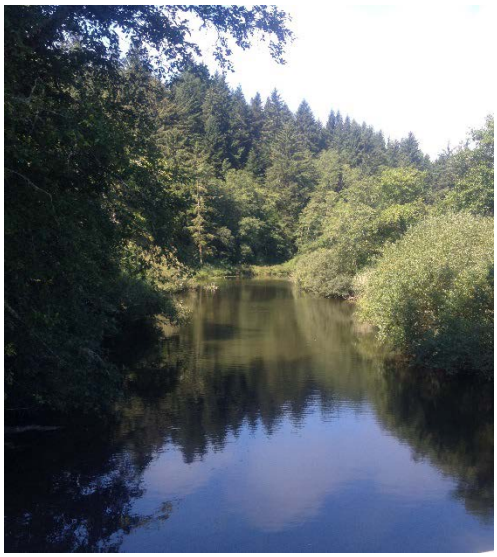
F I N A L

Phase IV Conceptual Design Report for the Seal Rock Water District Beaver Creek Water Supply

Prepared for

Seal Rock Water District, Oregon

September 2016



1100 NE Circle Blvd Suite 300
Corvallis, OR 97330-3538

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Executive Summary

Project Overview and Goals

Seal Rock Water District (District), Oregon, currently purchases potable water from the City of Toledo. As described in the March 2015 *Reconnaissance-Level Source Water Study*, the supply from Toledo is vulnerable, particularly to failure from a Cascadia Subduction Zone earthquake, which may be a magnitude 9 or higher event. The 2015 report found that the most favorable alternative to the Toledo supply is to develop the District's own water supply from Beaver Creek. The District is in the process of finalizing water rights for Beaver Creek. This report presents recommendations for developing the Beaver Creek water supply project, including proposed concepts for the intake and treatment plant.

The District's goals for the new water supply include the following:

- Improve seismic and tsunami resiliency, combined with facilitation of rapid recovery.
- Provide reliable treatment and safe drinking water.
- Minimize capital and ongoing operation and maintenance (O&M) costs.
- Match needed O&M skills for operating the treatment plant as closely as possible to District's current staff skills.

Current and Backup Water Supply

The District currently obtains treated drinking water from the City of Toledo through a 10-mile pipeline that is considered vulnerable to earthquakes, tsunamis, and landslides. The pipeline connects to the north end of the District's system. This supply line as well as the existing emergency connection to Newport will be maintained after implementation of the Beaver Creek supply project and will be available to supply water to the District in the event of interruptions of service from the Beaver Creek supply. The District will look to the Toledo supply as the primary backup, followed by the connection to Newport if needed. The District should periodically test both supplies to ensure they are readily available, including flushing procedures for the 10-mile pipeline.

Hazards and Risks

The predominant hazard for the District's system is a Cascadia Subduction Zone earthquake and associated tsunami. The proposed site for the treatment plant is well above the tsunami impact zone. New facilities will be designed to withstand strong earthquakes but it is very difficult or impossible to fully predict the performance of infrastructure in a Cascadia Subduction Zone earthquake of magnitude 9.0 or greater.

The intake structure will be located on Beaver Creek and is therefore, susceptible to a tsunami. It will also be at risk for rising sea levels as a consequence of climate change.

Production Capacity

The District's water right on Beaver Creek will be for 2.0 cubic feet per second (cfs), which is equal to 1.29 million gallons per day (mgd). When backwash waste flows are taken into account, this will yield a delivery capacity to customers of approximately 1.88 cfs (1.21 mgd). The District believes this capacity is sufficient for current and projected needs.

Beaver Creek Water Quality

A limited set of water quality data for Beaver Creek were available from the U.S. Geological Survey (USGS) and the Oregon Department of Environmental Quality (DEQ). The District is supplementing these data with an ongoing monitoring program. The preliminary discussion and conclusions relating to water quality and treatment presented herein will be revised as additional data are obtained.

Preliminary data indicate that a membrane filtration system will provide reliable and effective treatment for the particulate and microbiological quality of Beaver Creek water. A low coagulant chemical dose upstream of the membrane filtration is anticipated to remove a portion of the organics loading to minimize disinfection by-products formation.

A water quality concern is the level of iron and manganese in Beaver Creek. These two parameters may impact the fouling and necessary cleaning regime for membranes.

A known water quality concern is the occasional intrusion of salt water up river to the proposed intake site. According to USGS data, salt water intrusion may be a problem for multiple-day periods during extreme high tides. If salt water intrusion lasts more than the one or two days of demand that can be met by finished water storage, the District expects to obtain water from Toledo through the existing connection, or from the City of Newport as a backup source.

The corrosiveness of the finished water should be reduced, if necessary, to limit the dissolution of lead from pipe and plumbing materials as the water is distributed to customers. Corrosion control compliance is determined according to the state and federal Lead and Copper Rule, which requires water utilities to sample from prioritized sites that are considered the most likely to have high levels of corrosion by-products. Updates to this rule were being implemented as this report was prepared in 2016, arising out of the problems encountered in Flint, Michigan. The City of Flint changed to a new water supply and the difference in water chemistry resulted in elevated levels of lead in stagnant water as a result of the corrosion of lead service lines from the mains to customers. The new rules will likely require additional monitoring at other possible locations of concern such as schools or drinking fountains that may have stagnant water.

Predicting with certainty the corrosion impact and possibility for elevated lead levels from changing to the Beaver Creek supply is difficult. The recommended approach is to give consideration to further water quality testing to understand the potential impacts of changing to a new water supply, and for the preliminary planning to reserve space within the treatment building so that a corrosion-inhibiting chemical system can be added, if necessary. Because corrosion and lead dissolution are complex reactions, it may not be possible to fully predict the impacts of switching to the Beaver Creek supply even with additional water quality data. Therefore, as part of the plant start-up activities, the District should monitor for lead more frequently and at more locations than required by the current Lead and Copper Rule to track results and respond with treatment adjustments as warranted.

Treatment Process

The District indicated a desire to use a pressure membrane filtration system, if possible, rather than a conventional media filtration system. Membrane filtration is a proven treatment method and has been used successfully for many Oregon systems. A significant advantage is that the treated water quality is less dependent on the operator's water chemistry knowledge and treatment skills than for a conventional media filtration because the membranes provide an absolute barrier against pathogens. However, it still requires significant skills to operate and maintain a membrane treatment facility, with the skills being less focused on chemical treatment and more on instrumentation and mechanical systems. The District believes the skills required for a membrane filtration plant are more in line with current and projected staffing than would be the skills for a conventional media plant.

Clearwell

A clearwell tank will need to be included at the treatment plant to provide disinfection contact time, backwash supply, and to account for short-duration periods when the rate of production is less than needed deliveries to the system. The recommended volume to meet these needs is 750,000 gallons for the plant capacity of 2.0 cfs. However, as described in the body of the report, the plan is to include an initial tank with a volume of 500,000 gallons, with a second tank to be added in the future. The suggested material of construction for this tank is welded steel because it provides a durable facility at a relative low capital cost. The eventual use of two tanks will provide the flexibility needed for removing one tank from service for repainting.

Intake

After reviewing alternative locations, the recommended site for the intake is at the southwest corner of the South Beaver Creek Road Bridge. The stream channel appears to be relatively stable in this section, and the river depth is sufficient. One of the most important differentiating factors for this location is that an electrical facilities support building can be located nearby yet above the 100-year floodplain elevation. This is not the case for alternative locations.

The design of intake facilities must comply with environmental permitting criteria, primarily to minimize impacts to aquatic species. Additionally, the District has placed a high priority on having the intake minimize visual and noise impacts for recreational users of Beaver Creek. The renderings and drawings for the preliminary intake design, included with this report, present a concept that will achieve these goals. Depending on river levels, boaters may not even see the intake structure. Submersible pumps will be used to reduce noise to low levels.

As noted previously, the intake may be subject to tsunami damage. Changing sea levels resulting from climate change also pose a risk of increasing the duration of salt water events. No viable alternative site was found to mitigate these risks.

Raw Water Pipeline

The preliminary alignment and selection of the pipe size and material of the raw water pipeline are presented in the report. A route along South Beaver Creek Road and then North Beaver Creek Road, and then a south to north section on easements through private property appears to be the best route. The recommended selection is 14-inch nominal diameter high-density polyethylene (HDPE). HDPE is considered an excellent selection for providing earthquake resiliency because of its ductility.

The plan for crossing Beaver Creek is to install the raw water pipeline underneath the river using horizontal direction drilling. This installation approach provides greater seismic and tsunami protection than mounting the pipeline on the county bridge.

Plant Site Selection

Three alternative sites were considered for locating the plant. The most favorable site based on both cost and non-cost factors was the Makai site. The District owns this property and an existing storage tank is located on a portion of it. The Makai tank has not been used for many years. A structural evaluation of its design concluded that it is not suitable for rehabilitation to meet current seismic design standards. Nevertheless, even without the benefit of reusing the tank, the Makai site offers advantages for the planned treatment plant.

Permitting and Easements

A significant environmental permitting effort will be required for the project, primarily related to the Beaver Creek intake. The District has already begun conversations with private property owners to obtain use of the intake property and for the raw water pipeline.

Membrane Equipment Procurement

The recommended design approach is to pre-purchase the membrane system for the treatment plant, because membrane systems vary from one supplier to another and the differences will impact the design. The pre-purchase approach can allow the District to consider both cost and non-cost factors.

Project Construction Options

A discussion is presented within the report on the following three different construction contracting methodologies:

- Conventional design-bid-build. This has been the common delivery method for infrastructure projects. The selected contractor is the one providing the lowest bid. The contractor may or may not be experienced and capable of efficiently constructing the project in line with the bid document. A prequalification process can be used to narrow the list of potential bidders.
- Construction manager-general contractor (CM-GC). Under this approach, a construction contractor is selected and engaged prior to finalizing the design. The contractor is selected through a process that allows consideration of cost, qualifications, and experience. The contractor provides review and input as the design is completed, with the combined goals of understanding the work to minimize surprises during construction and to provide input from a contractor's perspective to achieve cost savings.
- Design-build. In this methodology, the District's engineer would advance the design only far enough to provide definition after which an engineering-construction company is hired to complete the design and construct the project. It is a higher risk for both the District and the contractor and is generally only used when schedule is critical or there is another specific driver.

Many Oregon water utilities have begun using the CM-GC process and it is a favorable approach for the District's project. However, the District's anticipated funding package through the U.S. Department of Agriculture (USDA) may not allow the CM-GC process. In that case, a conventional design-bid-build process with a prequalification requirement is the preferred delivery approach.

Schedule

The biggest unknown in the project schedule is the timing for securing funding. Once funding is available, the design through construction will require about two years.

Cost Estimate

A preliminary cost estimate, based on the recommendations in the report, is presented. The total construction estimate is $10,600,000. This construction estimate includes escalation to a March 2018 mid-point of construction date and a 25 percent contingency. It is considered a Class IV level infrastructure estimate, with an expected range of +50 to -30 percent. Additional costs will be necessary for fulfilling USDA requirements for preliminary engineering and permitting, and for surveying, design, environmental permitting, engineering construction services, and startup services.

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Acronyms and Abbreviations

ACH	aluminum chlorohydrate
cfs	cubic feet per second
DBP	disinfection by-product
DEQ	Oregon Department of Environmental Quality
District	Seal Rock Water District
DR	diameter ratio (related to pipe wall thickness)
ER	Environmental Report
fps	feet per second
gpm	gallons per minute
HGL	hydraulic grade line
HP	horsepower
HVAC	heating, ventilating, and air conditioning
kVA	kilovolt-ampere
mgd	million gallons per day
NAVD88	North American vertical datum 1988
NMFS	National Marine Fisheries Service
NTU	nephelometric turbidity unit
O&M	operation and maintenance
OAR	Oregon Administrative Rules
ODFW	Oregon Department of Fish and Wildlife
PFO	Proposed Final Order
PV	photovoltaic
TDS	total dissolved solids
TSS	total suspended solids
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
V	volt(s)
VFD	variable frequency drive
WTP	water treatment plant

SECTION 1

Introduction

1.1 Project Overview and Project Goals

Seal Rock Water District (District) currently purchases potable water from the City of Toledo. As described in the March 2015 *Reconnaissance-Level Source Water Study*,[1] the supply from Toledo is vulnerable, particularly to failure from a Cascadia Subduction Zone earthquake, which may be a magnitude 9 or higher event. The most favorable alternative, as described in the study, is to develop District's own water supply from Beaver Creek.

The District's goals for the new water supply include the following:

- Include seismic and tsunami resiliency, combined with facilitation of rapid recovery
- Provide reliable treatment and safe drinking water
- Minimize capital and ongoing operation and maintenance (O&M) costs
- Match needed O&M skills for operating the treatment plant as closely as possible to District's current staff skills
- If possible, use membrane filtration

Figure 1-1 provides an overview Google Earth image for the potential project locations. The District has been issued a Proposed Final Order (PFO) for a water right permit on Beaver Creek. Beaver Creek enters the Pacific Ocean at Ona Beach State Park in the central area of the District's distribution system.

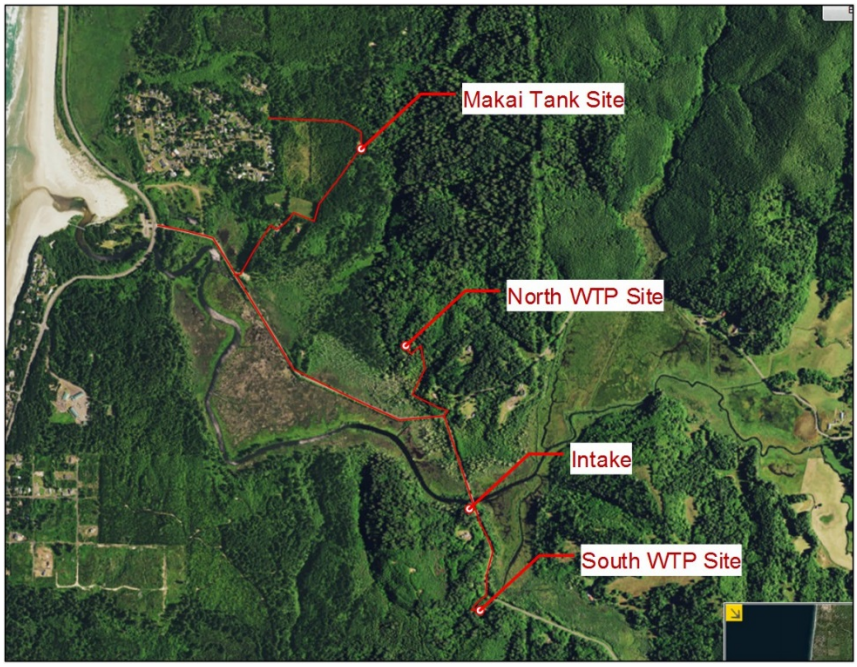

Figure 1-1. Project Locations

Phase IV Conceptual Design Report for the Seal Rock Water District

[1] *Reconnaissance-Level Source Water Study*, prepared for Seal Rock Water District by GSI Water Solutions, Inc., and Civil West Engineering Services, Inc., March 2015.

1.2 Current and Backup Water Supply

The District currently obtains treated drinking water from the City of Toledo through a 10-mile pipeline that is considered vulnerable to earthquakes, tsunamis, and landslides. The supply line connects to the north end of the District's system. This supply line as well as the existing emergency connection to Newport will be maintained after implementation of the Beaver Creek supply project and will be available to supply water to the District in the event of interruptions of service from the Beaver Creek supply. The District will look to the Toledo supply as the primary backup, followed by the connection to Newport if needed. The District should periodically test both supplies to ensure they are readily available, and should establish flushing procedures for the 10-mile pipeline.

1.3 Site Conditions and Seismic Vulnerability

1.3.1 Site Conditions

The regional geology includes the following geologic formations (see Appendix A):

- Coastal Terrace Deposits of weakly cemented fine to medium grained sandstone
- Alluvial deposits of silt, sand, and gravel along rivers and streams
- Alsea Formation of siltstone and fine grained sandstone

The planned location for the intake facility is adjacent to Beaver Creek. From a review of the available mapping and site observations, it appears that this site has weathered sandstone (an outcrop of Coastal Terrace Deposits) although the location could also be on native alluvium soils associated with Beaver Creek. Further geological investigation is necessary to determine the subsurface conditions sufficiently for design of facilities.

The three water treatment plant sites that were considered were labeled the South, North, and Makai Tank sites. Limited information was available regarding these plant sites, though given their location on hills it is anticipated that the native bedrock formation (Coastal Terrace Deposits or the Alsea Formation) will be relatively close to the ground surface.

The proposed raw water pipeline alignment along North Beaver Creek Road will be in the alluvial deposits in the Beaver Creek Valley. Higher elevation sections of pipelines will be in the Coastal Terrace Deposits or in weathered-in-place soils from the bedrock formations.

1.3.2 Seismic and Tsunami Hazards

There are no known active crustal faults that cross the potential project locations. Therefore, the predominant seismic hazard is associated with the Cascadia Subduction Zone earthquake and the possible tsunami. Seismic hazards to be considered include:

- Ground shaking, including amplification of ground motions due to the types of soils and rock
- Landslides that may be triggered from the strong ground shaking
- Liquefaction and its potential effects, such as lateral spreading and loss of bearing capacity
- A tsunami associated with the Cascadia Subduction Zone earthquake and as a potential hazard from a distant earthquake such as one striking Japan. The approximate limits to the tsunami inundation zone from a Cascadia Subduction Zone earthquake are at an elevation of 75 feet above mean sea level in the vicinity of Beaver Creek Bridge. The North and Makai Tank sites are above elevation 75 feet; the South plant site has an elevation of approximately 70 feet.

A map illustrating the tsunami hazard is attached in Appendix B. The pink line delineates the predicted boundary for a major tsunami. The South WTP may be just outside the tsunami inundation limits but if this site was selected, it warrants closer examination.

1.3.3 Changing Sea Levels

Changes in the sea level relative to ground elevations represent a project risk. The primary concern is that a relative rise in sea level compared to the intake will result in more frequent seawater intrusions. There are three primary sources of relative sea level changes that may impact the project, as follows:

- Rising ocean levels predicted as a consequence of climate change: 3 to 9 mm/year, which is equal to about 6 to 18 inches in 50 years[2]
- Rising land (a mitigating factor compared to rising sea levels) due to tectonic forces that occurs during stress build up in the continental crust between Cascadia Subduction Zone earthquakes: a minor change of 0.5 to 1.5 mm/year, which is equal to 1.0 to 3.0 inches in 50 years[3]
- Subsidence of the coast at the time of a Cascadia Subduction Zone earthquake: estimated to be 0.1 to 1.5 m, which is equal to 0.3 to 5 feet[4]

The preceding references estimate that the relative sea level rise will be less than 18 inches in the next 50 years. However, if a Cascadia Subduction Zone earthquake occurs, the elevation of the intake relative to sea level may decrease by up to 5 feet, likely decreasing the usefulness of the intake, especially depending on the post-tsunami river profile and estuary condition.

The predicted relative rise in sea level compared to the intake site is expected to result in more frequent and longer periods of seawater intrusion at the intake. Unfortunately, there does not appear to be a cost-effective alternative intake location that would mitigate the risks from sea level rise, seismic events, and tsunamis. The Beaver Creek bridge site is just downstream of the confluence of the South Fork with the main stem of Beaver Creek, and the South Fork provides a substantial contribution of flow. Therefore, moving upstream on either stem significantly reduces the available river flow, and this factor would be a major concern for obtaining a water rights permit. The river gradient is very slight moving upstream on either the main stem or the South Fork. Therefore, there may not be a single withdrawal location on either branch that provides adequate flow and is outside of the potential ocean water intrusion zone. It would be necessary to move a considerable distance upstream on either the main stem or South Fork to reach an elevation protected from a tsunami, but such a location would still be subject to a seismic event.

