Parametrix. 2014. DRAFT
Preliminary Engineering Report
Wastewater Treatment Plant Upgrade. Prepared by
CERTIFICATION

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

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## ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
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<tr>
<td>ADWF</td>
<td>Average Dry Weather Flows</td>
</tr>
<tr>
<td>AWWF</td>
<td>Average Wet Weather Flow</td>
</tr>
<tr>
<td>BLM</td>
<td>Bureau of Land Management</td>
</tr>
<tr>
<td>BOD₅</td>
<td>Biochemical Oxygen Demand, five day</td>
</tr>
<tr>
<td>CMU</td>
<td>concrete masonry units</td>
</tr>
<tr>
<td>CZMA</td>
<td>Coastal Zone Management Act</td>
</tr>
<tr>
<td>DEQ</td>
<td>Oregon Department of Environmental Quality</td>
</tr>
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<td>DLCD</td>
<td>Department of Land Conservation and Development</td>
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<tr>
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<td>Endangered Species Act</td>
</tr>
<tr>
<td>FEB</td>
<td>flow equalization basin</td>
</tr>
<tr>
<td>gpcd</td>
<td>gallons per capita per day</td>
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<td>I/I</td>
<td>infiltration/inflow</td>
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<td>IFA</td>
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<td>membrane bioreactor</td>
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<tr>
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<tr>
<td>MLSS</td>
<td>mixed liquor suspended solids</td>
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<tr>
<td>PER</td>
<td>Preliminary Engineering Report</td>
</tr>
<tr>
<td>PIF</td>
<td>peak instantaneous (hourly) flow</td>
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<td>RCAC</td>
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<td>SCADA</td>
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<td>SHPO</td>
<td>Oregon State Historic Preservation Office</td>
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<td>TSS</td>
<td>Total suspended solids</td>
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### ACRONYMS (CONTINUED)

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<td>U.S. Department of Agriculture Rural Development</td>
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<tr>
<td>USFWS</td>
<td>US Fish and Wildlife Service</td>
</tr>
<tr>
<td>UV</td>
<td>ultraviolet</td>
</tr>
<tr>
<td>VOC</td>
<td>volatile organic compound</td>
</tr>
<tr>
<td>WAS</td>
<td>waste activated sludge</td>
</tr>
<tr>
<td>WPCF</td>
<td>Water Pollution Control Facility</td>
</tr>
<tr>
<td>WWMP</td>
<td>Wastewater Master Plan</td>
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<tr>
<td>WWTP</td>
<td>Wastewater treatment plant</td>
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1. INTRODUCTION

1.1 BACKGROUND AND PROJECT OBJECTIVES

The Pacific City Joint Water-Sanitary Authority (PCJWSA) is a publicly owned water and sewer authority located in Pacific City, Oregon in southern Tillamook County, adjacent to the confluence of the Nestucca River and the Pacific Ocean, at latitude 45° 12’ north, longitude 123° 57’ west. Pacific City is approximately midway between Lincoln City and Tillamook. The Pacific City Sanitary District was organized in 1974. The Pacific City Water District was formed in 1959. The two organizations shared offices and were joined into one agency in 1998 and called the Pacific City Joint Water-Sanitary Authority. PCJWSA is controlled by a five member Board of Directors.

PCJWSA owns and operates the wastewater treatment plant (WWTP) that serves approximately 1,000 full time residents and up to approximately 5,000 seasonal residents in the unincorporated communities of Pacific City and Woods.

Parametrix completed a Wastewater Master Plan (WWMP) in 2005 and developed a recommended list of WWTP improvements and their costs. The listing and costs were updated in a 2009 update to the WWMP. Appendix A contains the Executive Summary from the 2005 WWMP and the improvement listing from the 2009 WWMP update. A CD copy of the 2005 WWMP is included as an exhibit to Appendix A.

The WWTP has experienced permit violations and recently PCJWSA was fined by the Oregon Department of Environmental Quality (DEQ). PCJWSA desires to implement selected projects from the WWMP improvement list in order to bring the WWTP back into compliance.

To construct these improvements, PCJWSA will need funding assistance. Four organizations are the primary source of funding assistance to public agencies: the DEQ, the Oregon Business Development Department of Infrastructure Finance Authority (IFA), the U.S. Department of Agriculture Rural Development (USDA-RD), and the Rural Community Assistance Corporation (RCAC). These funding organizations published a joint guideline in May 2013 to assist public agencies in preparing planning documents to support their application for funding to improve wastewater systems: Preparing Wastewater Planning Documents and Environmental Reports for Public Utilities financed by IFA, DEQ, RCAC, USDA-RD, 2013 (Agency Guidelines).

The purpose of this project is to prepare a Predesign Report (Preliminary Engineering Report, or PER [this document]) and Environmental Report to successfully support PCJWSA’s application for funding assistance from one of the four funding assistance organizations. Based on meetings and correspondence with DEQ (Pinney 2013), information in the existing WWMP may be supplemented with a Predesign Report and that information will satisfy the requirements of the Agency Guidelines (2013).

1.2 REPORT CONTENT

DEQ agreed that this PER will address the following issues to supplement the 2005/2009 WWMP (Pinney 2013). Subsequent sections of this report cover these items:

- A summary of current National Pollutant Discharge Elimination System (NPDES) permit requirements.
- An update and summary of WWTP flows and loading from the past 3 years.
• An update of population and associated flow and loading projections through 2034.

• An evaluation of the feasibility of four potential options for management of wastewater. These are “big picture” planning level evaluations of the approach to managing wastewater:
  ➢ Build new centralized facilities.
  ➢ Optimize the current facilities.
  ➢ Develop centrally managed decentralized systems.
  ➢ Develop an optimum combination of centralized and decentralized systems.

• An evaluation of options for reuse of wastewater effluent including land application of effluent to neighboring property and reuse of effluent for WWTP washdown.

• An alternative evaluation of treatment processes will be conducted. It will consist of a qualitative analysis and comparison of costs for the following:
  ➢ Upgrade the existing WWTP by implementing projects identified in the 2009 WWMP Update.
  ➢ Converting the existing WWTP to a membrane bioreactor plant.
  ➢ Converting the existing WWTP to a sequencing batch reactor plant.

• An evaluation of options for reuse of wastewater effluent including land application of effluent to neighboring property and reuse of effluent for WWTP washdown.

• An evaluation of options for dewatering biosolids to determine the most cost effective method of reducing the volume of biosolids transported for disposal.

• Based on the above evaluations, an update will be prepared with recommended project improvement listing and costs.

• An Environmental Report meeting USDA requirements is included as Appendix B to the report, and a summary of findings of the Environmental Report is in this report.

• In accordance with the Agency Guidelines (2013), the appendices will include a summary of effluent data, rainfall statistics, a flood plain map, soils map, the current NPDES permit, and a land use map.

1.3 SERVICE AREA

The PCJWSA service area includes the communities of Pacific City and Woods. The service area is approximately 1.7 square miles in size. The properties within the service area are zoned as residential, commercial, planned development, or airpark land use types. There currently is one dairy farm located within the service area, and PCJWSA supplies water to that site. Figure 1 shows an aerial map of the Pacific City area and indicates the major streets, sanitary pipelines, pump stations, and PCJWSA service area boundary.

The boundary of the service area was defined in the Community Growth Plan. PCJWSA provides both sanitary and water service to property owners within the service area. PCJWSA may not serve sanitary service to customers outside of its service area. The service area was defined in the Community Development Plan, which was last updated in 1996. The service area defined in the community plan remains in effect for 20 years and cannot be changed during that time period (Krueger 2004).
If Pacific City incorporated and became a city rather than a community, the PCJWSA Board of Directors could modify the service area. However, this would be a lengthy process and incorporation would probably not be done solely to extend the service area boundaries.

### 1.4 EXISTING WASTEWATER TREATMENT PLANT

A site plan of the existing WWTP is shown in Figure 2. The original WWTP was constructed in 1979. Improvements since the original construction include the following:

- Influent Pump Station was upgraded in 2013.
- Side Hill Screens, the first unit was added in 1991, second unit was added in 2014.
- Flow Equalization Basin and Parshall flume were added in 1998.
- Two Cloth Media Filters replaced the dual-media filter in 2005.
- Ultraviolet Light disinfection system replaced the chlorine disinfection system in 2002.

The WWTP currently consists of an influent pump station, two side-hill screens; a Parshall flume; an in-line flow equalization basin (FEB) with three pumps; two activated sludge aeration basins; two secondary clarifiers; two 10-micron cloth media filters; and an ultraviolet disinfection system. The current WWTP design criteria is in Appendix C. The discharge is by gravity to the Nestucca River. The WWTP is rated by DEQ to treat an average monthly flow of 0.36 million gallons per day (MGD). Biosolids management consists of an aerobic digester, to which hydrated lime is added, and after appropriate time for pathogen destruction, the biosolids are land-applied.

### 2. REGULATORY REQUIREMENTS

#### 2.1 NPDES PERMIT

PCJWSA has a NPDES permit number 101519, which became effective on November 1, 2011, and expires on October 31, 2016. A copy of the current permit is in Appendix D. Table 1 summarizes the NPDES permit limitations.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Average Effluent Concentrations</th>
<th>Monthly&lt;sup&gt;a&lt;/sup&gt; Average (lbs/day)</th>
<th>Weekly&lt;sup&gt;a&lt;/sup&gt; Average (lbs/day)</th>
<th>Daily&lt;sup&gt;a&lt;/sup&gt; Maximum (lbs/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD₅</td>
<td>10 mg/L monthly, 15 mg/L weekly</td>
<td>30</td>
<td>45</td>
<td>60</td>
</tr>
<tr>
<td>TSS</td>
<td>10 mg/L monthly, 15 mg/L weekly</td>
<td>30</td>
<td>45</td>
<td>60</td>
</tr>
</tbody>
</table>

<sup>a</sup> Average dry weather design flow to the facility equals 0.36 MGD. Mass load limits are based upon average dry weather design flow to the facility.

BOD₅ = 5-day biochemical oxygen demand

TSS = total suspended solids
Other parameters limited year-round include the following:

- *E.coli* bacteria shall not exceed 34 organisms per 100 mL based on a monthly geometric mean. Not more than 10 percent of the samples shall exceed 110 organisms per 100 mL.
- pH shall be maintained between 6.0 to 9.0.
- The 5 day biochemical oxygen demand (BOD₅) and total suspended solids (TSS) removal efficiency shall not be less than 85 percent monthly.
- Not allowed to use chlorine compounds as a disinfecting agent of treated effluent.

### 2.2 PERMIT EXCURSIONS

The PCJWSA WWTP exceeded monthly and weekly permit discharge limits for TSS and BOD₅ three times in 2012 and two times in 2013. DEQ issued warning letters to PCJWSA in 2011 and 2012 for permit violations. In June 2013, DEQ issued a penalty to PCJWSA for permit violations. The DEQ pre-enforcement notice of April 9, 2013, stated that “the current treatment facility provides your operators with little margin for error.” The letter further stated that “without substantive facility changes these violations are likely to recur.”

Appendix C2 shows a summary of influent and effluent parameters and a chart of effluent BOD₅ and TSS from 2010 to 2014. This chart shows that permit excursions did not appear to correspond to either the wet season or to seasonal visitor loads; effluent BOD₅ and TSS values could occur throughout the year.

To address these permit violations, PCJWSA initiated identifying sources for funding the needed improvements to eliminate future permit violations.

### 2.3 NUTRIENT REMOVAL, MIXING ZONE, INFILTRATION/INFLOW ANALYSIS, BIOSOLIDS MANAGEMENT, AND SEWER RATES

Based on discussions with DEQ, the following components of the Agency Guidelines (2013) are adequately covered in other documents or are not applicable, and do not need to be included in the Predesign Report (Pinney 2013):

- Nutrient removal is not an anticipated requirement of future permits.
- A mixing zone study need not be addressed in the Predesign Report because it will be required as part of the next NPDES permit renewal.
- The 2005 WWMP accurately described the existing collection system. There have been recent updates such as the replacement of the Pacific Avenue Bridge force main and Airport Pump Station.
- Because peak flows to PCJWSA occur in warmer months, corresponding to seasonal population peaks, Infiltration/Inflow (I/I) is not a concern, and no further evaluation of I/I is needed. A formal I/I analysis following Environmental Protection Agency (EPA) guidelines is not required. The I/I report prepared by PCJWSA is included as Appendix E.
- The current DEQ approved biosolids management plan submitted in compliance with the permit satisfactorily addresses biosolids management. A copy is in Appendix F.
A sewer use rate study was conducted as part of the 2009 WWMP Update and any further rate analyses will be addressed by IFA.

