test

3" O.D. Shelby Tube

Plastic Limit — Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Horn Creek Water System Improvement
Pacific City, Oregon

LOG OF BORING B-5

July 2008 | 24-1-03458-001

SHANNON & WILSON, INC.
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FIG. A6
Sheet 1 of 2

Total Depth:	36.5 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	4 in.
Top Elevation:		Easting:	~	Drilling Company:	Western States	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Track CME 55	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.*	Elev. Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.	PENETRATION RESISTANCE, N (blows/ft.) ▲ Hammer Wt. & Drop: lbs / inches 140 lbs / 30 inches 0 20 40 60
Very dense brown sandy GRAVEL with silt; wet. (weathered sandstone) (GM)	36.5		10			50-4"
Boring Completed on 09/25/2007.					40 45 50 55 60 65	

0 20 40 60

LEGEND

* Sample Not Recovered

Standard Penetration Test

3" O.D. Shelby Tube

Plastic Limit ⊢—●—⊣ Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Horn Creek Water System Improvement
Pacific City, Oregon

LOG OF BORING B-5

July 2008 24-1-03458-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

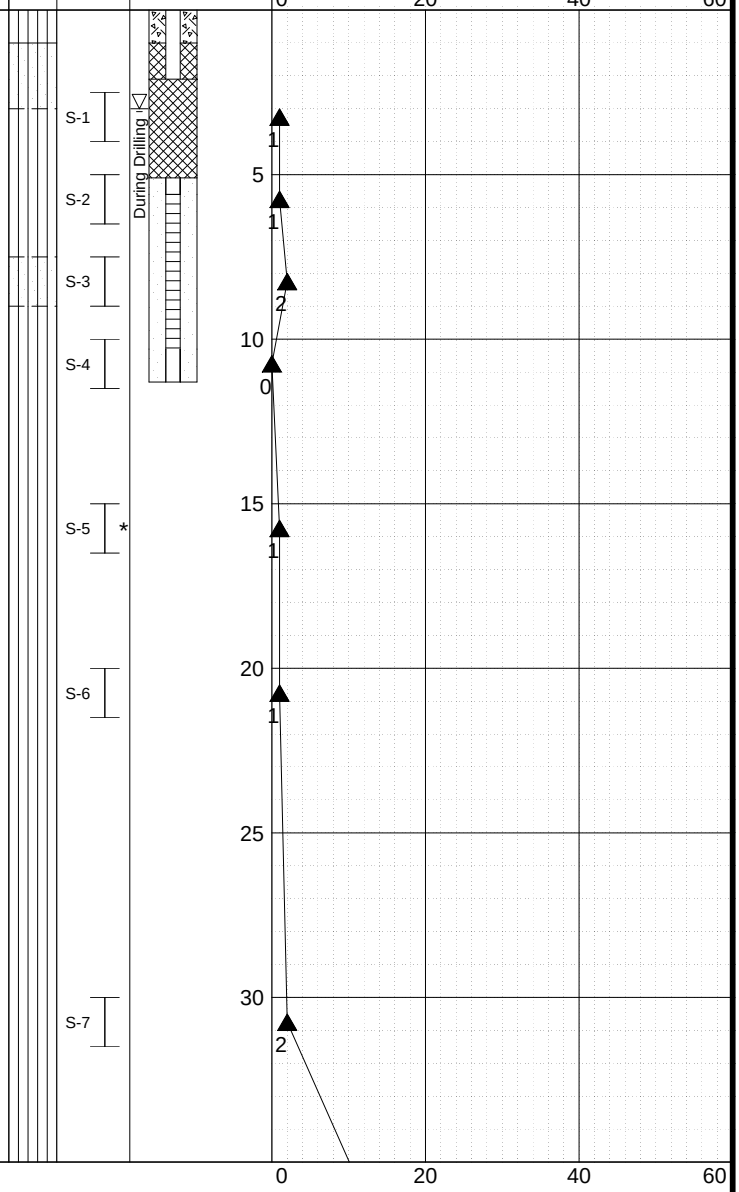
FIG. A6
Sheet 2 of 2

Total Depth:	58 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	5 in.
Top Elevation:		Easting:	~	Drilling Company:	Subsurface Technologies	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Diedrick Truck Rig	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION	Elev. Depth (ft.)
Topsoil	
Very soft brown sandy SILT (ML); moist.	1.0
Very soft gray SILT (ML) trace of gravel; low plasticity, fine to medium rounded gravel; wet.	3.0
Sandy GRAVEL layer at 6 feet.	
Soft gray sandy SILT(ML) with gravel and peat; rounded to subrounded gravels, no to low plasticity, highly decomposed wood fragments and flecks; wet.	7.5
Soft gray SILT to clayey SILT (ML); medium to high plasticity, occasional fine rounded gravel; wet.	9.0
FLOOD PLAIN ALLUVIUM	
Gravel layer approximately 12-inches thick at 19 feet.	
Artesian conditions encountered below 30 feet.	

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.

CONTINUED NEXT SHEET



LEGEND

- * Sample Not Recovered
- Standard Penetration Test
- Piezometer Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout
- Ground Water Level

Plastic Limit — Liquid Limit
Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Horn Creek Water System Improvement
Pacific City, Oregon

LOG OF BORING B-6

July 2008 | 24-1-03458-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

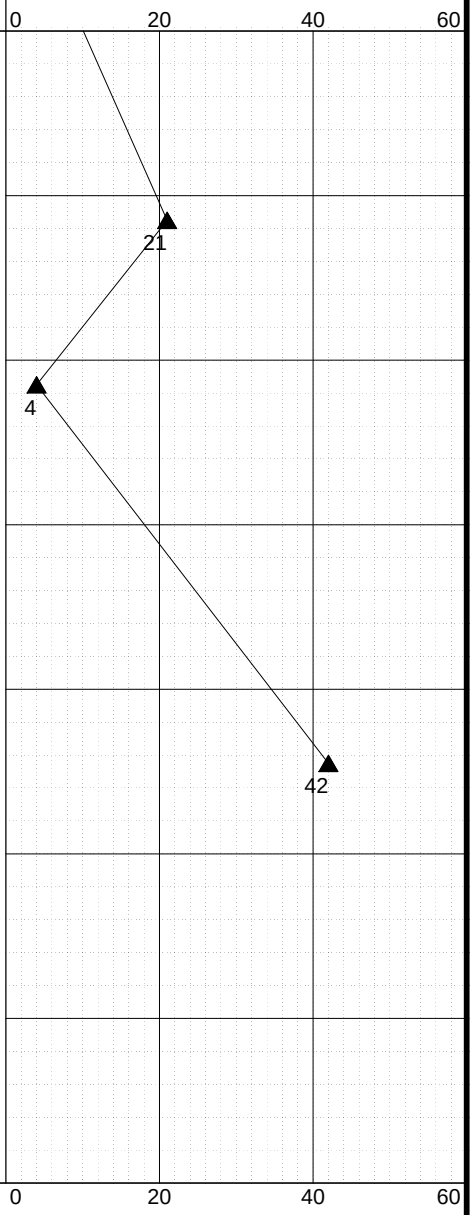
FIG. A7
Sheet 1 of 2

Total Depth:	58 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	5 in.
Top Elevation:		Easting:	~	Drilling Company:	Subsurface Technologies	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Diedrick Truck Rig	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.*	Elev. Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.
continued, Soft gray SILT to clayey SILT (ML); medium to high plasticity, occasional fine rounded gravel; wet.					
FLOOD PLAIN ALLUVIUM Sandy GRAVEL layer from 38 to 42 feet.			S-8		40
Silt with Gravel encountered at 45 feet.			S-9		45
					50
					55
Dense dark brown to gray sandy GRAVEL (GM-GW) with silt; wet. (weathered sandstone)	55.5		S-10		
OLIGOCENE AND MIOCENE SEDIMENTARY ROCKS	58.0				60
Bottom of Boring Completed 05/16/2008.					65

PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

- * Sample Not Recovered
- Standard Penetration Test
- Piezometer Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout
- Ground Water Level

Plastic Limit ⊢●⊣ Liquid Limit
Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Horn Creek Water System Improvement
Pacific City, Oregon

LOG OF BORING B-6

July 2008 | 24-1-03458-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A7
Sheet 2 of 2

Total Depth:	65.25 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	8 in.
Top Elevation:		Easting:	~	Drilling Company:	Subsurface Technologies	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Diedrick Truck Rig	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

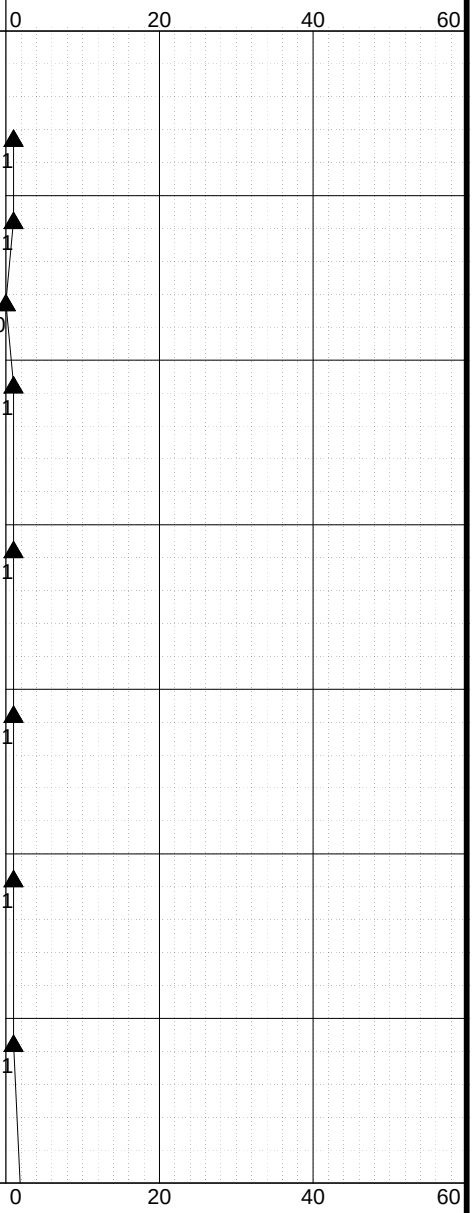
SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.*	Elev. Depth (ft.)
Topsoil.	
Very soft brown sandy SILT (ML); no plasticity; moist.	1.0
Very soft gray SILT to clayey SILT (ML); medium to high plasticity, trace of sand seams, occasional to scattered organics; wet. **FLOOD-PLAIN ALLUVIUM**	3.5
Peat Layer from 20 to 22 feet.	22.0
CONTINUED NEXT SHEET	

Samples: S-1, S-2, S-3, S-4, S-5, S-6, S-7, S-8

Ground Water: During Drilling

PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

Standard Penetration Test

Ground Water Level

Plastic Limit ●—● Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Horn Creek Water System Improvement
Pacific City, Oregon

LOG OF BORING B-7

July 2008 24-1-03458-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A8
Sheet 1 of 3

Log: YWL Rev: YWL Typ: CKS

MASTER LOG E HORN-CREEK.GPJ SHAN WIL.GDT 7/10/08

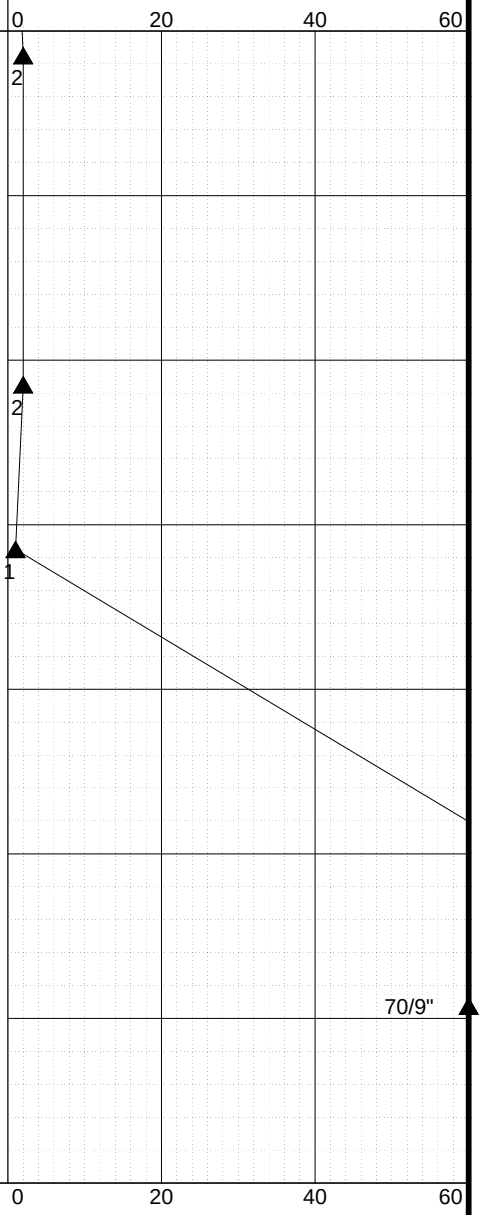
Total Depth:	65.25 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	8 in.
Top Elevation:		Easting:	~	Drilling Company:	Subsurface Technologies	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Diedrick Truck Rig	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION	Elev. Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.					
continued, Very soft gray SILT to clayey SILT (ML); medium to high plasticity, trace of sand seams, occasional to scattered organics; wet. **FLOOD-PLAIN ALLUVIUM** Gravel layer from 44 to 45 feet.	45.0		S-9 S-10 *		40 45
			S-11		50 55 60
Very dense dark brown to gray sandy GRAVEL (GW-GM) with silt; moist to wet. (Weathered Sandstone) **OLIGOCENE AND MIOCENE SEDIMENTARY ROCKS**	64.0 65.3		S-12		65