1.3.4 Other Hazards

In addition to the seismic concerns, the project design shall consider the 100-year floodplain and natural landslide hazards.

- The 100-year floodplain boundary is at an elevation of approximately 20 feet above mean sea level near Beaver Creek Bridge. The FEMA 100-year floodplain map is included in Appendix C. The withdrawal structure must be at the river's edge, inside of the floodplain. However, the electrical

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[2] Intergovernmental Panel on Climate Change (IPCC). 2013. Climate Change 2013, The Physical Science Basis. Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Stocker, T.F., et al. editors. Cambridge University Press.

[3] Burgette, R.J., Weldon, R.J. II, and Schmidt, D.A. 2009. "Interseismic uplift rates for western Oregon and along-strike variation in locking on the Cascadia subduction zone." *Journal of Geophysical Research*. Vol 114, B01408. 24 pp.

[4] Leonard, L.J., Currie, C.A., Mazzotti, S., and Hyndman, R.D. "Rupture area and displacement of past Cascadia great earthquakes from coastal coseismic subsidence." *GSA Bulletin*. Vol 122, No 11/12, pp 1951-1968, November/December 2010.

support building for the intake withdrawal structure must be located above the floodplain to protect it against high water. The locations of these facilities are shown in the preliminary design drawings.

- Local landslides are common along the coast, and the potential for landslides that may affect the intake, pipeline alignment, and treatment plant will need to be evaluated. No known landslides are mapped at any of the proposed facility locations. Maps of known and possible landslides are included in Appendix D. This mapping is regional, developed by the state. A site-specific evaluation will need to be conducted during final design to confirm the selected facility locations will not be impacted by a local landslide. Based on recent topographic data, the valley east of the Makai site has indications of landslide activity. An evaluation is needed to confirm that the Makai site will not be affected by landslides, most importantly during a seismic event.

SECTION 2

Production Capacity

The March 2015 study indicated that the District needed a supply of 2.0 cubic feet per second (cfs), which is equal to 1.29 million gallons per day (mgd) to meet current and projected water demands. The District is in the process of filing for a 2.0 cfs water right permit. A copy of the PFO is included in Appendix E. This permit can be changed to a permanent water rights certificate once beneficial use is documented.[5]

During the June 2016 board meeting, the District's board discussed the possible need to serve a portion of either south Waldport or Newport in the event of an emergency or if those communities grow beyond their available water supplies. Although the District could potentially become a regional supplier, this possible need to expand the capacity of the Beaver Creek supply was determined to be too uncertain to justify expanding facilities in the initial project, especially as the water rights will be limited to 2.0 cfs.

The delivery capacity to customers will be less than the water right and treatment plant production rate because a portion of treated water is used in the plant for filter backwashing. For the membrane treatment process being considered, a typical value for the backwash waste flow is 6 percent of the treatment rate. Therefore, the withdrawal and treatment rate of 2.0 cfs (1.29 mgd) will result in delivery of approximately 1.88 cfs (1.21 mgd) to District customers.

Some treatment systems, such as Newport's new water treatment plant, have included a recycle step to recover much of the waste flow. This could be considered for the District's system but would add cost and complexity to the project, and is therefore not recommended.

The District's 2015 maximum day demand was approximately 1.0 mgd. However, the District was in the midst of a major effort to reduce nonrevenue water as this report was being prepared, including the installation of advanced metering infrastructure. The District anticipates achieving a significant reduction in nonrevenue water rates as a result, with a corresponding reduction in maximum day demand. However, because the savings are uncertain and to accommodate expected growth, the District applied for the 1.29 mgd water rights permit and the new supply facilities should be designed for this value. If it is found during detailed design that there are components that could be initially sized for 1.0 mgd and would allow for a straight-forward and cost-effective expansion to 1.29 mgd, then the District may wish to consider the slightly smaller initial capacity as a cost-saving measure. As described later in this report, the one initial down-sized facility is the plant clearwell. It has been sized appropriately for the 1.0 mgd capacity, with the idea that a second tank can be added in the future. The second tank will be needed both for the higher future production and to provide flexibility so either tank can be removed from service for maintenance. The potential savings obtained by installing a smaller initial tank are estimated in the cost estimate chapter.

[5] Typically, water rights and river withdrawal rates are presented in units of cubic feet per second (cfs) whereas treatment plant sizes and system water demands are presented in units of million gallons per day (mgd). 1.0 cfs = 448.8 gallons per minute or 646,317 gallons per day. 1.0 mgd = 1.547 cfs.

SECTION 3

Water Quality and Treatment

3.1 Water Quality

Published water quality data for Beaver Creek were available from the U.S. Geological Survey (USGS) and the Oregon Department of Environmental Quality (DEQ). The USGS operated a water level gauge and performed some water quality monitoring on Beaver Creek at the bridge from 2009 to 2013.[6] The USGS efforts focused on salinity and conductivity measurements to document the periodic incursion of ocean water to the bridge. The DEQ performed water quality measurements on the South Fork of Beaver Creek just upstream of the confluence with the main stem, which is just upstream from the proposed intake site at the bridge, from 2008 to 2013. The District began a water quality monitoring program in the summer of 2016 to supplement these available data.

3.1.1 Salinity

Salinity is a general term referring to the total concentration of all dissolved salts in water. Most often, salinity is not measured directly, but is instead derived from measuring conductivity. Conductivity is a measurement of water's capability to pass electrical flow. The more ions that are present, which come from dissolved salts, the higher the conductivity of water. Specific conductance is a conductivity measurement made at or corrected to a temperature of 25 degrees Celsius (^{o}C).

The USGS monitored conductivity at the Beaver Creek Bridge to identify seawater intrusions. According to the summary of work provided by the USGS, their findings included the following:[7]

- High specific conductance events in Beaver Creek result from storm surges, when seawater overtops a sand bar near the mouth of Beaver Creek, and such overtopping events correspond with tides above 9.5 feet measured at the National Oceanic and Atmospheric Administration tidal stage gage at Yaquina Harbor.
- Based on specific conductance measurements, storm surge conditions caused seawater to enter Beaver Creek 13 times in the period 2010-2012. All of these events occurred from September to May.
- Specific conductance values varied in the water column from top to bottom by as much as 45,000 µs/cm.

Detailed conductivity data obtained from the USGS website for the Beaver Creek station at the bridge indicated most of the seawater intrusions occurred in the October through December period, and in this period, they were most frequent in October.

The USGS summary report indicates that seawater intrusion events occurred 13 times during the three-year period of 2010-2012. The tidal height predictions for 2016 indicate that tides greater than 9.5 feet will occur 31 times in the calendar year, grouped into 9 events lasting from 2 to 6 days per event.

The acceptable level for conductivity in drinking water is not defined but there is a secondary (non-health related) standard for total dissolved solids (TDS) of 500 mg/L, and the level of TDS is directly

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[6] USGS location 14306080, Beaver Creek Below South Beaver Creek, Latitude 44°30'37", Longitude 124°03'07", Oregon Hydrologic Unit 17100205, Drainage area = 30.5 square miles. River mile = 2.0. http://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=14306080

[7] *Hydrology of the Beaver Creek Estuary at Ona Beach State Park, Oregon*, by Hess, Glen, USGS, obtained from USGS website in May 2016 (www.or.water.usgs.gov/proj/beaver_creek/)

related to specific conductance. Total dissolved solids are the sum of all ion particles smaller than 2 microns. Levels of TDS above 500 mg/L will not harm people but people may notice a salty or bitter taste. Additionally, elevated TDS levels will cause precipitates to form on water fixtures. The relationship between specific conductance and TDS varies depending on water quality parameters within the seawater and stream, and based on temperature, but can be approximated using the following equation[8]:

TDS (mg/L) = Specific conductance (µs/cm) x 0.65

Using this relationship, a specific conductance value of approximately 750 µs/cm would result in a TDS level of 500 mg/L. To provide a margin of safety and because the exact conductivity to TDS relationship for Beaver Creek is unknown, it is suggested that water should not be withdrawn for treatment and distribution whenever the specific conductance exceeds 600 µs/cm, which would result in a TDS of about 400 mg/L. Specific conductance can be measured using an online instrument whereas TDS cannot, sousing specific conductance for monitoring seawater intrusions is desirable.

During one period recorded by the USGS in 2010, the elevated levels of conductance continued for seven days. The USGS indicated that the levels in the water column varied significantly but data for the Beaver Creek bridge location comparing conductivity to depth were not available. It may be that the seawater remained close to the bottom and that an intake nearer the surface would avoid all or part of this episode. The District plans to install an online instrument to capture conductivity and other water quality data with depth, so more will be known in the coming year.

The District indicated that it would not be necessary to include storage sufficient to meet system water demands through an extended saltwater intrusion period. Instead, the District's intent is to obtain water from Toledo or Newport through the existing connections with these systems. Tide charts should allow the District to anticipate these events, with online or grab sampling of conductivity providing confirmation. In the event of seawater intrusion to the intake, the operators will select to discontinue production from the Beaver Creek supply and manually introduce water from Toledo or Newport on an as-needed basis.

3.1.2 Turbidity

Turbidity, which is a measure of the particulate level, can impact the efficiency of membrane filtration. A limited data set for turbidity was obtained from DEQ for South Beaver Creek, just upstream of its confluence with Beaver Creek, near the bridge. DEQ made 90 measurements of turbidity at this site from June 2008 through February 2013. The turbidity averaged 6.9 nephelometric turbidity units (NTUs) and ranged from a low of 1 NTU to a high of 33 NTU. Since this was a limited data set, it can be expected that turbidities may exceed 33 NTU. No data were obtained for the main stem of Beaver Creek but South Beaver Creek provides a substantial contribution to the main stem flow and the two watersheds are similar, so the values on the main stem of Beaver Creek at the bridge may be similar. Turbidity values in the range of 1-33 NTU are effectively treated with membrane filtration. The District will monitor for turbidity on the main stem near the bridge to provide more specific data for selecting the treatment process.

3.1.3 Temperature

Water temperature is important for membrane filtration because the production rate per unit area of membrane is temperature dependent. Since warmer water temperatures occur in the summer when customer water demands are also higher, this is a favorable characteristic for membrane filtration.

[8] "Conductivity, Salinity & Total Dissolved Solids," http://www.fondriest.com/environmental-measurements/parameters/water-quality/conductivity-salinity-tds/

The USGS data include water temperatures for 2010 to 2012. Table 3-1 compares the lowest monthly water temperature for these three years of data to the District's monthly water demand profile. The demand values reflect possible monthly maximum demands when the demands increase to the full use of the 1.29 mgd water right. The temperature-water demand profile was provided to a membrane filtration equipment company to obtain preliminary sizing for the District's plant, and will be provided to all potential bidders when the membrane filtration equipment is procured.

Table 3-1. Water Temperature versus Maximum Production Need by Month
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		Estimated Maximum Required Production (mgd)	
Month	**Lowest Expected Temperature (°C)**	**Current**	**Buildout**
January	5	0.64	0.83
February	7	0.63	0.81
March	7	0.72	0.93
April	9	0.75	0.97
May	10	0.75	0.97
June	12	1.00	1.29
July	14	1.00	1.29
August	15	1.00	1.29
September	14	1.00	1.29
October	10	0.75	0.97
November	8	0.73	0.94
December	6	0.77	0.99

3.1.4 Iron and Manganese

The slow flowing Beaver Creek and the relatively warm water temperatures in the summer may result in reducing conditions, which could dissolve iron and manganese from the river sediments into the water. Neither iron nor manganese are of health concerns, but each has a state secondary drinking water standard because they cause aesthetic impacts. Further, the presence of elevated iron and manganese will have an impact on membrane fouling and cleaning. The District is beginning a sampling program to determine iron and manganese levels. The District provided the first monitoring results for iron and manganese in late July 2016, for samples collected July 6, 2016, from near the bridge. The iron level was 0.7 mg/L, about two times the secondary standard of 0.3 mg/L. The manganese level was 0.036 mg/L, just below the secondary standard of 0.05 mg/L. These initial results confirm that iron and manganese are a water quality concern.

DEQ's data set for South Beaver Creek included 821 values for dissolved oxygen. The average dissolved oxygen was 6.4 mg/L and the range was from 1 to 10.6 mg/L. DEQ also provided a determination of the percent saturation of dissolved oxygen for these 821 values. The percent saturation of dissolved oxygen averaged 59 percent and ranged from 40 to 102 percent. The dissolved oxygen and percent saturation of dissolved oxygen indicate that reducing conditions are likely to occur, especially at the bottom of the water column.

The DEQ data set also included pH values. Low pH is also a contributing factor for the release of iron and manganese from river bottom sediments into the water column. The average of 817 values was 6.44 pH units and the range from was from 5.77 to 7.63 pH units. The average pH below neutral and the low end of the range for pH indicate that metals release is a concern.

3.1.5 Disinfection by-Products (DBPs)

DBPs monitoring results, both for the District's system and the City of Toledo, have consistently been well below the maximum contaminant levels (MCLs). Total trihalomethanes have averaged 20 µg/L (25 percent of the MCL) in the District's system, with a maximum valve of 33 µg/L, for quarterly monitoring results from 2004 through the present. The District's haloacetic acid results for the same period have averaged 9 µg/L (14 percent of the MCL) and the maximum has been 16 µg/L.

Total trihalomethanes have averaged 13 µg/L (16 percent of the MCL) in Toledo's distribution system, with a maximum valve of 20 µg/L, for quarterly monitoring results from 2002 through the present. The city's haloacetic acid results for the same period have averaged 6 µg/L (11 percent of the MCL) and the maximum has been 14 µg/L.

Since 2012, Newport's total trihalomethanes have averaged 43 µg/L (54 percent of the MCL), with a maximum value of 77 µg/L. For the same period, Newport's haloacetic acid results have averaged 17 µg/L (29 percent of the MCL), with a maximum value of 40 µg/L. Prior to 2012, Newport exceeded both the 80 µg/L total trihalomethanes MCL and the 60 µg/L haloacetic acid MCL on several occasions.

Although the monitoring results indicate that DBPs have not been a concern for the present water supply and treatment system, DBP levels may be higher in treated water from Beaver Creek because of differences in naturally occurring DBP precursors between the Siletz River and Beaver Creek, and the use of membrane treatment rather than coagulant-aided media filtration such as Toledo uses. It has been common for Oregon utilities using low-pressure membrane treatment to require the use of a small dose of coagulant upstream of the membranes to remove a portion of the DBP precursors to reduce distribution system levels of DBPs. This is the recommended approach for the District's treatment system. Additionally, it is recommended that DBP formation potential tests[9] be performed prior to design to provide confirmation of the proposed treatment system. At least one simulated distribution system DBP formation test is recommended for an early fall rainy period to capture a time when DBP levels may be relatively high.

3.1.6 Corrosiveness and Potential for Elevated Lead Levels

The corrosiveness of the finished water should be reduced, if necessary, to limit the dissolution of lead and copper from pipe and plumbing materials as the water is distributed to customers. Corrosion control compliance is determined according to the state and federal Lead and Copper Rule, which requires water utilities to sample from prioritized sites that are considered the most likely to have high levels of corrosion by-products. Updates to this rule were being implemented as this report was prepared in 2016, arising out of the problems encountered in Flint, Michigan. The City of Flint changed to a new water supply and the difference in water chemistry resulted in elevated levels of lead in stagnant water as a result of the corrosion of lead service lines from the mains to customers. The new rules will likely require additional monitoring at other possible locations of concern such as schools or drinking fountains that may have stagnant water.

The primary concern of the Lead and Copper Rule is the occurrence of lead, because of its documented negative health effects. The levels of lead measured in the District's system, supplied by Toledo, have averaged 0.004 mg/L (26 percent of the lead action level of 0.015 mg/L) and the maximum value has

[9] Formation potential tests for DBPs simulate the treatment process including chlorination, and the conditions in the distribution system to estimate levels of DBPs that may occur.

been 0.009 mg/L (60 percent of the lead action level) for sampling from 1993 to the present. The values within the Toledo system have been similar. Newport also has reported low values for lead and copper measurements under the Lead and Copper Rule. While these are favorable results compared to the existing Lead and Copper Rule, the following two cautions should be considered for the proposed Beaver Creek supply:

- The water quality and treatment for a Beaver Creek supply will differ from the current Toledo supply, which may impact corrosion rates (either positively or negatively).
- The regulations relating to corrosion control and the occurrence of lead are likely to be made more stringent than the current regulations.

It is unknown how the results for the Beaver Creek water supply will compare to the existing Toledo water supply. The low dissolved oxygen values for Beaver Creek are favorable to lowering the corrosiveness of the water but it is difficult to accurately predict corrosion rates and resulting lead levels from these and other general water quality data.

The recommended approach is to give consideration to further water quality testing to understand the potential impacts of changing to a new water supply, and for the preliminary planning to reserve space within the treatment building so that a corrosion-inhibiting chemical system can be added, if necessary. Because corrosion and lead dissolution are complex reactions, it may not be possible to fully predict the impacts of switching to the Beaver Creek supply even with additional water quality data. Therefore, as part of the plant start-up activities, the District should monitor for lead more frequently and at more locations than required by the current Lead and Copper Rule to track results and respond with the treatment adjustments as warranted. Options for a corrosion-inhibitor chemical include sodium carbonate (soda ash), sodium hydroxide (caustic soda), and a phosphate compound. All three could be fed from a small drum or tote. Caustic soda and phosphates are available in liquid form. Soda ash would typically be purchased in a dry, granular form, and the operator would mix a liquid solution. Therefore, space should be reserved for pallet storage of dry chemical, drum or tote storage, and chemical metering pumps.

3.2 Treatment Process

The District indicated a desire to use a low-pressure membrane filtration system, if possible, rather than a conventional media filtration system. Membrane filtration is a proven treatment method and has been used successfully for many Oregon systems. A significant advantage is that the treated water quality is less dependent on the operator's water chemistry knowledge and treatment skills than for a conventional media filtration because the membranes provide an absolute barrier against pathogens. However, it still requires significant skills to operate and maintain a membrane treatment facility, with the skills being less focused on chemical treatment and more on instrumentation and mechanical systems. The District believes the skills required for a membrane filtration plant are more in line with current and projected staffing than would be the skills for a conventional media filtration plant.

According to state and federal regulations for a surface water supply, the treatment system must be capable of meeting the removal/inactivation levels for viruses, *Giardia*, and *Cryptosporidium*. The specific level of treatment is based on source water monitoring for Cryptosporidium or *E. Coli*.[10] Compliance with the required removal/inactivation levels are based on the type of treatment provided, and confirmed through bacteriological and turbidity monitoring, and by achieving at least the minimum primary disinfection level, as determined by a CT value. The CT value is the product of the chlorine

[10] The current state and federal rules allow for small systems, those serving 10,000 people or less, to substitute *E. Coli* monitoring for *Cryptosporidium*, as a cost-saving measure. However, there may not be a good correlation between *E. Coli* and *Cryptosporidium*. An average of 100 colony forming units per 1 mL for *E. Coli*, places a water supply into Bin 2 for treatment requirements. Membrane filtration is effective for removing *Cryptosporidium*, so this would not change the proposed treatment process selection.

residual and the contact time (the time between when chlorine is applied and when the residual is measured). Membrane filtration is considered a mature treatment technology. It is currently used by a number of Oregon water utilities and it has complied with the surface water treatment requirements in all cases.