2.4 NATURAL RESOURCES, AND LAND USE REQUIREMENTS

2.4.1 Natural Resources

Parametrix prepared a draft Environmental Report for submission to the USDA Rural Development Grants program (RDG). The complete report is in Appendix B. The primary goal of this report was to provide brief analysis of the potential impacts to environmental resources from construction of improvements to the PCJWSA WWTP.

The Environmental Report complies with RDG’s requirements regarding conformity with the National Environmental Policy Act (NEPA), Endangered Species Act (ESA), and Coastal Zone Management Act (CZMA), among others. Some of the requested funds for this project originate with USDA-RUS, and the project requires DEQ approval. Therefore, several Federal and State processes must occur. Federal processes include screening of project impacts for NEPA compliance, determination of any effects to species listed under the federal ESA, and compliance with Section 106 National Historic Preservation Act and CZMA.

The following tasks were completed to support preparation of the Environmental Report and compliance with agency requirements.

- Contacted agency staff including DEQ, State Historic Preservation Office (SHPO), Department of Land Conservation and Development (DLCD), Oregon Department of Fish and Wildlife (ODFW), U.S. Fish and Wildlife Service (USFWS), and the Tillamook County planning department.
- Coordinated with SHPO and the Oregon Legislative Commission on Indian Services to determine appropriate contacts with tribes and to confirm tribal communication protocols.
- Reviewed zoning and summarized land use requirements for proposed improvements.

The Environmental Report addresses the following elements:

- Land Use.
- Floodplains (addressing 100- and 500-year floodplains).
- Wetlands.
- Historic Properties and Archaeology.
- Biological Resources.
- Water Quality.
- Wild and Scenic Rivers Act.
- Coastal Zone Management Act.
- Socio-economic and Environmental Justice.
- Air Quality.
- Transportation.
• Noise.
• Cumulative Effects.

Additional documents addressing grant processes include the following:
• CZMA Consistency Determination:
  ➢ The Environmental Report contains a project description and brief analysis of consistency with local land use designations.
  ➢ A consistency review request was submitted to DLCD.
• No-effect determination addresses the following species:
  ➢ Oregon Coast Coho salmon.
  ➢ Southern resident green sturgeon.
  ➢ Northern spotted owl.
  ➢ Marbled murrelet.
  ➢ Short-tailed albatross.
  ➢ Western snowy plover.

The requirement to conduct a civil rights impact analysis will be completed by the loan specialist. The draft Environmental Report, no-effect determination, and CZMA consistency determination will be submitted to PCJWSA, USDA and DEQ for review. Based on PCJWSA and agency comments, these documents will then be finalized.

2.4.2 Land Use

No changes to land use or zoning are required, and no special permits are required for the proposed project. Necessary permits would be limited to those required for any construction project, such as construction, grading, and development permits. Details of land use issues can be found in the Environmental Report in Appendix B.

There will likely need to be construction and grading permits, as with any construction project. But is not likely to need a Type II or Type III review for changes to the zoning or allowed uses.

3. POPULATION AND WASTEWATER FLOW AND LOADS

3.1 EXISTING AND PROJECTED POPULATIONS

The current population is difficult to precisely estimate because of the seasonal nature of the community. There are permanent residents, estimated at approximately 1,000, and seasonal residents, which can bring the total population to between 2,500 and 5,000.

A recent review of available data from the U.S. Census Bureau, Portland State University, and Oregon Office of Economic Analysis revealed no projections for Pacific City (U.S. Census Bureau 2013; Portland State University 2013; and Oregon Office of Economic Analysis 2013). Review of the Tillamook County Comprehensive Plan (2013) and calls with Tillamook County staff indicated they had no population data for Pacific City.

The method used to approximate the total current population was to use the number of sewer service connections. As of December 2013, there were 1,352 sewer service connections, of
which 1,099 were residential and 169 were residential rentals. There were also 83 commercial services (restaurants, gift shops, grocery stores, offices, and motels) and one industrial service (the Pelican Pub brewery). These commercial and industrial services were not considered separately for estimating the population. Using residential services, there were a total of 1,268 residential and rental service connections.

From the 2005 WWMP, population and persons-per-household estimates were examined from Tillamook County and the U.S. census. In that previous analysis, 2-persons per household best represented the housing density in Pacific City. Based on residential and rental service connections and using 2-persons per household, the current population was estimated as 2,536.

To project future population, the number of service connections added per year were evaluated. Between 1995 and 2014, the growth in service connections per year ranged from 0.3 percent to 7.7 percent, averaging 2.7 percent per year. The highest growth rate occurred in 2005, and the years 2011 to 2014 saw 0.3 to 0.4 percent growth. It is interesting to note that the growth rate since 2000 has averaged 2.4 percent. It is inferred that growth will taper off somewhat as the density increases and the economic growth rate is reduced. Therefore, for the future population projection, a growth rate of 2.5 percent per year was used.

A 20-year period was used for the span of this report. Using a 2.5 percent growth rate, the predicted 2035 population is 4,259. Figure 3 shows a graph of the population projections based on service connection growth and compares it to projected population growth rates from the Tillamook County Comprehensive Plan (2013), and the State Office of Economic Analysis, Department of Administrative Services (2013). The Tillamook County Comprehensive Plan predicts an average growth rate of 0.65 percent and the state predicts an average growth rate of 0.62 percent in Tillamook County from 2015 to 2035.

There are other justifications besides the growth in service connections for using a 2.5 percent growth rate in PCJWSA while state projections for growth are less than 1 percent. Currently, approximately 30 to 35 percent of the homes in PCJWSA service area are occupied year round. There is a real potential for significant numbers of non-permanent residents, who live in the other 65 percent of homes, to retire in Pacific City. There are also approximately 1,000 undeveloped lots. Should more persons sell their first homes and retire in Pacific City (becoming permanent residents), while seeing continued growth in service connections, further coupled with the “crush” of vacationers using the WWTP, the flows and loading can easily meet or exceed the values projected.

### 3.2 EXISTING AND PROJECTED WASTEWATER FLOWS AND LOADS

DEQ defines flows to WWTPs based on seasonal differences. Typically, in western Oregon, flows are described as Average Dry Weather Flows (ADWF) and Maximum Monthly Dry Weather Flow (MMDWF) for dry periods (May through October) and Average Wet Weather Flow (AWWF) and Maximum Monthly Wet Weather Flow (MMWWF) for the wet season (November through April). DEQ does not typically use an average annual flow to describe flows in western Oregon because of seasonal flow variations due to the rainy and dry seasons. The closest National Oceanic and Atmospheric Administration station that records precipitation is in Cloverdale, Oregon; data from 2009 – 2014 is in Appendix C3. A chart comparing daily rainfall and daily wastewater flows indicates little or no correlation between high flows and high rainfalls at the PCJWSA WWTP. See Figure C3 in Appendix C3.

To estimate future wastewater flows and loads, first the historical trends were evaluated. Unlike other communities in western Oregon, Pacific City does not experience the maximum flows based on the wet season, but based on peak populations from seasonal visitors. Maximum month flows to the Pacific City WWTP typically occur in July or August. Figure 4 shows daily
flows from 2010 to 2014. For this period, the annual average flow was 0.135 MGD. The average flow in just the months of July and August was 0.187 MGD. This July and August value is the MMDWF. It was used with the estimated population to determine a per capita flow rate of 74 gallons per capita per day (gpcd). The per capita flow rate was in turn used with population projections to estimate the future MMDWF.

The maximum daily flow also typically occurs in July and August. The maximum daily flow from 2010–2014 was 0.377 MGD (July 2011). The ratio of the maximum daily flow to the MMDWF was 2.01, and this ratio was used to predict future maximum daily flows.

A summary of flows to the PCJWSA WWTP from 2010 to 2013 is shown in Table 2, comparing the typical ADWF, MMDWF, AWWF, and MMWWF values to the average and maximum flows observed in July and August. Table 2 demonstrates why the July and August values should be used for evaluating and projecting flows for PCJWSA.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>ADWF (May to October)</td>
<td>0.127</td>
<td>0.156</td>
<td>0.152</td>
<td>0.149</td>
</tr>
<tr>
<td>MMDWF (May to October)</td>
<td>0.256</td>
<td>0.377</td>
<td>0.276</td>
<td>0.310</td>
</tr>
<tr>
<td>AWWF (November to April)</td>
<td>0.113</td>
<td>0.130</td>
<td>0.134</td>
<td>0.122</td>
</tr>
<tr>
<td>MMWWF (November to April)</td>
<td>0.283</td>
<td>0.286</td>
<td>0.324</td>
<td>0.254</td>
</tr>
<tr>
<td>July and August Averages</td>
<td>0.143 &amp; 0.186</td>
<td>0.196 &amp; 0.187</td>
<td>0.186 &amp; 0.184</td>
<td>0.188 &amp; 0.184</td>
</tr>
<tr>
<td>July and August Maximums</td>
<td>0.215 &amp; 0.239</td>
<td>0.377 &amp; 0.249</td>
<td>0.252 &amp; 0.259</td>
<td>0.310 &amp; 0.233</td>
</tr>
</tbody>
</table>

The peak instantaneous (hourly) flow (PIF) is an important parameter used to size hydraulic facilities. The PCJWSA WWTP does not have flow recording instrumentation to record the PIF, so this value must be estimated. All the flows into the WWTP are pumped from two sources: the Airport Pump Station and the plant influent pump station. The combined flows from these pump stations are routed to the side-hill screens and then to the FEB. Thus, the screens, flume, future grit chamber, and equalization basin must handle the PIF. The remainder of the WWTP must have the hydraulic capacity to manage flows from the pumps from the FEB. To estimate the PIF, a hydraulic analysis previously conducted and approved by DEQ was used (Parametrix 2000). This analysis developed a peaking factor of 5.4 to apply to the MMDWF to estimate PIF.

Historical BOD₅ and TSS loadings to the WWTP have not increased in proportion to the increase in service connections. While service connections increased at about 2.4 percent per year over 13 years, BOD₅ and TSS increased at 7.1 percent and 4.0 percent per year, respectively. Typically BOD₅ and TSS loadings increase in proportion to the population.

An obvious reason and potential cause for an increase in BOD₅ and TSS loading would be the Pelican Pub Brewery. Brewery production over the past 5 years was compared to annual BOD₅ and TSS loadings at the WWTP as shown in Figure 5. While changes in production at the brewery contribute to loads at the WWTP, they do not appear to correspond uniformly to proportional increases at the WWTP. See Table 3. The brewery has an industrial discharge permit and have consistently met permit limits.
Figure 3. Comparison of Population Projections for Pacific City

- PCJWSA Svc Conn/Yr-2.5%
- State Projections 0.62%
- Tillamook County Rate of Growth

Build-out population: 5,368
Figure 4. PCJWSA Wastewater Flow Data 2010-2014

\[ y = 1E^{-5}x - 0.3392 \]

\[ R^2 = 0.0153 \]
Figure 5. Pelican Pub Production vs WWTP Load

Table 3. Annual Percent Change in Brewery Production Compared to Organic (BOD₅) and Solids Loading (TSS)

<table>
<thead>
<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Barrels Produced per Year</td>
<td>14</td>
<td>15</td>
<td>7</td>
<td>-50</td>
</tr>
<tr>
<td>BOD₅, Pounds per Year</td>
<td>6</td>
<td>13</td>
<td>1</td>
<td>-58</td>
</tr>
<tr>
<td>TSS, Pounds per year</td>
<td>9</td>
<td>45</td>
<td>2</td>
<td>-46</td>
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</tbody>
</table>

Other potential causes of increased rates of organic and solids loading are higher density in the use of seasonal housing. It is common for multiple people (approximately 4 to 10) to stay in motels or rental homes in Pacific City during seasonal peaks. In addition, numerous visitors use rest rooms at restaurants and parks, but are not staying at motels using showers, which could increase the concentration of wastewater.