CONTINUED NEXT SHEET

PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

Standard Penetration Test

Ground Water Level

Plastic Limit — Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Horn Creek Water System Improvement
Pacific City, Oregon

LOG OF BORING B-7

July 2008 | 24-1-03458-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A8
Sheet 2 of 3

Total Depth:	65.25 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	8 in.
Top Elevation:		Easting:	~	Drilling Company:	Subsurface Technologies	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Diedrick Truck Rig	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.*	*Elev.* Depth (ft.)	Symbol	Samples	Ground Water	Depth, ft.	PENETRATION RESISTANCE, N (blows/ft.) ▲ Hammer Wt. & Drop: *140 lbs / 30 inches* 0 20 40 60
Bottom of Boring Completed 05/16/2008. Borehole caved at 5.0 feet, no piezometer installed.					75 80 85 90 95 100	

LEGEND

* Sample Not Recovered

Standard Penetration Test

Ground Water Level

Plastic Limit ⊢—●—⊣ Liquid Limit
Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Horn Creek Water System Improvement
Pacific City, Oregon

LOG OF BORING B-7

July 2008 24-1-03458-001

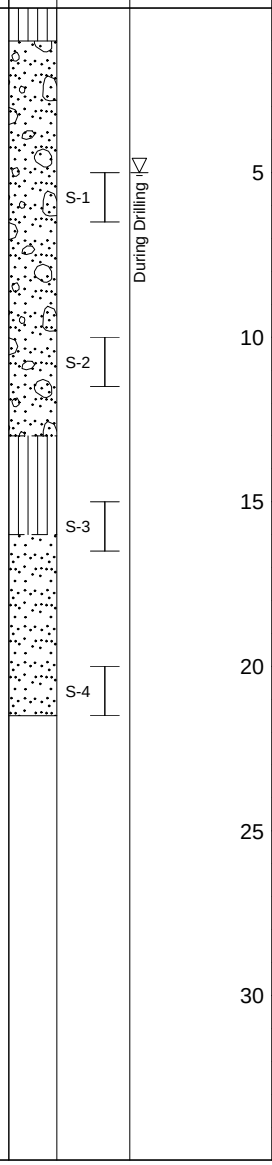
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A8
Sheet 3 of 3

Total Depth:	21.5 ft.	Northing:	~	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:		Easting:	~	Drilling Company:	Subsurface Technologies	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Diedrick Truck Rig	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

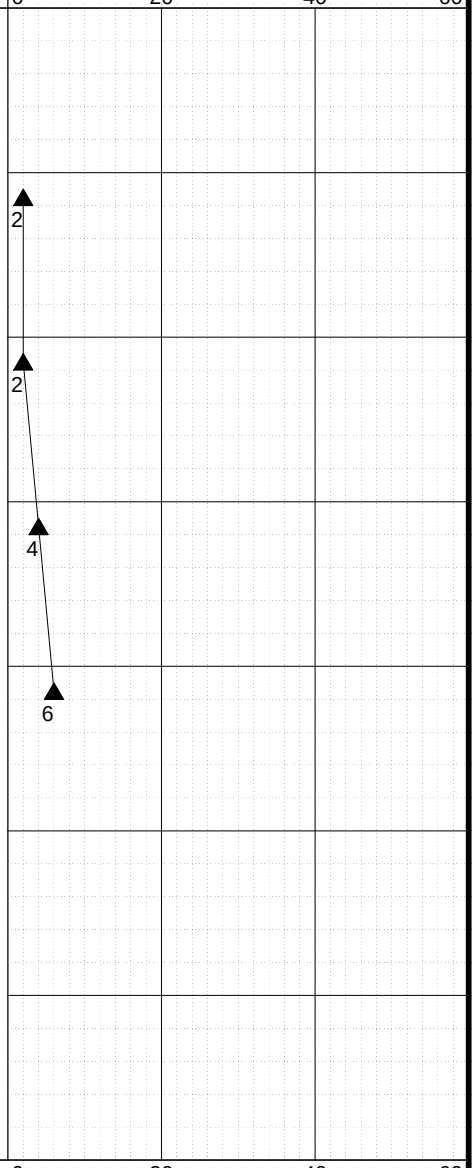
SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.*	Elev. Depth (ft.)
Topsoil.	
Loose gray gravelly SAND (SW) trace of silt; occasional to scattered wood debris and fragments; wet. **FLOOD-PLAIN ALLUVIUM**	1.0
Soft gray SILT to clayey SILT (ML) trace of sand; wet.	13.0
Loose gray SAND (SW) trace of gravel; wet.	16.0
Bottom of Boring Completed 05/16/2008.	21.5

Symbol | Samples | Ground Water | Depth, ft.



PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

Standard Penetration Test

Ground Water Level

Plastic Limit ●—● Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Horn Creek Water System Improvement
Pacific City, Oregon

LOG OF BORING B-8

July 2008 | 24-1-03458-001

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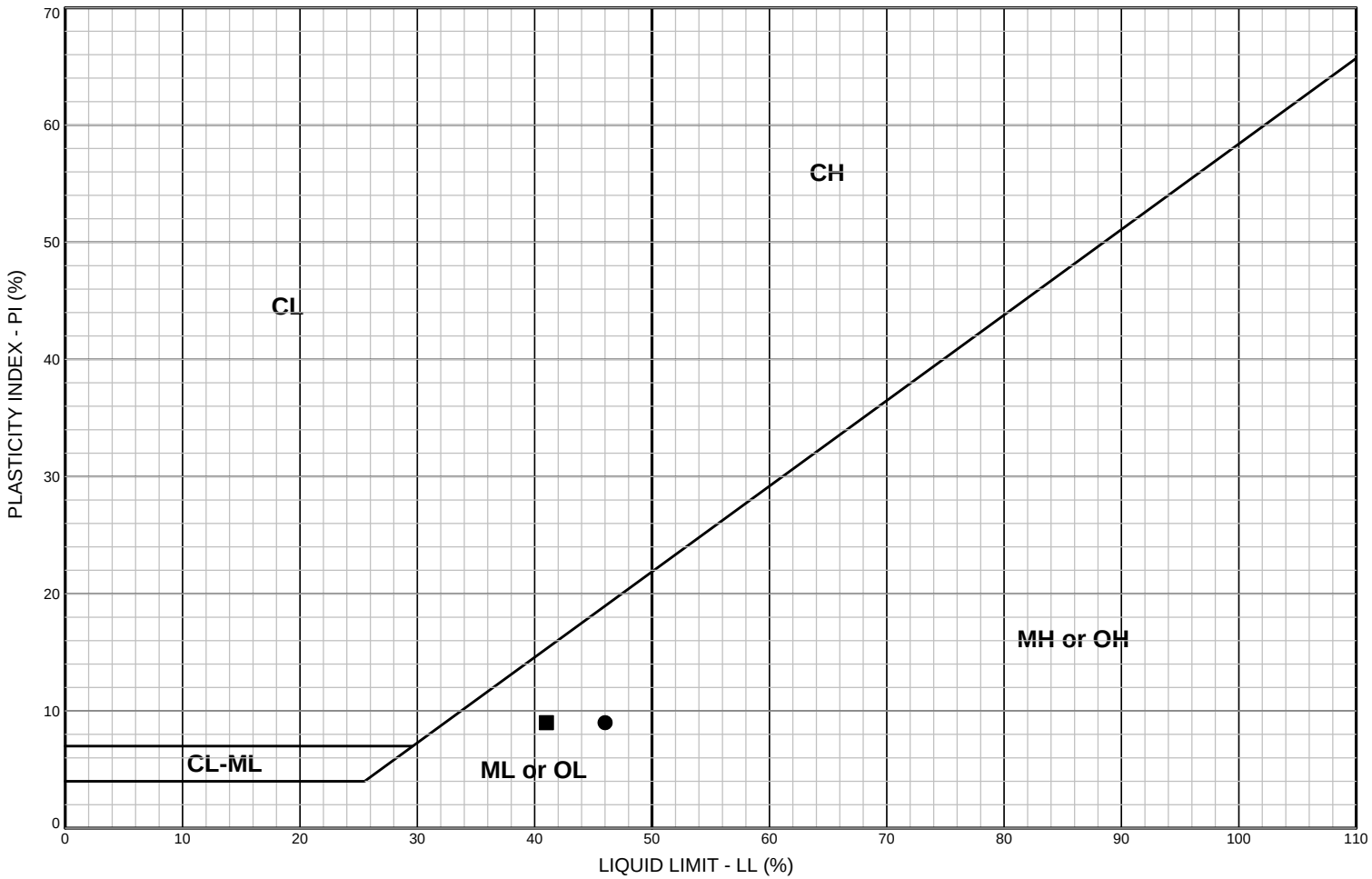
FIG. A9



LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	FINES %
● B-5, 6	15.0	ML	Gray SILT	46	37	9	69.4	
■ B-5, 8	25.0	ML	Gray sandy SILT	41	32	9	38.0	

Horn Creek Water System Improvement
Pacific City, Oregon

ATTERBERG LIMITS RESULTS

July 2008 24-1-03458-001

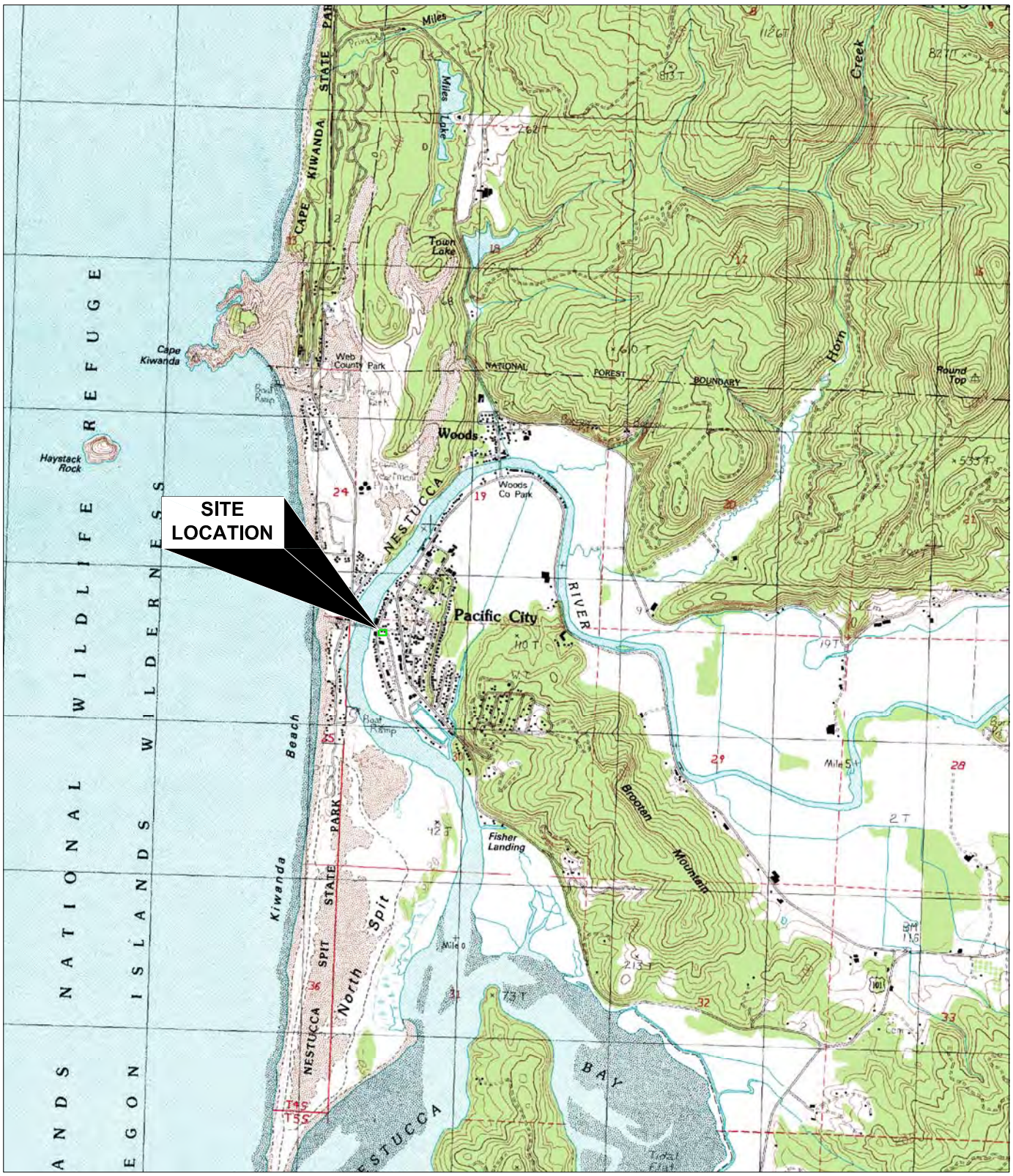
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A10

Pacific City Joint Water - Sewer Authority

FIG. A10

ATT_MAIN_HORN-CREEK.GPJ SHAN WIL.GDT 7/7/08



0 3000 6000

Scale in Feet

N

From Nestucca, Oregon
USGS 7.5 Minute Topographic Quadrangle Map.