Prior to gaining experience with membrane treatment systems, the State of Oregon Drinking Water Services required pilot testing of membrane filtration to confirm its effectiveness. The state has allowed recent projects using membrane filtration to proceed without pilot testing because of its demonstrated performance. The state's website lists membrane suppliers whose products have been determined to comply with the challenge testing requirements of the state's rules. As long as the treatment system uses one of the listed membrane systems, it is unlikely that the state will require piloting. Provided the state does not require piloting, CH2M recommends proceeding without piloting. A pilot study that provides meaningful data will require 12-15 months of time and cost in excess of $100,000 in equipment rental, vendor labor costs, laboratory services, and engineering costs. Since the state accepts several membrane systems because of their proven records in meeting the treatment requirements, the main value of piloting is to assist the manufacturers with sizing their equipment and selecting the appropriate cleaning approach. In lieu of piloting, an adequate water quality data set can provide the manufacturers the information they need.

Membrane equipment is available from several suppliers. Many of the recent similar sized plants in Oregon and the U.S. have used membrane systems supplied by Pall Corporation but this is not the only supplier that should be considered for the District's plant. Just to obtain preliminary information, CH2M contacted Pall Corporation about the District's project, and Pall Corporation provided a preliminary sizing and layout for the District's system, as well as a preliminary cost. CH2M discussed with Pall Corporation the options of providing three skids each sized at 50 percent of the maximum production or two skids each sized at 100 percent of production. Pall determined that for their equipment, the use of three skids sized at 50 percent each was the more economical approach and this was the basis for the cost estimate included in this report.

The recommended design approach is to pre-select the membrane equipment before completing final design because different membrane equipment suppliers provide differently configured systems. The selection of the membrane equipment will have an impact on the final design layout. Additional discussion of the membrane procurement approach is provided in a later section of this report.

In addition to the source water quality sampling, the state requires a watershed sanitary survey as part of developing a new water source. The survey is to include the following components in assessing human-caused and natural impacts on water quality:

- Nature of and condition of dams, impoundments, intake facilities, diversion works, screens, disinfection equipment, perimeter fences, signs, gates;
- Nature of surface geology, character of soils, presence of slides, character of vegetation and forests, animal population, amounts of precipitation;
- Nature of human activities, extent of cultivated and grazing land, zoning restrictions, extent of human habitation, logging activities, method of sewage disposal, proximity of fecal contamination to intake, recreational activities and measures to control activities in the watershed;
- Nature of raw water, level of coliform organisms, vulnerability assessments of potential contaminants, algae, turbidity, color, mineral constituents, detention time in reservoir, time required for flow from sources of contamination to intake;
- Type and effectiveness of measures to control contamination, and algae, disinfection applications and residuals carried, monitoring practices, patrol of borders.

The proposed treatment system will use the following chemicals:

- Bagged salt. The salt will be used for onsite generation of chlorine. The chlorine is needed both for disinfection and for membrane cleaning. It is common to use 12 percent hypochlorite product for membrane cleaning but it is possible to accomplish this using the weaker (0.8 percent) chlorine solution generated onsite.[11]
- Aluminum chlorohydrate (ACH). This is a coagulant chemical that enhances the effectiveness of the membranes for removal of organic DBP precursors. A small dose of approximately 4.0 mg/L will be applied.[12] The selection of ACH and the estimate of its dose is based on experiences with other Oregon membrane treatment facilities.
- Membrane cleaning chemicals. The final selection of cleaning chemicals will be decided based on additional water quality monitoring. These chemicals will be supplied in drums or totes.

All of these chemicals can be delivered on a small flatbed or pickup truck. The specific size of delivery truck will need to be determined and considered for final design of the plant site and its access road.

In addition, as noted in the discussion about water quality, space should be provided in the treatment building to allow for the possible addition of a corrosion control chemical, should it be needed.

3.3 Clearwell Size and Material

A clearwell storage tank is an essential element of a water treatment plant to provide disinfection contact time, water supply for backwashing membrane filters, and equalization storage to allow for short-term plant shutdowns or variations in flow (mismatches between production and system needs).

The volume for chlorine contact needs to provide a level of disinfection considered sufficient for 0.5-log *Giardia* inactivation, if membrane filtration is used as the treatment process as proposed for the District. The 0.5-log *Giardia* criterion sets the required minimum CT value, where CT is the product of the chlorine residual (C) measured prior to the first customer and the contact time (T) between chlorine addition and the point where the chlorine residual is measured. The required minimum CT varies depending on the chlorine residual, water temperature, and water pH. Colder water temperatures have higher CT requirements but colder water occurs during the winter when the District's water demands are lower.

Table 3-2 provides a monthly evaluation of CT requirements for the Beaver Creek supply, using conservative values for temperature and pH, and shows the resulting volume needed for disinfection. The highest monthly need is 130,000 gallons in December.[13]

[11] Options for chlorine supply should be evaluated during final design. One option is to use onsite generation for both primary disinfection and for membrane cleaning. A second option is to use bulk hypochlorite for both functions. A third is to use onsite generation for primary disinfection, and to use bulk hypochlorite for membrane cleaning.

[12] Disinfection by-product formation potential tests are planned for bench-scale treated Beaver Creek water with and without the use of a coagulant. The raw water samples will be collected during an initial fall season heavy rain, which is often a time with high levels of disinfection by-product precursors in Oregon streams. The results will guide decisions about the use of a coagulant.

[13] Clearwell efficiency reflects the amount of short-circuiting that occurs as water passes through a tank. A higher efficiency indicates that there is less short-circuiting.

Table 3-2. Clearwell Volume Needed for Disinfection
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Month	Lowest Expected Temperature (°C)	Maximum Required Production (mgd)	Maximum Required Protection (gpm)	Approximate CT Required for pH 7.5 and Cl2 = 1.0 mg/L	Time Required for 1.0 mg/L Residual (min)	CT Minimum Volume (gal) if Efficiency = 15%
January	5	0.83	573	29.8	29.8	110,000
February	7	0.81	564	26.8	26.8	100,000
March	7	0.93	645	26.8	26.8	120,000
April	9	0.97	672	23.8	23.8	110,000
May	10	0.97	672	22.3	22.3	100,000
June	12	1.29	896	19.4	19.4	120,000
July	14	1.29	896	16.5	16.5	100,000
August	15	1.29	896	15.0	15.0	90,000
September	14	1.29	896	16.5	16.5	100,000
October	10	0.97	672	22.3	22.3	100,000
November	8	0.94	654	25.3	25.3	110,000
December	6	0.99	690	28.3	28.3	130,000

The storage volume for backwashing is estimated at approximately 6 percent of the production. This results in a range of 50,000 gallons during the lower production winter months to 80,000 gallons during the higher production summer months.

Clearwell storage is also needed to allow for short-term plant shutdowns or for a short-term mismatch between the rate of plant production and the needed flow into the system. A short-term shutdown might be necessary because of a mechanical, electrical, or controls failure that interrupts production. A production versus system need mismatch might result if system water demands suddenly increase while the plant is slowly ramping up production. The storage needed for this purpose is not one set value. It is a system-specific value depending on the amount of storage provided in other tanks and how risk-adverse a utility wishes to be. Our recommendation is for this storage component to be equal to at least 8 hours of production at the maximum plant rate, which equals 430,000 gallons (1.29 mgd x 8/24 hours). A value equal to 12 hours of production at the maximum plant rate could be considered, which is equal to 650,000 gallons (1.29 mgd x 12/24 hours). As a compromise, the proposed size for this storage component is 540,000 gallons, which is equal to 10 hours at the maximum plant rate (1.29 x 10/24 hours).

In summary, the following volumes for the clearwell are proposed for the project:

- Disinfection contact time storage = 130,000 gallons
- Backwash storage = 80,000 gallons
- Short-term shutdown storage = 540,000 gallons
- Total proposed storage = 750,000 gallons

The recommended clearwell volume is 750,000 gallons for the full plant capacity of 1.29 mgd. This will be storage dedicated for plant operations and does not add storage for general system equalization, emergency, and fire needs. However, should an emergency occur near the central part of the

distribution system, such as the need for high water flows for fire-fighting, a portion of the clearwell volume could be 'borrowed' to meet the need, although recognizing that during this period, the operators may need to respond more quickly than normally if there was a plant interruption or failure.

Another design question is the selection of the clearwell tank material of construction. There are three recommended options for this tank, welded steel, conventionally reinforced concrete, and prestressed concrete. Either of the concrete options would provide a tank requiring virtually no maintenance, whereas the use of welded steel requires repainting every 20-25 years. Repainting requires the tank to be off-line for about eight weeks, effectively requiring a shutdown of the plant during this time if there is a single tank. Therefore, either of the concrete options is a more favorable in this regard. However, the use of concrete for a tank volume of 750,000 gallons may have a significantly higher cost than for steel, and the concrete options may not even be feasible depending on the required dimensions. A fourth tank material is glass-lined, bolted steel. However, CH2M does not recommend this material because of known problems with leaks at one Oregon utility and a need for major rehabilitation or replacement at another Oregon utility when the panel caulking began failing.

Based on conversations with District staff, the proposed material for construction is welded steel, primarily because of its lower first cost. Because welded steel requires periodic repainting, which necessitates removing the tank from service for about eight weeks, the proposed approach is to provide two tanks, allowing for one to be removed from service at a time. Although this results in a higher cost than providing the entire volume in one tank, it also affords the District an opportunity to stage the two tanks, thus lowering the initial project cost. The proposed approach is to install a 500,000 gallon welded steel tank for the initial plant, and then to add a second, 250,000-gallon tank in the future prior to when the initial tank requires repainting. The final decision on the clearwell sizing and material selection is dependent on the needed hydraulic grade line leaving the plant, as discussed in a subsequent section of this report.

3.3.1 Plant Electrical Supply

It is assumed that the electrical utility will provide any required service transformer and would be responsible for providing and installing all primary (medium voltage) conductors. The District would be responsible for providing and installing all secondary (480V) conductors, and also a concrete pad or vault to mount the service transformer.

Central Lincoln PUD serves the residential subdivision next to the Makai site. The service in the subdivision is mostly single phase, but 3-phase has been extended from Highway 101 to a pull box part-way into the subdivision. Central Lincoln PUD has provided a cost estimate of $56,000 to extend 3-phase power to the Makai site, to be paid to the PUD. Additionally, a portion of this extension will require trenching or boring of new underground conduits, which must be performed by the District. The costs for paying the utility to extend 3-phase power and for construction of the buried conduit have been included in the project cost.

3.3.2 Plant Power Concepts

For conceptual purposes, it is assumed that the treatment plant electrical loads will generally consist of the following:

- Membrane system:
  - 185 HP of motor load
  - 50 kilovolt-ampere (KVa) general load
- 2-kW onsite hypochlorite generator
- 30-kVA HVAC for membrane treatment building
- 5-kVA lighting for building and outdoor lighting
- 10-kVA telecom, outlets, and miscellaneous

- 10 percent spare capacity

The total connected load would be approximately 360 kW. Demand load can be conservatively approximated at 70 percent of the connected load, or about 250 kVA. The recommended service size and configuration would be 400 amps, 480V, 3-phase.

The main plant electrical service panel would likely consist of a service entrance rated motor control center. This motor control center would have two main breakers; one would accept utility power and the other would accept backup generator power. These two breakers would be electrically interlocked to avoid any paralleling of sources and would also be controlled by a microprocessor-based automatic transfer controller. The automatic transfer controller would detect outages, facilitate starting the generator when necessary, and operate the breakers to maintain power to the plant from one of the two sources. The motor control center would also contain starters, VFDs, and circuit breakers as necessary to power and control the plant loads.

The treatment plant will require backup standby power in order to operate during utility outages. A diesel fueled standby generator is recommended, with automatic transfer controls. The generator can be placed inside a building with an external fuel tank or a packaged generator can be provided with a weatherproof enclosure and an integral 'belly tank' that is part of the generator skid. An outdoor unit recommended because it will have a lower cost than adding to the building size to place it inside.

In order to provide full capacity backup power, the generator would be sized at about 250kVA. This sizing could be reduced if the plant can operate at a lower power draw during emergencies; the loading requirements can be evaluated during final design.

Regarding fuel storage, the District will want to consider refueling times, availability of fuel during emergencies such as wind storms or seismic events, utility reliability, exercising and maintenance activities, testing, and fuel conditioning. A common approach for water treatment facilities is to provide fuel for 48 hours of operation at full load, although a shorter period and/or sizing for a lesser load may be reasonable. A supply for 48 hours of operation would require approximately 900 gallons of fuel for a 250kVA generator. In discussions with the District, the staff indicated that it may be sufficient to provide less fuel storage, maybe 24 hours at 50 percent production. Furthermore, the fuel storage could be evaluated for its capability to enable the plant to produce water at a greatly reduced rate for two months or longer, such as might be necessary following a Cascadia Subduction Zone earthquake.

If a large amount of fuel storage is desired, such that fuel spoiling is a concern, an external fuel tank should be considered in lieu of a belly tank. A full size external tank will come with the necessary mixing pumps, fuel conditioning, and level controls to protect the quality of the fuel over a longer storage period. The evaluation of the fuel volume to store on site requires further analysis during final design.

The cost estimate provided with this report includes a 250-kVA generator with a sound attenuated weatherproof enclosure and integral fuel tank with 48 hours of fuel. The footprint of the generator would be about 20 feet long by 7 feet wide. Additional side access platforms may be required depending on the overall height of the generator skid. The height is determined primarily by the amount of fuel to be stored in the base mounted fuel tank.

In addition to a permanently installed standby generator, it is recommended that the plant power system be designed with provisions to connect a portable standby generator, in the event that the installed standby generator fails. The required generator size for full plant operation would be roughly equivalent to the size needed for the intake, which means the District may consider assigning a single portable generator as the primary backup for the intake and as the secondary backup for the treatment plant.

Many new infrastructure projects consider incorporation of photovoltaics (PV) as a supplemental power supply, although this is less common in western Oregon and even less common on the Oregon coast. A

PV system installed at the plant site would provide ongoing clean energy production, offset plant energy usage, and provide a small, emergency backup power supply, and reduce operating costs.

During normal plant (daytime) operations, grid-tied PV will offset utility costs by generating on-site power. During emergency operations in which the standby generator powers the plant, a PV system would typically be isolated from the plant electrical system in order to ensure personnel safety and equipment protection. As such, PV does not provide any benefit during standby generator operations.

However, PV could be used as part of a resiliency plan in which the diesel standby generator cannot power the plant because of generator failure or the inability to be refueled because of a regional event/emergency. In this scenario, a small to moderate PV installation at the treatment site could be used to provide some amount of power although it would not be enough power to drive all plant loads. Modern solar inverters have the capability to power loads directly, without the need for a grid connection or batteries. The output wattage capability is usually limited to some reduced percentage of the PV system's inverter rating. Without batteries, the PV system could provide reliable power during daylight hours. Even during cloudy days, a PV system will produce power at a reduced output, but even a few watts can be sufficient for charging critical communications devices such as a cell phones, radios, laptops, or other devices that can be plugged into a standard outlet. A PV system was not included in the preliminary cost estimate because it was assumed that it would not have a favorable cost-benefit ratio for this project.

3.4 Backwash Waste Handling

Backwash waste from the membrane filters will be sent to one of two settling basins. Solids will settle out of the liquid flow and will accumulate on the basin floor. Supernatant from the basin will be returned to Beaver Creek. Settling basin operation will alternate: the on-line basin will receive all backwash flow, while solids accumulated in the off-line basin thicken prior to being pumped out of the basin for disposal.

Solids sent to the settling basin will be made up of solids from the raw water plus solids produced by the addition of ACH coagulant. For every 1.0 mg/L of ACH added to the raw water, 0.44 mg/L of ACH particulate floc will be formed. This type of aluminum-based floc particles does not thicken easily. A settled solids concentration of approximately 1 percent following an extended period of settling up to 6 months is assumed. Table 3-3 shows the build out design criteria and assumptions used to size the settling basin.

Table 3-3. Backwash Settling Basin Design Criteria and Assumptions for Buildout Conditions
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Assumption	Value
Average raw water turbidity (NTU)	5
Conversion of turbidity to total suspended solids (TSS): 1 NTU = 1 mg/L TSS	1
Average solids concentration (mg/L)=	5.00
ACH dose (mg/L)	4.00
Ratio: mg solids produced per mg ACH	0.44
Solids from ACH mg/L	1.8
Total concentration of solids to filters (mg/L)	6.8
Buildout average day raw water flow (cfs)	1
Buildout average day raw water flow (mgd)	1.29

Table 3-3. Backwash Settling Basin Design Criteria and Assumptions for Buildout Conditions
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Solids to Settling Basin (pounds per day)	**73**
Water production efficiency	94%
Daily backwash flow to settling basin (gpd)	77,000
Average backwash solids concentration (mg/L TSS)	113

With a water production efficiency of 94 percent, approximately 6 percent of the raw water, or 77,000 gallons per day will be used for backwash at the maximum production rate of 1.29 mgd and will flow through the backwash settling basin as shown in Figure 3-1. The supernatant from the settling basin will flow by gravity to a discharge on Beaver Creek.

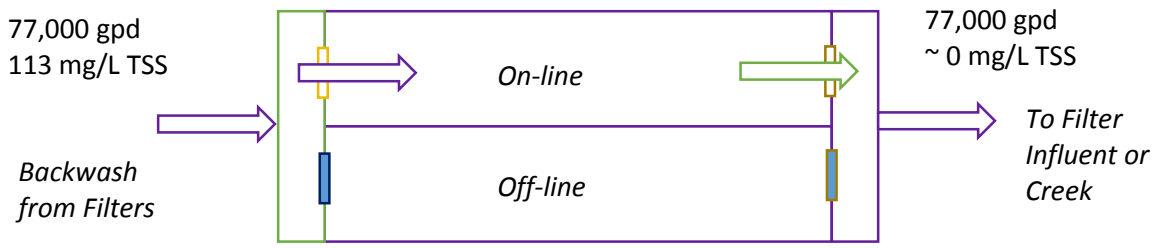

Figure 3-1. Backwash Settling Basin Daily Flow at Buildout
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Based on raw water quality and average daily raw water flow at buildout, the estimated solids loading to the basin will be 73 pounds per day. Because the plant site is relatively constrained, space for the backwash basins is limited. Two basins, each sized at 12 feet wide by 100 feet long, by 9 feet deep (overall dimension: 30 feet by 100 feet), would allow a 2-plus months on-line, off-line cycle. After approximately two months of settling, the supernatant will be drawn from the off-line basin and routed to a discharge, and the remaining settled solids will be pumped from the basin floor, with a temporary or permanently installed submersible pump to tanker trucks, or directly via a TracVac style truck.

If a 1 percent settled solids concentration is achieved, approximately 26,000 gallons of slurry will need to be removed from a basin every two months. A typical tanker truck may carry 3000 gallons, so this represents 9 truckloads every two months. It may be possible to haul this waste to the Newport wastewater treatment plant. If space is available for additional or larger settling basins, the time between solids removal operations could be extended, providing longer settling periods, and more operational flexibility. Basin construction could be staged, with additional basins constructed as demand grows. The solids may be discharged at a local wastewater treatment plant, or if an appropriate location is available, they could be land applied. Table 3-4 presents the calculated volumes and sludge blanket depth in a 12-feet by 100-feet settling basin at a solids loading of 73 pounds per day and 3 different settled solids concentrations. At a settled solids concentration of 1 percent, solids from approximately 2 months of backwash operations at buildout demand would fill a settling basin to a depth of 7 feet.

Table 3-4. Estimated Depth and Volume of Accumulated Solids after 30 days at 73 pounds per day Loading Rate
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Settled Solids Concentration	Settled Solids Concentration (mg/L)	Daily Volume of Slurry (gal/day)	Daily Volume of Slurry (cf/day)	Accumulated Solids volume in 30 days (gal)	Accumulated volume in 30 days (cf)	Slurry Depth after 30 days (ft)
0.5%	5,000	1,700	230	51,000	6,900	5.8
1%	10,000	900	120	27,000	3,600	3.0
2%	20,000	400	50	12,000	1,500	1.3

There will be a need to discharge the supernatant from the settling basin. Generally, such discharges are approved by DEQ under the requirements of the National Pollutant Discharge Elimination System Waste Discharge Permit 200-J, although Oregon's general permit under which 200-J permits are issued expired in 2002. According to DEQ representatives, the permit would probably be approved under the 200-J program despite its expired status.