The maximum organic and solids loadings are important as they dictate the size of aeration and biosolids systems. To predict future organic and solids loadings, data from 2010 to 2014 were evaluated. The maximum month values for this period were first examined, but there was concern that it might undersize the systems. So a running 30-day average was calculated, and the 95th percentile of those values was used to establish the loadings to start the projections. The loadings were then increased by 4 percent per year for BOD₅ and 5 percent per year for TSS. These were not compounded percent increases.

Table 4 summarizes by year projected population, flows, and organic and solids loadings from 2014 through the planning year 2035. These flows and loadings were used in sizing future system needs for the WWTP.
Table 4. PCJWSA Flow and Load Projections

<table>
<thead>
<tr>
<th>Year</th>
<th>Increases at 2.5 percent per year</th>
<th>Population</th>
<th>Wastewater Flows, GPD</th>
<th>Wastewater Loading, ppd</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At 54 GPCD</td>
<td>At 74 GPCD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average Annual Daily Flow</td>
<td>Maximum Monthly Average Daily Flow</td>
<td>Maximum Day per Year</td>
<td>Peak Instantaneous Flow (hourly)</td>
</tr>
<tr>
<td>2014</td>
<td>2,536</td>
<td>136,944</td>
<td>187,664</td>
<td>377,205</td>
</tr>
<tr>
<td>2015</td>
<td>2,599</td>
<td>140,368</td>
<td>192,356</td>
<td>386,635</td>
</tr>
<tr>
<td>2016</td>
<td>2,664</td>
<td>143,877</td>
<td>197,164</td>
<td>396,301</td>
</tr>
<tr>
<td>2017</td>
<td>2,731</td>
<td>147,474</td>
<td>202,094</td>
<td>406,208</td>
</tr>
<tr>
<td>2018</td>
<td>2,799</td>
<td>151,161</td>
<td>207,146</td>
<td>416,363</td>
</tr>
<tr>
<td>2019</td>
<td>2,869</td>
<td>154,940</td>
<td>212,325</td>
<td>426,772</td>
</tr>
<tr>
<td>2020</td>
<td>2,941</td>
<td>158,813</td>
<td>217,633</td>
<td>437,442</td>
</tr>
<tr>
<td>2021</td>
<td>3,015</td>
<td>162,783</td>
<td>223,074</td>
<td>448,378</td>
</tr>
<tr>
<td>2022</td>
<td>3,090</td>
<td>166,853</td>
<td>228,650</td>
<td>459,587</td>
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<tr>
<td>2023</td>
<td>3,167</td>
<td>171,024</td>
<td>234,367</td>
<td>471,077</td>
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<tr>
<td>2024</td>
<td>3,246</td>
<td>175,300</td>
<td>240,226</td>
<td>482,854</td>
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<tr>
<td>2025</td>
<td>3,327</td>
<td>179,682</td>
<td>246,231</td>
<td>494,925</td>
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<tr>
<td>2026</td>
<td>3,411</td>
<td>184,174</td>
<td>252,387</td>
<td>507,298</td>
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<tr>
<td>2027</td>
<td>3,496</td>
<td>188,779</td>
<td>258,697</td>
<td>519,981</td>
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<tr>
<td>2028</td>
<td>3,583</td>
<td>193,498</td>
<td>265,164</td>
<td>532,980</td>
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<tr>
<td>2029</td>
<td>3,673</td>
<td>198,336</td>
<td>271,793</td>
<td>546,305</td>
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<tr>
<td>2030</td>
<td>3,765</td>
<td>203,294</td>
<td>278,588</td>
<td>559,962</td>
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<tr>
<td>2031</td>
<td>3,859</td>
<td>208,376</td>
<td>285,553</td>
<td>573,961</td>
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<tr>
<td>2032</td>
<td>3,955</td>
<td>213,586</td>
<td>292,692</td>
<td>588,311</td>
</tr>
<tr>
<td>2033</td>
<td>4,054</td>
<td>218,926</td>
<td>300,009</td>
<td>603,018</td>
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<tr>
<td>2034</td>
<td>4,156</td>
<td>224,399</td>
<td>307,509</td>
<td>618,094</td>
</tr>
<tr>
<td>2035</td>
<td>4,259</td>
<td>230,009</td>
<td>315,197</td>
<td>633,546</td>
</tr>
</tbody>
</table>

GPD = gallons per day
GPCD = gallons per capita per day
ppd = pounds per day

4. ALTERNATIVE WASTEWATER MANAGEMENT APPROACHES AND WATER REUSE CONSIDERATIONS

This section describes alternative wastewater management options, as well as evaluates the potential for implementing practices such as water reuse, energy efficiency, and green infrastructure.
4.1 ALTERNATIVE WASTEWATER MANAGEMENT

An analysis of the feasibility of four potential options for alternative management of wastewater is required by the Agency Guidelines (2013). The four options are listed below, and discussion and evaluation of each option follows in this section:

- Build new centralized facilities.
- Optimize the current facilities.
- Develop centrally managed decentralized systems.
- Develop an optimum combination of centralized and decentralized systems.

4.1.1 Build New Centralized Facilities

Building new centralized facilities entails either constructing an entirely new WWTP at a new site or consolidating the current WWTP with a neighboring facility. There were four sub-alternatives considered:

1. Build a new WWTP at a remote site serving PCJWSA.
2. Build a new WWTP at a site neighboring the existing WWTP, utilizing some of the existing infrastructure, and serving PCJWSA.
3. Build a new WWTP at the site of a neighboring WWTP community, serving PCJWSA and that neighboring community.
4. Expand the existing WWTP at the current site, serving PCJWSA and that neighboring community.

Option 1. Build a new WWTP at a remote site serving PCJWSA

Constructing an entirely new WWTP at a new site would require obtaining a new site, routing flows from where they collect at the existing WWTP site and transferring them to the new WWTP with a new pump station and force main, and obtaining a new outfall or connecting into the existing outfall.

If the WWTP were moved some distance from the existing site, not allowing the reuse of the existing outfall, the cost of constructing a new WWTP at a new site, the force mains to transfer flows, and the cost of a new outfall would make it much more expensive, more time consuming, and would not be a feasible alternative.

Option 2. Build a new WWTP at a site neighboring the existing WWTP, utilizing some of the existing infrastructure, and serving PCJWSA

There are over 30 acres of property east and north of the existing WWTP site owned by the Bureau of Land Management (BLM). This property is attractive because it is on higher ground (approximate elevation 85 feet above sea level [ASL]) and it is out of the tsunami inundation zone. The existing WWTP is at an approximate elevation of 25 feet ASL, within the tsunami inundation zone (ODGMI 1995). PCJWSA is currently negotiating with BLM to explore use of this property for siting a water reservoir. For the WWTP upgrade to utilize this BLM property, it is assumed that the existing headworks and FEB would be maintained at the current site. The pumps in the FEB would be upsized to provide sufficient head and a new 12-inch-diameter pipeline routed to the new site. The secondary and tertiary treatment process upgrades (activated sludge, clarifiers, and filters; or SBR and filters; or MBR) and biosolids processes would be conducted at the new site. The two existing tertiary filters would be relocated to a new basin at the new site. A new ultraviolet (UV) basin would be constructed and the existing
UV banks would be relocated to the new site. A new effluent pipe would be routed down from the site and connected to the existing outfall pipe. Relocation of existing equipment would be phased after the new site was on-line. The approximate construction costs are listed below.

- Further upgrade of pumps in Flow Equalization Basin: $25,000.
- New force main from the Flow Equalization Basin to new WWTP site, 1,200 feet of 12-inch pipe: $70,000.
- WWTP upgrade at PCJWSA: $9.5 to $10 million (as described in subsequent analyses).
  - New filter sump, piping, and relocate two tertiary filters: $100,000.
  - New UV basin, relocate existing UV banks: $130,000.
  - Yard piping: $40,000.
- New outfall to connect to existing outfall, 1,200 feet of 12-inch pipe: $70,000.
- New administration building, 2,000 square feet: $300,000.
- Site work: $300,000.
- Property lease: $500,000.
- Total Construction Costs: $10.7 to $11.2 million.

The high cost of this option makes it infeasible.

**Option 3. Build a new WWTP at the site of a neighboring WWTP community, serving PCJWSA and that neighboring community**

The nearest neighboring WWTPs are in Cloverdale which is 7 miles away, Hebo which is 9 miles away, and Neskowin which is 10 miles away. Because Cloverdale is the nearest facility, the approach would be as follows:

- Use the existing Airport Pump Station as a central point. It already collects sewage from all of the service area east of the Nestucca River. New pumps would be needed to provide the higher discharge head and flow.
- The existing influent pump station at the WWTP would be changed out to pump to the Airport Pump Station. New pumps would be needed to provide the higher discharge head to pump to the Airport Pump Station. The existing force main from the Airport Pump Station to the WWTP would be re-used, but flow direction would be reversed.
- A new force main would be needed from the Airport Pump Station to the Cloverdale WWTP. Six miles of new 12-inch pipeline would be needed. The most feasible pipeline alignment would be along Old Woods Road, to avoid the higher traffic encountered and Oregon Department of Transportation permits needed if the alignment was in US 101.
- The existing Cloverdale WWTP consists of a “donut” hole activated sludge facility constructed in 1978 and with a dry weather capacity of 0.04 MGD. To utilize this option would require constructing a 2-MGD WWTP on the site and up sizing the existing outfall.
- The Cloverdale WWTP discharges into the Nestucca River. The NPDES permit would need to be revised and reissued, requiring added time.

The estimated construction costs for transferring flows to Cloverdale WWTP are listed below:
• Upgrade/retrofit the Airport and Influent Pump Stations: $100,000.
• New force main from Airport Pump Station to Cloverdale WWTP: $2 to $3.2 million.
• New WWTP and outfall at Cloverdale: $10 to $11 million.
• Total Construction Costs: $12.1 to $13.3 million.

The Hebo WWTP has a dry weather capacity of 0.025 MGD and discharges into Three Rivers. The approach used for Cloverdale would work for Hebo, but the length of the force main would be longer, and portions of the pipeline alignment would need to be in US 101 for the last 2 miles.

The Neskowin WWTP has a dry weather capacity of 0.2 MGD and discharges into Neskowin Creek. The approach used for Cloverdale would work for Neskowin, but the length of the force main would be longer, and pipeline alignment would need to be in US 101 for 7 miles.

The cost of retrofitting the existing pump stations, a new force main to any of these other WWTPs, and a new 2-MGD WWTP and outfall would make any of these options infeasible.

Option 4. Expand the existing WWTP at the current site, serving PCJWSA and that neighboring community

This option was considered only for Cloverdale. It is similar to Option 3, except the pump station would be installed at the Cloverdale WWTP. The advantage is the pump station would have a smaller capacity and the force main would be smaller diameter. The NPDES permit held by PCJWSA would need to be modified to allow it to accept the added flows. The approach would be as follows.

A new pump station would be constructed to pump the peak wet weather flows. Current Cloverdale dry weather flows are 40,000 gpd, or 28 gallons per minute (gpm). Even with a 6:1 peaking factor, the peak flow would not dictate the needed pump size. The pumps would be sized at a pumping rate to maintain solids in suspension in the force main. For the distance involved, a 6-inch-diameter pipeline is recommended. The force main would follow Old Woods Road from the Cloverdale WWTP to the PCJWSA Airport Pump Station. To maintain a minimum scouring velocity of 3 feet per second in a 6-pipeline, two 300-gpm pumps would be provided. The estimated construction costs are listed below.

• New duplex submersible pump station: $500,000.
• New force main from the Cloverdale WWTP to the Airport Pump Station: $1.6 to 2.4 million.
• WWTP upgrade at PCJWSA: $9.5 to $10 million (from subsequent analyses).
• Total Construction Costs: $11.6 to $12.9 million.