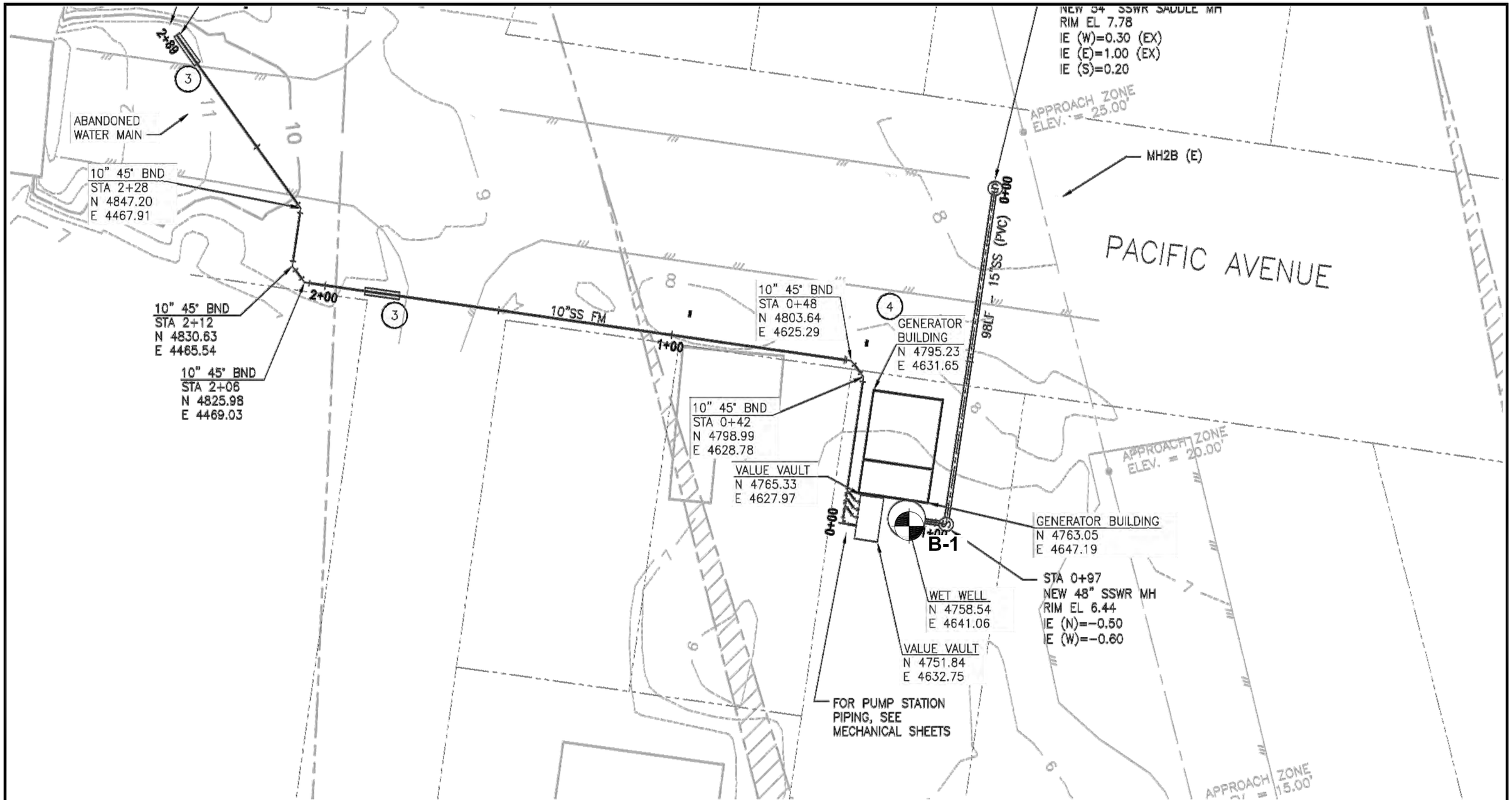
Airport Pump Station Replacement Project
Pacific City Joint Water-Wastewater Authority
Pacific City, Oregon

VICINITY MAP

March 2011 24-1-03553-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 1



EXPLANATION

B-1 Approximate Location and Designation of Boring

Base Map provided by Parametrix, Inc.

0 400 800

Approximate Scale in Feet

N

Airport Pump Station Replacement Project
Pacific City Joint Water-Wastewater Authority
Pacific City, Oregon

SITE PLAN

March 2011 24-1-03553-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

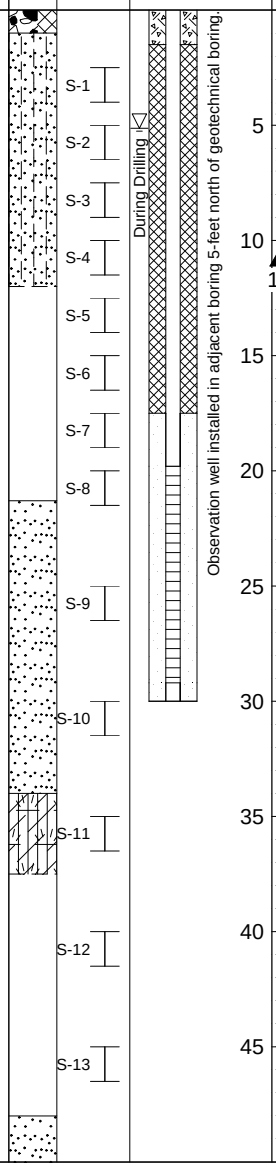
FIG. 2

Total Depth:	81.5 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	5 in.
Top Elevation:	6.5	Easting:	~	Drilling Company:	Subsurface Technologies	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Diedrich D-50	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

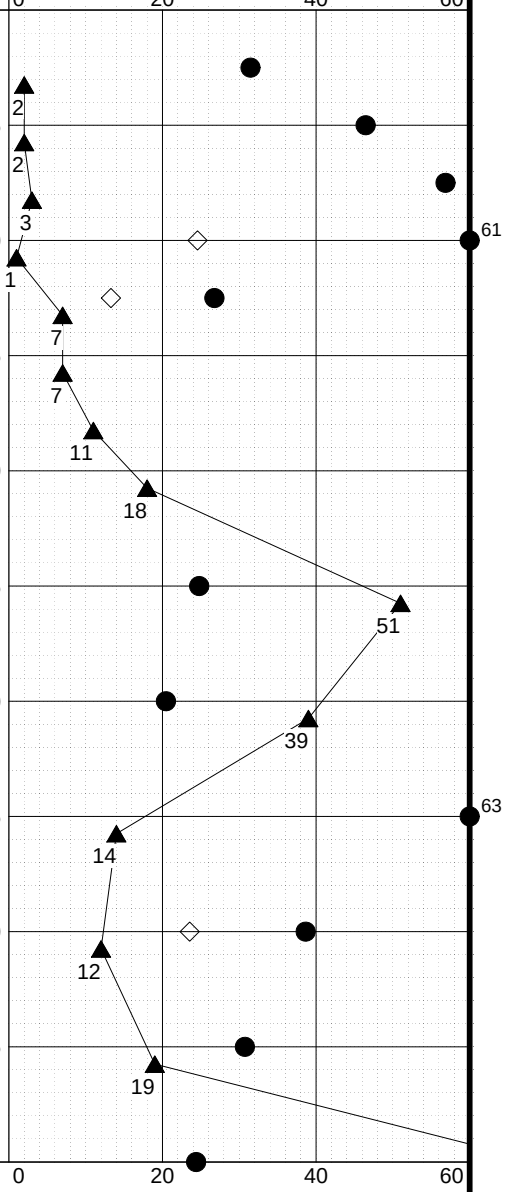
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.

Elev. Depth (ft.)	Description
	Quarry Spalls
5.5 / 1.0	**FILL**
	Very loose brown grading to gray SAND to silty SAND; moist grading to wet below 5 feet depth, non-plastic, fine sand. (SP/SM)
	NESTUCCA RIVER ALLUVIUM
	7.8 feet depth: 1-inch layer of organics.
	11 Feet depth: One 1-inch wood chip.
-5.5 / 12.0	Loose gray SAND with gravel and silt; wet, medium to coarse subangular sand, fine rounded gravel. (SP-GP)
-14.8 / 21.3	Very dense grading to dense tan SAND; wet, fine sand. (SP)
	DUNE SANDS
-27.5 / 34.0	Stiff dark brown organic clayey SILT; moist, medium to high plasticity. (OH)
-31.0 / 37.5	Medium dense dark gray SAND trace silt and some silt/clayey silt interbeds; moist. (SP-SM)
	NESTUCCA RIVER ALLUVIUM
-41.5 / 48.0	



PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered

Standard Penetration Test

Ground Water Level

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Airport Pump Station Replacement Project
Pacific City Joint Water-Wastewater Authority
Pacific City, Oregon

LOG OF BORING B-1

March 2011 | 24-1-03553-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 4
Sheet 1 of 2

Total Depth:	81.5 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	5 in.
Top Elevation:	6.5	Easting:	~	Drilling Company:	Subsurface Technologies	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	Diedrich D-50	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.

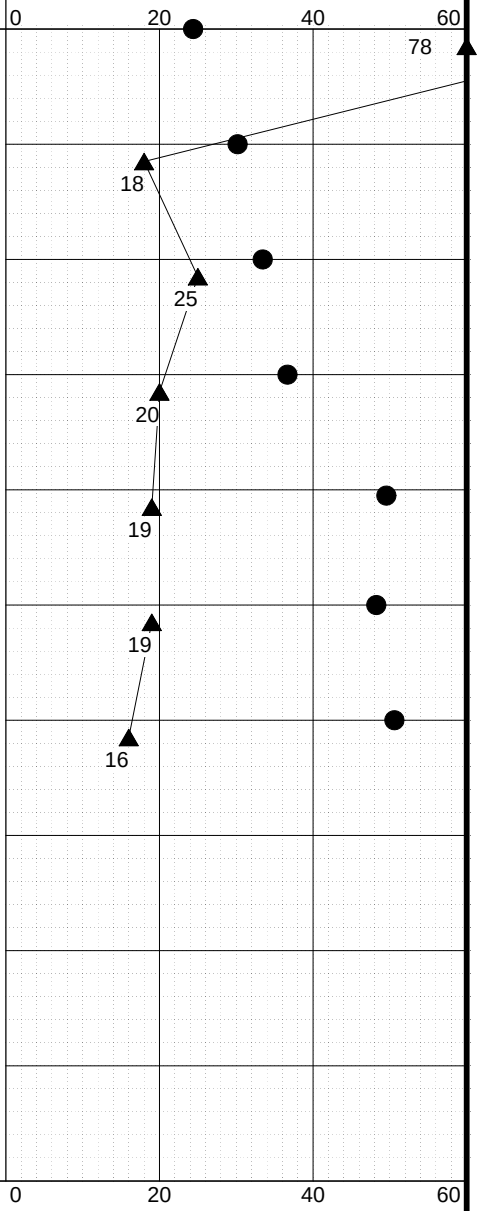
Description	Elev. / Depth (ft.)
Very dense tan SAND; wet, fine sand, trace coarse rounded sand. (SP)	
DUNE SANDS	-47.5 / 54.0
Medium dense gray silty SAND; wet, non-plastic to low plasticity, fine sand, one 1-inch wood chip at 56.2 feet depth. (SM)	
NESTUCCA RIVER ALLUVIUM	
Very stiff gray sandy SILT; wet, low plasticity, fine sand. (ML)	-61.5 / 68.0
Medium dense gray silty SAND. (SM)	-64.1 / 70.6
Very stiff gray SILT with sand. (ML)	-64.7 / 71.2
Very stiff sandy SILT; moist to wet, low to medium plasticity, fine sand, ~ 1-inch thick peat laminations separated by ~5-inch thick beds of silty sand, occasional laminations of shells. (ML)	-66.5 / 73.0
Bottom of Boring Completed on 4/29/2009	-75.0 / 81.5

Symbol | Samples | Ground Water | Depth, ft.

S-14, S-15, S-16, S-17, S-18A, S-18B, S-18C, S-19, S-20

PENETRATION RESISTANCE, N (blows/ft.)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND

* Sample Not Recovered

Standard Penetration Test

Ground Water Level

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location and elevation should be considered approximate.