The NPDES 200-J permit has the following conditions:

1. Daily maximum settleable solids shall not exceed 0.1 ml/l
2. pH shall be within the range 6.0 - 9.0.
3. The receiving stream flow shall provide a 30:1 minimum dilution ratio with the effluent during periods of discharge.
4. Facilities that discharge to water quality limited streams and meet the dilution requirements will be deemed to satisfy the requirement of developing and implementing a surface water management plan
5. The allowable mixing zone shall not extend downstream beyond a distance of 30 feet from the point of discharge and shall not exceed one-half the width of the receiving stream.
6. The permittee can land apply filter backwash, settling basin, and reservoir cleaning wastewater provided written approval is obtained from the Department and the following conditions are met: i) No surface runoff or discharge to surface waters from the land application site is allowed; ii) Wastewater must not be land applied at rates which exceed the hydraulic or organic loading capacity of the soil; and iii) The application of wastewater must not result in odors or other nuisance conditions.
7. Prior to discharge to waters of the State, all filter backwash water shall pass through a settling pond or other approved treatment system and meet the effluent limitations.
8. If super-chlorinated water (i.e. chlorine concentrations above 4 mg/L) is used for cleaning reservoirs or for water main disinfection and flushing, the water must be dechlorinated prior to discharge. Dechlorination must be sufficiently effective to reduce total residual chlorine concentrations to 0.1 mg/L. Alternatively, the permittee can use non-discharge options such as discharge to sanitary sewer or land application.

The 30:1 dilution requirement precludes the use of a natural drainage unless the drainage has sufficient natural flow to provide the needed dilution. DEQ was asked if it would be acceptable to discharge to the natural drainage that runs near the Makai site with the understanding that this natural drainage leads to Beaver Creek. DEQ said that was unacceptable, as the first receiving stream must provide the 30:1 dilution. DEQ said it will be necessary to pipe the supernatant from the waste basins to Beaver

Creek. Another alternative would be to put the water to land apply the waste flow, provided it met the land application restrictions.

The preliminary selection is to use a 3-inch HDPE DR 9 (internal diameter = 2.675 inches) pipeline for the backwash discharge line. At the maximum discharge flow of 65 gpm, this yields a velocity of 3.7 fps. The pipeline will be placed parallel to the raw water line to the bottom of the hill by the road. It will require an additional easement from North Beaver Creek Road to the creek, and possibly a discharge control structure.

SECTION 4

Intake Facility

As with all aspects of the project, seismic/tsunami resiliency was an important consideration in selecting the location and type of intake. Other criteria included complying with the water right permit conditions, including the monitoring requirements added by DEQ, developing an intake facility that would minimize visual and noise impacts to recreational users of the creek, and complying with fisheries and design requirements from the Oregon Drinking Water Services section of the Oregon Health Authority, the National Marine Fisheries Service (NMFS), the Oregon Water Resources Department, and the Oregon Department of Fish and Wildlife (ODFW). Other criteria used in the conceptual design were minimizing capital and operating costs, minimizing maintenance, and operator safety.[14]

The intake construction will need to occur during the in-water work window dictated by the fishery agencies. Typically, for a coastal stream, this window is mid-August through the end of September. However, it may be that the in-water work for Beaver Creek is shifted to February because Oregon State Parks and Recreation hosts a number of kayaking trips in August and September.

A review of location options for the intake resulted in the decision to place the intake on the southwest corner of the South Beaver Creek Road Bridge crossing. It is often desirable to locate an intake near a bridge because bridges are typically sited where the stream channel has remained constant over time. If a major flood event did damage the bridge, the current location of the roads would motivate the county to restore the river bank conditions in a similar manner to the existing conditions to allow for replacement of the bridge.

An additional factor supporting this choice is that it is the only location along this reach of the river that has nearby land located above the floodplain. An intake structure will include pumps and it is necessary to have an electrical building within about 200 feet—and closer, if possible—of the pumps to house the variable speed motor starters and the air backflush system for cleaning the intake screens.

Finally, this site matches the District's water right permit application point of diversion, which simplifies the process.

However, this withdrawal site is subject to risks, as described earlier in this report. In particular, there is concern about rising sea levels and the possibility of more frequent sea water intrusions to the proposed intake location.

The PFO for the District's water right, issued by the Oregon Water Resources Department, included the following conditions related to design and operation of the intake:

- The District must install a totalizing flow meter at the point of diversion. Another statement in the PFO says the "Director may provide an opportunity for the permittee to submit alternative measuring and reporting procedures for review and approval." The agencies may agree to allow the flow meter to be placed at the inlet to the water treatment plant rather than at the intake, which would reduce the amount of equipment and electronics at the intake site. This could be explored during final design.

[14] Oregon's Construction Standards for Public Water Systems require restrictions on swimming and boating near a surface intake. According to a person conversation with Jay MacPherson of the state's program, posting a sign or signs is sufficient to meet this requirement. If the District did not feel posting a sign was appropriate or desirable for Beaver Creek, it would be possible to request a waiver for this item during the plan review for the project.

- The District shall maintain a streamflow gaging station from May 15 to October 15. A minimum of eight streamflow measurements, at various rates of flow, are required during the first full period of operation, with one measurement being performed every four to six weeks thereafter.
- The District shall monitor water temperature upstream and downstream of the diversion. Data shall be collected and recorded every 30 minutes from May 15 to October 15, with reports submitted to DEQ. The planned temperature monitoring shall be described in a sampling and analysis plan to be submitted and approved by DEQ.
- If the riparian area is disturbed during construction, it is to be restored per ODFW's Fish and Wildlife Habitat Mitigation Policy OAR 635-415.
- The intake shall use fish screening and bypass devices consistent with ODFW standards.

The PFO states that the temperature, and streamflow gaging should occur "before water use may begin." It may be necessary to discuss these requirements with the agencies to understand if the monitoring can be included as part of the permanent intake facility or if the monitoring must truly begin prior to construction of the intake.

The Oregon Drinking Water Services rules for public water systems include the following two rules in the construction standards section (OAR 333-061-0050) that apply to intake facilities:

1. Motors shall be located above flood level
2. Provisions shall be made to restrict swimming and boating in the vicinity of the intake

These requirements were discussed with Jay Macpherson of the state to understand their implications for the District's project. He indicated it is acceptable to use submersible pumps, as proposed, even though the motors will be located below the flood level. With respect to the second item, he indicated that minimal signage would be sufficient or maybe none at all for the proposed type of withdrawal facility.

Generally, NMFS and ODFW have the same requirements relating to fisheries, which consist of the following:

- Align screen face with river bank
- Approach velocity shall be less than or equal to 0.40 fps for active screens
- Maximum screen angle is 45 degrees
- Slotted screen shall be used, with openings less than or equal to 1.75 mm (approx. 1/16 inch)
- Material of screen shall be corrosion resistant
- Screen open area shall be less than or equal to 27 percent

A slant screen design is the recommended intake configuration for providing a reliable facility and to achieve compliance with the criteria. The concept is shown in the attached drawings. The intake is designed to minimize both visual and sound impacts for people using the river and for the neighboring property owner. The screen area shown is 8.0 square feet, which exceeds the approach velocity criteria (2.0 cfs / 0.4 fps = 5 square feet). The concept is to use submersible pumps, which keeps the mechanical equipment out of sight and limit noise. They will be paired with variable frequency drives (VFDs) to allow for variable pumping rates. The VFDs will be located in the nearby electrical/controls building, which will also house the air backflush compressor. The building will use sound-absorbing construction to minimize noise.

The anticipated low water level determines the top of the inlet screen. The lowest river level reported by the USGS for 2010-2013 was 8.40 feet. The mean reported by USGS was 9.2 feet and the high water

level was 12.1 feet. [15] This is a relatively short period of record but represent the only data available for Beaver Creek. Based on these values, the proposed intake design is to set the top of the slant screen at elevation 8.3 feet and the bottom of the screen at elevation 6.3 feet.

The proposed design is to keep much of the structure below the mean water level of 9.2 feet to minimize the visual impact for boaters. As shown in the attached concept drawings and the images included in Appendix F, the intake structure is buried until it extends about 10 feet away from the normal river waterline. At this point, the top rises to about 12 inches above grade for access. With the natural regrowth of brush along the bank, the above-ground section set back from the river will quickly become obscured from boaters using the river.

The floor of the intake structure will slope back toward the pumps. The concept is to limit deposition of solids within the intake structure although the slow velocity of water moving through the structure will allow some settlement to occur.

Submersible pumps have been selected. Their installation below water level reduces noise, which is important to protect an environmentally sensitive area. The submersed condition of the motor promotes long life. A drawback is that submersible pumps are less energy efficient than some types of pumps.

The proposed submersible pumps for the intake will be installed using guide rails to facilitate lifting them out of the wetwell for maintenance. The concept shown is to use three pumps, each sized at 50 percent of the 2.0 cfs capacity. Any two operating pumps will provide the full capacity with the third pump provided for redundancy. They will need to lift water from the low river level of 8.4 feet to about 10 feet above the floor of the treatment building, which will have a finished floor elevation of approximately 216 feet, for a static lift of 218 feet. Each pump will require a motor size of approximately 125 horsepower to enable it to deliver water to the Makai site, considering the static lift and the dynamic losses. All three pumps are variable speed so their production rate can be matched to system demands.

The design concept is intended to limit necessary maintenance for the river intake facility. The intake will include a water level probe to signal abnormal high or low water level conditions. It will also include a probe for monitoring conductivity so the intake can be shut off if there is seawater intrusion.

The river intake structure will require a Joint 404 U.S. Army Corps of Engineers/Department of State Lands permit. Refer to the permitting section of this report.

The bridge site does not currently have 3-phase electrical power. It is located within Consumers Power Inc. service area and the cost estimate includes a preliminary estimate from the utility for extending 3-phase power to the site. The cost is for overhead power; the cost for buried service, which could reduce vulnerability to storm-caused interruptions to power, would be higher.

4.1 Raw Water Pipeline

The preliminary selection for the raw water pipeline is 14-inch nominal high-density polyethylene (HDPE). HDPE is considered an excellent selection for providing earthquake resiliency because of its ductility. Its performance was better than other pipe materials in earthquakes in Chile, New Zealand, and Japan; in fact, no failures of HDPE pipe were noted in these three examples while many failures occurred for other pipe materials.[16] For diameter ratio (DR) 9 HDPE pipe, the inside diameter equals 11.696 inches. At the maximum design flow of 2.0 cfs (1.29 mgd), this yields a velocity of 2.7 fps. This is a relatively low velocity but the long length of line (approximately 8,100 feet) results in a steep increase in

[15] All elevations in this report and on the accompanying drawings are reported in NAVD88 unless specifically noted otherwise.

[16] Water Research Foundation, "Recent Earthquakes: Implications for U.S. Water Utilities," Project 4408, July 2012.

headloss (with an associated increase in energy) for a small decrease in diameter. The proposed route for the raw water line from North Beaver Creek Road to the Makai site is shown in Figure 4-1. This routing is preliminary and depends on obtaining easements from private property owners.

Figure 4-1. Proposed Route for Raw Water Line from North Beaver Creek Road to the Makai Site

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The proposed approach for installing the raw water pipeline from the south side of the creek, where the intake will be located, to the north side is to use horizontal directional drilling. An alternative approach would be to hang the pipe from the underside of the bridge, but this option would be more vulnerable to flooding or intentional damage by vandals. In addition, based on preliminary discussions with the county, the county may not be willing to allow attachment of the pipe to the bridge.

The ground conditions appear to be suitable for horizontal directional drilling based on a preliminary assessment using the geotechnical drilling logs that were developed for the bridge construction. Figure 4-2 illustrates the proposed location for the horizontal directional drilling for the raw water line.

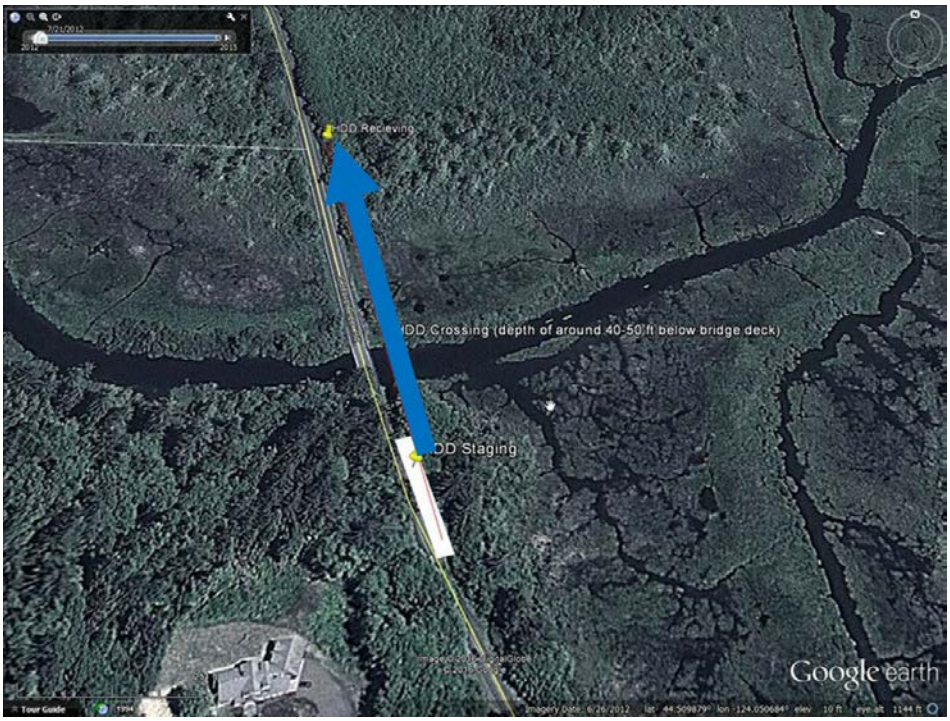

Figure 4-2. Proposed Location for Raw Water Line Horizontal Directional Drilling
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To provide for emergency service in the case of a major earthquake, a 2-inch diameter pipe connection tee with a valve could be installed in the raw water line to facilitate a temporary intake and pump station downstream on Beaver Creek. The recommended location is where the line turns off North Beaver Creek Road uphill to the Makai site. This location is relatively close to the river and could provide an emergency supply to the plant if the intake and upstream portions of the raw water line were lost in a seismic event.

4.2 Intake Electrical Power Supply

It is assumed that the electrical utility will provide any required service transformer, and would be responsible for providing and installing all primary (medium voltage) conductors. The District would be responsible for providing and installing all secondary (480V) conductors, and also a concrete pad or vault to mount the service transformer.

The intake site is located within Consumer Power Inc. (CPI) service territory, at the South Beaver Creek Bridge crossing of Beaver Creek. There is currently no electrical service at the proposed intake site. CPI has provided an estimate cost of $250,000 to extend 3-phase service to the intake site. The extension would be along overhead lines. An option to consider, one which would add to the cost, is asking CPI to install underground power to the intake site. This option would make the line less vulnerable to storm disruption or damage but since much of the upstream power supply is above-ground, may not appreciably improve the reliability of the service.

For conceptual purposes, it is assumed the intake loads will consist of following:

- Three variable speed submersible pumps, two duty, and one standby, 125 HP each.
- 2-kVA HVAC
- 1-kVA lighting
- 2-kVA telecom
- 5-HP air compressor for backflush air cleaning of the intake screen

The total connected load would be approximately 270-kVA (not including the standby pump). Demand load is expected to be nearly the same as connected load due to the fact that majority of the load is the intake pumps. The recommended service size and configuration would be 400 amps, 480V, 3-phase. A main distribution panel would be provided to distribute power to the VFDs and other loads. The service entrance panel would likely consist of a manual transfer switch as discussed below.

The pumps will require variable frequency drives (VFDs) for control. VFDs contain sensitive electronic components that must be kept cool and dry in order to function properly. As such, VFDs are often placed inside rooms and provided with ventilation or air conditioning as required to keep the equipment within specified operating temperatures. Additionally, VFDs located outdoors at the intake will be subject to environmental degradation and damage, and also vandalism. It is recommended that a small, secure structure be built to house VFDs and any other electrical/communications equipment. The required size of this structure is estimated to be about 10 by 15 feet or 150 square feet. This building will also house a blower unit for air backflushing of the intake screen. Each 125 HP VFD would have an approximate footprint of 28 inches wide by 20 inches deep by 90 inches high.

Because the pumps are the primary electrical load, the VFD-generated harmonics are not diluted by other electrical loads. Therefore, the use of a specialty VFD is needed. This has been captured in the cost estimate.

The intake will require backup standby power in order to operate during utility power outages. The required size of generator would be approximately 250 kW. Placing a permanently mounted standby generator at the intake site represents several concerns. The intake is sited in a tsunami flood plain, and it is likely that a tsunami would destroy any permanent above-grade structure, including a standby generator. Additional reasons for not installing a permanent generator at the intake include concerns related to vandalism, maintenance, noise, and fuel storage.

For these reasons, a permanently installed standby generator is not recommended. Instead, provisions to connect a portable, trailer-mounted standby generator are recommended for the intake. An exterior plug would be made available at the electric building to facilitate connection to a portable generator, and a permanently installed, service entrance rated manual transfer switch would be provided to facilitate transfers to and from utility power. A relatively flat area for the trailer should be provided next to the building.

Fiber optic or wireless technology is recommended for control communications between the intake and the treatment plant. Fiber optics provide the most reliable pathway, but is the more expensive option due to the distances involved. Wireless communications could prove to be a less expensive option if concerns related to reliability and robustness can be addressed. The cost of the fiber optic line construction would be partially offset by running this line in parallel with the raw water pipeline connection the intake with the treatment plant. The cost estimate includes an allowance for instrumentation and controls, but the decision on which technology will need to be made during final design.

SECTION 5

Plant Site Selection

5.1 Criteria and Comparison

Three potential sites were considered for locating the treatment plant, labeled South, North, and Makai. The criteria considered for selecting among them included the following:

- Property ownership
- Current zoning
- Tsunami protection—above approximately 75 feet in elevation
- Sufficient land area
- Minimal requirements for earthwork
- Minimal requirements for access road
- Security and visibility
- Noise impacts for neighbors
- Electrical supply proximity

The District owns the property at the Makai site. The 1.0-million-gallon tank currently located on this property was thought to be a significant advantage. It is no longer in service but the hope was that it could be used with some rehabilitation and thereby provide significant cost savings for the project. Specific shop drawings were not found for this tank. However, its design was determined based on photographs of the interior and comparison to design drawings for a similar sized tank in Central Point built by the same construction company at the same time. If this understanding is correct, the tank has a thin floor slab, thin walls, and thin dome roof, and it would be as costly as building a new tank to improve these features and their connections to meet current seismic criteria. Figure 5-1 provides a photograph of the interior of the Makai Tank.

Figure 5-1. Photograph of Makai Tank Interior

A Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis was performed for the three sites to consider cost and non-cost factors for the site selection. The SWOT analysis table is located in Appendix G. Based on this analysis and a comparison of development costs, the Makai site was the recommended selection even though the existing tank was determined not to provide value. Figure 5-2 provides a photograph of the Makai site looking from the entry gate.

Figure 5-2. Photograph of Makai Site from Entry Gate
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The Makai site will require a longer raw water pipeline than the other two sites, but a shorter finished water pipeline. A significant advantage is that it does not require a finished water pump station, with the resulting savings in capital and maintenance costs. This does not represent an energy savings because the water from the creek must eventually be pumped to the same hydraulic grade line, whether by one pump station at the intake or by the combination of an intake pump station and a finished water pump station. But it does reduce the amount of equipment needed and the building area at the plant site.