This option is not deemed feasible for the following reasons. There are approximately 242 residents in Cloverdale. The added costs for the pump station and force main over and above the WWTP upgrade that PCJWSA would conduct would be passed on to Cloverdale. Additionally, PCJWSA would be due a service charge to treat the added flows. These added costs to Cloverdale bring them no real benefit since their WWTP is currently in compliance. There are also added risks that Cloverdale takes on by pumping sewage 6 miles. The force main could potentially be broken or leak from construction activity, flooding, or other events.

4.1.2 Optimize the current facilities

This option has the most merit and is discussed in greater detail in subsequent sections.
4.1.3 Develop centrally managed decentralized systems

This option would entail decommissioning the existing WWTP and constructing decentralized treatment systems serving clusters of homes.

According to the US Environmental Protection Agency (2010), there are two approaches for decentralized treatment that can be summarized as follows:

- Conventional decentralized systems, such as septic tanks with soil dispersal fields (drainfields).
- Advanced decentralized systems, designed to pretreat septic tank effluent before discharge to drainfields. Examples include elevated mound systems, aerobic treatment units, and media filters. Another alternative is the submerged flow wetland, or vegetative submerged bed, which was not considered further because of the larger amount of land required.

Properly designed and maintained septic tank/drainfield systems can serve the wastewater treatment needs of a population adequately. However, regional septic systems by nature contain a number of points of possible failure distributed over a large area, which can threaten the health of the individual system owner, community, or local ecology in the event of a malfunction. Drainfield failures, for example, caused by overloading and/or plugging of the soil are common sources of both groundwater and surface water contamination by fecal coliforms and nutrients. In addition, individual homeowner maintenance of each system varies, which introduces considerable heterogeneity in septic tank operations that can be contentious or difficult to resolve if any issues with local contamination or other problems arise.

All of these decentralized systems require drainfields. The original WWTP in Pacific City was constructed because the existing septic tank drainfields were failing. Soil conditions were not uniformly suitable in the community for drainfields. In addition, current development has led to more dense housing with lots that are too small to support drainfields. Thus, decentralized treatment systems are not feasible.

4.1.4 Develop an optimum combination of centralized and decentralized systems

Neither the centralized option nor decentralized option described above was feasible, so combining them is also not feasible.

4.2 WATER REUSE, ENERGY EFFICIENCY, AND GREEN INFRASTRUCTURE

4.2.1 Water Reuse

Recycled water refers to any treated effluent from a domestic wastewater treatment system that (as a result of treatment) is suitable for a direct beneficial purpose [OAR 340-055-0010(13)]. The April 2008 revisions to Oregon’s Recycled Water Use Rules allow the use of recycled water for beneficial purposes so long as the use provides a resource value, protects public health, and protects the environment (OAR 340-055-0007). Recycled water use in Oregon requires at a minimum an NPDES or Water Pollution Control Facility permit, and a Recycled Water Use Plan.

The new WWTP will produce water that has the potential to meet Water Reuse Rules and Class A requirements. According to DEQ (2009), there are three major beneficial uses for recycled water:
Irrigation – crops not intended for human consumption, nursery, sod, animal grazing, golf courses, cemeteries, and industrial or business campuses. The level of treatment dictates which beneficial use can receive treated effluent. For example, parks, playgrounds, and landscaping accessible to the public must receive effluent having Class A treatment.

Industrial, Commercial, or Construction – aggregate washing, dust control, non-structural firefighting using aircraft, cooling water, sewer flushing, stand-alone fire suppression systems, non-residential toilet or urinal flushing, commercial vehicle washing, and fountains when the water is not available for human consumption.

Impoundments or Artificial Groundwater Recharge – landscaping impoundments, restricted recreational impoundments, and artificial groundwater recharge.

Crop irrigation is not feasible because there are no crops within reasonable distance from the WWTP. The nearest irrigated crops are in Cloverdale, over 6 miles away. Impoundments are not located within a reasonable distance from the WWTP. The neighboring property to the WWTP is owned by BLM and leased by PCJWSA for one of their wellfields. That groundwater is a direct potable water source and the water table is relatively close to the surface and would not be suitable for aquifer recharge. There are no applicable industrial or commercial users that have fire suppression, cooling towers, vehicle washes, or fountains.

Potential uses for recycled water at the PCJWSA WWTP include the following:

- Washwater for screenings, general plant washdown, and filter wash.
- Sewer flushing. This will require a holding tank.

The above options can be examined in more detail and potentially implemented during detailed design.

4.2.2 Energy Efficiency

Potential savings in power use can be achieved through the following measures:

- Use of super premium high efficiency (greater than 90 percent) motors on all equipment will result in power savings.
- All new structures will fully comply with the Oregon Energy Code and utilize high efficiency insulation.
- Variable frequency drives for blowers can be coupled with dissolved oxygen sensors in the aeration basins to optimize blower operation. This runs the blower at the needed speed to provide the appropriate level of dissolved oxygen, but does not over-aerate and waste electrical energy.
- Variable frequency drives for pumps optimizes pump run time and saves on power use.
- Raising the walls on the aeration basins will allow flows to be transmitted to the clarifiers and filters by gravity, instead of being pumped as is currently practiced. Eliminating the need to pump will yield a significant energy savings.
- Control of the WWTP with a programmable logic controller (PLC) can optimize power demand and reduce peak power use.
- Use of energy efficient fixtures for lighting.
4.2.3 Sustainability and Green Infrastructure

Considerations for sustainable practices and green infrastructure are discussed below:

- Leadership in Energy and Environmental Design (LEED)-certified structures. This is a certification of use of sustainable materials of construction, water conservation, and energy use. Obtaining LEED certification increases design costs, construction costs, and there is an added cost to become LEED-certified. LEED certification is most applicable to structures which are occupied, such as offices or apartments, because much of the energy savings come from heating and cooling systems. This is not applicable to the proposed new buildings at the WWTP. However, there are sustainable, green approaches to construction that can be adopted without obtaining the LEED certification.

- By implementing a biosolids dewatering system, the volume of water in the solids is greatly reduced. This will reduce the volume of biosolids to haul, which will reduce the number of trips by the truck. Currently solids are hauled at 1.5 percent solids. If 15 percent solids is achieved, the volume hauled will be reduced by a factor of 10. This will lead to lower fuel usage, lower vehicle maintenance costs, and reduced labor costs.

- A potential to manage stormwater is the use of eco-roofs. This consists of a slightly sloping roof with a layer of soil and native plantings over a waterproof membrane. This is not applicable for the generator building but is potentially feasible for the biosolids building. Implementing an eco-roof requires increased structural capacity of the roof and supporting structure. The cost of the building increases. The feasibility of using an eco-roof will be investigated during detailed design.

- Specify domestic ductile iron pipe, which is made from 93 percent recycled scrap steel.

- Submit and process deliverables (reports, drawings, correspondence, construction submittals) electronically to reduce paper use.

- Specify paint coatings that have minimal to no volatile organic compound content.

5. EVALUATION OF ALTERNATIVE TREATMENT PROCESSES

5.1 OVERVIEW OF PROCESSES

Three alternative approaches were evaluated for upgrading the existing WWTP.

- Upgrade the existing activated sludge WWTP in general as described in the WWMP.
- Convert the existing WWTP to a sequencing batch reactor plant (SBR).
- Convert the existing WWTP to a membrane bioreactor (MBR) plant.

For each alternative, flow and loadings under current and future conditions were provided to representatives of equipment manufacturers and technical proposals were requested. Information from these proposals was developed into design criteria. Appendix G contains details on the design criteria for each alternative and technical proposals from the equipment representatives. Data on equipment common to all the alternatives is in Appendix G1. A description of each alternative and associated advantages and disadvantages is presented below. This is followed by comparison of alternatives using a matrix and weighted evaluation criteria.
Common to all the alternative approaches are the following improvements:

- **Headworks improvements.** The current WWTP does not have grit removal equipment. A new grit tank, grit pump, grit classifier/washer, and screenings compactor are recommended. The system would be sized for over 2.0 MGD. A second side-hill screen was added in 2014. The MBR process would require new screens with smaller slot sizes of 1 or 2 mm.

- **Replacement of pumps in the 82,000 gallon FEB.** Currently, at periods of high flows, all three pumps (each rated at 170 gpm) are required to provide adequate flow. Regulatory requirements include redundancy such that flows can be pumped with the largest pump out of service. Pumps would be provided with an individual capacity of 350 gpm (0.5 MGD). With two (out of three) pumps operating, a firm capacity of 700 gpm (1.0 MGD) would be provided, which is sufficient for post-equalization flows. Replacement discharge piping and valves will also be provided.

- **Filter Feed Holding Tank.** Currently, this 32-foot square tank with a usable volume of 38,000 gallons is used as a wet well for the feed pumps for the cloth media filters. For the Activated Sludge and SBR options, the tank would still fulfill this role. This tank also provides the operator with the ability to hold effluent in the event of a process upset, and it would be retained for all options for this purpose. The tank has a flat floor and accumulates solids. Improvements to this tank would be constructing a sloped floor. For options retaining the cloth media filters, the filter feed pumps would be replaced—this is described in the appropriate section.

- **A second UV light disinfection system.** The previous UV upgrade in 2002 installed channels and empty conduits which allow installation of future UV modules/banks with minimal new construction. Two duplicate UV banks would be installed parallel to the existing unit, providing a redundant UV system at typical flows, and a total capacity of 2.0 MGD to handle future peak flows.

- **Improvements to the existing aerobic digester.** New coarse bubble aeration system, two new blowers, and associated piping and valves.

- **New aerobic digesters in a square concrete tank, coarse bubble diffusers, blowers, pumps, piping, and valves.** Note that originally one added digester was envisioned, however, future loading dictates that added capacity is needed and two rectangular units are recommended to provide staged digestion.

- **A new biosolids dewatering system housed in a new building.** The specific dewatering technology is dependent upon outcome of the analysis in the subsequent section. As part of that biosolids system, a new modular lime handling system is envisioned.

- **A new standby diesel generator and automatic transfer switch housed in a 26 by 17 foot expansion of the existing blower building.** The generator capacity is described in a subsequent section.

- **Instruments and controls.** New unit processes will have integrated control panels. Level sensors (ultrasonic) with backup floats will be provided in all pumped systems. Dissolved oxygen meters will monitor aeration systems. New flow meters and a new level sensor for the Parshall flume will be provided. A supervisory control and data acquisition (SCADA) system will be included to make the operation easier to monitor and to increase reliability.
5.2 DESCRIPTION AND ADVANTAGES AND DISADVANTAGES OF ALTERNATIVES

5.2.1 Activated Sludge

There have been excursions exceeding permit limits for BOD₅ and TSS. Appendix C2 contains a summary of BOD₅ and TSS and a graph showing when these excursions occurred. The graph shows that the excursions do not appear to correspond to wet weather or to the seasonal visitor load, but occur throughout the year. The capacity of the existing aeration basins and shallow secondary clarifiers (8-foot side water depth) were determined to be limiting factors and contributed to the inability of the WWTP to consistently meet permit requirements. The BioWin model was used to determine design parameters for improving the activated sludge process. The model provided output on several design parameters including aeration air, effluent quality, and waste sludge quantity. The design criteria for the activated sludge process are included in Appendix G2 along with technical proposals from manufacturers’ representatives. Figure 6 shows the proposed site layout for the activated sludge alternative. The below listed improvements are recommended for upgrading the existing activated sludge treatment system.

- Replacement of existing mechanical aeration system with fine bubble diffusers and associated air piping, valves, and blowers in the two existing aeration basins. To accommodate clarifier improvements, this also entails raising the walls of the existing aeration basins to provide sufficient head for flows to go through the new clarifiers and filters without the need for pumping. This feature will reduce power needs and improve effluent quality by bypassing the solids accumulation and resuspension that occurs in the holding tank.

- Addition of a third aeration basin located on the east side of the existing basins. The new basin would include new fine bubble diffusers and supporting piping and valves.