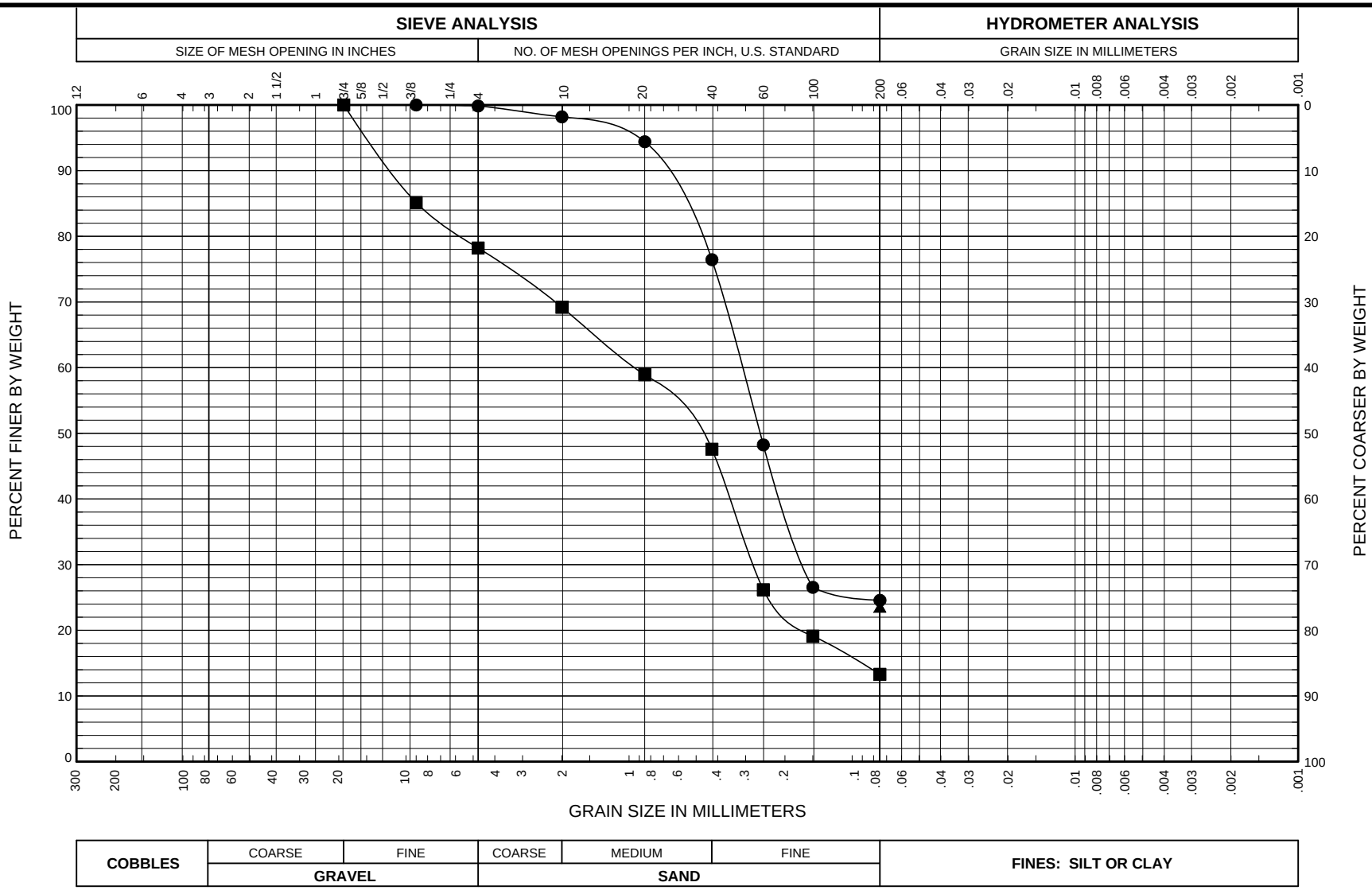
Airport Pump Station Replacement Project
Pacific City Joint Water-Wastewater Authority
Pacific City, Oregon

LOG OF BORING B-1

March 2011 | 24-1-03553-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 4
Sheet 2 of 2



COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	FINES: SILT OR CLAY
	GRAVEL		SAND			

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-1, S-4	10.0	SM	Gray SAND with silt and wood debris	-	75	25	61	
■ B-1, S-5	12.5	SM	Gray silty SAND with gravel and sand	-	65	13	27	
▲ B-1, S-12	40.0	SM	Gray SAND with silt	-	-	24	39	

Airport Pump Station Replacement Project
Pacific City Joint Water-Wastewater Authority
Pacific City, Oregon

GRAIN SIZE DISTRIBUTION

March 2011 24-1-03553-002

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Geotechnical and Environmental Consultants

FIG. 5

FIG. 5

GSA MAIN 03553 PAC CITY PMP STN.GPJ SHAN WIL.GDT 3/25/11

Pacific City Pump Sation

N

NOT TO SCALE

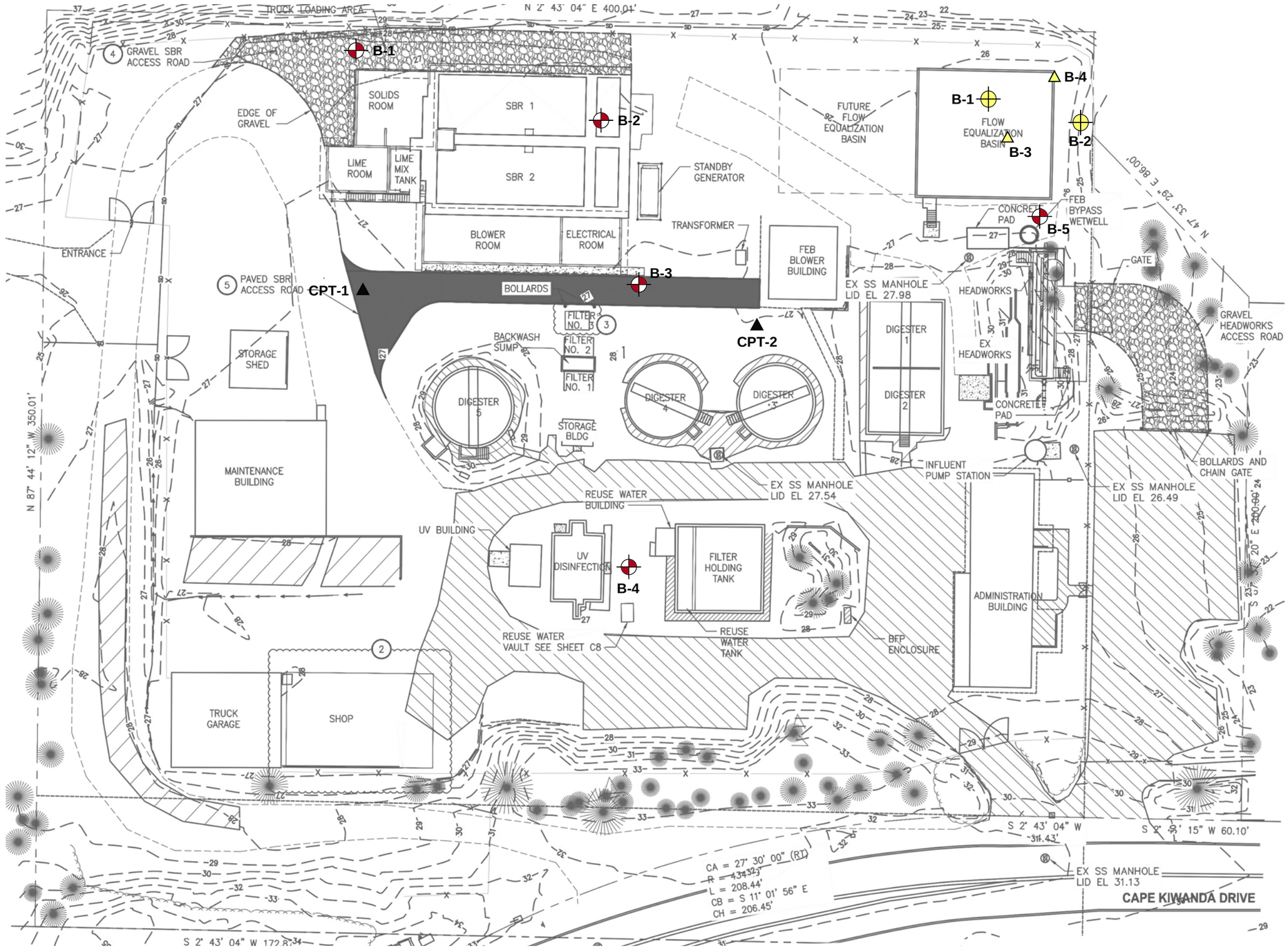
GEOTECHNICS

VICINITY MAP

Pacific City WWTP Upgrade
Pacific City, Oregon

Project No. 15-008-1

Figure 1



LEGEND

B-5 — Boring, Geotechnics LLC, 2016

CPT-2 — Cone Penetrometer Test, Geotechnics LLC, 2016

B-2 — Boring, AGRA Earth & Environmental, 1996

B-4 — Cone Penetrometer Test, AGRA Earth & Environmental,1996

N

40 0 40

APPROXIMATE SCALE IN FEET

GEOTECHNICS

SITE AND EXPLORATION PLAN

Pacific City WWTP Upgrade
Pacific City, Oregon

Project No. 15-008-1

Figure 2

Appendix A

FIELD EXPLORATIONS - DRILLING

APPENDIX A
FIELD EXPLORATIONS - DRILLING

We completed five rotary drilled borings on June 15th and 16th, 2016. The borings were drilled by Hard Core Drilling, Inc. of Dundee, Oregon, using a CME 75 truck mounted drill rig and mud rotary methods to advance a tricone bit. The locations of the explorations are shown in the report on Figure 2.

The borings were coordinated by a geotechnical engineer who located the borings, classified the various soil units encountered, obtained representative soil samples for geotechnical testing, observed and recorded groundwater conditions, and maintained detailed logs of the explorations.

Standard Penetration Tests (SPT) were completed in general conformance with ASTM Test Method D1586, "Standard Method for Penetration Test and Split-Barrel Sampling of Soils". The sampler was driven with a 140-pound auto-trip hammer falling 30 inches. Recorded blows for each 6 inches of sample penetration are shown on the boring logs. The N-value, or number of blows required to drive the sampler the final 12 inches was used in our analyses. Disturbed samples were obtained from the split barrel for subsequent classification and index testing.

Materials encountered in the explorations were classified in the field in general accordance with ASTM Standard Practice D2488, "Standard Practice for the Classification of Soils (Visual-Manual Procedure)". Soil classifications and sampling intervals are shown in the exploration logs in this appendix. A legend to the terms and symbols used on the logs is presented on the following page.

ABBREVIATIONS

Laboratory Tests:

AL	Atterberg Limits
PL	Plastic Limit
LL	Liquid Limit
%F	Fines Content
GSD	Grain Size Distribution
DD	Dry Density
MD	Moisture/Density Relationship
-S	Standard Proctor (ASTM D-698)
-M	Modified Proctor (ASTM D-1557)
SG	Specific Gravity
CBR	California Bearing Ratio
RM	Resilient Modulus
K	Permeability
CN	Consolidation
DS	Direct Shear
TX	Triaxial Shear
-UU	Unconsolidated Undrained
-CU	Consolidated Undrained

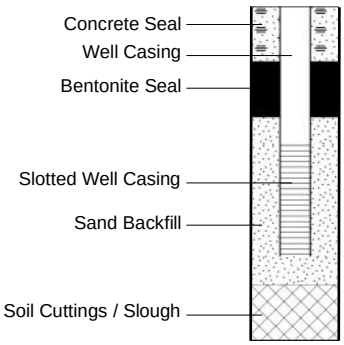
Field Tests:

PP	Pocket Penetrometer
TV	Torvane

Sample Type:

SPT	Standard Penetration Test (2.0" OD)
D&M	Ring Sampler (3.25" OD)
C-MOD	California Modified Sampler (3.0" OD)
SH	Thin-Walled Shelby Tube (3.0" OD)
GRAB	Disturbed Sample collected from auger cuttings or test pit

WELL DETAIL



COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to #4 (5 mm)
Coarse Gravel	3 in to ¾ in
Fine Gravel	¾ in to #4 (5 mm)
Sand	#4 (5 mm) to #200 (0.075 mm)
Coarse Sand	#4 (5 mm) to #10 (2 mm)
Medium Sand	#10 (2 mm) to #40 (0.4 mm)
Fine Sand	#40 (0.4 mm) to #200 (0.075 mm)
Silt and Clay	Smaller than #200 (0.075 mm)

NOTES

Soil descriptions are based on the general approach presented in ASTM D-2488 (Visual-Manual Procedure). Where laboratory data are available, soil classifications are in accordance with ASTM D-2487.

Solid lines between soil unit descriptions indicate change in interpreted geologic unit. Dashed lines indicate stratigraphic change within the geologic unit.

Blowcount (N) is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted) per ASTM D-1586. See exploration log for hammer weight and drop.

