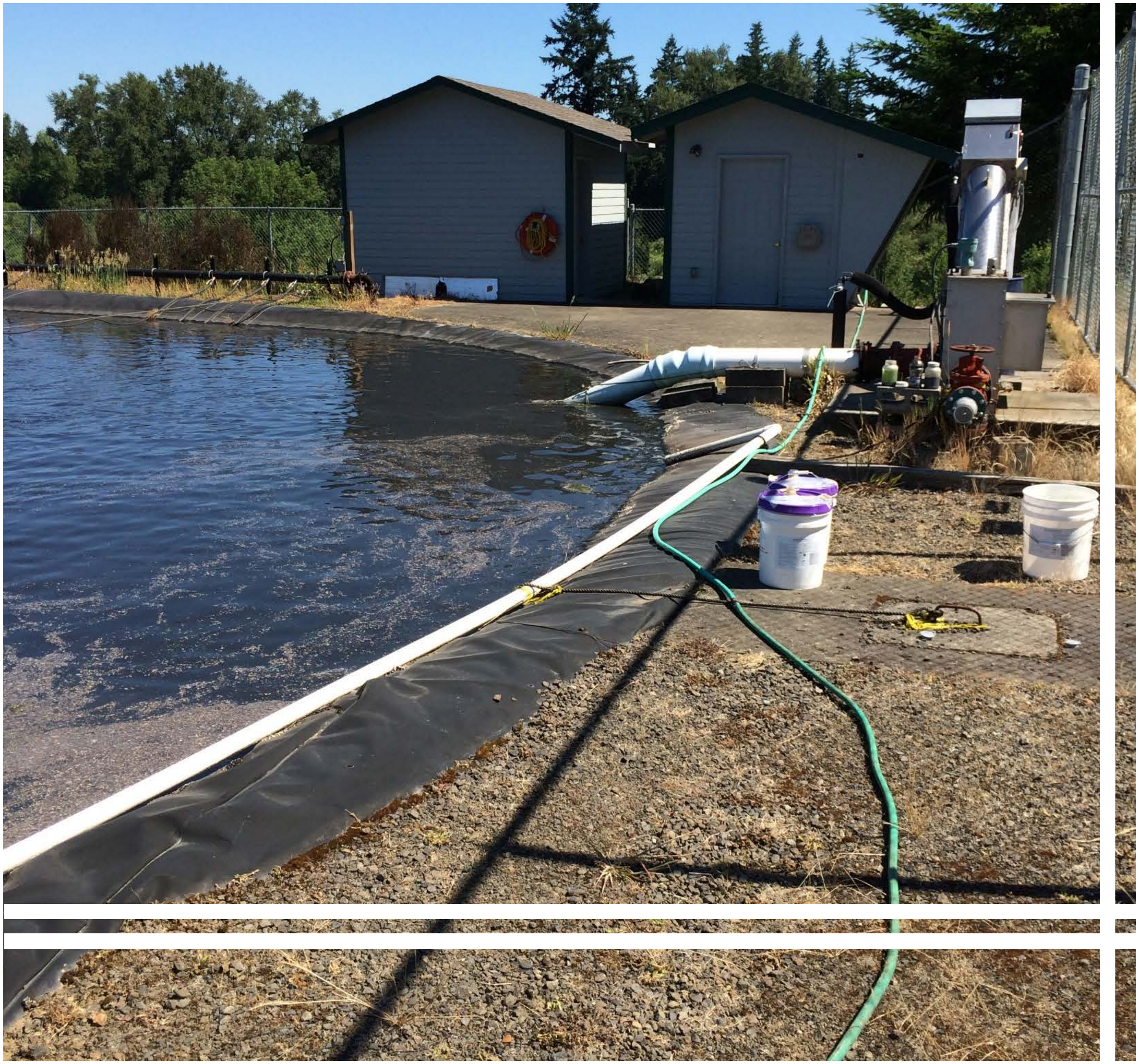

City of Aurora

WASTEWATER FACILITIES PLANNING STUDY

May 2019

May 2019

City of Aurora, Oregon

Wastewater Facilities Planning Study

City Council Adopted
on May 14, 2019

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Wastewater Facilities Planning Study