The raw water pipeline to the Makai site has been described previously. The finished water pipeline will follow the access road from the site down to the existing 12-inch main on NW Kona Street.

5.2 Finished Water System Hydraulic Grade Line

The following information on system hydraulics was based on the preliminary system schematic drawing provided by the District. According to this schematic, the existing Makai tank has an overflow elevation of 240 feet.[17] The District is in the process of abandoning the Beaver Creek Pump Station. The schematic shows a suction pressure to this station of 90 psi at an elevation of 35 feet, or a hydraulic grade line (HGL) of 243 feet. This is slightly higher but approximately equal to the overflow elevation of 240 feet for the Makai tank, which is directly connected to the suction side of the pump station. However, the Makai tank elevation is lower than the downstream side of the pressure-reducing valve downstream of the Lost Creek Master Meter. The HGL at this location is 266 feet (160 feet + 46 psi). Further, the HGL

[17] All elevations shown on the schematic are indicated to be plus or minus (+/-).

downstream of the existing Beaver Creek Pump Station is 275 feet (35 feet + 104 psi). The HGL on the suction side of the Cross Street Pump Station, also to the south of the proposed new plant site, is 269 feet (119 feet + 150 psi).

From this information, it appears that the overflow elevation of the new plant clearwell(s) should be set at approximately 275 feet. When the tank is full or nearly full, the pressure from the system will be similar to existing pressures, although higher than they currently are directly to the north of Beaver Creek. Pressures will be lower than currently experienced in the system when the water level drops below the full level of 275 feet.

The elevation of the Makai site is approximately 218 feet at the base of the existing tank but the south half of the property is at a higher elevation, approximately 223 feet. If the tank base was 223 feet with a water depth of 52 feet, it would have an overflow elevation of 275 feet. This would allow the plant to distribute flow by gravity from the tank into the system.

The system hydraulic information and tank height need to be further considered and confirmed during design. The District indicated that the HGL schematic was preliminary until ongoing pipeline work was completed and the final version may result in changes to this evaluation. Furthermore, it will need to be confirmed that the membrane feed pumps can be sized to provide an outlet pressure of approximately 25 psi, sufficient to fill the tank downstream of the membranes.

A clearwell tank(s) with a height of 52 feet and a volume of 500,000 gallons results in a diameter of 40 feet. These dimensions put this in a standpipe category, where the height is greater than the diameter. This is acceptable but does increase the unit cost per gallon for construction. It also means there are fewer gallons per foot of height. Water levels will fluctuate more rapidly than for a larger diameter tank, which will cause variations in pressure downstream of the tank.

An alternative would be to use a lower tank height and install a finished water pump station to add head to the water entering the system. There would be additional costs for the pump station facility but it does offer the advantage of flexibility. The pumps could be changed if there was a need to change the discharge hydraulics.

SECTION 6

Permitting and Easements

The following list summarizes permits and easements that will be needed for the project:

1. The District confirmed that the Makai site is already appropriately zoned and an allowed use is the installation of a water treatment plant. No further permitting appears to be necessary for this property.
2. An Environmental Report will be required for the U.S. Department of Agriculture (USDA) funding.
3. The Beaver Creek intake must comply with the conditions listed in the water right Final Order, to be issued by Oregon Water Resources Department. The conditions listed in the draft PFO include flow, temperature, and stream gaging monitoring requirements, as well as design features for the intake. The intake will require a Joint 404 U.S. Army Corps of Engineers and Oregon Department of State Lands permit. The Joint 404 permit includes review and approval by NMFS, ODFW, and DEQ. It requires sufficient analyses to address biological resources, cultural resources, wetlands delineation, and consideration of sensitive species.
4. The riparian area around the intake that is disturbed during construction is to be restored per ODFW's Fish and Wildlife Habitat Mitigation Policy OAR 635-415.
5. The county's review and approval will be necessary for installation of the pipelines along the county roads and for the horizontal directional drill pipeline installation under Beaver Creek.
6. The design documents will require review and approval by the Oregon Drinking Water Services section of the Oregon Health Authority.
7. The water treatment plant discharge waste must be permitted under the 200-J permit required by DEQ. This permit has a listed application fee of $245 and a $557 annual cost.
8. A land use compatibility statement is a necessary component of one or more of the permits.
9. Easements will be required for the raw water pipeline from Beaver Creek road up the hill to the plant site, and for the waste discharge line from the road to the river.

SECTION 7

Membrane Procurement

The recommended approach for procuring the membrane equipment is to issue a pre-purchase request for proposals (RFP) during the early stage of final design. CH2M will prepare this pre-purchase RFP, with input and guidance from the District. The membrane equipment systems vary from one vendor to another, and so it is important to know the details of the selected equipment before finalizing the design. As part of the specified services, the selected membrane supplier will provide submittals, attend design coordination/review meetings and provide other engineering support to the design team.

An RFP process allows the District to consider qualifications, experience, and other non-cost factors when selecting membrane equipment, in addition to cost. The non-cost factors can include the following:

- History of the supplier, since the intent would be to form a long-term relationship between the District and the membrane supplier
- Demonstrated experience and performance on projects of similar size and raw water quality
- Supplier's administrative and technical capability, including personnel qualifications
- Preliminary system layout

Cost factors can include the following:

- Equipment capital cost
- Other capital costs associated with the equipment package, such as:
  - Chemical storage and feed, if not included in proposed equipment capital cost
  - Waste pump station
  - Yard piping
  - Building space
  - Backwash and spent cleaning solution treatment
- Operating costs
  - Power use
  - Treatment chemical consumption
  - Cleaning chemical consumption
  - Chemical consumption required to neutralize backwash and/or cleaning solution waste prior to disposal
  - Membrane module replacement cost (annualized based on warrantied membrane life)
  - Labor hours per day of operation during normal production (if deemed to be different between membrane technologies)
  - Labor hours per membrane cleaning event

As discussed earlier in the report, piloting of membrane filtration is no longer a state requirement, and is not recommended because of its expense. In lieu of pilot testing, CH2M has achieved good results by requiring the membrane equipment supplier to be responsible for a one-year monitored test period after startup of the finished plant. The membrane supplier's contract will include performance guarantees and penalties for not meeting the guarantees, and the one-year monitored test period is the process for determining compliance with the guarantees.

SECTION 8

Project Construction Options

This section describes optional methods for contracting with a construction firm.

8.1 Conventional Design-Bid-Build

The conventional design-bid-build approach is the most common method for delivering civil infrastructure projects. The engineer develops detailed design documents, which are then publically bid. The award of the construction contract is made to the lowest bid from a responsible, responsive bidder. The contractor's qualifications are not considered in the selection. The terms responsible and responsive simply refer to a contractor that is licensed to do work in Oregon, has fulfilled its financial obligations on past projects without unresolved legal actions, and that has completed the bid form properly. A prequalification requirement for bidders can be used to eliminate inexperienced contractors from bidding on the work.

8.2 Construction Manager-General Contractor (CM-GC)

Under this approach, a construction contractor is hired early in the design process through consideration of qualifications, experience, and overhead rates. The contractor then provides review and input as the design is completed, with the combined goals of understanding the work to minimize surprises during construction, and to provide input from a contractor's point of view to achieve cost savings. The CM-GC contractor provides a guaranteed maximum price as the design nears completion. Price competition is retained in the process as the CM-GC contractor, in cooperation with the owner and engineer, must openly bid major portions of the work.

8.3 Design-Build

A design-build approach means that a single firm is responsible for the design and construction of the project. This is only feasible after the owner's engineering firm advances the design far enough to define the work so that all design-build firms bidding on the work are bidding on a project that will deliver similar value to the owner. The project is not defined explicitly as it would be using either of the other two delivery approaches. A preliminary design is advanced far enough so that the essential elements are defined but the design-build contractor determines the details. The owner considers experience, qualifications, and ideas on the project design to short-list the design-build firms, but generally makes the final selection based on price. The strongest benefits to design-build are to achieve schedule savings or to deliver highly complex projects. Since schedule is not a primary driver for the District's project and it is not overly complex, this approach does not appear to offer benefits and is not further considered.

8.4 Comparison of Conventional Delivery and CM-GC

The conventional delivery approach is the most common approach and is understood by all contractors, but it does entail the following inherent weaknesses:

- The owner holds all risk for performance and budget
- The owner lands in the middle of all disputes between the contractor and engineer
- The low bid can lead to a contentious environment or low quality of workmanship; it is not uncommon to experience excessive change order requests and disputes for convention design-bid-build projects

The CM-GC process has been developed to address these weaknesses. The process can minimize disputes and change orders by allowing the owner to consider a contractor's qualifications and by involving the contractor in the latter aspects of the design. The contractor's involvement during design means the contractor has a thorough understanding of the work, reducing both the need and justification for change orders. The contractor becomes part of the owner-engineer team and ideally, all three parties work together for project success. The contractor provides constructability input before the design is complete, often leading to cost savings. The CM-GC approach avoids the risk of ending up with a low bidder that has not done similar work previously or has not done projects of the same size.

The downside of a CM-GC approach is that the CM-GC contractor sets their firm's overhead and profit rates as part of the proposal, and not in a competitive bid environment. This typically adds cost to the work. However, the cost savings accrued through involvement of the contractor during the later stages of design and by minimizing change orders generally counter-balance the higher overhead and profit rates.

A further benefit of CM-GC for the District for the Beaver Creek Water Supply Project is the ability to attract qualified contractors. CH2M discussed the proposed project with three Oregon contractors experienced in building treatment plants and intakes. All three indicated that they would be more likely to pursue the work if it was packaged as a CM-GC project than if it was issued as a conventionally bid project, with one of the three indicating that they would almost certainly not pursue the project if it was delivered as a convention design-bid-build. A CM-GC process is more likely to attract an experienced contractor whereas the low bidder for a conventionally delivered design-bid-build project may be a smaller, local contractor that is marginally qualified for this type of work.

CH2M's preliminary recommendation was for the District to implement this project using CM-GC based on these factors. However, the District plans to obtain project funding from the USDA and the USDA may not accept the CM-GC project delivery methodology. This was being further explored with USDA officials as this report was being prepared.

8.5 Process for Using CM-GC Delivery

Oregon's contracting laws consider the use of conventional design-bid-build as the standard method, and allow CM-GC as an alternative contracting method. According to Oregon Revised Statutes 270C.335, CM-GC is allowed as an alternative method if the following conditions are met:

1. It is unlikely that CM-GC will encourage favoritism in selecting a contractor and unlikely that it will substantially diminish competition
2. It is likely that the CM-GC process will result in substantial cost savings, where such cost savings may be demonstrated by any of the following:
   - Long-term operational costs
   - Capital cost savings for the public
   - Value engineering
   - Incorporation of specialized experience that improves project delivery
   - Improvements to public safety during and after construction
   - Responsiveness to market conditions
   - Better matching the selection of the contractor to the technical complexities involved with the work
   - More favorable view of the work by funding sources

It has been CH2M's experience that these conditions are fully satisfied on similar water supply and treatment projects, therefore allowing the use of CM-GC. The following three steps are necessary to gain approval for using CM-GC:

1. Prepare a findings report to justify CM-GC as an alternative delivery method, which discusses how the CM-GC process will fulfill the necessary conditions
2. Hold a public hearing to discuss the findings report
3. Documents results at the conclusion of construction, which compares estimated and actual costs and the successes and failures of the approach

Oregon's rules allow for flexibility in making the contractor selection for the CM-GC process. The District can consider the contractor's qualifications and experience in doing similar work, the contractor's proposed methodology for participating in the design, the contractor's ideas for carrying out the construction, and the contractor's proposed overhead rates. Often, the approach has been to issue a request for proposals from interested contractors followed by an interview with the two or three that present the most favorable written proposal.

SECTION 9

Schedule

Table 9-1 provides a possible project schedule. It allows time for preparation of the Preliminary Engineering Report (PER) and Environmental Report (ER) required by USDA.

Table 9-1. Preliminary Project Schedule
Phase IV Conceptual Design Report for the Seal Rock Water District

Item	Duration	Possible Start Date	Possible End Date
Preliminary Engineering Report	3 months	November 2016	February 2017
Environmental Report	3 months	November 2016	February 2017
Funding application	3 months	February 2017	May 2017
Joint 404 permit	12 months	January 2017	December 2017
Membrane procurement	3 months	May 2017	August 2017
Final design	9 months	August 2017	June 2018
Construction	12 months	July 2018	June 2019
Startup	2 months	July 2019	August 2019

SECTION 10

Cost Estimate

Table 10-1 provides a preliminary cost estimate based on the project as described within this report and the drawings included in Appendix H. The total construction estimate is $10,600,000. The scope of work for this estimate includes the installation of one of two steel clearwell tanks in the initial project, with the second to be added in the future. The final design approach for a clearwell or clearwell and pump station is uncertain until system hydraulic needs are confirmed. Additional water quality data may also necessitate changes in the design, with cost implications.

This construction estimate includes escalation to a March 2018 mid-point of construction date and a 25 percent contingency. It is considered a Class IV level infrastructure estimate, with an expected range of +50 to -30 percent. With additional costs for USDA preliminary engineering and permitting, and for surveying, geotechnical investigations, membrane equipment pre-purchase, final design, environmental permitting, engineering construction, and startup services, the preliminary total project estimate is $12,100,000.

Table 10-1. Project Cost Estimate

Phase IV Conceptual Design Report for the Seal Rock Water District

Item	Quantity	Units	Unit Cost	Line Total	Discussion
Intake (river structure and electrical building about 80 feet away)					
River structure	20	cy	$2,000.00	$40,000	
Coffer dam	1	ea	$50,000	$50,000	Allowance, based on Kernville infiltration gallery work
Wedge wire screen	8	sf	$750.00	$6,000	
Pumps and motors	3	ea	$60,000	$180,000	Installed cost. Based on discussion with manufacturer: Flygt NP3202SH-273 with FM rating and shielded cable, each at $45k + 2K for guide rail
Raw water line to road	150	ft	$210.00	$31,500	14" nominal HDPE (from intake structure to start of HDD pipeline)
Air compressor, air lines	1	ea	$35,000	$35,000	Based on recent Kernville intake
Instrumentation	1	ea	$40,000	$40,000	Allowance for level indicator, conductivity probe, temperature upstream and downstream; streamflow gaging separate (installed beforehand at bridge by District)
Electrical - VFD equipment	3	ea	$30,000	$90,000	Estimate by supplier
Electrical installation	1	ea	$40,000	$40,000	
Electrical power supply	1	ea	$250,000	$250,000	Estimate provided by CPI
Electrical & blower building	150	sf	$250.00	$37,500	Building 10' x 15', 9' interior height, block material, with sound-absorbing interior
Retaining wall	35	ft	$200.00	$7,000	Maximum height 3'.
Road and site improvements	1	ea	$10,000.00	$10,000	Allowance
Site restoration	1	ea	$10,000.00	$10,000	Allowance
Property purchase	1	ac	$20,000.00	$20,000	Allowance as suggested by District
Raw water pipeline, 14" nominal HDPE					
HDD under river	800	ft	$420	$336,000	Based on comparison with recent projects
Trenched line	7,300	ft	$210	$1,533,000	Shoulder, along existing N Beaver Creek county road
Easement purchase	1	ea	$20,000	$20,000	
Water treatment plant					
Pall membrane package	1	ea	$1,190,000	$1,190,000	Pall preliminary quote (June 3, 2016)
General mechanical; installation of membrane equipment	1	ea	$120,000	$120,000	5 workers, 8 weeks = $120,000
Miscellaneous mechanical piping allowance	1	ea	$238,000	$238,000	20% of membrane equipment cost
Onsite hypochlorite system	1	ea	$100,000	$100,000	Based on $70k equipment quote from TMG, with allowance for installation
Coagulant system	1	ea	$40,000	$40,000	Feed pumps, valve arrangement; rough estimate based on recent TVWD ASR facility