Please also refer to the discussion in the report for a general description of subsurface conditions.

Pacific City Wastewater Treatment Plant
Pacific City, Oregon

Client: Parametrix

Project Number: 15-008-1

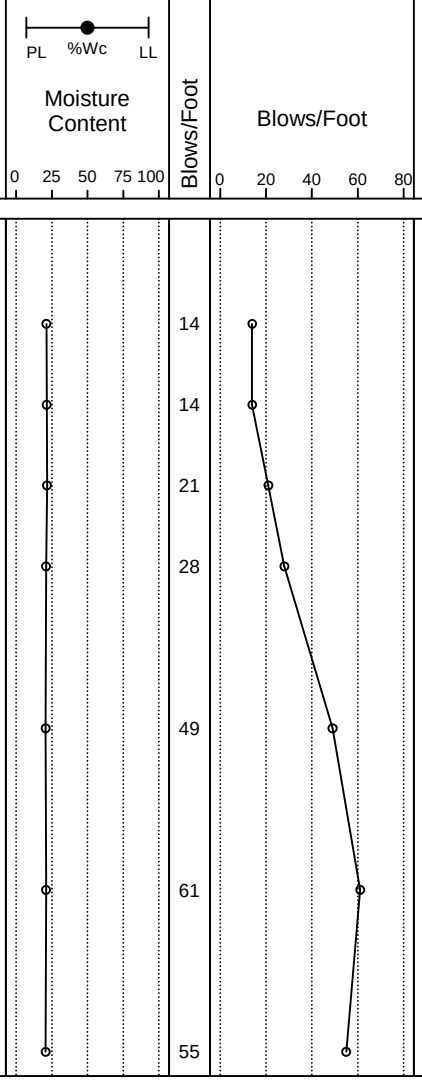
LOG OF BORING B-1

Surface Elevation:	26.7 feet	Start Date:	June 16, 2016	Drilling Method:	Mud Rotary
Northing:	5,006,796	End Date:	June 16, 2016	Drilling Equipment:	Truck Rig - CME 75
Easting:	424,252	Logged By:	ADM	Hammer Weight:	140 lb.
Coordinate System:	UTM Zone 10, NAD 83	Contractor:	Hard Core Drilling, Inc.	Hammer Drop:	30 in.

SAMPLE TYPE

- SPT — Standard Penetration Test
- CMOD — California Modified Split-Barrel
- SHELBY — Thin-Walled Tube - 3"
- GRAB — Bag or Bucket

Depth in Feet	Sample Type	Sample Number	Graphic Symbol	USCS	MATERIAL DESCRIPTION	Water Level, ATD	Moisture Content, %	Blows/Foot	Other Tests
0					6 inches angular 2-inch minus rock over 18 inches 4-inch minus rock.				
		S-1		SP	Light grayish brown, Poorly Graded SAND (SP), moist, medium dense. Fine grained.		21.3	14	
					Becomes wet.				
5		S-2					21.4	14	
		S-3					21.7	21	GSD %F=3.5
10		S-4					20.9	28	
					@13', becomes dense.				
15		S-5					20.8	49	
					@18', becomes very dense.				
20		S-6					21.0	61	
25		S-7					20.8	55	
30					Total Depth = 26.5 feet. Groundwater level not determined.				
35									



GEOTECHNICS

Boring B-1

Pacific City Wastewater Treatment Plant
Pacific City, Oregon

Figure A1

Pacific City Wastewater Treatment Plant
Pacific City, Oregon

Client: Parametrix

Project Number: 15-008-1

LOG OF BORING B-2

Surface Elevation:	26.3 feet	Start Date:	June 16, 2016	Drilling Method:	Mud Rotary
Northing:	5,006,769	End Date:	June 16, 2016	Drilling Equipment:	Truck Rig - CME 75
Easting:	424,245	Logged By:	ADM	Hammer Weight:	140 lb.
Coordinate System:	UTM Zone 10, NAD 83	Contractor:	Hard Core Drilling, Inc.	Hammer Drop:	30 in.

SAMPLE TYPE

- SPT — Standard Penetration Test
- CMOD — California Modified Split-Barrel
- SHELBY — Thin-Walled Tube - 3"
- GRAB — Bag or Bucket

Depth in Feet	Sample Type	Sample Number	Graphic Symbol	USCS	MATERIAL DESCRIPTION	Water Level, ATD	Moisture Content, %	Blows/Foot	Other Tests
0					Light grayish brown, Poorly Graded SAND (SP), moist, medium dense. Fine grained.				
		S-1					23.1	17	
					Becomes wet.				
5		S-2					22.7	20	GSD %F=2.3
					@7', becomes dense.				
		S-3					21.6	34	
10		S-4					21.0	35	
		S-5		SP			20.4	48	
					@14.5', becomes very dense.				
15		S-6					20.5	54	
20		S-7					20.0	56	
25		S-8					19.1	69	
					Total Depth = 26.5 feet. Groundwater level not determined.				
30									
35									

Moisture Content: PL %Wc LL; 0 25 50 75 100

Blows/Foot: 0 20 40 60 80

GEOTECHNICS

Boring B-2

Pacific City Wastewater Treatment Plant
Pacific City, Oregon

Figure A2

Pacific City Wastewater Treatment Plant
Pacific City, Oregon

Client: Parametrix

Project Number: 15-008-1

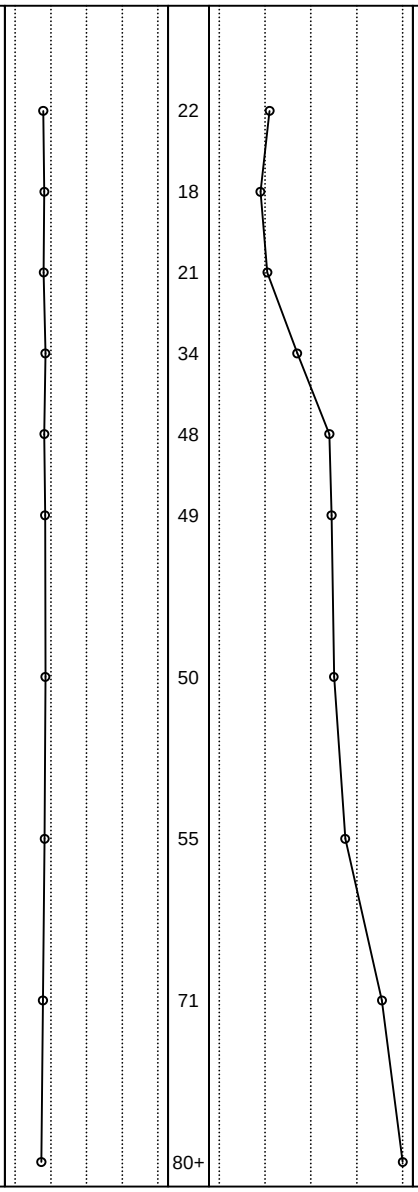
LOG OF BORING B-3

Surface Elevation:	27.3 feet	Start Date:	June 15, 2016	Drilling Method:	Mud Rotary
Northing:	5,006,763	End Date:	June 15, 2016	Drilling Equipment:	Truck Rig - CME 75
Easting:	424,226	Logged By:	ADM	Hammer Weight:	140 lb.
Coordinate System:	UTM Zone 10, NAD 83	Contractor:	Hard Core Drilling, Inc.	Hammer Drop:	30 in.

SAMPLE TYPE

- SPT — Standard Penetration Test
- CMOD — California Modified Split-Barrel
- SHELBY — Thin-Walled Tube - 3"
- GRAB — Bag or Bucket

Depth in Feet	Sample Type	Sample Number	Graphic Symbol	USCS	MATERIAL DESCRIPTION	Water Level, ATD	Moisture Content, %	Blows/Foot	Other Tests
0					Fine sand with scattered angular gravel. Description based on drilling action.				
				SP	Light grayish brown, Poorly Graded SAND (SP), moist, medium dense. Fine grained.				
		S-1					19.7	22	
					Becomes wet.				
5		S-2					20.4	18	
		S-3					19.9	21	
					@9.5', becomes dense.				
10		S-4					21.3	34	
		S-5					20.5	48	
15		S-6					21.0	49	%F=4.3
					@18', becomes very dense.				
20		S-7					21.2	50	
25		S-8					20.7	55	
				SP-SM	Light grayish brown, Poorly-Graded SAND with Silt (SP-SM), wet, very dense. Fine grained. Several black laminae (1 to 5 mm thickness) in Sample S-9.				
30		S-9					19.5	71	%F=6.2
35		S-10			Total Depth = 36.5 feet. Groundwater level not determined.		18.3	80+	



GEOTECHNICS

Boring B-3

Pacific City Wastewater Treatment Plant
Pacific City, Oregon

Figure A3

Pacific City Wastewater Treatment Plant
Pacific City, Oregon

Client: Parametrix

Project Number: 15-008-1

LOG OF BORING B-4

Surface Elevation:	27.3 feet	Start Date:	June 15, 2016	Drilling Method:	Mud Rotary
Northing:	5,006,764	End Date:	June 15, 2016	Drilling Equipment:	Truck Rig - CME 75
Easting:	424,192	Logged By:	ADM	Hammer Weight:	140 lb.
Coordinate System:	UTM Zone 10, NAD 83	Contractor:	Hard Core Drilling, Inc.	Hammer Drop:	30 in.

SAMPLE TYPE

- SPT — Standard Penetration Test
- CMOD — California Modified Split-Barrel
- SHELBY — Thin-Walled Tube - 3"
- GRAB — Bag or Bucket

Depth in Feet	Sample Type	Sample Number	Graphic Symbol	USCS	MATERIAL DESCRIPTION	Water Level, ATD	Moisture Content, %	Blows/Foot	Other Tests
0					Light grayish brown, Poorly Graded SAND (SP), moist, medium dense. Fine grained.				
		S-1					18.9	18	
					Becomes wet.				
5		S-2					20.4	16	%F=2.5
		S-3					22.0	25	
					@9.5', becomes dense.				
10		S-4					22.3	32	
		S-5					24.6	41	
15		S-6		SP			22.4	42	
					@18', becomes medium dense.				
20		S-7					23.3	28	
					@23', becomes dense.				
25		S-8					22.4	49	
					@28', becomes very dense.				
30		S-9					21.1	58	
35									

Moisture Content: PL %Wc LL; 0 25 50 75 100

Blows/Foot: 0 20 40 60 80

Total Depth = 31.5 feet.
Groundwater level not determined.

GEOTECHNICS

Boring B-4

Pacific City Wastewater Treatment Plant
Pacific City, Oregon

Figure A4

Pacific City Wastewater Treatment Plant
Pacific City, Oregon

Client: Parametrix

Project Number: 15-008-1

LOG OF BORING B-5

Surface Elevation:	26.8 feet	Start Date:	June 15, 2016	Drilling Method:	Mud Rotary
Northing:	5,006,716	End Date:	June 15, 2016	Drilling Equipment:	Truck Rig - CME 75
Easting:	424,233	Logged By:	ADM	Hammer Weight:	140 lb.
Coordinate System:	UTM Zone 10, NAD 83	Contractor:	Hard Core Drilling, Inc.	Hammer Drop:	30 in.

SAMPLE TYPE

- SPT — Standard Penetration Test
- CMOD — California Modified Split-Barrel
- SHELBY — Thin-Walled Tube - 3"
- GRAB — Bag or Bucket

Depth in Feet	Sample Type	Sample Number	Graphic Symbol	USCS	MATERIAL DESCRIPTION	Water Level, ATD	Moisture Content, %	Blows/Foot	Other Tests
0					4-inch minus angular rock.				
				SP	Light grayish brown, Poorly Graded SAND (SP), moist, medium dense. Fine grained.				
		S-1					15.3	10	
					Becomes wet, medium dense.				
5		S-2					21.0	21	
		S-3					21.4	28	GSD %F=2.8
					@9.5', becomes dense.				
10		S-4					22.2	34	
		S-5					20.8	42	
					@14.5', becomes very dense.				
15		S-6					20.8	52	
20		S-7					21.2	53	
25									
30									
35									

Moisture Content: PL %Wc LL; 0 25 50 75 100

Blows/Foot: 0 20 40 60 80

Total Depth = 21.5 feet.
Groundwater level not determined.