Aurora, Oregon

Acronyms, Abbreviations, and Selected Definitions

AADF	average annual daily flow
AAF	annual average flow
ADWF	average dry weather flow
AWWF	average wet weather flow
BLM	Bureau of Land Management
BOD	biochemical oxygen demand
cfs	cubic feet per second
CIP	Capital Improvement Plan
DDT	dichlorodiphenyltrichloroethane
DEQ	Oregon Department of Environmental Quality
DMR	discharge monitoring report
DO	dissolved oxygen
EDU	equivalent dwelling unit
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
fps	feet per second
ft	feet (or) foot
HDPE	high density polyethylene
hp	horsepower
GIS	geographic information system
gpcd	gallons per capita per day
gpd	gallons per day
gph	gallons per hour
gpm	gallons per minute
hrs	hours
I/I	inflow and infiltration
IFA	Infrastructure Finance Authority
in	inch
kW	kilowatt
kwh	kilowatt hour
MBBR	Moving Bed Biofilm Reactor
MG	million gallons
MGD	million gallons per day
mg/L	milligrams per liter
mL	milliliter
MM	maximum month flow
MMDWF	maximum monthly average dry-weather flow
MMWWF	maximum monthly average wet-weather flows
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NTU	Nephelometric turbidity units
OAR	Oregon Administrative Rules

ODF&W	Oregon Department of Fish and Wildlife
ODSL	Oregon Department of State Lands
O&M	operation and maintenance
OH&P	overhead and profit
PAA	peracetic acid
PCB	polychlorinated biphenyl
PDAF	peak daily average flow
PIF	peak instantaneous flow
pH	Hydrogen ion concentration (measure of the acidity or basicity)
PLC	programmable logic controller
ppcd	pounds per capita per day
ppd	pounds per day
PSU	Portland State University
PWkF	peak week flow
QA/QC	quality assurance and quality control
RWUP	recycled water use plan
SBR	sequence batch reactor
SCADA	supervisory control and data acquisition
SDC	system development charge
sf	square feet
SHPO	State Historic Preservation Office
SRF	state revolving loan fund
SRT	sludge retention time
TDH	total dynamic head
THM	trihalomethane
TKN	total Kjeldahl nitrogen
TMDL	total maximum daily load
TSS	total suspended solids
UGB	urban growth boundary
US	United States
USGS	U.S. Geological Survey
USDA	U.S. Department of Agriculture
USDA-RUS	U.S. Department of Agriculture, Rural Utilities Services
UV	ultraviolet radiation
VFD	variable frequency drive
WWFPS	wastewater facilities planning study
WWTP	wastewater treatment plant

ES. EXECUTIVE SUMMARY

The City of Aurora, Oregon contracted with both Ashley Engineering Design, P.C. and Keller Associates, Inc. to complete a wastewater facilities plan for the City's sanitary sewer wastewater treatment plant (WWTP) and collection system. The Wastewater Facilities Planning Study (WWFPS) was initially completed in early 2017 and evaluated the City's WWTP facilities. However, the WWFPS was updated in 2019 to reflect the June 2017 PSU Population Forecast Report per discussions with the DEQ for funding eligibility. This study reflects the updated population projections and subsequent modification to the analysis based on the updated flow projections for the updated populations. The collection system evaluation was also included in the updated WWFPS. Details about growth and flow projections are discussed in Sections 1.3 and 1.4. This section summarizes the major findings of the facilities plan, including brief discussions of alternatives considered and final recommendations.

ES.1 PLANNING CRITERIA

Regulatory requirements, engineering best practices, and City-defined goals and objectives form the basis for planning and design. Applicable regulatory requirements include the National Pollutant Discharge Elimination System (NPDES) permit, Total Maximum Daily Loads (TMDLs), State Water Quality Standards, Recycled Water (Reuse) Regulations, and Land Use and Comprehensive Plan Requirements.

ES.2 DESIGN CONDITIONS

ES.2.1 Study Area and Land Use

The study area consists of all areas within the City of Aurora Urban Growth Boundary (UGB). Figures 1 and 2 in Appendix A show the study area and existing service areas, including the Zoning and Study Area (Figure 1) and Topography and Flood Plain (Figures 2 and 2A). The study area sits between Mill Creek and the Pudding River.

ES.2.2 Demographics

The City's population has been increasing over the past few decades. Historical populations were obtained from the U.S. Census and Marion County in cooperation with Portland State University (PSU). PSU analyzes historical trends, and anticipates growth patterns to develop growth rates for 5-year increments. The most current, certified population estimate from PSU was 980 in 2017. The overall estimated population growth rate from 2017-2035 is 1.4% and from 2035-2067 is 0.6%. Using these growth rates, the population projection for 2038 is 1,281 (average annual growth rate of 1.3%). These growth rates were reviewed and approved by the technical advisory committee and the Oregon DEQ for this planning study. Growth calculation details can be found in Section 1.3.