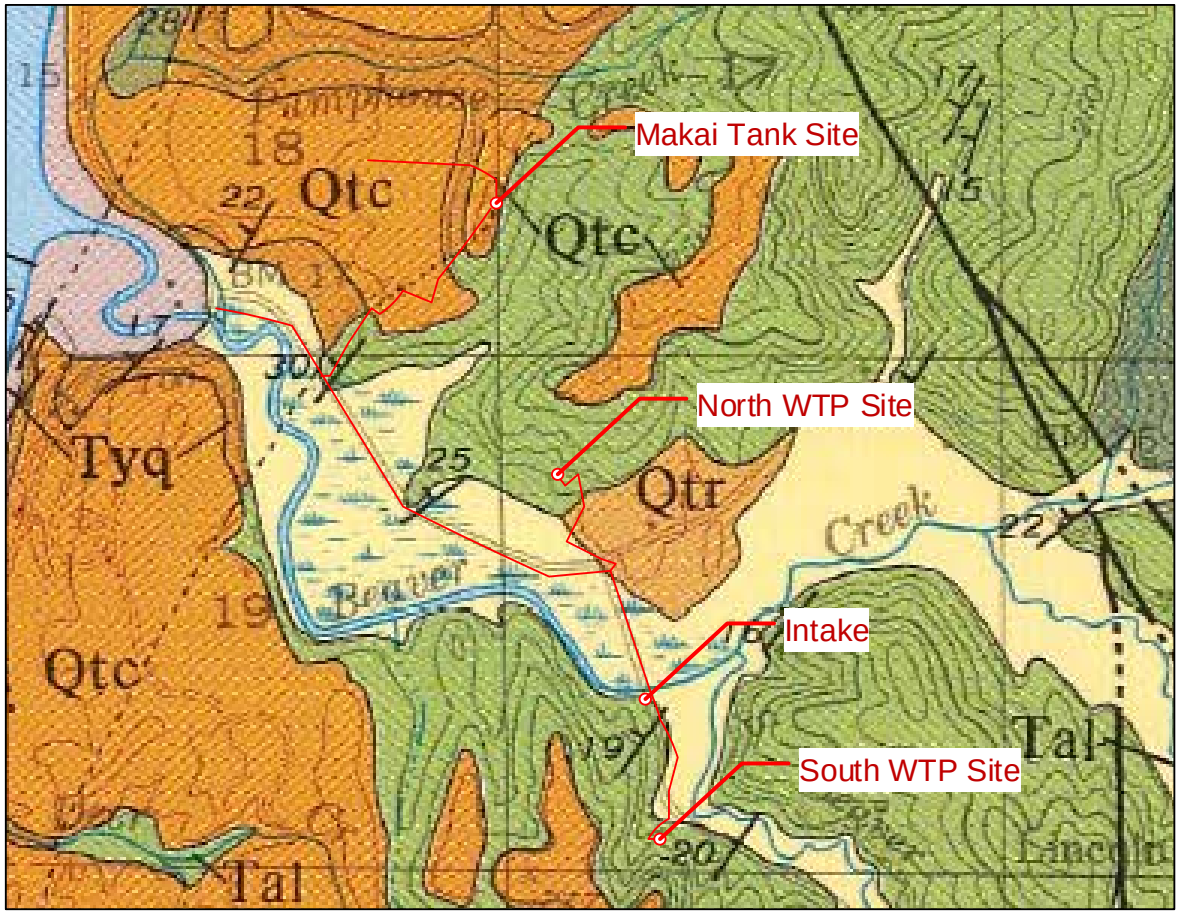
Table 10-1. Project Cost Estimate

Phase IV Conceptual Design Report for the Seal Rock Water District

Item	Quantity	Units	Unit Cost	Line Total	Discussion
Building	3,300	sf	$228.72	$754,776	2016 RS Means office 1-story (reinforced concrete structure)
Backup generator	1	ea	$130,000	$130,000	Installed cost for 250kW generator with a sound attenuated weatherproof enclosure and integral fuel tank with 48 hours of fuel
Clearwell, welded steel	500,000	gal	$1.30	$650,000	Early quote provided by CBI contractors; unit cost increased to account for smaller, taller tank
Steel tank foundation	2,000	sf	$100	$200,000	Allowance for shallow piles for supporting standpipe
Site improvements	1	acres	$20,000	$20,000	Allowance for gravel, misc improvements
Site excavation (cut)	2,297	cy	$10	$22,970	
Site backfill (fill)	478	cy	$20	$9,560	
Export excess material	1,819	cy	$40	$72,760	Assumes disposal within 5 miles
Fence	500	ft	$41	$20,405	2016 RS Means 8' Aluminized Steel Fence
Yard piping	500	ft	$300	$150,000	
Electrical power supply	1	ea	$56,000	$56,000	Preliminary estimate of cost to be paid by District to Central Lincoln PUD for extending 3-phase power to the Makai site
Electrical power buried conduit	1	ea	$50,000	$50,000	Allowance for buried conduit for new power feed from development to Makai site
Backwash basins					
Site Excavation (Cut)	625	cy	$10	$6,250	
Export Excess Material	625	cy	$40	$25,000	
Weir Gates	2	ea	$10,000	$20,000	
Concrete Liner	60	cy	$1,000.00	$60,000	
Concrete Walls & Footings	45	cy	$2,000.00	$90,000	
Backwash discharge outlet in river	1	ea	$10,000.00	$10,000	Allowance
Backwash discharge line	3,500	ft	$60.00	$210,000	3-inch line
Electrical	1	ea	$637,000	$637,000	15% of subtotal for plant
Instrumental and controls, SCADA	1	ea	$255,000	$255,000	6% of subtotal for plant
Finished water pipeline					
Trenched line, 12-inch	1,500	ft	$210.00	$315,000	C900 PVC, along access road
Construction Summary					
Subtotal construction				$8,190,000	
Escalated 2% per year				$250,000	To mid-point of March 2018
Escalated subtotal construction				$8,440,000	
Contingency at 25%				$2,110,000	
Construction Estimate				**$10,600,000**	Class IV estimate; range of +50% to -30%
Engineering Services					
Preliminary Engineering Report				$55,000	Per USDA requirements
Environmental Report				$25,000	Per USDA requirements
Surveying				$10,000	Allowance for additional surveying to supplement work that has been done to date
Geotechnical site investigation				$30,000	Allowance for drill rig, soils testing, and engineering evaluation of findings
Joint 404 Permit				$60,000	Joint Division of State Lands/US Army Corps of Eng. River intake permit, including cultural resources, wetlands, and biological assessment reviews
Membrane pre-purchase				$30,000	Pre-purchase process for membrane equipment
Design				$820,000	Engineering design to develop bid documents
Bid services				$25,000	
Services during construction				$400,000	Level and approach to construction observation not yet defined
Startup, support for first year of operations				$25,000	
Engineering Estimate				**$1,480,000**	
			TOTAL PROJECT ESTIMATE	**$12,100,000**	

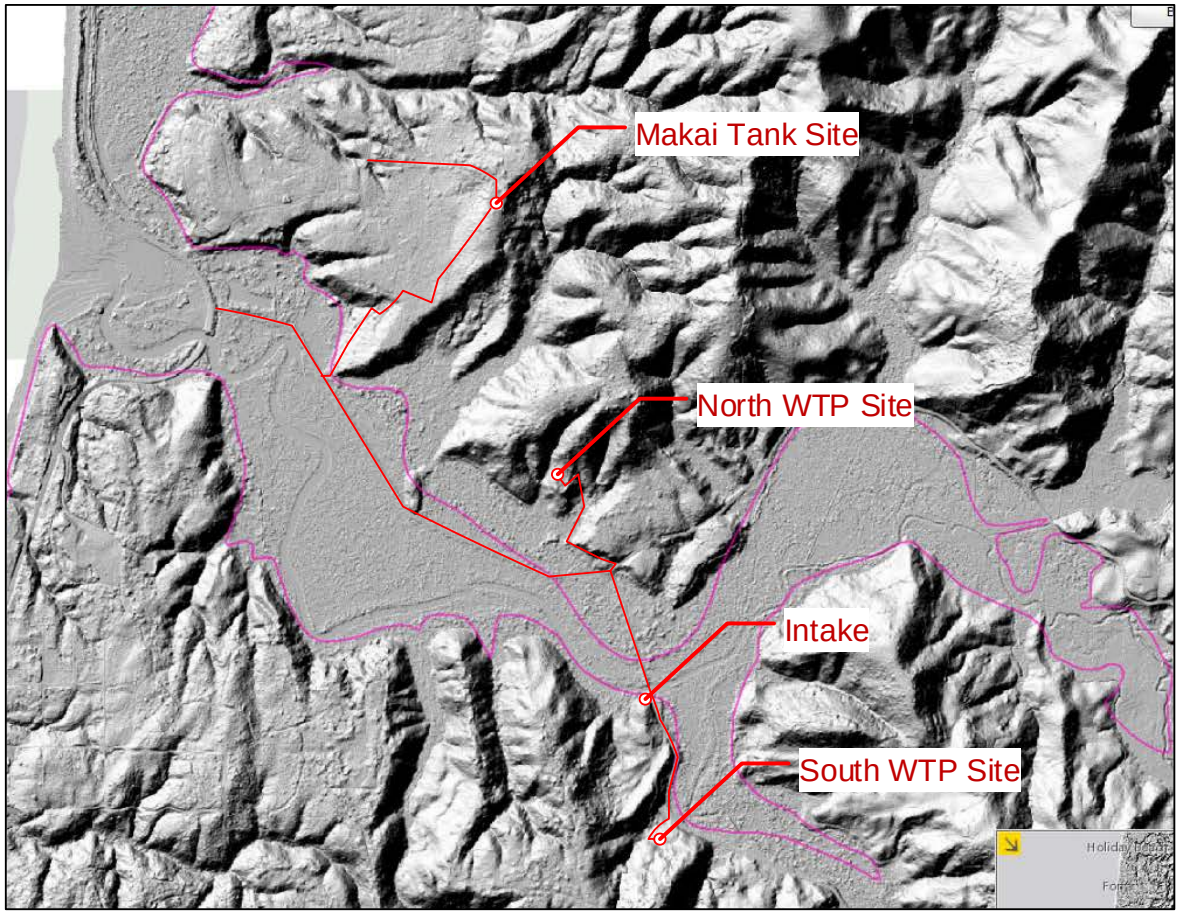
Appendix A
Regional Geology Map

Geology


Makai Tank Site
North WTP Site
Intake
South WTP Site
Qtc
Qtc
Tyq
Qtr
Qtc
Tal
Tal
Beaver
Creek
Creek

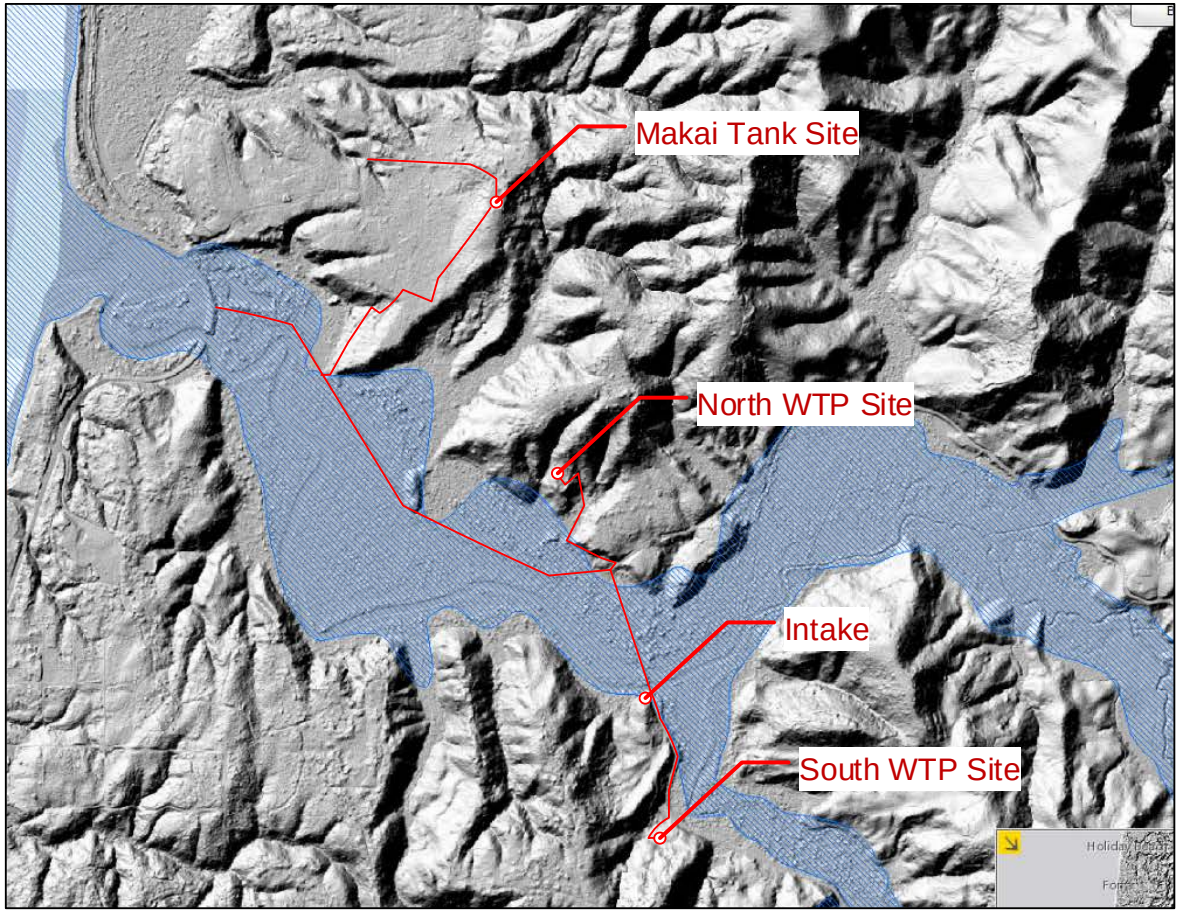
Appendix B
Tsunami Inundation Map

Tsunami Inundation



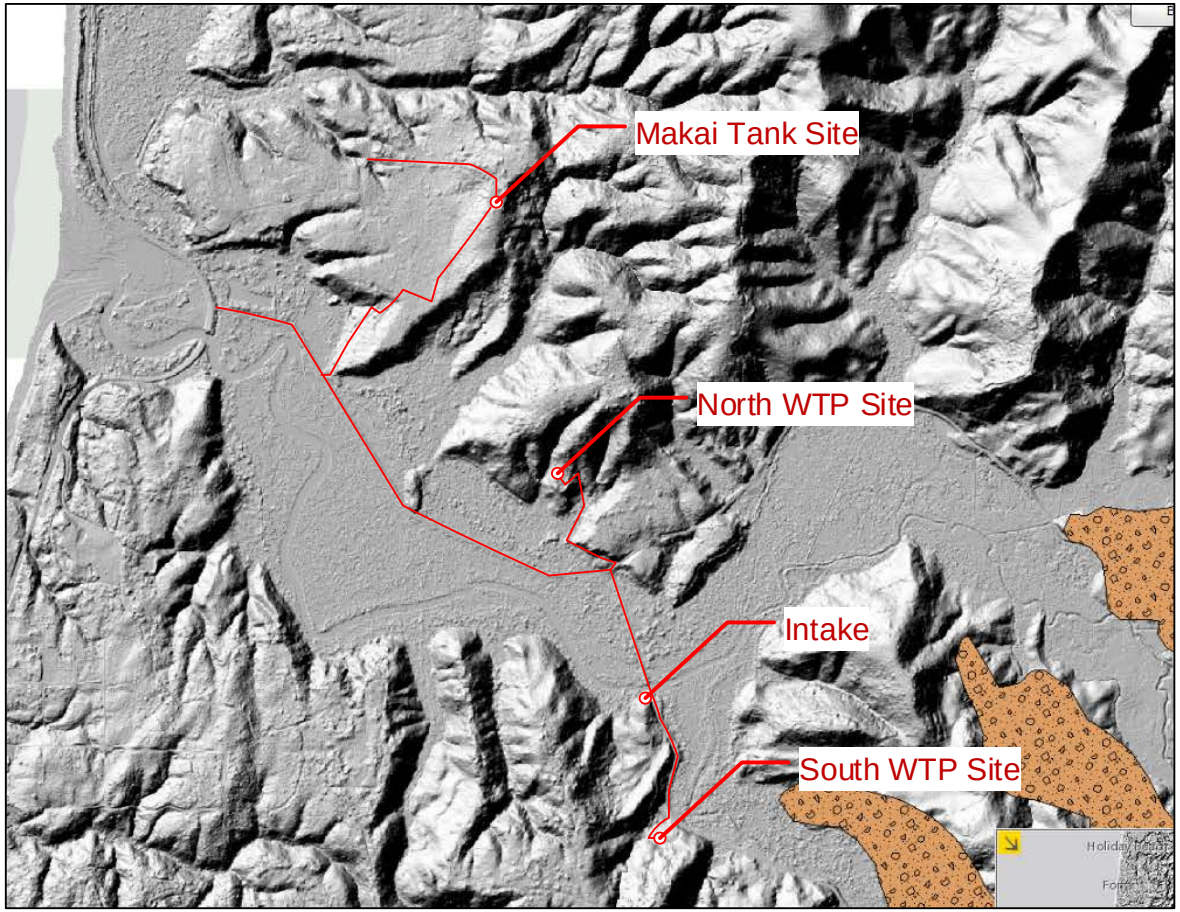
Appendix C
Floodplain Map

100-year Flood Inundation

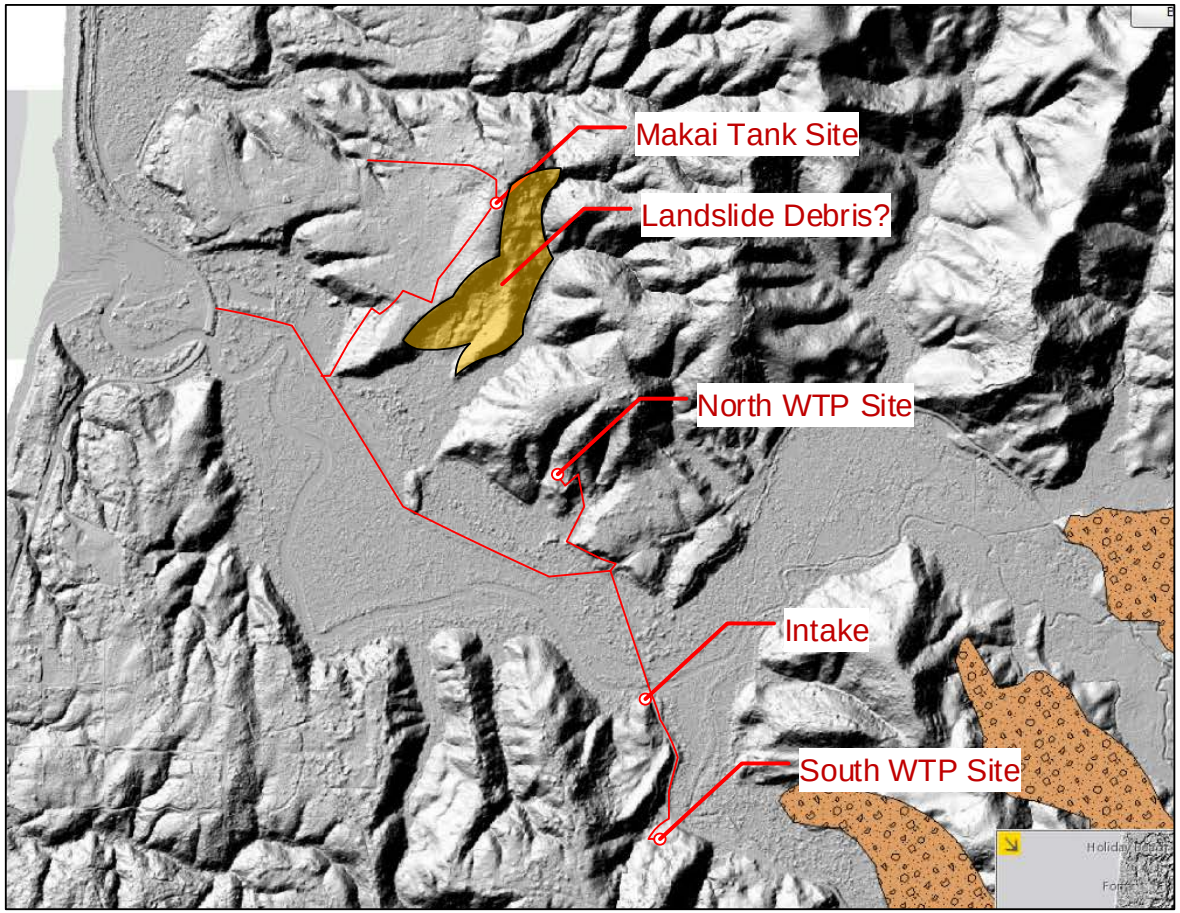


Appendix D
Landslide Maps (Known and Possible Landslide Hazards)

Known Landslide Hazard



Possible Landslide Hazard



Appendix E
Beaver Creek Water Rights Proposed Final Order

Oregon Water Resources Department
Water Right Services Division

Water Rights Application
Number S-88124

Final Order

Hearing and Appeal Rights
Under the provisions of ORS 537.170 and ORS 537.622, the applicant may request a contested case hearing by submitting the information required for a protest under ORS 537.153(6) or ORS 537.621(7) to the Department within 14 days after the date of mailing of this order as shown below. If a contested case hearing is requested, the Department must schedule one. In the contested case hearing, however, only those issues based on the modifications to the Proposed Final Order may be addressed.

ORS 536.075 allows for additional appeal rights for other than contested case. 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 137-004-0080 you may either petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the Director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied.

Findings of Fact

1. On August 26, 2015, Seal Rock Water District submitted an application to the Department for a water use permit.

2. The Department issued a Proposed Final Order on June 21, 2016.

3. The protest period closed August 5, 2016, and no protest was filed.

4. On August 5, 2016, the Department received correspondence from Seal Rock Water District requesting the following modifications to the Proposed Final Order:

Seal Rock Water District requests the addition of the following conditions:

1) The permittee shall not withdraw, or allow another to withdraw, water from the Siletz River under Permit S-40277 (or any water right derived from Application S-50094), except to the extent that water is not reasonably available under this permit for all use authorized by the terms and conditions of this permit.

2) The authorized point of diversion shall not be moved through a permit amendment or water right transfer (or any other water right

transaction) more than 250 feet upstream or 1320 feet downstream from the authorized location in this permit.

Seal Rock Water District requests that the Department modify the condition under "Water Temperature Monitoring" on page 2 of the draft permit as follows: (Additional language is underlined and language to be deleted is struck through.)

> 3) Two years ~~P~~prior to initiating water diversion from Beaver Creek, the permittee shall install temperature data loggers that meet DEQ specifications at locations upstream and downstream of the point of diversion. The temperature monitoring shall be conducted during the period from May 15 to October 31 of each year for two years before and five years after water use begins. The permittee shall record water temperature data at a minimum of 30 minute intervals and provide the collected data and supporting audit documentation to the Department and DEQ by December 31 each year, or upon the request of the Director.
>
> 4) The Permittee shall develop a sampling and analysis plan (SAP) to identify project management responsibilities, monitoring locations, schedule, quality assurance and data management activities. The permittee shall submit the SAP to the Department and DEQ prior to initiating the above described ~~five years of~~ temperature monitoring. Data loggers shall be operated and maintained consistent with the SAP.