GEOTECHNICS

Boring B-5

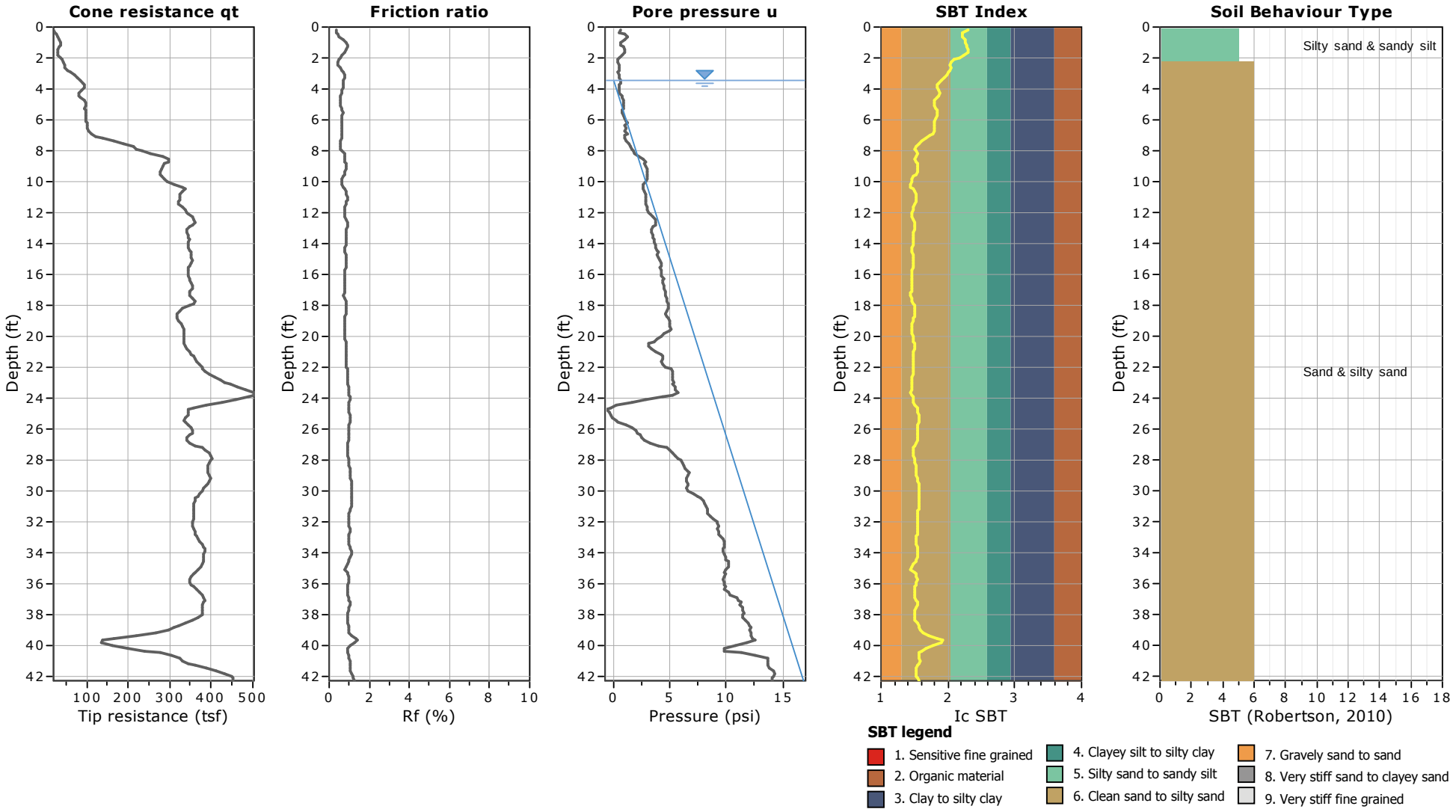
Pacific City Wastewater Treatment Plant
Pacific City, Oregon

Figure A5

GEOTECHNICS
7629 SE Harrison St
Portland, Oregon 97215
www.GeotechnicsNW.com

Project: **Pacific City WWTP**
Location: **Pacific City, OR**

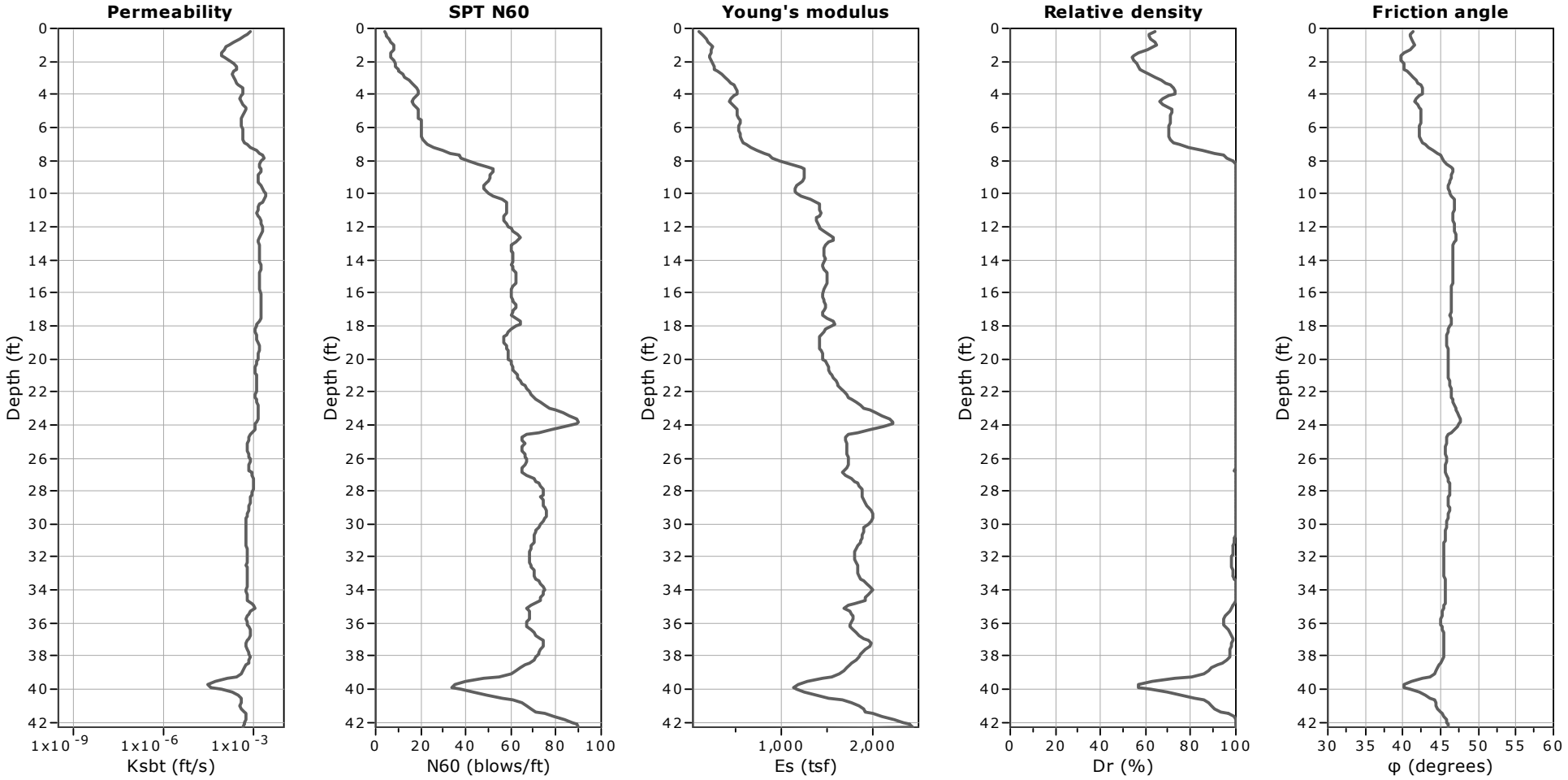
CPT: 16052 CPT-2 Text File
Total depth: 42.49 ft, Date: 6/16/2016
Surface Elevation: 27.20 ft
Coords: X:0.00, Y:0.00
Cone Type: 10cm subtraction
Cone Operator: Oregon Geotechnical Explorations, Inc.



7629 SE Harrison St
Portland, Oregon 97215
www.GeotechnicsNW.com

CPT: 16052 CPT-2 Text File
Total depth: 42.49 ft, Date: 6/16/2016
Surface Elevation: 27.20 ft
Coords: X:0.00, Y:0.00
Cone Type: 10cm subtraction
Cone Operator: Oregon Geotechnical Explorations, Inc.

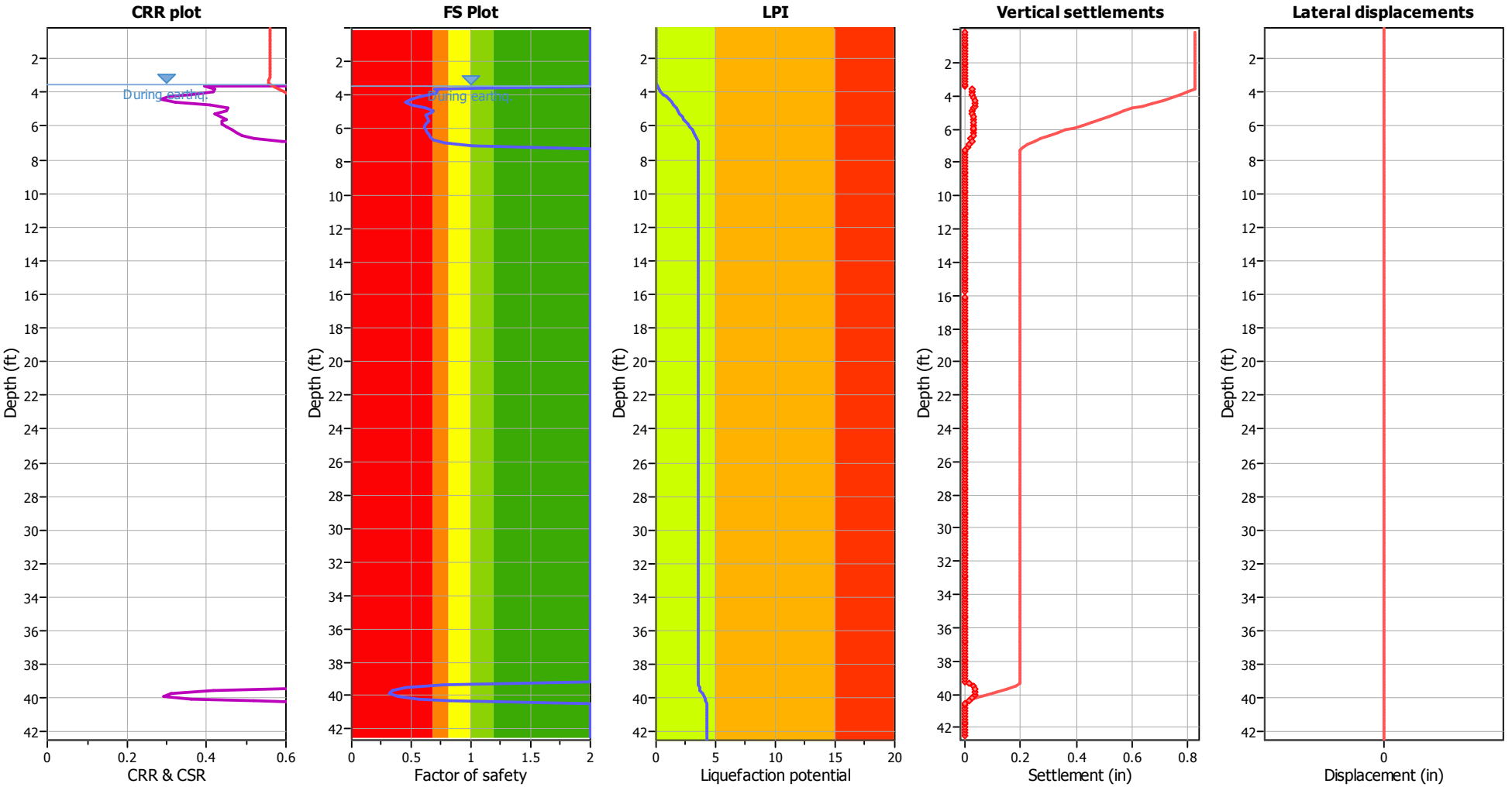
Project: **Pacific City WWTP**
Location: **Pacific City, OR**



Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative desnisty constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	3.50 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.50 ft	Fill height:	N/A	Limit depth:	N/A