ES.2.3 Wastewater flows

Data on daily and monthly treatment plant flows from January 2010 to December 2015 were provided by the City for analysis. The design influent flows listed in Table ES-1 were calculated from this information using methods recommended by the Oregon DEQ (see Section 1.4 for further details).

TABLE ES-1: Summary of Projected City Sewer Flows

	Design Flow (MGD)	Design Unit Flow (gpcd)	Projected Design Flow (MGD)	Projected Flows (MGD)			
Year	2015	2015	2018	2023	2028	2033	2038
Population	950	950	994	1,065	1,142	1,224	1,281
ADWF	**0.058**	61	0.061	0.065	0.070	0.075	0.079
$MMDWF_{10}$	**0.061**	64	0.064	0.068	0.073	0.079	0.082
AADF	**0.059**	62	0.062	0.067	0.071	0.076	0.080
AWWF	**0.060**	64	0.063	0.068	0.073	0.078	0.081
$MMWWF_5$	**0.065**	68	0.068	0.073	0.078	0.083	0.087
PWkF	**0.075**	79	0.078	0.084	0.090	0.096	0.101
$PDAF_5$	**0.139**	147	0.146	0.156	0.167	0.179	0.188
PIF_5	**0.180**	189	0.188	0.202	0.216	0.232	0.243

* MGD – million gallons per day, gpcd – gallons per capita per day, ADWF – Average Dry-Weather Flow, $MMDWF_{10}$ – Max Month Dry-Weather Flow, AADF – Average Annual Daily Flow, AWWF – Average Wet-Weather Flow, $MMWWF_5$ – Max Month Wet-Weather Flow, PWkF – Peak Week Flow, $PDAF_5$ – Peak Daily Average Flow, PIF_5 – Peak Instantaneous Flow.

ES.2.4 Wastewater Composition

The influent BOD_5 and TSS data for the time period of January 2010 to December 2015 was evaluated to determine annual average, dry weather average, dry weather maximum month, wet weather average, and wet weather maximum month loads (pounds per day). The pounds per day BOD_5 and TSS loading data was used to calculate the pounds per capita per day (ppcd) for the various flows; these values were used to estimate the design year 2038 loadings using the 2038 population of 1,281. A summary of the BOD_5 and TSS data and projections are provided in Tables 3-1 through 3-3.

ES.3 WASTEWATER TREATMENT

ES.3.1 Existing Facilities

The Aurora WWTP consists of an aerated lagoon plant with effluent storage and disinfection. Figure 5 in Appendix A illustrates the layout and Figure 6 provides a general schematic. The influent wastewater is sampled and screened adjacent to the aerated lagoon. The screenings are placed in a 55-gallon barrel or rolling garbage container until they are periodically taken to the landfill. Following the influent mechanical fine screen, the wastewater flows by gravity into the aerated lagoon where it is aerated in three (3) aeration cells and the solids are settled in two (2) settling cells. Following treatment in the aerated lagoon, the wastewater is stored in a 7.2-million-gallon effluent storage lagoon. If there is a process upset in the aerated lagoon, the wastewater can be diverted and temporarily stored in this effluent storage lagoon. When the wastewater leaves the effluent storage lagoon it typically flows by gravity through a magnetic flow meter, past a modulating flow control valve, and enters a chlorine contact basin where it can be chlorinated and dechlorinated.

Following the disinfection process the flow is sampled in accordance with NPDES Permit No. 101772. From May 1st to October 31st the treated wastewater is pumped by the River Pump Station/Irrigation Pump Station and land applied on approximately 6 acres of City land adjacent to the WWTP. From November 1st to April 30th the effluent is dechlorinated and pumped by the River Pump Station/Irrigation Pump Station to the Pudding River. In the river, the effluent discharges through a single-port diffuser, which helps distribute and mix the effluent with the river channel flow.

Solids generated in the aerated lagoon are pumped out of the settling cells to the Sludge Holding Tanks in the Sludge Transfer Station area of the treatment plant. Solids are held in these tanks, periodically removed using a vacuum truck, and hauled to the City of Salem for treatment. Some solids consolidation will take place as the solids are held in the holding tanks. The solids consolidation allows some of the water to be removed and drained to the Return Pump Station, where it can be recycled to the aerated lagoon. The bathroom in the WWTP Office and the drain for the Chlorine Contact Basin are also connected to the Return Pump Station.