- Clarifier improvements.
  - In the 2005 WWMP, it was envisioned to improve the existing clarifiers by adding scum beach/skimmer, and peripheral baffles. However, these improvements would still depend on 8-foot-deep clarifiers. Current practice is for new clarifiers to be at least 14 feet deep to provide a buffer for the rising sludge blanket during flow surges and prevent solids carry-over from the sludge blanket.
  - Originally, one additional (third) clarifier was envisioned. After evaluation, it was felt that retaining the two existing shallow clarifiers with one larger, deeper clarifier would not provide adequate redundancy. So it was decided to add two new 35-foot-diameter circular secondary clarifiers, each sized to take the maximum monthly average daily flow. During peak hourly events, both clarifiers would be needed. Having a second clarifier also allows one clarifier to be taken out of service for maintenance during lower flow periods.
  - Supporting equipment would also be included such as return-activated sludge (RAS) pumps, waste-activated sludge (WAS) pumps, piping, valves, and flow meters.

- Filter Feed Holding Tank. As described under improvements applicable for all options, this tank has a flat floor and accumulates solids. Improvements to the tank would include providing a sloped floor in the tank. In addition, the existing dry pit horizontal filter feed pumps are undersized and from the original 1979 construction. They would
be replaced with submersible pumps on slide rails. The tank would be provided with baffles around the pumps to prevent solids from being pumped to the filters. The floor would slope to a sump to make cleaning easier.

- Currently, the two cloth media filters have a capacity of 1 MGD. Projected future flows will exceed this capacity. A new (third) tertiary cloth media filter and associated piping and valves is needed to accommodate future flows and provide needed redundancy.

**Advantages of Activated Sludge**

- Great process familiarity. This is the process that current operators have been utilizing for many years.
- Maximizes use of existing aeration basins.
- Minimal need for new process flow and no piping needs to be upsized.
- Can be modified by adding anoxic zones to provide for nutrient removal

**Disadvantages of Activated Sludge**

- Requires added excavation and concrete for clarifiers when compared to SBR or MBR.
- When operated in a continuous flow configuration, as is done in PCJWSA, the activated sludge process can be operationally difficult to control when it is subjected to highly variable flows and loads.
- Construction would need to be phased, building the third aeration basin and replacing the pumps in the flow equalization basin, and then sequentially taking each existing aeration basin out of service prior to raising the wall height and installing the diffused aeration systems.

### 5.2.2 Sequencing Batch Reactor

The SBR process is used effectively in many communities the size of Pacific City to treat organic loads and remove solids from wastewater. The SBR treats flows in batches. Each batch includes phases for filling, aerobic reaction, settling, and decanting (emptying). Additional phases can be included to provide anoxic phases for nitrogen removal. The SBR system would include two parallel basins. Each SBR uses the same basin for aerobic reaction as for settling, thus eliminating the need for separate clarifiers. During the settling cycle, the tank mixing and aeration are stopped to provide completely quiescent conditions—which makes for excellent solids removal—an important aspect for any treatment system. Appendix G3 contains the design criteria for the SBR, manufacturer’s technical quotations, and an EPA bulletin describing the process in more detail. The SBR quotation includes three blowers (one duty for each SBR and one standby), a control panel, influent valves, mixers, decanters, pumps, retrievable fine bubble diffuser equipment, and level sensors. Materials of construction would be concrete tanks with stainless steel for exposed or submerged metallic features.
Figure 6
Activated Sludge Site Plan
PER-WWTP UPGRADE - PCJWSA
For Pacific City, modification to the existing headworks, flow equalization basin, cloth media filters, and UV disinfection would be the same as for the activated sludge process. See Figure 7 for a proposed site layout of the SBR alternative. Pumped flows from the equalization basin would alternate between the SBR tanks for the filling cycle. While one tank is filling, the second tank would be going through mixing, aeration, settling, or decanting cycles. During the decant cycle, flows would be directed to the holding tank, if desired, then pumped to the cloth media filters and then the UV disinfection basin prior to discharge. Use of the holding tank should not normally be necessary.

**Advantages of SBR**

- The process utilizes less equipment and is therefore simpler to operate and maintain.
- Eliminates the need for clarifiers and associated costs for excavation and concrete. Also eliminates need for maintenance of clarifier equipment. This means a smaller footprint on the site.
- System programming allows significant flexibility. The process can be adjusted for different cycles, such as anoxic cycles, to provide nutrient removal (this reduces available basin volume).
- Systems are typically highly automated, reducing operator attention.
- The new system could be constructed separately from the existing WWTP with minimal impact to its operation.
- Removable aeration diffusers make the system easier to maintain.
- SBR process has more operational flexibility in adjusting to significant seasonal flow patterns, summer versus winter.
- If the SBR option is implemented, the existing aeration basins and clarifiers could be converted to aerobic digesters. This could save significantly on construction costs for excavation, dewatering, and concrete.

**Disadvantages of SBR**

- The process would require operators to learn a new treatment system.
- Requires more sophisticated controls.
- Higher level of maintenance (compared to conventional systems) associated with more sophisticated controls, automated switches, and automated valves.
- Potential of discharging floating or settled sludge during the decant phase with some SBR manufacturers.
- When the SBR is in decant cycle, it discharges the working volume of the tank, which can overwhelm downstream processes. The flow rate is estimated at 755 gpm and total volume is 48,400 gallons. Sufficient downstream equalization in existing holding tank needs to be evaluated in detailed design.
Figure 7
SBR Site Plan
PER-WWTP UPGRADE - PCJWSA
5.2.3 Membrane Bioreactor

MBRs combine the biological process with membrane technology by submerging membrane cartridges within an activated sludge basin. Within one basin, a high standard of treatment is achieved, replacing the conventional clarifier and filters needed to achieve tertiary treatment. The membranes have pore openings ranging from 0.01 to 0.1 microns, which capture microorganisms, reducing their concentration in the effluent. MBRs typically operate at a higher mixed liquor suspended solids (MLSS) concentration and older sludge age. Appendix G4 contains the design criteria for the MBR, the manufacturer’s technical quotation, and an EPA bulletin describing the process in more detail. For Pacific City, the UV disinfection would remain the same as with activated sludge and SBR. Modifications to the existing flume would be needed, and finer influent screens would be provided. A second flow FEB required to minimize flow peaks to the MBR. See Figure 8 for a proposed site layout for the MBR alternative. Flows from the equalization basin would be pumped to both of the MBR tanks simultaneously. Upon passing through the MBR, flows would be directed to the UV disinfection basin prior to discharge.

Advantages of MBR

- Eliminates the need for clarifiers and cloth media filters and associated costs for excavation and concrete. Also eliminates need for maintenance of clarifier and filter equipment.
- The MBR has the smallest site footprint of the alternatives considered.
- Process can be adjusted to provide nutrient removal.
- Effluent from MBRs have lower concentrations of bacteria and TSS, enabling high level of disinfection, easing the load on the UV system.
- Systems are highly automated, reducing operator attention.
- Effluent is highly polished and ready for reuse applications.
- The new system could be constructed with minimal impact to the operations of the existing WWTP.
- If the MBR option is implemented, the existing aeration basins and clarifiers could be converted to aerobic digesters. This could save significantly on construction costs for excavation, dewatering, and concrete.

Disadvantages of MBR

- The process would require the most significant changes from current operational practices.
- Requires a second FEB.
- Requires 2-mm screens at the headworks. This increases the volume of screenings for disposal.
- Higher level of maintenance (compared to conventional systems) associated with more equipment and automated valves.
- The MBR requires replacement of the membranes about every ten years, at a cost of about $1,000,000.
- MBR has the highest capital and O&M costs of alternatives considered.
- Membranes are susceptible to fouling.
5.2.4 Treatment Alternative Costs and Comparisons

5.2.4.1 Treatment Alternative Construction Costs

A summary of construction costs for treatment alternatives is presented in Table 5. Details for development of the construction costs are in Appendix I and discussed relative to other factors in a subsequent section.

Table 5. Capital Cost for Treatment Alternatives

<table>
<thead>
<tr>
<th>Option</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activated Sludge</td>
<td>$9,513,400</td>
</tr>
<tr>
<td>SBR</td>
<td>$8,603,600</td>
</tr>
<tr>
<td>MBR</td>
<td>$10,043,900</td>
</tr>
</tbody>
</table>

5.2.4.2 Comparison of Treatment Alternatives

In this section, evaluation criteria are described and the treatment alternatives are compared against selected criteria in an evaluation matrix. The criteria are listed and where not self-explanatory, briefly described below:

- Treatment dependability – how dependably the process will meet permit requirements. Also, how will process respond to variations in flow and loading?
- Constructability – complexity of construction as it relates to needing more sophisticated contractors to conduct the work.
- Ease of operation – more complicated systems are more difficult to operate. More automated systems are easier to operate.
- Ease of maintenance – access. More complex items require specialized support. Added equipment means there is more to maintain.
- Construction cost.
- Annual operating cost for power, chemicals, materials, and operational labor.

The criteria were first assigned an importance factor between 1 and 5 that compares each criterion independent of the options. See Table 6. Higher numbers represent more important issues or more influence on feasibility. Each criterion was then given a raw score relative to other options using a rating of 1 to 10, with 10 being a more favorable rating. The raw score was then multiplied by the importance factor to determine a weighted score for each criterion and each option. The weighted scores were then summed for each option in Table 6. Based upon this evaluation, the options were ranked from most favorable (highest score) to least:

1. SBR: 211
2. Activated Sludge: 195
3. MBR: 178

Note that the ratings for importance factors and raw scores below need to be adjusted based on PCJWSA selection of importance factors.
Table 6. Treatment Process Option Evaluation Matrix

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Importance Factor</th>
<th>Activated Sludge</th>
<th>SBR</th>
<th>MBR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Raw Wtd</td>
<td>Raw Wtd</td>
<td>Raw Wtd</td>
</tr>
<tr>
<td>Treatment Dependability</td>
<td>5</td>
<td>8 40</td>
<td>8 40</td>
<td>9 45</td>
</tr>
<tr>
<td>Constructability</td>
<td>3</td>
<td>8 24</td>
<td>9 27</td>
<td>9 27</td>
</tr>
<tr>
<td>Ease of Operation</td>
<td>4</td>
<td>8 32</td>
<td>9 36</td>
<td>7 28</td>
</tr>
<tr>
<td>Ease of Maintenance</td>
<td>5</td>
<td>7 35</td>
<td>8 40</td>
<td>6 30</td>
</tr>
<tr>
<td>Construction Cost</td>
<td>4</td>
<td>8 32</td>
<td>9 36</td>
<td>6 24</td>
</tr>
<tr>
<td>Annual Costs</td>
<td>4</td>
<td>8 32</td>
<td>8 32</td>
<td>6 24</td>
</tr>
<tr>
<td><strong>Total Weighted Score:</strong></td>
<td><strong>195</strong></td>
<td><strong>211</strong></td>
<td><strong>178</strong></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
- Wtd – weighted score
- Importance factor compares criteria independent of options.
- Raw score is relative score of an option compared to other options.

5.3 OTHER IMPROVEMENTS

5.3.1 Subsurface Geotechnical Conditions

Geotechnical investigations have not yet been conducted for the proposed improvements. Based on previous geotechnical reports, the subsurface is sand to 40 feet below grade. Groundwater depth varies seasonally and can rise to within a few feet of the surface. There is a piezometer on the south side of the site. Dewatering during construction is anticipated for excavation of deeper structures (aeration basin and clarifiers or SBRs or MBRs and digesters).

Another consideration for design of the new facilities is potential seismic activity. In the event of an earthquake, beside direct damage, the subsurface sand can liquefy, where groups of soil particles collapse together and behave as a liquid rather than a solid. This creates an unstable subsurface for structures and causes further damage. Liquid filled tanks need to be designed to resist the “sloshing” of fluid inside them during a seismic event, which can cause rises/falls of liquid, creating load surges on vessels.

It is assumed that the building and adjacent tanks can be supported on a traditional concrete slab foundation. Pilings, deep foundations, or preloading of the site are not anticipated, however, further geotechnical investigations specific to the proposed improvements will be conducted to support the design. As data becomes available, foundation design may need to be modified accordingly.