Seal Rock Water District requests that the Department modify the condition under "Other Conditions" on page 3, paragraph 3 of the draft permit as follows:

> 5) For purposes of this condition, "short-term" supply means supplying water for not more than one continuous period of two calendar years, and not more than two years total in any 10-year period; and "emergency" supply means supplying water for not more than one continuous period of one calendar year, and not more than one year total in any five-year period, to an entity in the event the entity loses it's water supply due to unforeseen circumstances.

Conclusions of Law

1. The proposed use would not impair or be detrimental to the public interest pursuant to ORS 537.153(2).

Order

Application S-88124 therefore is approved with the above modifications to the proposed Final Order, and Permit S-55012 is issued as limited by the conditions therein.

DATED

E. Timothy Wallin, Water Rights Program Manager
for Thomas M. Byler, Director

This document was prepared by Lisa Graham. If you have any questions about any of the statements contained in this document I can be reached at Elisabeth.A.Graham@wrd.state.or.us or 503-986-0808.

If you have previously filed a protest and want to know its status, please contact Patricia McCarty at 503-986-0820.

If you have other questions about the Department or any of its programs please contact our Customer Service Group at 503-986-0801.

Address all other correspondence to: Water Rights Section, Oregon Water Resources Department, 725 Summer St NE Ste A, Salem OR 97301-1266, Fax: 503-986-0901.

STATE OF OREGON

COUNTY OF LINCOLN

PERMIT TO APPROPRIATE THE PUBLIC WATERS

THIS PERMIT IS HEREBY ISSUED TO

SEAL ROCK WATER DISTRICT
1037 NW GREBE STREET
SEAL ROCK, OR 97376

The specific limits and conditions of the use are listed below.

APPLICATION FILE NUMBER: S-88124

SOURCE OF WATER: BEAVER CREEK, A TRIBUTARY OF PACIFIC OCEAN

PURPOSE OR USE: MUNICIPAL USE

MAXIMUM RATE: 2.0 CUBIC FEET PER SECOND

PERIOD OF USE: YEAR-ROUND

DATE OF PRIORITY: AUGUST 26, 2015

POINT OF DIVERSION LOCATION: NE ¼ SW ¼ SECTION 20, T12.0S, R11.0W, W.M.; 610 FEET SOUTH AND 1360 FEET EAST FROM W1/4 CORNER, SECTION 20

THE PLACE OF USE IS LOCATED AS FOLLOWS:

WITHIN THE SEAL ROCK WATER DISTRICT BOUNDARIES

<u>Measurement devices, and recording/reporting of annual water use conditions:</u>

A. Before water use may begin under this permit, the permittee shall install a totalizing flow meter at each point of diversion. The permittee shall maintain the device in good working order.

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

C. The permittee shall keep a complete record of the volume of water diverted each month, and shall submit a report which includes water-use measurements to the Department annually, or more frequently as may be required by the Director. Further,

the Director may require the permittee to report general water-use information, including the place and nature of use of water under the permit.

D. The Director may provide an opportunity for the permittee to submit alternative measuring and reporting procedures for review and approval.

Streamflow Monitoring

Prior to initiating water diversion from Beaver Creek, the permittee shall install and operate a suitable streamflow gaging station at or near the point of diversion on Beaver Creek. Such installation shall be made under the supervision of and approved by the Watermaster. The permittee, following USGS protocol and standards, shall operate and maintain the streamflow gaging station during the period of May 15 to October 15 of each year. A minimum of eight streamflow measurements, at various rates of flow, are required during the first full period of operation, one measurement every four to six weeks is required thereafter. The streamflow and gage height data shall be collected for five years. Measurement and flow data shall be completed to the Department's standards and shall be provided to the Department by December 31 of each year.

The permittee may satisfy the streamflow-monitoring requirement above by entering into an agreement with the Department, or any qualified person selected by the permittee to install, maintain, and operate the required gage.

Water Temperature Monitoring

Two years prior to initiating water diversion from Beaver Creek, the permittee shall install temperature data loggers that meet DEQ specifications at location upstream and downstream of the point of diversion. The temperature monitoring shall be conducted during the period from May15 to October 31 of each year for tow years before and five years after water use begins. The permittee shall record water temperature data at a minimum of 30 minute intervals. Temperature data and supporting audit documentation shall be made available to DEQ and the Department by December 31 each year or upon request of the Director.

The Permittee shall develop a sampling and analysis plan (SAP) to identify project management responsibilities, moni toring locations, schedule, quality assurance and data management activities. The permittee shall submit the SAP to the Department and DEQ prior to initiating the above described temperature monitoring. Data loggers shall be operated and maintained consistent with the SAP.

Fish Screening and By-Pass Condition

The permittee shall install, maintain, and operate fish screening and by-pass devices consistent with current Oregon Department of Fish and Wildlife (ODFW) standards. Fish screening is to prevent fish from entering the proposed diversion while by-pass devices provide adequate upstream and downstream passage for fish. The required screen and by-pass devices are to be in place and functional, and approved in writing by ODFW prior to diversion of any water. The permittee may submit evidence in writing that ODFW has determined screens and/or by-pass devices are not necessary.

Other Conditions

Water use under this permit shall be consistent with the permittee's Water Management and Conservation Plan under OAR Chapter 690, Division 86.

The authorized place of use under this permit shall be limited to the district boundaries. This restriction does not prevent the permittee from providing water outside its district boundaries for short-term or emergency supply.

For purposes of this condition, "short-term" supply means supplying water for not more than one continuous period of two calendar years, and not more than two years total in any 10-year period; and "emergency" supply means supplying water for not more than one continuous period of one calendar year, and not more than one year total in any five-year period, to an entity in the event the entity loses its water supply due to unforeseen circumstances.

The diversion of water under this permit in combination with that under Permit S-40277 shall not exceed a total of 2.6 CFS.

Prior to diversion of water or any associated construction, the permitee shall submit all required land use approvals.

The permittee shall not withdraw, or allow another to withdraw, water from the Siletz River under Permit S-40277 (or any water right derived from Application S-50094), except to the extent that water is not reasonably available under this permit for all use authorized by the terms and conditions of this permit.

The authorized point of diversion shall not be moved through a permit amendment or water right transfer (or any other water right transaction) more than 250 feet upstream or 1320 feet downstream from the authorized location in this permit.

STANDARD CONDITIONS

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

Where two or more water users agree among themselves as to the manner of rotation in the use of water and such agreement is placed in writing and filed by such water users with the watermaster, and such rotation system does not infringe upon such prior rights of any water user not a party to such rotation plan, the watermaster shall distribute the water according to such agreement.

If the riparian area is disturbed in the process of developing a point of diversion, the permittee shall be responsible for restoration and enhancement of such riparian area in accordance with ODFW's Fish and Wildlife Habitat Mitigation Policy OAR 635-415. For purposes of mitigation, the ODFW Fish and Wildlife Habitat Mitigation Goals and Standards, OAR 635-415, shall be followed.

The use may be restricted if the quality of the source stream or downstream waters decreases to the point that those waters no longer meet state or federal water quality standards due to reduced flows.

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

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

The use of water allowed herein may be made only at times when sufficient water is available to satisfy all prior rights, including prior rights for maintaining instream flows.

Construction of the water system shall begin within twenty years of the date of permit issuance. The deadline to begin construction may not be extended. This permit is subject to cancellation proceedings if the begin construction deadline is missed.

Complete application of the water shall be made within twenty years of the date of permit issuance. If beneficial use of permitted water has not been made before this date, the permittee may submit an application for extension of time, which may be approved based upon the merit of the application.

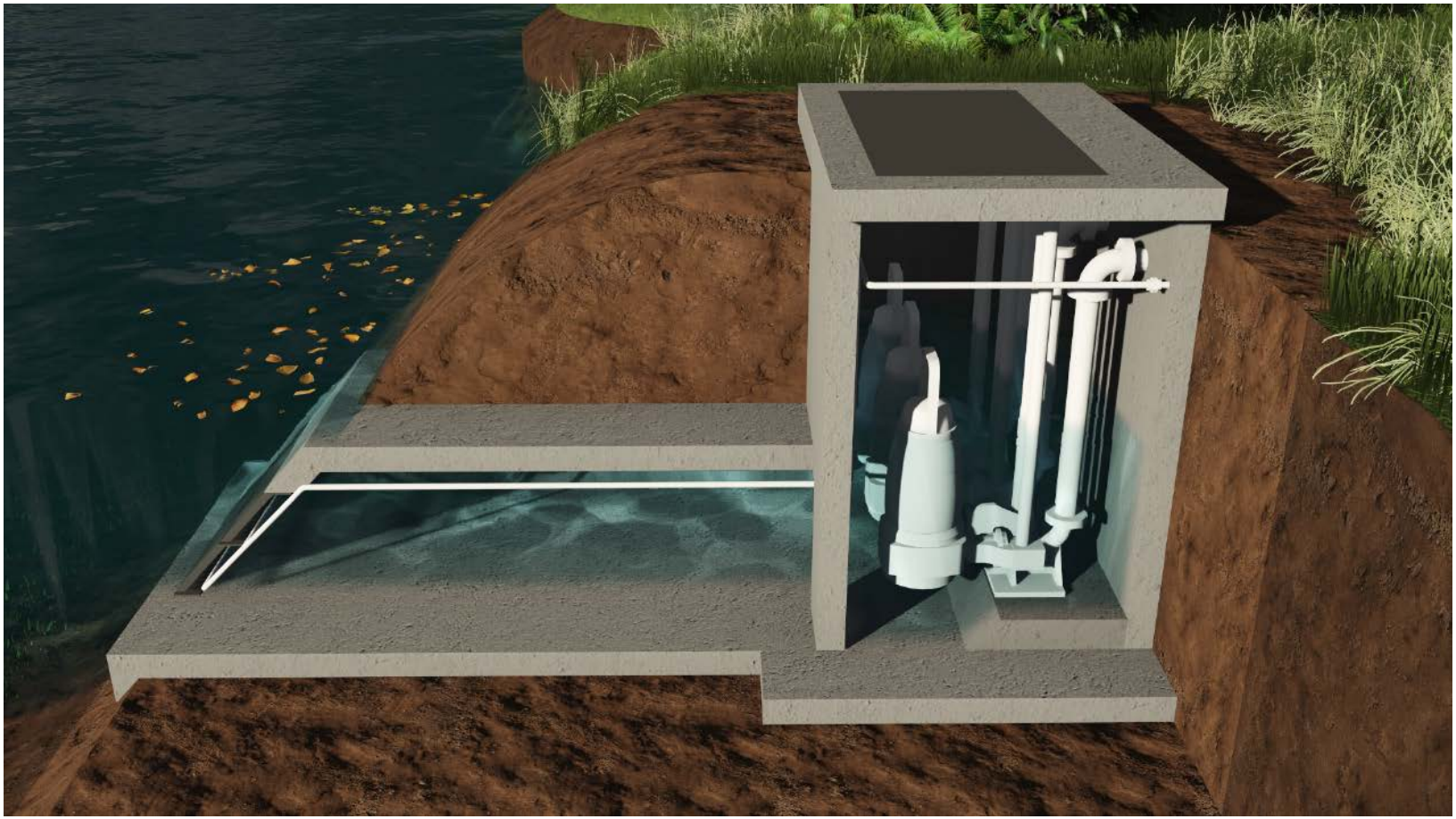
Within one year after making beneficial use of water, the permittee shall submit a claim of beneficial use, which includes a map and report, prepared by a Certified Water Rights Examiner.

Issued

E. Timothy Wallin, Water Rights Program Manager
for Thomas M. Byler, Director

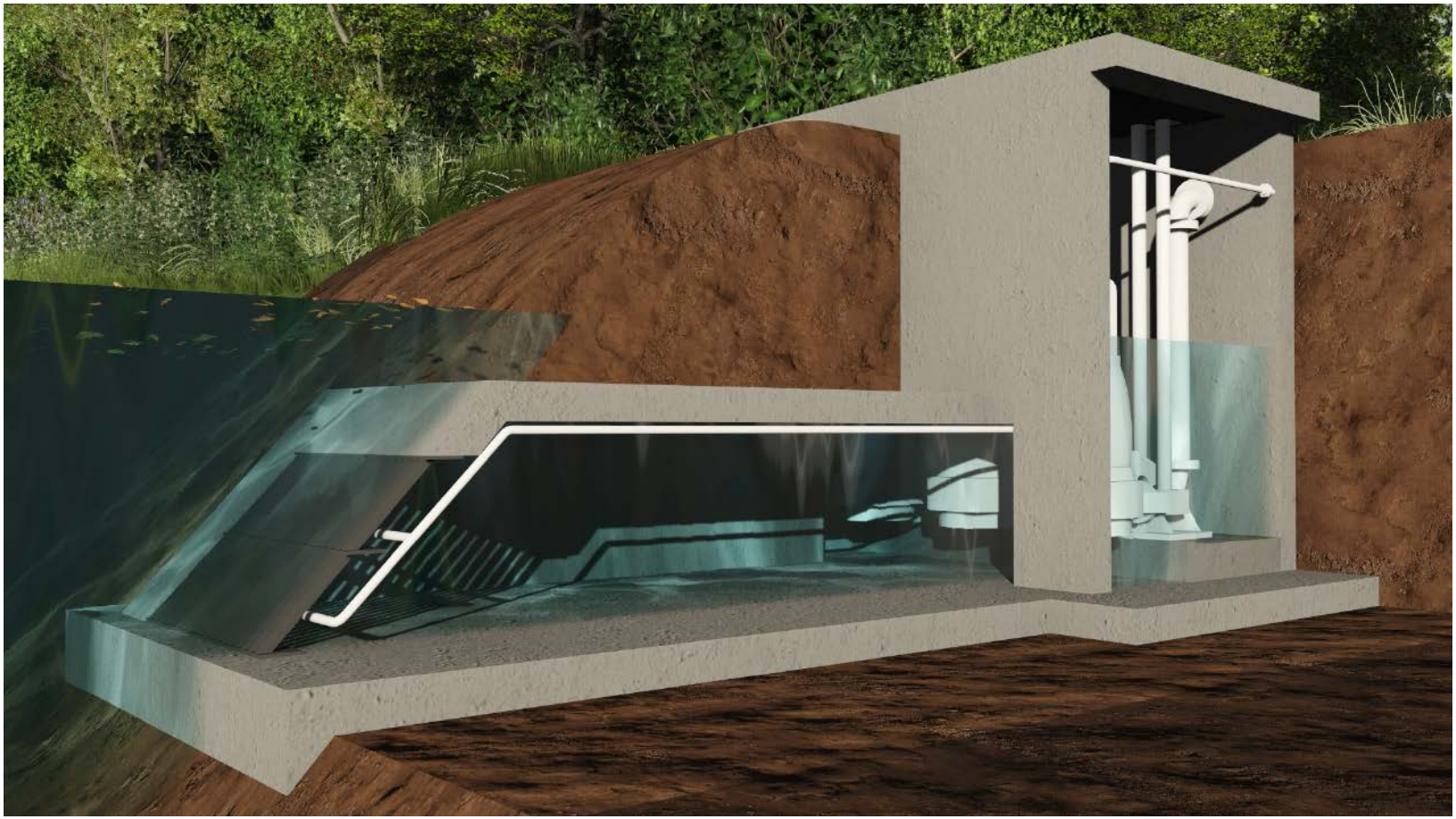
Appendix F
Intake Renderings (5 Views)

Intake Concept



Intake Concept

Intake Concept



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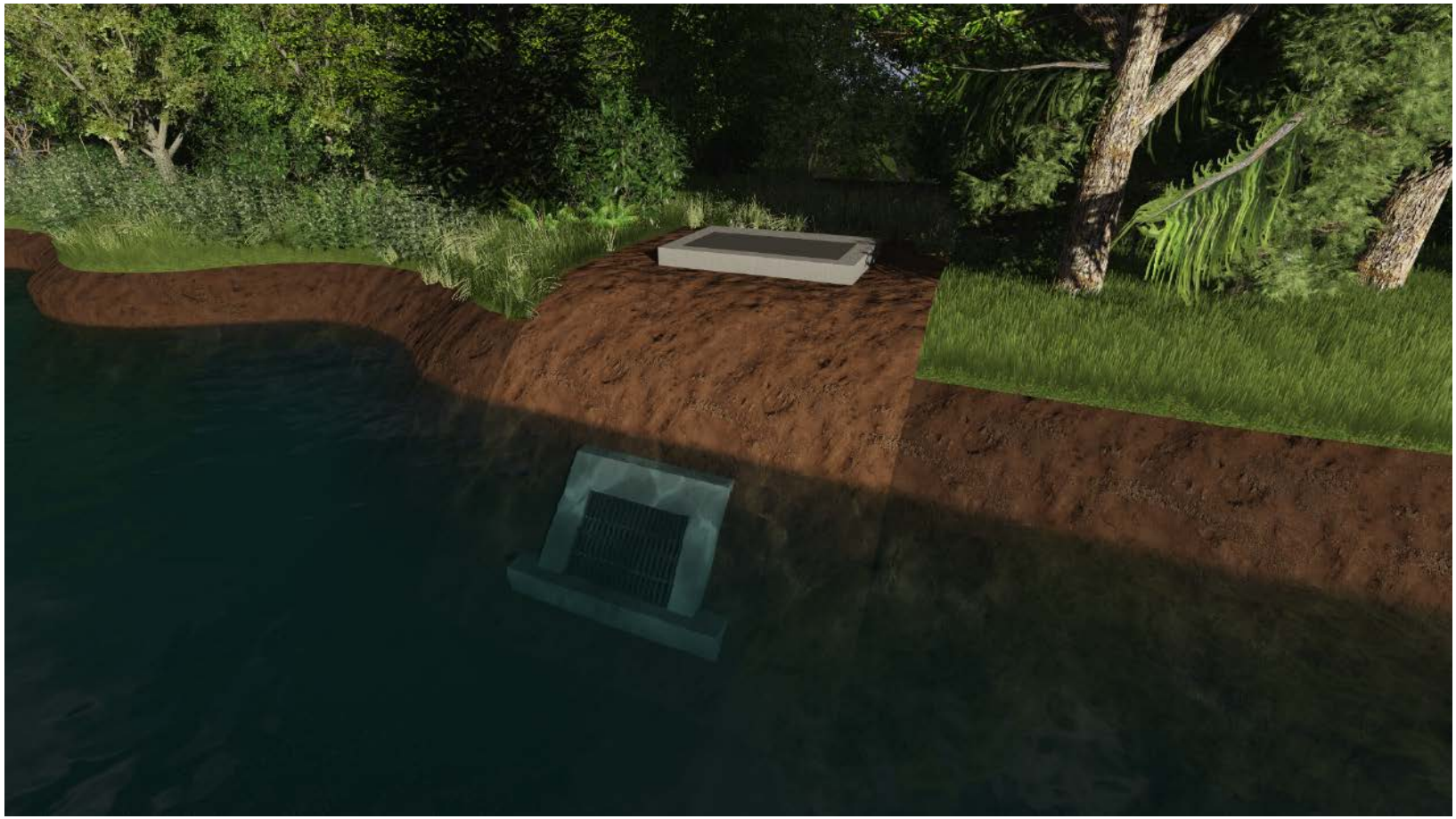
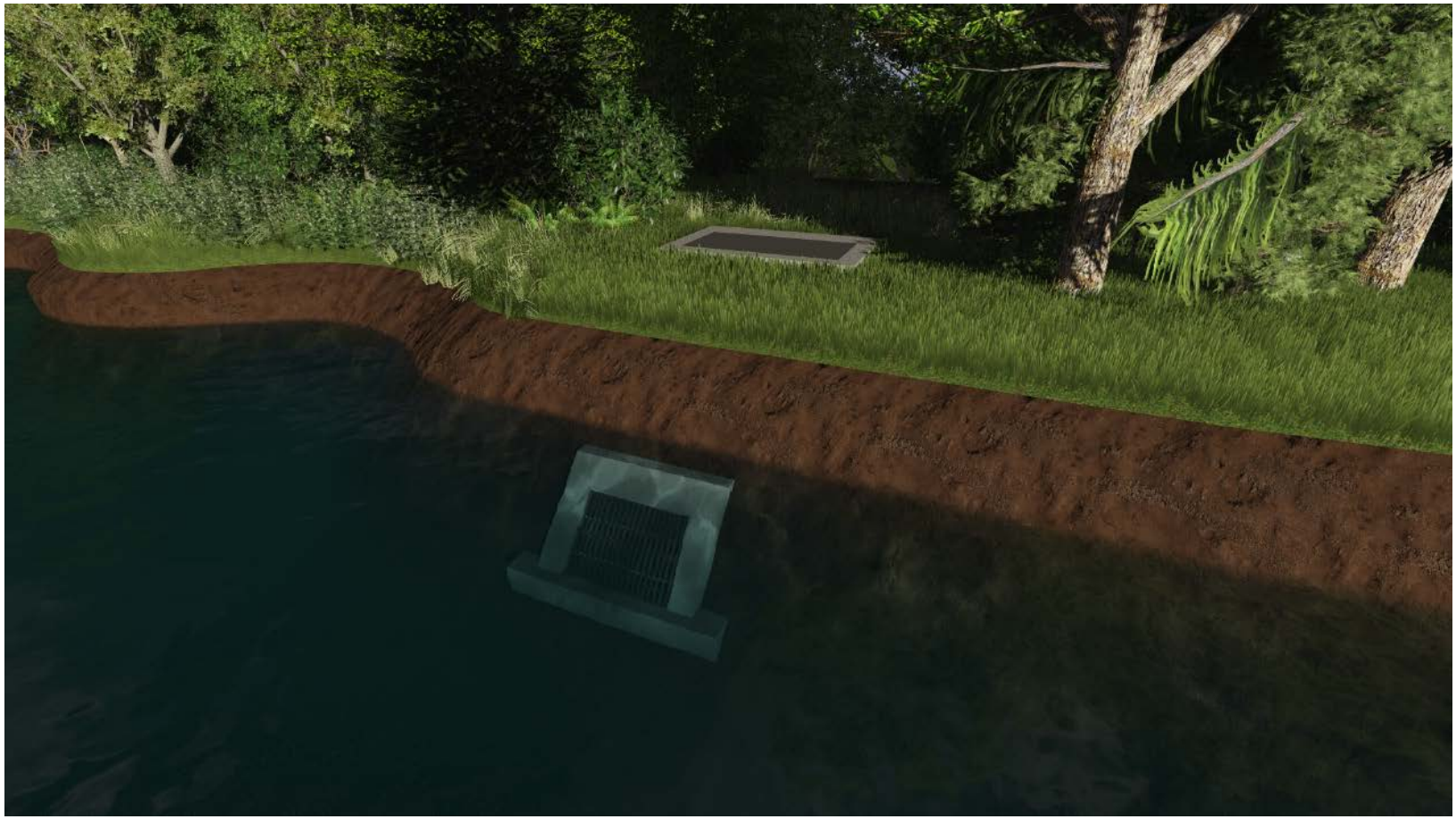