Deficiencies of the existing wastewater treatment include:

- *Headworks* – There is no grit removal at the headworks, which can contribute to grit buildup in the aerated lagoon. Also, there is no freeze protection for the influent screen and composite sampler. There is also limited room around the screen for maintenance.
- *Aerated Lagoon* – The lagoon aeration system is currently under capacity. There is only one aerated lagoon and limited space around the lagoon, which makes maintenance difficult. The dissolved oxygen (DO) probes in the lagoon are non-operational. There is no emergency overflow if the effluent pipe plugs. There are also no permanent pumps, piping, and flow meter for solids removal and process control.
- *Effluent Storage Lagoon* – The effluent storage lagoon is nearing its storage capacity. There is insufficient storage volume and/or land application area for the 20-year design flows. There has been some history of TSS and BOD_5 removal percent being a challenge. There is limited space around the lagoon, which makes maintenance difficult; there is no emergency overflow if the effluent pipes plug; and the lagoon has not been structurally inspected recently, which may be an issue since it is reaching capacity.
- *Disinfection* – The chemical storage buildings are not well ventilated, are prone to freezing, and have experienced significant corrosion. There are no automatic alarms if a dosing pump fails or if the chlorine residual rises. There also is no railing around the chlorine contact basin. Further evaluation of the disinfection capacity is recommended as baffles and/or mixer modifications in the chlorine contact basin may be necessary to disinfect future flows.

- *River Pump Station/Irrigation Pump Station* – There is no fence to secure the area, no fall protection for the wet well, and no sign reading "confined space, entry by authorized personnel only". The pumps cycle on/off rather than being continuously controlled via VFDs for energy savings. There is no permanent irrigation system, which means that the operators need to spend time manually moving the pipes and sprinklers.
- *Return Pump Station* – This pump station also needs a fence, fall protection, and a sign reading "confined space, entry by authorized personnel only". There is no flow meter on this line, so the return flows, (which can have an effect on the aerated lagoon), are not measured. There also may be some gases that are making their way to the control panel, which may require modifications.
- *Solids Treatment* – The Sludge Transfer Station is not covered, which can lead to rain water being collected, pumped, and treated in the WWTP. The walls in the Sludge Transfer Station are only on three sides, so it is possible for solids to escape the station. There is no solids treatment and mechanical dewatering, which can limit where the solids can be disposed and increases the cost of hauling.
- *Other* – It is difficult (due to the programming language) to incorporate new items into the SCADA system. There is a gate on Millrace Road, but a fence is missing around part of the WWTP including the WWTP Office, disinfection buildings, pump stations, and Sludge Transfer Station. The stormwater detention basin near the WWTP Office washed out and bank stabilization is urgently needed in this area. The road down to the WWTP Office and around the WWTP is gravel and periodically washes out.

ES.3.2 Effluent Disposal Options

Currently, the WWTP effluent is disinfected in a chlorine contact chamber. From November 1st to April 30th, the disinfected effluent is dechlorinated and discharged to the Pudding River under NPDES Permit No. 101772. From May 1st to October 31st, the wastewater is land applied to an approved site adjacent to the WWTP Office. Alternative disposal options were evaluated in this wastewater facilities plan, including summer storage (no land application) and year-round river discharge.

ES.3.3 Treatment Alternatives

Process alternatives were considered to address WWTP deficiencies. Alternatives considered for the aerated lagoon included surface aerators, expanding the existing diffused aeration system, and replacing the system with a new diffused aeration system. The treatment options considered to improve TSS and BOD_5 removal percentages included adding filtration or a moving bed biofilm reactor downstream of the lagoons, or adding aeration, baffles, covers, and chlorination to the effluent storage lagoon(s). The disinfection options that were evaluated included modifications to the existing chlorination/dechlorination system, or converting to a peracetic acid (PAA) or ultraviolet (UV) disinfection system. The options considered for the solids handling included upgrading the existing sludge holding, adding sludge treatment, or adding sludge treatment and dewatering.