5.3.2 Code Requirements

Building designs will conform to the current Oregon Structural Code and Oregon Energy Code. Features will include:

- Seismic design Importance factor = 1.25 for Risk Category III – structures with potential to cause a substantial economic impact and/or mass disruption of day-to-day civilian life in the event of a failure.
- Roof live load = 25 pounds per square foot.
- Wind ultimate design speed = 145 mph, exposure O.
- Insulation in conformance with prescriptive Energy Code requirements for non-residential buildings, i.e., R-19 roof insulation and perlite type insulating fill in the CMU walls (or R-13 wall insulation for metal framed walls).
- Slab edge insulation of R-7.5 in accordance with prescriptive Energy Code requirements.
- Thermal rated doors to conform to code. (Note: Entry/exit doors less than 4-foot leaf width and overhead coiling doors are exempt per Table 13-E footnote 4).
- Building openings will be sealed, caulked, gasketed, or weather-stripped to conform to the code.

5.3.3 Generator Building

The existing building housing blowers for the FEB will be expanded to the west to house a new standby diesel generator and automatic transfer switch. The expansion will be 26 by 17 feet in plan view. Materials of construction will match the existing building: wood frame construction, T111 siding, truss framing with a metal roof.

The roof will be of aluminum/galvanized or painted sheet steel, raised rib pattern with a factory-applied high-performance coating system. These roof systems are typically warranted for periods of up to 25 years and should provide a low maintenance roofing system.

5.3.4 Solids Handling Building

The Solids Handling Building will be 39 feet, 4 inches by 35 feet, 4 inches in size with walls 15 feet, 4 inches tall. There will be one 12-foot overhead rollup door for material and equipment access and one 3-foot door for personnel access. The interior will contain two smaller rooms: one for electrical controls and the other one for the blowers. The electrical room will be 9 feet by 14 feet with one, two-leaf, 6-foot access door. The blower room will be 14 feet by 9 feet with one, two-leaf, 6-foot door for access. The remaining interior of the building will house the screw press, progressive cavity pumps, belt conveyor, and other related solids-handling appurtenances. The belt conveyor will transport solids from the screw press to a truck parked outside, adjacent to the east side of the building. The truck parking area will be 12 feet by 30 feet, open walls covered with an overhead roof approximately 15 feet high. The solids spreader truck will load on a concrete pad under the overhead roof. The location of the conveyor and covered pad will accommodate longitudinal travel of the truck to facilitate even loading of biosolids.

Concrete is considered the most suitable material of construction for treatment plants given the nature of the material being processed. Concrete options consist of cast-in-place, precast, or concrete masonry units (CMU). Given the size of the proposed building, CMU is the most economical and will be used for the exterior walls. Textures may be varied to provide aesthetic features as deemed appropriate. Interior walls will be steel framed.

The roof of both the solids handling building and the truck loading area will be as described for the generator building: aluminum/galvanized or painted sheet steel, raised rib pattern with a factory-applied high-performance coating system.
5.4 ELECTRICAL AND CONTROL

5.4.1 Existing Electrical System

The existing electrical system at the WWTP is shown on the record drawings and is described in the Operation and Maintenance Manuals. There are three power feeds into the WWTP: the original service enters from the west near the administration building, a second service enters from north near the maintenance and storage building, and a newer service enters the WWTP from the north.

The original service is rated 230 V, 3-phase, 3-wire and supplies the influent pump station, administration building, and all plant processes except the FEB, the equalization basin blower building, and the UV light disinfection system. Stand-by power is provided by a portable diesel generator and manual transfer switch. This generator is housed adjacent to the administration building. Its rating is 80 kW, 100 kVA, 230 V, 3-phase, 3-wire. It is capable of serving the entire original WWTP, the administration building, and the influent pump station.

The second service is rated 230 V, single-phase, 3-wire and supplies the maintenance and storage building. There is currently no permanent stand-by power available for the maintenance and storage building. Standby power is available from a portable 30 kW portable generator that also serves smaller pump stations in the collection system.

The third and newer service is rated 480Y/277 V, 3-phase, 4-wire and supplies power to a 500 kVA pad-mounted transformer near the blower building. This in turn supplies power to a Power Distribution Panel labeled “PP-BB.” The equipment and loads served by this panel are listed in Table 7. As indicated, the 500 kVA transformer and panel PP-BB have spare capacity for future loads.

<table>
<thead>
<tr>
<th>Table 7. Power Distribution Panel “PP-BB” in Blower Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rating: 480 “Y” / 277 volt, 3-phase, 4 wire, 800 ampere</td>
</tr>
<tr>
<td>Equipment</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Motor Control Center – Panel “BB”</td>
</tr>
<tr>
<td>Automatic Transfer Switch for UV System</td>
</tr>
<tr>
<td>Transformer 480-volt to 240-volt, 3-phase</td>
</tr>
<tr>
<td>Motor Control Center – MCC “BB” / Future Process Loads</td>
</tr>
</tbody>
</table>

Stand-by power is not available for Power Distribution Panel PP-BB. Therefore, it is necessary to manually by-pass the equalization basin during a power outage. However, stand-by power is available for the UV disinfection system. This stand-by power is a diesel generator and automatic transfer switch, which are installed in the UV System Control Building, adjacent to the UV Basin. The generator rating is 11.5 kW, 14.4 kVA, 480 V, 3-phase, 3-wire. It is capable of serving both banks of the UV system as well as the future two new banks.

PCJWSA staff reported that they experience a power outage about once every 3 to 4 months. A new standby generator is needed that can supply power to the entire WWTP.
5.4.2 Existing Instrumentation and Controls

There is an existing autodialer system to alert the on-site or on-call operator of the following malfunctions:

- High or low level at the equalization basin
- Pump seal failure
- Pump or variable frequency drive failure
- UV system failure

There are flow measuring devices at the following locations:

- The Parshall flume at the headworks uses an ultrasonic level sensor to monitor the water level in the flume and thus, influent flow. There is a chart recorder located in the blower building. It has a one-week circular paper chart and a digital read-out that is manually recorded every day.
- Discharge from the FEB pumps is measured by a magmeter mounted in a manhole near the pumps. A signal from the magmeter is sent to a recorder in the blower building. It has a digital readout that is manually recorded every day. There is no paper chart on this instrument.
- A V-notch weir monitors effluent flow and controls the operation of the banks of the UV disinfection system. Typically, both UV banks run continuously. It has a digital read-out. There is no paper chart on this instrument.

5.4.3 Recommended Future Electrical and Control Improvements for the Wastewater Treatment Plant

These electrical and control improvements are applicable to any of the options.

5.4.3.1 Electrical

The new 480 VAC electrical system has enough available capacity to serve all of the existing and projected future loads to 2024. Improvements to the electrical components must be made as part of the improvements to the individual process units and operations described previously.

The following improvements should be made specific to the electrical system:

- Provide a 500 kW stand-by generator and 800 A automatic transfer switch to supply power to the WWTP, administration building, and the influent pump station. The generator will be supplied fuel by a 3,000 gallon, outdoor, free standing, UL 142–listed fuel tank. Due to the frequent power outages seen at the WWTP and the extended response times, it is necessary that the fuel tank be large enough to provide a minimum of 72 hours of fuel for generator operation at full load.
- Install a step-down transformer to connect the original 230 VAC power system to the new 480 VAC Power Distribution Panel PP-BB at the blower building; disconnect the original 230 VAC service entrance and utility meter.
- Install multiple distribution panels as needed for marshaling of electrical feeders for the new process loads.
5.4.3.2 Instrumentation and Control

Improvements to the control and monitoring systems must be made as part of the improvements to individual processes and operations previously described.

The following improvements should be made specific to the control system:

- Incorporate monitoring and alarm functions to alert the on-site or on-call operator of the following additional malfunctions:
  - Failure at the influent pump station
  - Failure of the equalization basin pumps
  - Failure of the activated sludge aeration blowers
  - Failure of the filter feed pumps
  - Failure of UV system

A new SCADA system should be provided. Although not originally part of the proposed improvements for this phase of work, a SCADA system should be strongly considered for these improvements. It allows real-time monitoring of the system status and can fine-tune the operation of many functions of the WWTP. SCADA also allows remote operation of the WWTP. This allows operators to make remote adjustments prior to arriving on site. The efficiency obtained by controlling operations from the SCADA will result in energy savings. SCADA systems can be fairly simple or comprehensive and complex. As a minimum, the improvements should consist of the following.

- Install a base station for a proposed system-wide SCADA system.
- Provide sensors at key points within the process stream. Connect these to the plant-wide SCADA system. This would include the above-listed monitoring and alarm functions into the new SCADA system.
- The SCADA system would accept signals from an anticipated 11 level sensors, 2 flow meters, 4 pump on/off sensors, and 3 dissolved oxygen meters. Construction would include new vaults, a computer with an uninterruptable power supply, an ethernet switch, Wonderware software, PLC configuration, and new conduit and wire to connect the system.
- The SCADA system should be constructed to allow expansion in the future to accept signals from future WWTP improvements as well as status signals from pump stations in the collection system.

5.5 OPERATION AND MAINTENANCE COSTS

The 2014 budget and expenditures for the actual operation and maintenance (O&M) costs to PCJWSA were used to estimate future O&M costs for each alternative. Because the actual budget includes costs to operate and maintain both the potable water and wastewater systems, the data were evaluated and costs distributed appropriately between the two systems. The O&M costs were inflated at 3 percent per year to project future costs, after adjustments specific to each option.

The O&M costs include labor, materials, supplies, chemicals, training, office supplies, biosolids management and disposal, repair and maintenance (R&M), laboratory supplies and testing, electricity, and equipment.
The R&M line items for each option provide a set-aside of dollars each year so that equipment can be replaced at the end of its useful life. A 20 year life was assumed and a value of 5 percent of all equipment costs is budgeted each year for R&M. The equipment includes pumps, control panels, motors, grit systems, drives, filters, chemical systems, generator, instruments, dewatering equipment, etc.

Table 8 shows a summary of estimated O&M costs projected through the year 2035 and converted to present worth values. A 1.6 percent interest rate (OMB 2014), 3 percent inflation, and 20-year return period were used to determine the present worth, assuming O&M costs begin in 2015. The O&M costs were estimated for each alternative. See Appendix I for details on O&M costs.

As shown in Table 8, the present worth O&M costs for the three alternatives are very similar, varying 2.3 percent between the activated sludge and SBR options and 20.3 percent between the SBR and MBR options. The percent difference between the Activated Sludge and SBR options is well within the variability of the cost estimates.

Table 8. Operation and Maintenance Costs for Alternatives

<table>
<thead>
<tr>
<th>Category Name</th>
<th>Activated Sludge</th>
<th>SBR</th>
<th>MBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual O&amp;M Cost, 2015</td>
<td>$740,612</td>
<td>$723,959</td>
<td>$778,014</td>
</tr>
<tr>
<td>Membrane Replacement Present Worth Cost</td>
<td>$ -</td>
<td>$ -</td>
<td>$1,581,214</td>
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<tr>
<td>O&amp;M Present Worth Cost</td>
<td>$12,590,841</td>
<td>$12,307,720</td>
<td>$13,226,684</td>
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<tr>
<td>Total O&amp;M Present Worth</td>
<td>$12,590,841</td>
<td>$12,307,720</td>
<td>$14,807,898</td>
</tr>
</tbody>
</table>

Assumes discount rate of 1.6 percent and 20 year planning period.

5.6 TOTAL PROJECT CAPITAL COST COMPARISON

Table 9 shows the costs needed to implement the projects. These costs include construction, contingency, one year of inflation, administrative costs, and SCADA programming. The most cost-effective biosolids management option was selected based on the analysis conducted in this report. Professional services are included for survey of the site, geotechnical subsurface investigation and report, engineering design, engineering services during construction, and full-time construction observation. Construction observation costs assume one full-time observer and includes the cost of lodging for one year. SCADA programming is listed as a range in recognition of the different levels of complexity. The extent of SCADA programming will be finalized during detailed design.