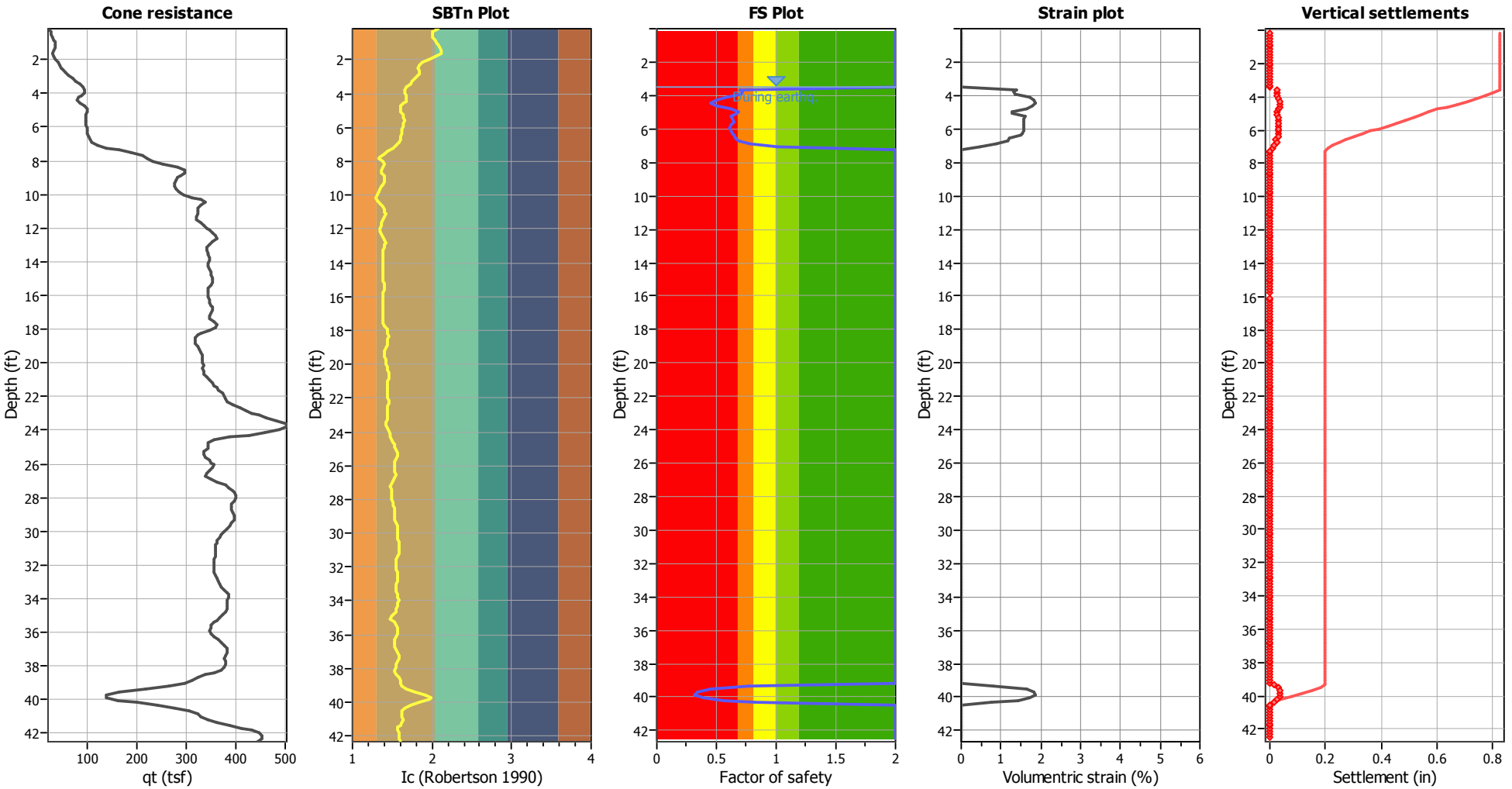
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

Attachment to and part of Report: 104600
Date: February 2021
To: Matt Steiner
Parametrix

Important Information About Your Geotechnical/Environmental Report

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland

Appendix E

PCJWSA Water System Development Charges Methodology Report

Methodology Report

Water System Development Charges

Prepared for PACIFIC CITY JOINT WATER-SANITARY AUTHORITY

March 28, 2022

GALARDI ROTHSTEIN GROUP

Table of Contents

Tables

Section 1 Introduction

Oregon legislation establishes guidelines for the calculation of system development charges (SDCs). Within these guidelines, local governments have latitude in selecting technical approaches and establishing policies related to the development and administration of SDCs. A discussion of this legislation follows.

In conformance with state law and industry standard practices, the recommended water SDC methodology for the Pacific City Joint Water-Sanitary Authority (PCJWSA) are presented in this report.

SDC Legislation in Oregon

In the 1989 Oregon state legislative session, a bill was passed that created a uniform framework for the imposition of SDCs statewide. This legislation (Oregon Revised Statute [ORS] 223.297-223.314), which became effective on July 1, 1991, (with subsequent amendments), authorizes local governments to assess SDCs for the following types of capital improvements:

- Drainage and flood control
- Water supply, treatment, and distribution
- Wastewater collection, transmission, treatment, and disposal
- Transportation
- Parks and recreation

The legislation provides guidelines on the calculation and modification of SDCs, accounting requirements to track SDC revenues and expenditures, and the adoption of administrative review procedures.

SDC Structure

SDCs can be developed around two concepts: (1) reimbursement fee, and (2) improvement fee, or a combination of the two. The **reimbursement fee** is based on the costs of capital improvements already constructed or under construction. The legislation requires the reimbursement fee to be established or modified by an ordinance or resolution setting forth the methodology used to calculate the charge. This methodology must consider the cost of existing facilities, prior contributions by existing users, gifts or grants from federal or state government or private persons, the value of unused capacity available for future system users, rate-making principles employed to finance the capital improvements, and other relevant factors. The objective of the methodology must be that future system users contribute no more than an equitable share of the capital costs of existing facilities. Use of reimbursement fee revenues are restricted only to capital expenditures for the specific system which they are assessed, including debt service.

The methodology for establishing or modifying an **improvement fee** must be specified in an ordinance or resolution that demonstrates consideration of the projected costs of capital improvements identified in an adopted plan and list, that are needed to increase capacity in the system to meet the demands of new or expanded development. Use of revenues generated through improvement fees are dedicated to capacity-increasing capital improvements or the repayment of debt on such improvements. An increase in capacity is established if an improvement increases the level of service provided by existing facilities or provides new facilities.

In many systems, growth needs will be met through a combination of existing available capacity and future capacity-enhancing improvements. Therefore, the law provides for a **combined fee** (reimbursement plus improvement component).

Credits

The legislation requires that a credit be provided against the improvement fee for the construction of "qualified public improvements" by a developer or other private party. Qualified public improvements are improvements that are required as a condition of development approval, identified in the system's capital improvement program, and either (1) not located on or contiguous to the property being developed, or (2) located in whole or in part, on or contiguous to, property that is the subject of development approval and required to be built larger or with greater capacity than is necessary for the particular development project to which the improvement fee is related.

Update and Review

The methodology for establishing or modifying improvement or reimbursement fees must be available for public review. The local government must maintain a list of persons who have made a written request for notification prior to the adoption or amendment of the methodology. The legislation includes provisions regarding notification of hearings and filing for reviews. Periodic application of an adopted specific cost index or modification to certain factors incorporated into the SDC rate are not considered modifications to the methodology, provided that:

- "Factors related to the rate" are limited to changes to costs in materials, labor, or real property as applied to projects in the required project list.
- The cost index must consider average change in costs in materials, labor, or real property and must be an index published for purposes other than SDC rate setting.

The local government is not required to adhere to the notification provisions under these circumstances. Changes to the fees that *do* represent a modification to the methodology require a 90-day written notice prior to first public hearing and that the SDC methodology be available for review 60 days prior to public hearing.

Other Provisions

Other provisions of the legislation require:

- Preparation of a capital improvement program or comparable plan that includes a list of the improvements that the jurisdiction intends to fund in whole or in part with SDC revenues and the estimated timing, cost, and eligible portion of each improvement.
- Deposit of SDC revenues into dedicated accounts and annual accounting of revenues and expenditures, including a list of the amount spent on each project funded, in whole or in part, by SDC revenues.
- Creation of an administrative appeals procedure, in accordance with the legislation, whereby a citizen or other interested party may challenge an expenditure of SDC revenues.

The methodology presented in this report has been prepared in accordance with Oregon SDC requirements.

Note: The calculations contained in this report were produced using numbers that extend beyond the decimal places shown in the tables presented, so slight variations exist due to rounding. These variations are not material.

Section 2 Water SDC Methodology

This section presents the updated water system development charge (SDC) methodology and calculations for the Pacific City Joint Water-Sanitary Authority (PCJWSA) based on the 2021 Water Master Plan (Parametrix, March 2021). The general methodology begins with an analysis of system planning and design criteria to determine growth's capacity needs, and how they will be met through existing system available capacity and capacity expansion. Then, the existing and future facilities needed to serve growth over the planning period are valued to determine the "cost basis" for the SDCs. The cost basis is then divided over the projected total growth capacity to determine the system-wide unit costs of capacity. The final step is to determine the SDC schedule, which identifies how different developments will be charged, based on their estimated capacity requirements.

Growth Capacity Needs

Table 2-1 shows the relevant planning assumptions for the water system through 2040 and beyond, when the Horn Creek Water Treatment Plant (WTP) capacity is utilized. Capacity requirements are generally evaluated based on the following system design criteria:

- **Maximum Day Demand (MDD)** -- The highest daily recorded rate of water production in a year. Used for evaluating capacity of allocating source and delivery facilities.
- **Storage Requirements** – Stored water capacity used for operational (or equalization) and emergency and fire protection needs. Used for allocating storage facility costs.

Table 2-1
Pacific City Joint Water-Sanitary Authority
Water System Planning Assumptions

Capacity Parameter	MDD (gpm)	Storage (mg)
Current Requirements	586,704	890,491
Future Storage Requirements		981,458
Capacity – WTP Filters	864,920	
Capacity – WTP Structure	1,727,360	
Growth – Storage		90,967
Growth – WTP interim capacity	278,216	
Growth – WTP buildout capacity	1,140,656	

Source: Water System Master Plan

As shown in Table 2-1, system MDD is currently 586,704 gallons per day (gpd). Interim production capacity at the WTP is 864,920 gpm, reflecting filter capacity. However, major

structural facilities are sized for the ultimate plant capacity of 1,727,360 gpm. Transmission mains are assumed to be sized consistent with buildout supply capacity. Distribution system capacity and improvements have been evaluated for the interim capacity period.

Storage requirements are currently 890,491 gpd and are projected to increase to 981,458 gpd over the master planning period.

Available Capacity

The total capacity needs of growth will be met in part by existing system available capacity, as well as future capacity expansion. **Table 2-2** provides a summary of the existing capacities by major function and compares the capacity to existing requirements in order to determine the portion of available capacity by component and facility type.

Table 2-2
Pacific City Joint Water-Sanitary Authority
Available Capacity Analysis

	Existing Capacity	Existing Requirements	Available Capacity Quantity	%
Supply – WTP Filters (gpd)	864,920	586,704	278,216	32.2
Supply – WTP & Transmission (gpd)	1,727,360	586,704	1,140,656	66.0
Storage (mg)	864,00	890,491	0	0.0
Distribution (gpd)	864,920	586,704	278,216	32.2

SDC Cost Basis

As discussed in Section 1, the reimbursement fee is intended to recover the costs associated with the growth-related capacity in the existing system; the improvement fee is based on the costs of capacity-increasing future improvements needed to meet the demands of growth. The value of capacity needed to serve growth in aggregate within the planning period is referred to as the cost basis.

Reimbursement Fee

Table 2-3 shows the reimbursement fee cost basis calculations. Facility value is based on acquisition cost and the growth share for each facility type is based on the assumptions provided in Table 2-2. Existing storage facilities are excluded from the reimbursement fee due to lack of available capacity. Growth requirements will be met through expansion only. Furthermore, the acquisition cost of water mains has been reduced based on the linear feet that will be replaced by planned future improvements.

As show in Table 2-3, of the total asset value of $12.6 million (net of water main replacements), approximately $5.4 million is associated with meeting the capacity requirements of future development (the reimbursement fee cost basis).

Table 2-3
Pacific City Joint Water-Sanitary Authority
Water System Reimbursement Fee Cost Basis

Description	Acquisition Cost	Growth Share %	Growth Share $
Supply - WTP			
Horn Creek – Other Plant	$6,042,906	66%	$3,993,354
Horn Creek – Filters	$645,120	32%	$207,514
Water Rights	$5,774	32%	$1,857
Subtotal	$6,693,800		$4,202,725
Supply - Wells			
Well #1	$45,748	32%	$14,716
Well #2	$40,263	32%	$12,951
Well #3	$72,262	32%	$23,244
Well #4	$47,848	32%	$15,391
Well #5	$32,263	32%	$10,378
Well #6	$32,262	32%	$10,378
Subtotal	$270,646		$87,058
Storage & Pumping			
300,000 Gallon Reservoir	$382,200	0.0%	$0
100,000 Gallon Reservoir	$126,000	0.0%	$0
100,000 Gallon Reservoir Pump House	$36,750	0.0%	$0
Subtotal	$544,950		$0
Distribution[1]			
Water Mains	$3,400,437	32%	$1,093,807
Developer Funded	$1,727,068	0.0%	$0
Subtotal	$5,127,505		$1,093,807
Total	**$12,636,901**		**$5,383,590**

[1]Excludes mains to be replaced by Project List improvements.

Improvement Fee

Table 2-4 shows the improvement fee cost basis. The current Horn Creek WTP capacity is sufficient to meet the needs of existing development; therefore, 100 percent of future expansion is SDC-eligible. The well system will serve as back-up supply to the WTP, and thus will benefit existing and future development in proportion to future share of total water supply. As mentioned previously, transmission and distribution improvements are allocated to new development in proportion to future water supply requirements.

A portion (56 percent) of the planned 200K reservoir and fire pump are included in the SDC cost basis; 44 percent of the capacity is needed to replace existing capacity or otherwise benefit existing development. Rehabilitation and other costs that do not increase system capacity or level of performance are excluded from the improvement fee cost basis.