ES.4 COLLECTION SYSTEM

ES.4.1 Lift Station Evaluation

The City operates and maintains four lift stations and approximately 1.5 miles of force main in its wastewater collection system (Figure 7 in Appendix A). Lift stations are numbered one through four, with Lift Station 4 as the influent lift station to the wastewater treatment plant. All lift stations are duplex systems with submersible pumps. Table 6-2 contains summary information for each lift station. Appendix E includes lift station pump curves.

An onsite facility evaluation was completed in November 2018 with City operations personnel to review conditions of the lift station facilities, current maintenance activities, and operational problems encountered by City staff. The evaluation presents general observations and recommendations, along with specific recommendations for individual lift station sites. General recommendations are provided as a guideline to the City to maintain the lift stations for the 20-year planning period. Functionality, inventory, and any items of concern observed during the onsite evaluation are noted in Section 6.4.

Overall, the City's four lift stations are in good condition. Each lift station is in need of minor preventative repairs and maintenance. Recommended lift station upgrades are discussed for each lift station in Section 6.4.

ES.4.2 Pipeline Condition and Capacity Evaluation

The City's gravity collection system was constructed between 1999 and 2001. It includes approximately 5.7 miles of 8-inch and 10-inch PVC D-3034 sewer mains. Based on discussions with City staff, the gravity mains appear to be in good condition. There are no reported issues with inflow and infiltration (I/I), blockages, grease, or leaks.

A hydraulic evaluation using InfoSWMM Suite 14.6 was conducted on the collection system. Model design criteria and flow scenarios are discussed in Section 6.5. Results of the hydraulic evaluation indicate that the collection system has no capacity-related problems associated with existing and projected 20-year flows (Figures 9 and 11 of Appendix A). The collection system was also assessed based on low velocity flows (under 2 fps). Low velocity flows are prevalent throughout the collection system (Figure 10 of Appendix A).

Recommended improvements for the collection system include a system-wide survey to confirm manhole and pipe invert elevations, CCTV inspection and cleaning of the system to better assess existing conditions, and minor lift station upgrades. Sections 7 and 9 provide further discussions on these operation and maintenance-related recommendations.

ES.4.3 Collection System Alternatives

No alternatives were considered for the collection system as there are no capacity-related issues.

ES.5 PROPOSED PROJECT (RECOMMENDED ALTERNATIVES)

ES.5.1 Effluent Disposal Recommendation

The recommendation is to keep with the current disposal plan of discharging to the river in the wet season (November 1st to April 30th) and increase the storage volume for the non-discharge season.

ES.5.2 Recommended Treatment Improvements

The recommended treatment processes include:

- *Aeration Capacity* – Replacing the existing aeration system with new diffusers and blowers that are more easily removable for inspection and maintenance and sized to increase the aeration capacity through the planning period.
- *Tertiary Treatment* – Either of two options - aeration, baffle walls, floating cover, and chlorine piping added to the Effluent Storage Lagoons, or a downstream filter - could be installed to improve the tertiary removal of TSS and BOD_5.
- *Disinfection* – Continue using liquid sodium hypochlorite (chlorination) and sodium bisulfite (dechlorination), but upgrade the storage building, install a chlorine residual analyzer, and add alarms. It is also recommended to further evaluate the disinfection capacity as baffles and/or mixer modifications may be necessary to disinfect future flows.
- *Solids Handling* – Add solids treatment using an aerobic digester to provide disposal flexibility.

A proposed layout of treatment plant improvements is shown in Figure 12 (Appendix A).

ES.5.3 Additional NPDES Permit Items

In addition to the Influent, Effluent, and Recycled Water Monitoring Reports, the City's NPDES permit also included details on the following items:

- *Outfall Inspection Report* – In 2019 the City must inspect the integrity of the Pudding River Outfall and submit a written report to DEQ.
- *Quality Assurance and Quality Control (QA/QC) Program* – If not already developed, the City must create a QA/QC program to verify the accuracy of the sample analysis.
- *Wastewater Solids Annual Report* – Describes the quality, quantity and disposal of solids generated at the plant.
- *Recycled Water Use Plan* – Describes how the plant distributes the reuse water.
- *Annual Inflow and Infiltration Report* – Details of activities performed during the past year and activities planned for the coming year.
- *Significant Industrial User Survey* – Determine the presence of any industrial users that are subject to pretreatment.

- *Emergency Response and Public Notification Plan* – Ensures the contact information for the applicable public agencies is accessible and up to date.

Refer to the NPDES Permit for additional information on these items.