A potential cost savings could be realized if the SBR or MBR options were implemented, which would leave the existing aeration basins and clarifiers out of service. These concrete basins could be converted into aerobic digesters. The total volume of these basins is greater than 23,000 cubic feet, which is the volume needed for two new digesters. This could save excavation, dewatering, and concrete costs for these alternatives. The cost savings were not considered in this evaluation, but these options should be considered during detailed design.

Construction costs were developed from manufacturer’s quotes, cost-estimating guides, and contractor bid prices from recent similar construction projects. The opinion of construction cost cannot account for variations in labor costs; attitudes of bidders regarding their need for work; availability of materials; climate and seasonal factors; local site conditions; and other variables that affect actual construction costs. The costs in Table 9 represent the capital costs needed to implement the project.
Table 9. Total Project Capital Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Activated Sludge</th>
<th>SBR</th>
<th>MBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opinion of Probable Construction Cost</td>
<td>$6,425,100</td>
<td>$5,778,000</td>
<td>$3,802,400</td>
</tr>
<tr>
<td>Contingency, 30%</td>
<td>$1,927,500</td>
<td>$1,733,400</td>
<td>$2,040,700</td>
</tr>
<tr>
<td>1 year Inflation adjustment to fall 2015, 3%</td>
<td>$250,600</td>
<td>$225,300</td>
<td>$265,300</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$8,603,200</strong></td>
<td><strong>$7,736,700</strong></td>
<td><strong>$9,108,400</strong></td>
</tr>
<tr>
<td>PCJWSA Administration, 5%</td>
<td>$430,200</td>
<td>$386,900</td>
<td>$455,500</td>
</tr>
<tr>
<td>SCADA Programming (range 160,000 to 480,000)</td>
<td>$480,000</td>
<td>$480,000</td>
<td>$480,000</td>
</tr>
<tr>
<td><strong>Total Construction</strong></td>
<td><strong>$9,513,400</strong></td>
<td><strong>$8,603,600</strong></td>
<td><strong>$10,043,900</strong></td>
</tr>
<tr>
<td>Survey</td>
<td>$20,000</td>
<td>$20,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>Geotechnical Investigation/Report</td>
<td>$25,000</td>
<td>$25,000</td>
<td>$25,000</td>
</tr>
<tr>
<td>Engineering – Design</td>
<td>$1,141,700</td>
<td>$1,032,500</td>
<td>$1,205,300</td>
</tr>
<tr>
<td>Engineering – Services During Construction</td>
<td>$761,100</td>
<td>$688,300</td>
<td>$803,600</td>
</tr>
<tr>
<td>Construction Observation (12 months)</td>
<td>$217,200</td>
<td>$217,200</td>
<td>$217,200</td>
</tr>
<tr>
<td><strong>Total Capital Costs</strong></td>
<td><strong>$11,678,400</strong></td>
<td><strong>$10,586,600</strong></td>
<td><strong>$12,315,000</strong></td>
</tr>
</tbody>
</table>

5.7 CONSIDERATION OF NON-MONETARY FACTORS

The Agency Guidelines (2013) require considering both life cycle costs and non-monetary factors in the analysis of alternatives. These include financial, social, and environmental factors.

5.7.1 Potential Financial Impacts

The financial impact is greatest if none of the proposed alternatives are implemented. Allowing the WWTP discharge to continue to violate the NPDES permit will lead to further, ever increasing fines from DEQ. Other potential financial impacts of not meeting the permit are degradation in the water quality of the Nestucca River and potential adverse impacts on the recreational and commercial fisheries in and around Pacific City.

The financial impact of implementing any of the feasible alternatives will be the added debt burden taken on by PCJWSA. This debt will lead to an increase in monthly sewer use rates and/or an increase in the system development charges. Determination of the exact increases is beyond the scope of this report. Those increases in sewer use rates and system development charges will be the subject of a separate study.

The financial impact of implementing any of the biosolids dewatering alternatives will have a positive financial impact on PCJWSA because of a reduction in the volume of biosolids hauled for land application. A higher solids content in the dewatering biosolids will reduce the number of truck trips, leading to lower fuel costs for the truck, less labor to operate the truck, and lower maintenance on the truck.
5.7.2 Potential Social Impacts

Implementing any of the feasible alternatives will not have any foreseeable impacts on social impacts, such as cost of living, changes to the minority makeup of the community, revenue generated by businesses, or wages of employees.

Not implementing any of the feasible alternatives could degrade the water quality of the Nestucca River and reduce the attractiveness of Pacific City as a resort community. It is also conceivable that unabated increases in organic and solids loading without concurrent capacity increases at the WWTP will increase odor generation and adversely affect the property value and desirability of properties neighboring or downwind of the WWTP. Implementing any of the feasible alternatives will have a positive impact on the receiving water, and will contribute to maintaining the recreational and commercial value of the water resource.

Implementing any of the alternatives will require additional initial training of the operators on new equipment, which would be a short term “learning curve.” Likewise, implementing any dewatering alternatives will require additional initial training of the operators in the use of the new equipment, which would also be a short term item. The operators are already required to take continuing education courses during each year as part of maintaining their operator certification. The choice of continuing education would naturally be tailored to include the new equipment at the upgraded WWTP.

5.7.3 Potential Environmental Impacts

Environmental impacts would be greatest if the proposed alternatives are not implemented. Increased solids and organic loads on the Nestucca River will have adverse impacts on water quality. The Environmental Report in Appendix B, as summarized in Section 2.4 concludes that there will be no significant adverse environmental impacts from implementing any of the alternatives.

Sustainability considerations are discussed in Section 4.2 and potential opportunities are identified. Implementing any of the dewatering options will significantly reduce the number of truck trips for land application of biosolids. This will reduce fuel use having a positive effect on the release of greenhouse gases.

6. BIOSOLIDS TREATMENT AND HANDLING ALTERNATIVES

This section evaluates options for dewatering biosolids to determine the most cost-effective method of reducing the volume of biosolids transported for disposal.

6.1 EXISTING BIOSOLIDS OPERATION

The existing biosolids treatment and disposal method used at the PCJWSA WWTP is to hold the solids in an aerated storage tank followed by lime stabilization. The facility has one aerated solids holding tank where the waste activated sludge (WAS) is stored and lime-treated. The stabilized sludge is land-applied at a concentration of 1.0 to 1.4 percent solids on property owned by PCJWSA in Beaver, approximately 13 miles from the WWTP.

When the sludge holding tank is full and waste biosolids needs to be removed from site, the operators add one ton of hydrated lime to the holding tank, thoroughly mix the lime and then monitor the pH of the biosolids over a 24-hour period to ensure it is stabilized. Once the biosolids are stabilized to meet Class B requirements, they are trucked off site and land-applied.
Operators also take samples to confirm and document that vector attraction reduction requirements have been met. Table 10 shows volume and dry tons of biosolids land-applied in 2010–2012.

<table>
<thead>
<tr>
<th>Year</th>
<th>Gallons Applied</th>
<th>Dry Tons Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>879,000</td>
<td>3.74</td>
</tr>
<tr>
<td>2011</td>
<td>738,000</td>
<td>2.71</td>
</tr>
<tr>
<td>2012</td>
<td>732,000</td>
<td>4.11</td>
</tr>
</tbody>
</table>

To size potential future biosolids stabilization and dewatering processes, projected future organic and solids loadings were developed, as shown in Table 3. Appropriate sludge yield factors were applied to project the volume and pounds of biosolids produced from the treatment processes. Yields for all processes were based on relatively short mean cell residence times to minimize nitrification. This resulted in similar solids production from each process, estimated as an average of 864 dry pounds per day in the year 2035. After digestion and reduction in volatile solids, a total of 554 dry pounds per day of solids will be processed by the dewatering system selected in 2035.

6.1.1 Sludge Stabilization Criteria

There are many methods of treating and disposing of waste biosolids including composting, anaerobic digestion, pasteurization, drying, incineration, lime stabilization, and aerobic digestion. The regulations for disposal of biosolids are contained in Title 40 of the Code of Federal Regulations, Part 503. The PCJWSA facility currently meets Class B biosolids stabilization standards and they would like to continue with processes that meet this criterion. They may choose to treat to Class A standards in the future, but because of capital costs and very large energy costs, they do not want to pursue this now.

Based on the existing facility tanks, cost of advanced treatment options and the fact that PCJWSA has viable land disposal options, they have chosen to continue using aerobic digestion followed by lime stabilization and dewatering.

Before biosolids can be land-applied they have to be tested to ensure that they are well-stabilized to minimize the risk of spreading disease. These rules are included in the federal vector attraction reduction requirements. Ultimately biosolids have to meet vector attraction reduction regardless of the treatment facility design sizing. The biosolids treatment criterion used in the alternative evaluation is based on EPA facility sizing guidelines. Biosolids facilities designed to these guidelines consistently meet the 40 CFR 503 vector attraction reduction requirements.

6.1.2 Lime Stabilization

PCJWSA currently uses lime stabilization and wanted to compare this method with one other for the evaluation. The 40 CFR 503 regulations for lime stabilization require the biosolids pH to be elevated to 12 for 2 hours and then held for an additional 22 hours at a pH above 11.5. This treatment method has operated effectively at the WWTP for many years. The disadvantage of the current method for lime stabilization is that lime bags are handled and added to the digester manually, which is inefficient and labor intensive.
6.1.3 Aerobic digestion

Aerobic digestion of biosolids has proven to be a cost-effective method of biosolids treatment for smaller communities. The reasons for this are the relatively small facility size, ease in operation, minimized labor cost, relatively small capital costs and the ability to integrate into existing facilities without major changes. The EPA guidelines for aerobic digestion require providing a mean cell residence time of 40 days while maintaining a temperature of 20°C.

6.2 BIOSOLIDS TREATMENT ALTERNATIVES

As stated above, PCJWSA wanted to compare their existing biosolids treatment and disposal with other options. To reduce trucking cost and operator time, they also want all alternatives to include dewatering systems. To provide system redundancy, all alternatives include the ability to add lime to biosolids upstream of dewatering. The three alternatives chosen are listed below and the layout of these options in a proposed solids handling building are in the figures indicated.

- Aerobic digestion with belt filter press dewatering – Figure 9
- Aerobic digestion with centrifuge dewatering – Figure 10
- Aerobic digestion/lime stabilization with screw press dewatering – Figure 11

6.2.1 Aerobic Digestion

Aerobic digestion is a common method of meeting the Class B biosolids stabilization requirements. The process for PCJWSA would include three digester tanks that would normally operate in series. By placing the tanks in series, it maximizes the treatment efficiency and minimizes the passing of fresh waste activated solids to the solids leaving the facility. The existing solids holding tank would become the first digester. Digesters 2 and 3 would be constructed west of the new solids building and east of the existing digester. See Figures 6, 7, and 8. The digesters would be covered and insulated to ensure the biosolids maintain at 20°C temperature. The digesters would be sized to provide 44 days mean cell residence time (including the lime mixing cell). Refer to the design criteria information in Appendix G and the site plan in Figures 9 to 11. Aeration and mixing of the digesters would be provided with regenerative blowers and coarse bubble diffusers. A mechanism will be provided in each digester to allow decanting of supernatant to allow drawing off excess water.

Justification for covering the digesters is warranted. Covers will allow digesters to maintain 20°C temperature and a 44-day detention time. Without covers, temperatures will fall to 15° to 20°C, in which case a 60-day detention time is required. Increasing the detention time to 60 days would require an increase in digester volume by close to 50 percent with proportional increases in diffusers and blower capacity. Thus, the added cost for covers is less than the added costs without covers because of costs for added digester size (excavation and concrete), added diffusers, added blower capacity, and increased power costs.

6.2.2 Lime Stabilization

Lime stabilization is a common method of meeting the Class B biosolids requirements. All of the process alternatives would include the ability to add lime to the liquid biosolids. This would provide a backup system for solids stabilization in the event the new dewatering process was out of service. The liquid biosolids could be land-applied with the equipment already owned by PCJWSA.
Figure 9. Solids Handling Building with Belt Press

Figure 10. Solids Handling Building with Centrifuge
Addition of lime upstream of belt presses or centrifuges is not recommended because of the maintenance issues caused by lime precipitation. Lime addition upstream of a screw press, however, has been proven to work effectively. The pH monitoring and holding times are met in the lime mix tank prior to pumping to the screw press. The final solids samples would be taken from the dewatered cake.