As shown in Table 2-4, the improvement fee cost basis is about $17.2 million.

Table 2-4
Pacific City Joint Water-Sanitary Authority

Water System SDC Project List

PROJECT	Time Period	Master Plan Cost	SDC Portion %	SDC Portion $
Water Supply				
Upgrade Horn Creek WTP to 1200 gpm	2025	$1,358,000	100%	$1,358,000
Standby Power for 300k BPS and Spit Wells	2021	$105,000	0%	$0
Wells Security Upgrades	2026	$50,000	66%	$33,017
Well Upgrades	2026	$1,000,000	66%	$660,346
Subtotal		**$2,513,000**		**$2,051,364**
Storage & Pumping				
New 150k-gal Reservoir	2032	$1,068,000	56%	$602,379
100K Reservoir Security Upgrade	2022	$50,000	0%	$0
300k Tank Rehabilitation	2021	$25,000	0%	$0
Upgrade 300K Booster PS	2025	$66,000	0%	$0
600k Tank Rehabilitation	2021	$150,000	0%	$0
300K Reservoir Security Upgrade	2025	$50,000	0%	$0
100K Fire Pump	2025	$1,439,000	56%	$811,632
600K Reservoir Security Upgrade	2026	$50,000	0%	$0
Subtotal		**$2,898,000**		**$1,414,011**
Facility Improvements				
Dune Wellhead Protection New 6' fence w/barbed wire around the site	2030	$40,000	0%	$0
Wells Evacuation Area Construction of evacuation area & Radio Tower	2031	$100,000	0%	$0
Subtotal		**$140,000**		**$0**
Transmission & Distribution				
SCADA Upgrades	2023	$50,000	32.2%	$16,083
Water Meter Replacement	2021	$400,000	0.0%	$0
Rueppell Ave Replace 2" w/ 6" and install hydrant	2021	$588,000	32.2%	$189,140
Roger Ave & Jumper Ln Install 8" (boring under Brooten Rd up Roger Ave) and hydrant	2022	$311,000	32.2%	$100,038
Ferry St in PC Replace 2" w/8" Brooten to Hillcrest; install hydrant	2021	$166,000	32.2%	$53,397
Stephens Ave, Wonder Lane, and Roger Ave Replace 2" w/ 6" and install hydrant	2022	$646,000	32.2%	$207,797
Ferry St Replace 6" w/ 8"	2035	$462,000	32.2%	$148,610
Brooten Road Replace 6" AC with 10" (where Pacific crosses Brooten) and install hydrant	2024	$47,000	32.2%	$15,118
4th St South Replace 2" w/ 6" (4th & Haystack south to Brooten Rd)	2025	$231,000	32.2%	$74,305
Brooten Road Upsize 4" pipe south of Slough Bridge and in Nestucca Manor with 8" and install hydrant	2027	$668,000	32.2%	$214,873

Table 2-4
Pacific City Joint Water-Sanitary Authority

Water System SDC Project List

PROJECT	Time Period	Master Plan Cost	SDC Portion %	SDC Portion $
4th St North	2025	$185,000	32.2%	$59,508
Replace 2" w/ 6" (4th & Haystack north to Pacific Ave)				
Relace 2" with 4" piping in Fisher and install hydrant				
Ella, Ray, Spike, Williams, and Nestucca Blvd	2030	$566,000	32.2%	$182,063
Replace 2" and 4" w/ 6" and install hydrants				
Resort Dr	2037	$152,000	32.2%	$48,893
Connect 4" in resort to 12" and 8" tap w/ hydrant				
Brooten Road	2035	$587,000	32.2%	$188,818
Replace 8" AC from Pacific to Airport Way with 12"				
6th St	2026	$128,000	32.2%	$41,173
Replace 2" w/ 6" (between Pacific & Haystack)				
Hillcrest Rd	2039	$139,000	32.2%	$44,712
New 4"				
Tent St	2027	$156,000	32.2%	$50,180
Replace 4" w/ 6"				
2nd St and Shade	2028	$145,000	32.2%	$46,642
Replace 2" w/ 6"				
3rd St	2027	$203,000	32.2%	$65,298
Replace 2" w/ 6"				
Hill Rd	2026	$1,183,000	32.2%	$380,532
Replace 2" w/ 8" or 12" (interconnected/looped)				
Pacific Ave	2024	$205,000	32.2%	$65,942
Replace 10" AC w/ 10" (from Brooten Rd to bridge)				
Pacific Ave	2023	$261,000	32.2%	$83,955
Replace 10" AC w/ 10" (from Brooten Rd to Hill) and install hydrant				
Brooten and Pacific Downtown Loop	2028	$434,000	32.2%	$139,603
Install 6" loop (River Ave is not connected to Pacific Ave)				
Woods Bridge	2029	$321,000	32.2%	$103,255
Replace 6" w/ 12" ductile iron				
Install air-release valve and seismic-rated joints				
Old Woods Rd	2035	$1,739,000	32.2%	$559,378
Connect HC pipeline along Old Woods Rd to Ferry St w/ 8"				
Cape Kiwanda Dr South End	2030	$174,000	32.2%	$55,970
Replace 2" w/ 6" connecting Pacific Ave to Nestucca Blvd				
Sunset Dr	2022	$746,000	32.2%	$239,963
Replace glued 6" w/ 8"				
Pine St and Madrona	2030	$231,000	32.2%	$74,305
Replace 2" w/ 6"				
Shore Dr	2030	$289,000	32.2%	$92,962
Replace 2" galv. w/ 6"				
Pacific City Heights	2032	$1,134,000	32.2%	$364,770
Replace 2" w/ 6" and connect loop along Fisher Rd w/ 6"				

Table 2-4
Pacific City Joint Water-Sanitary Authority

Water System SDC Project List

PROJECT	Time Period	Master Plan Cost	SDC Portion %	SDC Portion $
Ridge Road, Pine Road, and Hilltop Road Replace 2" galv. w/ 6"	2030	$1,444,000	32.2%	$464,487
Brooten Road Replace 8" from Slough Bridge to Airport Way with 8" Install air-release valve & seismic-rated joints (Bridge)	2034	$407,000	32.2%	$130,918
Cape Kiwanda Drive - North of Ridge Connector Replace 4" AC w/ 8"	2032	$516,000	32.2%	$165,980
Cape Kiwanda Drive - South of Ridge Connector Replace 4" AC w/ 8"	2032	$280,000	32.2%	$90,067
Brooten Road Upsize 4" pipe south of Nestucca Manor to 8"	2034	$474,000	32.2%	$152,470
Subtotal		**$15,668,000**		**$4,911,207**
Seismic Upgrades				
100k Reservoir to the Pacific Ave Bridge Replace 4" and 8" pipe with 8" earthquake-resistant DIP Replace 10" pipe with 10" earthquake-resistant DIP		$4,234,000	66.1%	$2,797,968
Pacific Ave Bridge to the HC Transmission Pipe Replace 8" pipe with 8" earthquake-resistant DIP Replace 10" pipe with 10" earthquake-resistant DIP Replace 12" pipe with 12" earthquake-resistant DIP		$6,156,000	66.1%	$4,068,090
HC Transmission Pipe to the 300k Reservoir Replace 12" pipe with 12" earthquake-resistant DIP		$2,460,000	66.1%	$1,625,650
300k Reservoir to the 600k Reservoir Replace 8" pipe with 8" earthquake-resistant DIP		$1,846,000	0.0%	$0
Pacific Ave Bridge Water line Replace 10" DI with 10" fusible PVC installed by HDD under Nestucca River		$530,000	66.1%	$350,242
Upgrade Existing Reservoirs Replace tank transmission connections with seismic flexible fittings; landslide mitigation		$540,000	0%	$0
Upgrade Horn Creek Water Treatment Plant Intake and transmission flexible connections, equip anchorage, metal bld upgrade		$90,000	0%	$0
Subtotal Other		**$15,856,000**		**$8,841,950**
Total		**$37,075,000**	46%	**$17,218,531**

Unit Costs

The unit costs of capacity shown in **Table 2-5** are determined by dividing the respective reimbursement and improvement cost bases by the growth capacity requirements presented in Table 2-1.

Table 2-5
Pacific City Joint Water-Sanitary Authority
Water System SDC Unit Cost Calculations

	System Component			
	Water Supply	Storage	Distribution	**Total**
Cost Basis				
Reimbursement	$4,202,725	$87,058	$1,093,807	$5,383,590
Improvement	$10,893,314	$1,414,011	$4,911,207	$17,218,531
Growth units (gpd)	1,140,656	90,967	277,920	
Unit cost ($/gpd)				
Reimbursement	$3.68	$0.96	$3.94	
Improvement	$9.54	$15.54	$17.67	
Capacity per EDU (gpd)	343	308	343	
Reimbursement Fee (per EDU)	**$1,265**	**$295**	**$1,351**	**$2,911**
Improvement Fee (per EDU)	**$3,278**	**$4,789**	**$6,066**	**$14,133**

The system-wide unit costs are multiplied by the capacity requirements per equivalent dwelling unit (EDU) to yield the fees per EDU. **Table 2-6** shows the calculation of MDD per EDU. Storage capacity requirements reflect projected growth storage needs relative to MDD.

Table 2-6
Pacific City Joint Water-Sanitary Authority
Water System Capacity Requirements per Equivalent Dwelling Unit (EDU)

Class and Meter Size	Number of Units/ Meters[1]	Equivalency Factor[2]	Number of EDUs
Lodging Units			
Hotel/Motel (per room)	85	0.90	77
Recreational Vehicle (per space)	225	0.60	135
Other Development (per meter)			
5/8" X 3/4"	1,433	1.00	1,433
1-inch	13	2.67	35
1 1/2-inch	1	3.33	3
2-inch	4	6.67	27
Total	**1,451**		**1,709**
MDD per EDU (gpd)[3]	*343*		

[1]From Pacific City Joint Water-Sewer Authority.
[2]Loding units based on summer average water use per unit relative to a residential dwelling. Meter factors based on hydraulic capacity relative to a 5/8" X ¾" meter.
[3] MDD per EDU = 586,704 gpd MDD / 1,709 EDUs

EDU factors for different types of lodging facilities shown in Table 2-6 were determined from an analysis of historical water use records which established the average water demand per lodging unit relative to an average residential dwelling unit. EDU factors for other development are based on the hydraulic equivalencies for each water meter size relative to a ⅝ X ¾" meter.

Compliance Costs

Local governments are entitled to use SDC revenue to fund costs associated with complying with the SDC statutes. Compliance costs include costs related to developing the SDC methodology and project list (i.e., a portion of master planning costs), and annual accounting and budgeting. As shown in **Table 2-7**, the estimated compliance cost per EDU is $518 (about 3 percent of the total SDC charge).

Table 2-7
Pacific City Joint Water-Sanitary Authority
Water System Compliance Charge

Component	Years	Total	Growth	Annualized
SDC Study	5	$10,000	100%	$2,000
Master Planning	10	$100,000	46%	$4,644
Auditing/Accounting/Legal/Development	1	$1,000	100%	$1,000
Total Annual Costs		$111,000		$7,644
Estimated Annual EDUs				15
Charge/EDU				**$518**

SDC Schedule

Table 2-8 shows the calculated water SDCs per EDU based on the updated SDC cost bases and projected growth capacity requirements. The total SDC per EDU is $17,561. The SDCs for multi-unit dwelling structures or lodging are applied per dwelling unit, hotel/motel room or recreational vehicle space, according to EDU factors shown in the table and described previously.

Inflationary Adjustments

In accordance with Oregon statutes, the SDCs may be adjusted annually based on a standard inflationary index. Specifically, PCJWSA uses the Engineering News Record Seattle Construction Cost Index as the basis for adjusting the SDCs annually.

Table 2-8
Pacific City Joint Water-Sanitary Authority
Water SDC Schedule

Type	Reimbursement SDC	Improvement SDC	Compliance Charge	Total SDC	EDU Factor[1]
Multi-Unit (Per Dwelling Unit or Space)					
Duplex/4-plex	$2,911	$14,133	$518	$17,561	1.00
Apartment	$2,328	$11,306	$414	$14,049	0.80
Lodging facility	$2,620	$12,720	$466	$15,805	0.90
RV Park (space)	$1,746	$8,480	$311	$10,537	0.60
Residential & Commercial by Meter Size					
5/8 X 3/4-inch	$2,911	$14,133	$518	$17,561	1.00
1-inch	$7,762	$37,688	$1,381	$46,830	2.67
1 1/2-inch	$9,702	$47,110	$1,726	$58,538	3.33
2-inch	$19,404	$94,220	$3,452	$117,075	6.67
3-inch	$67,914	$329,768	$12,081	$409,763	23.33
4-inch	$116,424	$565,317	$20,710	$702,452	40.00
6-inch	$242,550	$1,177,744	$43,147	$1,463,441	83.33
8-inch	$349,272	$1,695,952	$62,131	$2,107,355	120.00

[1]Meter sizes over 2-inch should be charged based on the type of meter and its capacity relative to 15 gpm.