ES.5.4 Recommended Collections Improvements

Recommended collection system improvements include a full system survey, pipeline cleaning and CCTV inspection, and lift station upgrades. Section 9 contains a discussion and estimated costs of these recommendations.

ES.6 CAPITAL IMPROVEMENT PLAN AND FINANCING

ES.6.1 Summary of Costs

Table ES-2 presents the 20-year capital improvement plan (CIP). Projects are organized by priority. Costs reflect planning-level estimates and should be refined in pre-design and design phases of implementation. Priority 1 improvement expenses are anticipated to occur over the next six years. Priority 2 improvements are items targeted as funds become available. Additional details on the CIP are discussed in Section 9.

TABLE ES-2: 20-Year Capital Improvement Plan

ID#	Site	Total Estimated Cost (2019)	SDC Growth Apportionment %	SDC Growth Apportionment Cost	City's Estimated Portion
Priority 1 Improvements (0-6 years)					
1.1	Aerated Lagoon Aeration	$ 200,000	33%	$ 67,000	$ 133,000
1.2	Lagoon Overflow, Structural Inspection, and Bank Stabilization	$ 308,000	24%	$ 72,000	$ 236,000
1.3	Additional Effluent Storage Lagoon	$ 3,020,000	24%	$ 726,000	$ 2,294,000
1.4	Chlorination/Dechlorination System Upgrade	$ 317,000	24%	$ 74,000	$ 243,000
1.5	Headworks Upgrade	$ 142,000	24%	$ 33,000	$ 109,000
1.6	Aerobic Digester	$ 575,000	24%	$ 135,000	$ 440,000
1.7	Site Work At WWTP	$ 308,000	24%	$ 72,000	$ 236,000
1.8	SCADA Upgrade	$ 205,000	24%	$ 48,000	$ 157,000
1.9	Lift Station Upgrades	$ 176,000	24%	$ 41,000	$ 135,000
	Total Priority 1 Improvements (rounded)	**$ 5,251,000**		**$ 1,268,000**	**$ 3,983,000**
Priority 2 Improvements					
2.1	Fall Protection	$ 124,000	24%	$ 29,000	$ 95,000
2.2	Fencing	$ 104,000	24%	$ 24,000	$ 80,000
2.3	WWTP Pump Station VFDs	$ 175,000	24%	$ 41,000	$ 134,000
2.4	Aerated Lagoon Sludge Pumps	$ 140,000	24%	$ 33,000	$ 107,000
2.5	Permanent Irrigation System	$ 59,000	24%	$ 14,000	$ 45,000
2.6	Headworks Grit Removal	$ 1,013,000	24%	$ 238,000	$ 775,000
2.7	Paving Access Road	$ 365,000	24%	$ 86,000	$ 279,000
2.8	Tertiary Treatment	$ 1,031,000	24%	$ 242,000	$ 789,000
	Total Priority 2 Improvements (rounded)	**$ 3,011,000**		**$ 707,000**	**$ 2,304,000**
	TOTAL WASTEWATER PLANT IMPROVEMENTS COSTS (rounded)	**$ 8,262,000**		**$ 1,975,000**	**$ 6,287,000**

All costs in 2019 Dollars. Costs include contractor mobilization (10%), contractor overhead and profit (OH&P; 15%), contingency (30%), and soft costs (e.g. engineering and construction management services, legal, administrative, and permitting services) (25%).
The cost estimate herein is concept level information only based on our perception of current conditions at the project location and its accuracy is subject to variation depending upon project definition and other factors. This estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures. This cost opinion is in 2019 dollars and does not include escalation to time of actual construction.

Table ES-3 illustrates how the Priority 1 improvement expenses are anticipated to occur over the next several years. This 6-year CIP should be used by the City's financial consultant to complete a more detailed rate study.

TABLE ES-3: 6-Year Capital Improvement Plan

ID#	Item	Cost	Opinion of Probable Costs (2019 Dollars)					
			2019	2020	2021	2022	2023	2024
Priority 1 Improvements (0-6 years)								
1.1	Aerated Lagoon Aeration	$ 200,000	$ 200,000					
1.2	Lagoon Overflow, Structural Inspection, and Bank Stabilization	$ 308,000		$ 308,000				
1.3	Additional Effluent Storage Lagoon	$ 3,020,000		$ 544,000	$ 2,476,000			
1.4	Chlorination/Dechlorination System Upgrade	$ 317,000			$ 58,000	$ 259,000		
1.5	Headworks Upgrade	$ 142,000					$ 142,000	
1.6	Aerobic Digester	$ 575,000					$ 575,000	
1.7	Site Work At WWTP	$ 308,000						$ 308,000
1.8	SCADA Upgrade	$ 205,000						$ 205,000
1.9	Lift Station Upgrades	$ 176,000				$ 88,000	$ 44,000	$ 44,000
	Total (rounded)	**$ 5,251,000**	**$ 200,000**	**$ 852,000**	**$ 2,534,000**	**$ 347,000**	**$ 761,000**	**$ 557,000**

All costs in 2019 Dollars. Costs include engineering and contingencies (30%).