6.3 DEWATERING

Waste activated sludge is currently stored in the solids storage tank at between 1 and 1.4 percent solids. For this evaluation the solids concentration was assumed to be 1.2 percent. PCJWSA wants to dewater these solids before land application to minimize the trucking and labor costs. The dewatering process considered should be able to achieve 16 percent to 19 percent solids concentrations. By taking 1.2 percent biosolids and dewatering 18 percent, the biosolids volume can be reduced by 93 percent. The next sections present three dewatering alternatives.

6.3.1 Belt Press Dewatering

The use of belt presses for biosolids dewatering is very common. Just upstream of the belt press, polymer would be added to the wet biosolids to help bind the solids together and maximize particle capture in the press. For the PCJWSA project, a three-belt system has been assumed. The belts would be 0.75 to 1 meter wide (depending on the manufacturer) and allow water to pass through, but hold the solids. The first belt section would be a gravity thickening belt to thicken the biosolids to 4 or 5 percent. The solids are placed on the horizontal gravity...
belt and water drains off the material. Then the thickened solids enter the next section of the press which consists of two belts. The solids are placed between the two belts just prior to where the belts are squeezed together. This squeezing action presses more water out of the biosolids. The belt press can achieve approximately 17 percent dry solids, although values vary with specific biosolids and polymer addition. The belt press can achieve approximately 98 percent solids capture. The solids capture is important because solids not captured pass through the dewatering process and are returned to the headworks in the centrate. Design criteria for the belt press are in Appendix G5.

After the squeezing step, the biosolids drop to a conveyor which moves them into a biosolids spreader truck. The spreader truck transports the solids to the land application site and then spreads the dewatered material.

6.3.2 Centrifuge Dewatering

The use of centrifuges for biosolids dewatering is also very common. Like the belt press process, polymer is added upstream of the centrifuge to help bind the solids. The centrifuge consists of an outer bowl (2-meter-long tube) and an inner scroll. The solids are pumped into the centrifuge while the outer bowl is spinning at a high speed. The high rotational speed creates centrifugal forces that push the solids to the outer circumference of the bowl. The scroll then pushes these solids onto a belt conveyor that moves the dewatered solids into the spreader truck. The water removed from the solids (centrate) drains back to the wastewater treatment process. The centrifuge can achieve approximately 18 percent dry solids, although values vary with specific biosolids and polymer addition. The centrifuge can achieve approximately 95 percent solids capture. Design criteria for the centrifuge is in Appendix G5.

6.3.3 Screw Press Dewatering

The third dewatering process alternative, the screw press, would include upstream polymer treatment to help with binding the solids. The main difference with the screw press process is that lime addition could occur upstream of the press ( unlike the belt press and centrifuge). The evaluation of the screw press process, therefore, includes lime stabilization combined with dewatering. A screw press consists of a cylindrical wedge wire basket that allows water to drain off the solids as the solids are pushed through by a slowly rotating screw. Continuous dewatering of the sludge takes place in the press while pressure builds up at the dewatered solids end of the press. This pressure build-up occurs because of the greater force required to move dewatered solids. The screw press can achieve approximately 16 percent dry solids, although values vary with specific biosolids and polymer addition. The screw press can achieve approximately 85 to 90 percent solids capture. Design criteria for the screw press are in Appendix G5. As with the belt press and centrifuge, the dewatered solids would be conveyed to a spreader truck for hauling and field spreading.

6.3.4 Dewatering Alternative Cost Summary and Comparison

6.3.4.1 Dewatering Alternative Cost Summary

An opinion of cost was generated for each of the three biosolids dewatering and treatment alternatives and is shown in Table 11. These costs include a new building, the dewatering system, polymer feed, and sludge pumps. These costs do not include contingency or inflation. As shown in Table 11, the costs of each option were very close.
Table 11. Dewatering System Capital Costs

<table>
<thead>
<tr>
<th>Option</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belt Filter Press</td>
<td>$1,054,000</td>
</tr>
<tr>
<td>Centrifuge</td>
<td>$1,071,000</td>
</tr>
<tr>
<td>Screw Press</td>
<td>$1,063,000</td>
</tr>
</tbody>
</table>

6.3.4.2 Advantages and Disadvantages of Dewatering Alternatives

As part of the alternative selection process, advantages and disadvantages for each process were described and are shown in Table 12.

Table 12. Biosolids Evaluation of Alternatives

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aerobic Digestion with Belt Press Dewatering</strong></td>
<td>• Produces a relatively dry sludge&lt;br&gt;• Low energy use&lt;br&gt;• Medium capital and operation cost&lt;br&gt;• Quick startup/shutdown</td>
<td>• Medium labor cost&lt;br&gt;• Largest space requirement (largest building)&lt;br&gt;• Skilled operator required&lt;br&gt;• Increased odor potential</td>
</tr>
<tr>
<td><strong>Aerobic Digestion with Centrifuge Dewatering</strong></td>
<td>• Produces a high solids product&lt;br&gt;• Has low odor potential&lt;br&gt;• Has smallest footprint (smaller building)&lt;br&gt;• Requires less operator time</td>
<td>• Skilled operator required&lt;br&gt;• High power requirement&lt;br&gt;• Highest capital cost&lt;br&gt;• Requires a long startup/shutdown</td>
</tr>
<tr>
<td><strong>Aerobic Digestion/Lime Stabilization with Screw Press Dewatering</strong></td>
<td>• Low odor potential&lt;br&gt;• Less operator time for press&lt;br&gt;• Lowest power cost&lt;br&gt;• Can be easily converted to a Class A sludge treatment system&lt;br&gt;• Can use both aerobic digestion and lime stabilization prior to dewatering</td>
<td>• Lower cake solids&lt;br&gt;• Outer casing cleaning required&lt;br&gt;• Medium space requirement&lt;br&gt;• More operator time to manage the lime system</td>
</tr>
</tbody>
</table>

6.3.4.3 Matrix Evaluation of Dewatering Alternatives

Evaluation criteria were developed for the dewatering alternatives, and the alternatives were compared against selected criteria in an evaluation matrix. The criteria are listed and where not self-explanatory, briefly described below:

- Dewatering and solids retention – the percent solids the dewatering process will produce and the level of solids that pass through the process.
- Ease of operation – more complicated equipment are more difficult to operate.
• Ease of maintenance – access. More complex equipment require specialized support. Added equipment means there is more to maintain.

• Construction cost.

• Annual operating cost for power, chemicals, materials, and operational labor.

The criteria were first assigned an importance factor between 1 and 5 that compares each criterion independent of the options. See Table 13. Higher numbers represent more important issues or more influence on feasibility. Each criterion was then given a raw score relative to other options using a rating of 1 to 10, with 10 being a more favorable rating. The raw score was then multiplied by the importance factor to determine a weighted score for each criterion and each option. The weighted scores were then summed for each option in Table 13. Based upon this evaluation, the options were ranked from most favorable (highest score) to least:

1. Screw Press: 208
2. Belt Filter Press: 208
3. Centrifuge: 195

Note that the ratings for importance factors and raw scores below need to be adjusted based on PCJWSA selection of importance factors.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Importance Factor</th>
<th>Belt Filter Press</th>
<th>Centrifuge</th>
<th>Screw Press</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Raw</td>
<td>Wtd</td>
<td>Raw</td>
</tr>
<tr>
<td>Dewatering/Solids Capture</td>
<td>4</td>
<td>8</td>
<td>32</td>
<td>9</td>
</tr>
<tr>
<td>Ease of Operation</td>
<td>5</td>
<td>8</td>
<td>40</td>
<td>8</td>
</tr>
<tr>
<td>Ease of Maintenance</td>
<td>5</td>
<td>8</td>
<td>40</td>
<td>7</td>
</tr>
<tr>
<td>Longevity</td>
<td>4</td>
<td>8</td>
<td>32</td>
<td>7</td>
</tr>
<tr>
<td>Construction Cost</td>
<td>4</td>
<td>8</td>
<td>32</td>
<td>8</td>
</tr>
<tr>
<td>Annual Costs</td>
<td>4</td>
<td>8</td>
<td>32</td>
<td>6</td>
</tr>
<tr>
<td>Total Weighted Score</td>
<td></td>
<td>208</td>
<td></td>
<td>195</td>
</tr>
</tbody>
</table>

Notes:
Wtd – weighted score
Importance factor compares criteria independent of options.
Raw score is relative score of an option compared to other options.
Higher values are more favorable.

6.4 PREFERRED ALTERNATIVE

The matrix scores and capital costs were very similar. The final solids produced from each of these dewatering systems can vary depending upon the specific sludge being processed. We recommend that each system be piloted on site with small scale units using PCJWSA sludge. Piloting will provide firm data on performance of the dewatering system and will help make a more informed decision. We also recommend that PCJWSA staff visit installed dewatering systems using each of these technologies and interview other operators before finalizing the ratings in Table 13 and selecting the preferred dewatering alternative.
7. RECOMMENDATIONS AND PROPOSED PROJECT IMPROVEMENTS

7.1 TOTAL PROJECT COSTS

Table 14 combines total project capital costs, the present worth value of O&M costs, subtracts the future salvage value of the proposed improvements, and determines the net present worth of each alternative. This approach is in conformance with Agency Guidelines (2013), uses a 20 year planning period, and a 1.6 percent interest rate. The SBR has the least cost life cycle cost, however, it is only 5.9 percent less than the activated sludge option. This is well within the variation of a planning level cost estimate.

<table>
<thead>
<tr>
<th>Items</th>
<th>Activated Sludge</th>
<th>SBR</th>
<th>MBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Project Capital Costs</td>
<td>$11,678,400</td>
<td>$10,586,600</td>
<td>$12,315,000</td>
</tr>
<tr>
<td>O&amp;M Costs Present Worth Cost</td>
<td>$12,590,841</td>
<td>$12,307,720</td>
<td>$14,807,898</td>
</tr>
<tr>
<td>Salvage Value</td>
<td>$483,917</td>
<td>$436,388</td>
<td>$610,858</td>
</tr>
<tr>
<td>Salvage Value Present Worth</td>
<td>$352,287</td>
<td>$317,687</td>
<td>$444,699</td>
</tr>
<tr>
<td><strong>Net Present Worth</strong></td>
<td><strong>$23,916,954</strong></td>
<td><strong>$22,576,634</strong></td>
<td><strong>$26,678,199</strong></td>
</tr>
</tbody>
</table>

7.2 RECOMMENDATIONS

Based on the evaluation conducted in this report, we recommend that PCJWSA implement design and construction of the sequencing batch reactor (SBR). The SBR was rated highest from the matrix comparison, had the lowest capital cost, and the lowest present worth O&M costs, and life cycle costs. The design criteria for the SBR are in Appendix G.3. Because the life cycle cost difference between the SBR and activated sludge alternatives are so close, PCJWSA may wish to make the selection based on other, non-monetary, considerations.

For biosolids dewatering, we recommend, with conditions, the screw press. The recommendation is conditional because the matrix evaluations and costs for the different systems were very close:

- PCJWSA should conduct field visits to observe the different dewatering technologies and interview operators of each system.
- PCJWSA should conduct on-site piloting of the three dewatering technologies to confirm performance using actual PCJWSA biosolids. Piloting the dewatering units allows them to be more accurately designed, saving on installation and operational costs. The cost for piloting was included in the estimates.

7.3 PROPOSED IMPROVEMENTS

Improvements identified in the 2009 Master Plan update that were not included in the current project improvement plan are listed with the proposed projects in Appendix H. Projects already completed by PCJWSA are also listed.
Costs for improvements from the 2009 WWMP that were not included in the current project improvement plan were updated to 2014 dollars using the *Engineering News-Record* construction cost indices. To bring the 2014 dollars to 2015 dollars, a 3 percent inflation factor was used.

8. REFERENCES

IFA, DEQ, RCAC, ad USDA-RD. 2013. Preparing Wastewater Planning Documents and Environmental Reports for Public Utilities financed by IFA, DEQ, RCAC, and USDA-RD.