Intake Concept



Intake Concept

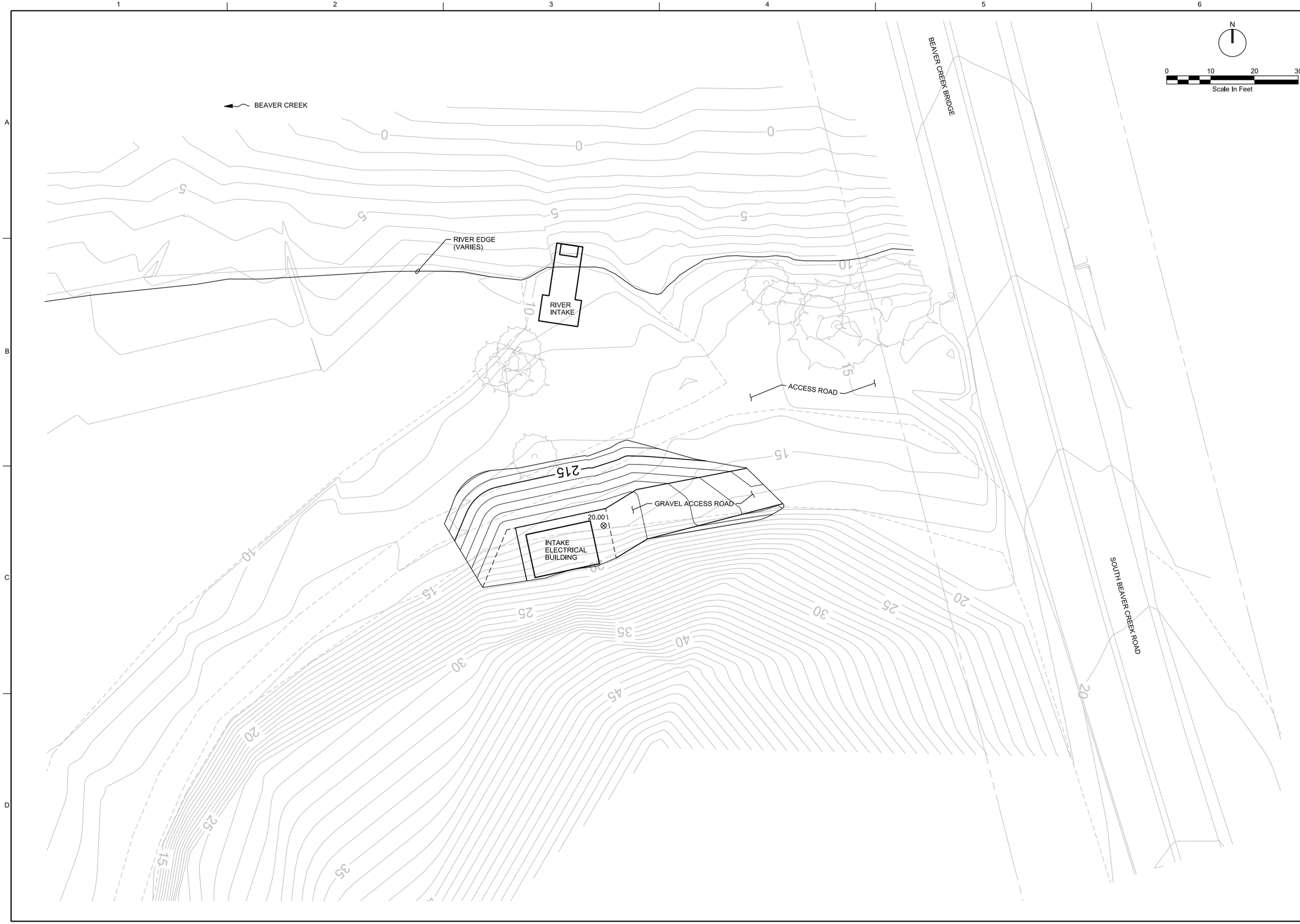
Appendix G
Strengths-Weaknesses-Opportunities-Threats Table

Seal Rock WD WTP Options

Option	Item	Strengths	Weaknesses	Opportunities	Threats
1 South Site	Plant site	Site is already partially prepared, mostly flat.	Small site--probably too small for plant facilities without major site work. Need to extend power lines, need to negotiate cost for replacement of barn	Use of site may help convince property owner to also sell land for intake	Requires negotiations with property owner for purchase. Site access may not be possible following tsunami (two vulnerable roads: Beaver Creek Road and South Beaver Creek Road). May required retaining walls to expand site for plant footprint.
	Plant access road	Access road in place.	Access road is relatively steep and too narrow		May require retaining wall to widen site and access road
	Raw water pipeline	Can follow South Beaver Creek Rd			Availability of alignment within road shoulder (versus needing to install under pavement at higher cost)
	Finished water pipeline	Can follow South Beaver Creek Rd	Requires crossing Beaver Cr at bridge. Long length of pipeline that is exposed to lateral spreading hazard along South Beaver Cr and North Beaver Cr Rds.		South Beaver Creek Rd is vulnerable to seismic damage. Beaver Cr Rd is vulnerable to seismic damage. Availability of alignment within road shoulder (versus needing to install under pavement at higher cost)
2 North Site	Plant site	Large land area appears to be available	Requires significant investment to survey land to understand amount of site work needed; may require substantial earthwork; need to bring in power	Property owner appears to be willing to sell	Permitting issues (clearing, zoning change)
	Plant access road	Do not need to cross Beaver Cr to access plant	Long access road installation with substantial earthwork and clearing; surveying required to understand feasible alignment; crosses wetland areas		Permitting for wetlands (including mitigation costs)
	Raw water pipeline		Requires 'extra' 3000 feet of line from road to site, has to cross Beaver Cr at bridge. Pipeline is exposed to lateral spreading hazard along South Beaver Cr Rd		Crosses a few apparent wetlands; Availability of alignment within road shoulder (versus needing to install under pavement at higher cost)
	Finished water pipeline	Does not have to follow South Beaver Cr Rd to cross Beaver Cr	Requires 'extra' 3000 feet of line from site down to road. Length of pipeline that is exposed to lateral spreading hazard along North Beaver Cr Rd.	Possibility to connect to Makai Tank overland. Possibility to go overland to North Beaver Cr Rd to shorten length of pipe.	Crosses a few apparent wetlands. May be necessary to extend small finished water pipeline back to intake owner's property to supply water in exchange for purchasing property.
3 Makai Site	Plant site	Site already prepared: flat, with fence; existing tank that can be reused; size appears adequate at 136 x 320 feet.	Constrained site; requires extension of higher voltage power lines	No pumping may be necessary from tank into system (more reliable supply in emergencies)	Intake will require larger sized pumps, which could be an issue for power supply. Appears that area of property beyond fence to the north is relatively flat but did not carefully view this portion of site. May not be able to confirm reuse of existing tank without further evaluation and design.
	Plant access road	Existing access road requiring only minimal work for plant needs			Construction access will be through neighborhood
	Raw water pipeline	Minimizes length of pipeline along Beaver Cr that is exposed to potentially lateral spreading	Long length of pipeline that is exposed to lateral spreading hazard along South Beaver Cr and North Beaver Cr Rds		Unknown if easements can be obtained to cross undeveloped land from Beaver Creek road to site
	Finished water pipeline	Eliminates pipeline along Beaver Cr that is exposed to potentially lateral spreading		District already installing 12-inch line with tee that may be sufficient	May be necessary to extend small finished water pipeline back to intake owner's property to supply water in exchange for purchasing property.

9/30/2016

Appendix H
Preliminary Intake and Plant Drawings
(3 Sheets)



NO.	DATE	REVISION	BY	APVD
DSGN	DR	CHK	APVD	

Beaver Creek Water Supply

Seal Rock Water District
Seal Rock, OR

ch2m

BEAVER CREEK INTAKE
CIVIL
SITE PLAN

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2016
PROJ	676178
DWG	06-C-2002
SHEET	

PRELIMINARY DESIGN

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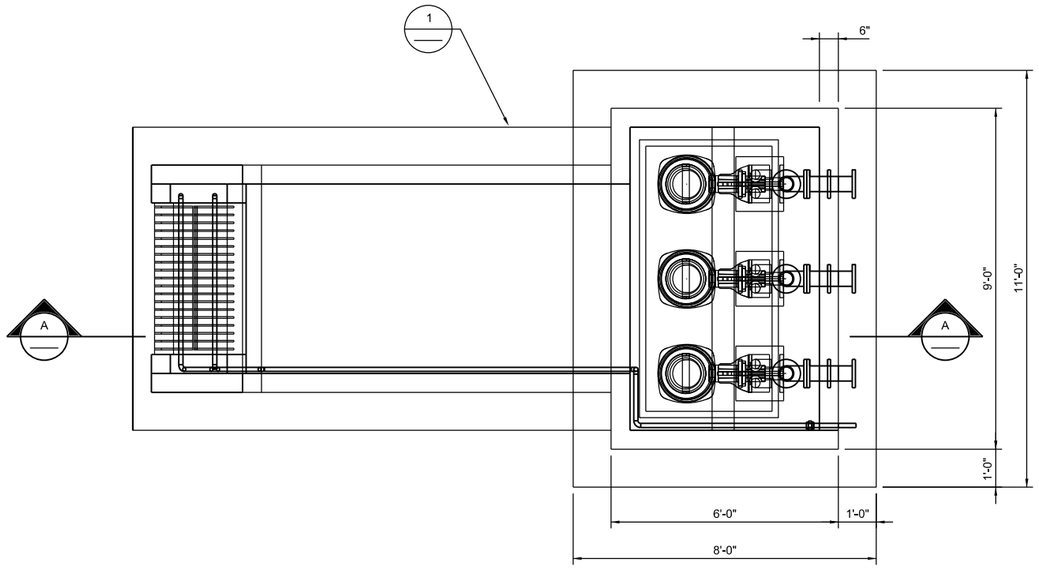

PLAN
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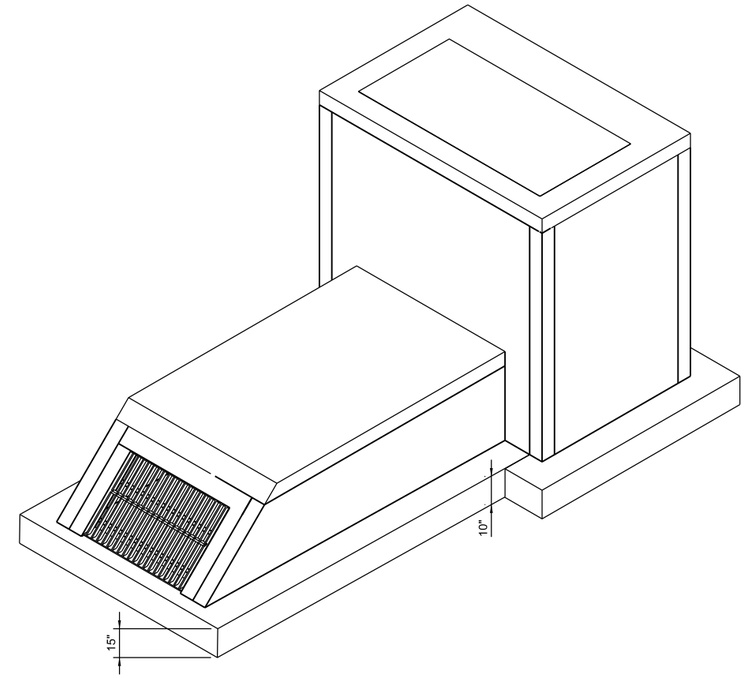
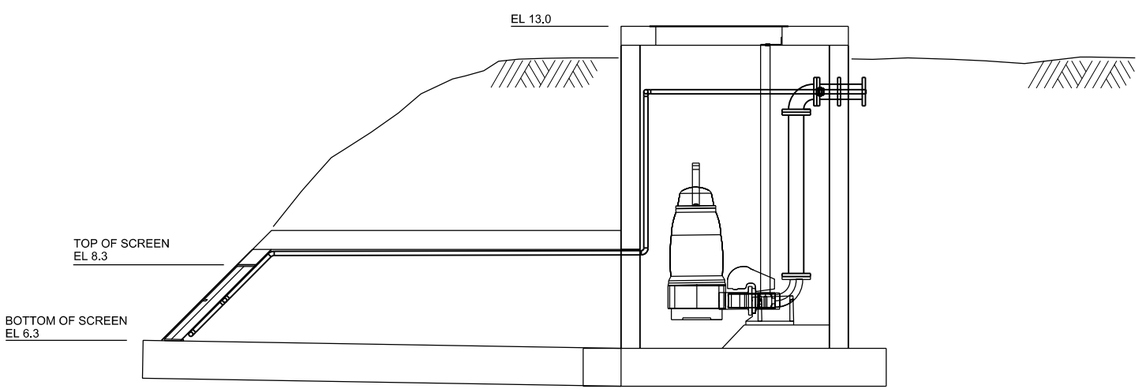


1 DETAIL
1"=1"



A SECTION
1/2"=1'-0"

NO.	DATE	REVISION	BY	APVD
DSGN	DR	CHK	APVD	

Beaver Creek Water Supply

Seal Rock Water District
Seal Rock, OR

INTAKE STRUCTURE
CIVIL
PLAN, SECTION, AND DETAIL

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JULY 2016
PROJ	676178
DWG	05-C-4001
SHEET	

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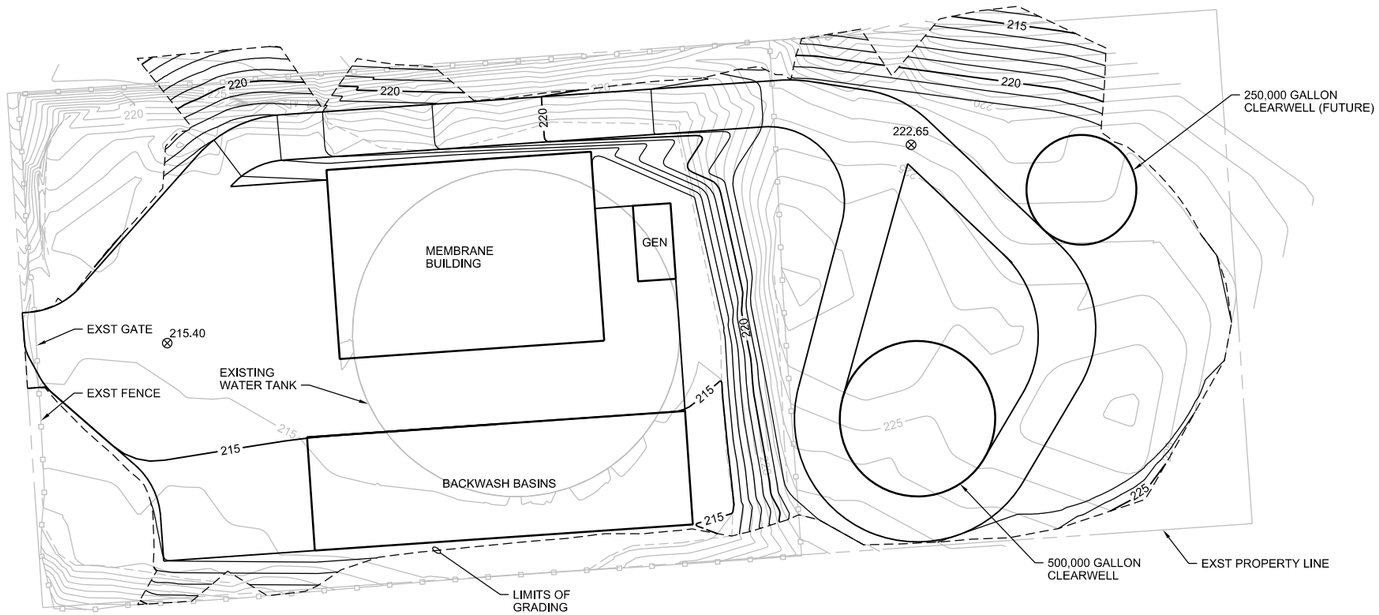

NO.	DATE	REVISION	BY	APVD
DSGN	DR	CHK	APVD	

Beaver Creek Water Supply

Seal Rock Water District

Seal Rock, OR

WATER TREATMENT PLANT

CIVIL

OVERALL SITE PLAN

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.

0 1"

DATE	JULY 2016
PROJ	676178
DWG	06-C-2001
SHEET	

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