ES.6.2 Budget and Rate Impacts

Funding for the recommended system improvements may come from any number of sources. The potential user rate impacts if all priority improvements are funded through a low interest loan with debt service payments (20 year, 1.6%) made through a user rate increase are shown below. Table ES-4 outlines the potential residential user rate impacts and assumes a flat rate increase to all 475 sewer EDUs. As shown in Table ES-4 actual rate impacts can vary depending on the City's available System Development Charge (SDC) funds, the rate structure, existing budget surplus, funding source(s), potential grants, and terms of the loan. A separate user rate study is recommended to complete a more detailed evaluation of potential user rate impacts. Details about budget and rate impacts can be found in Section 9.6.

TABLE ES-4: Potential Monthly User Rate Impact to Fund Priority Improvements

	Annual Payment (20 year, 1.6%)	Monthly User Rate without SDCs	Monthly User Rate including SDCs
Existing User Rates (2019)	-	$59.23	$59.23
Priority 1 Improvements	$308,872	$113.41	$100.33
Priority 2 Improvements	$177,112	$144.49	$124.10

ES.6.3 Other Annual Costs

In addition to the capital improvement costs presented in the previous section, Keller Associates recommends including additional annual operation and maintenance costs associated with the Capital Improvement Plan (additional aerators, aerobic digestion, grit removal, etc.) in setting annual budgets. It is anticipated that this cost may be close to twice the current amount by year 2038, most of which is associated with increased power usage.

ES.6.4 SDCs

The City's current SDC for the sewer system is $2,032. The scope of this study included estimating the SDC eligibility for each identified capital improvement. It is the intent that this information will be utilized by the City's financial consultant to update the City's SDCs. The estimated SDC eligibility (%) for each identified capital improvement is shown in Table ES-2. The SDC percentage was calculated using the capacity that can be utilized for future connections divided by the future capacity in 2038. For projects that did not have an increase in flows, the percent SDC eligible is derived from the percent growth in population over the 20-year planning period.

ES.6.5 Financing Options

Financing and incentive options that may assist with offsetting costs associated with implementing the CIP include, but are not limited to: user rate increases, SDCs, DEQ State Revolving Fund Loan Program, Oregon Infrastructure Finance Authority grants and loans, USDA Rural Utilities Services loans and grants, direct state loans, revenue bonds, general obligation bonds, US Economic Development Administration grants, and Energy Trust of Oregon. Additional financing options are discussed in Section 9.

1. PROJECT PLANNING

The City of Aurora owns and operates a municipal sewage collection system and wastewater treatment plant (WWTP). The purpose of this study is to determine the needs of the City for wastewater collection and treatment, evaluate if the existing pipe network and WWTP can meet those needs, and provide a long-term plan to implement improvements to the plant and collection system so the needs of the City can be met. This facilities plan describes the conditions, flows, and problems in the existing system; analyzes the hydraulic and biologic flow data; and provides recommendations for improvements to the WWTP and collection system.

1.1 LOCATION

The study area consists of all areas within the City of Aurora urban growth boundary (UGB). Figures 1 and 2 in Appendix A show the study area and existing service areas, including the zoning and study area (Figure 1) and topography and flood plain (Figure 2). The study area sits between Mill Creek and the Pudding River. The east side of town slopes to the east, and drains into the Pudding River; while the west side of town slopes west, and drains into Mill Creek. Low areas collect in flood plains surrounding Mill Creek and the Pudding River. The WWTP is located between the Southern Pacific railroad tracks and Mill Creek, just north of the westerly extension of the Ottaway Road.

1.2 ENVIRONMENTAL RESOURCES PRESENT

An inventory of the existing environmental resources is used to consider the environmental impacts of alternatives. The factors analyzed in this section include land use/prime farmland, floodplains, wetlands, cultural resources, coastal resources, and socio-economic conditions.

1.2.1 Zoning

Aurora zoning is shown in Figure 1 (Appendix A). The majority of the City is zoned for medium and low density residential, with some scattered split zoning. There is one industrial area at the west end of Ottaway Road, and commercial zoning along Highway 99E. The areas between the city limits and UGB are zoned as urban transition farm.

1.2.2 Floodplains

The Federal Emergency Management Agency (FEMA) publishes flood insurance studies that classify land into different flood zone designations. As shown in Figures 2 and 2.A, some portions of the study area are located inside the 100-year and 500-year floodplains of the Pudding River and Mill Creek.

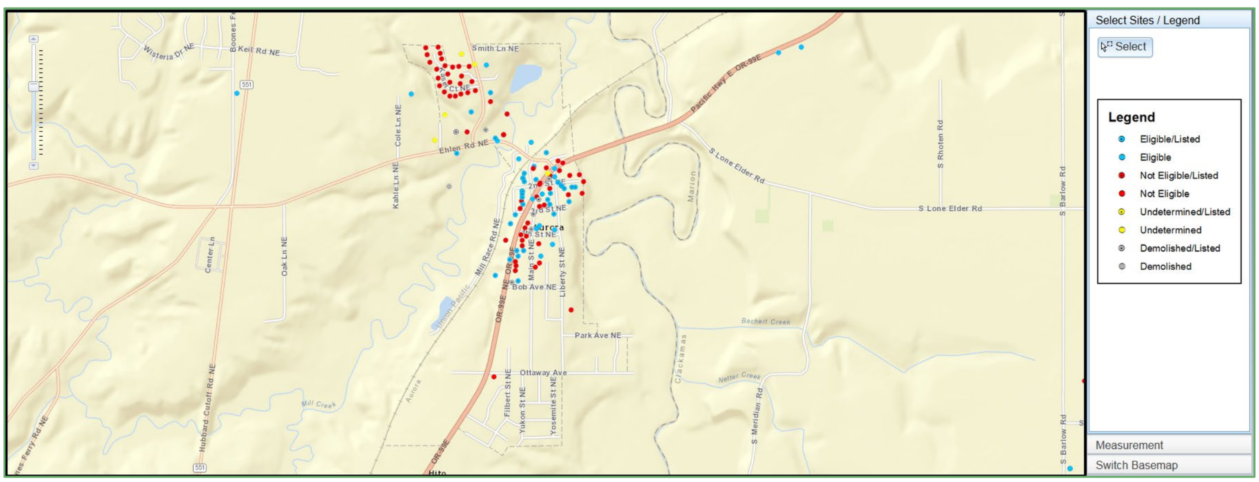
1.2.3 Wetlands

The Oregon Department of State Lands (ODSL) keeps an inventory of the local wetland areas in Oregon. Wetland delineation was not within the scope of this project, so the U.S. Fish and Wildlife National Wetlands Inventory was used to determine the wetland areas that could potentially be impacted. The map of delineated wetlands from the National Wetlands Inventory is shown in Figure 4 (Appendix A). The City has four sites delineated by the National Wetlands Inventory. Two on the north side of the City are designated as freshwater ponds. One on the northeast side of town along Highway 99E is designated as a freshwater forested/shrub wetland. The fourth is a freshwater emergent wetland on the eastern border of the city limits.

1.2.4 Cultural Resources

The State Historic Preservation Office (SHPO) maps above-ground cultural resources on their website. According to the SHPO website, there are many structures that are listed as "eligible" cultural resources within the UGB. The map from the SHPO website is shown in Chart 1-1. The SHPO also keeps track of underground cultural resources. They only provide information from their database to professional archaeologists, with one exception. They will provide information for small project areas if provided the complete legal description of the project location, a United States Geological Survey (USGS) map of the project area, and a description of the project and ground disturbance. The SHPO should be consulted as part of the design process of any proposed recommendation.

Chart 1-1: Above-Ground Cultural Resources



1.2.5 Biological Resources

The Pacific Northwest Interagency Special Status / Sensitive Species Program lists the endangered, threatened, and sensitive species for the state and county by Bureau of Land Management (BLM) district. The City of Aurora lies within the Salem BLM District. Endangered species in the district include the Fender's blue butterfly, Taylor's checkerspot, Bradshaw's desert parsley, and Willamette Valley daisy. The fish in the Salem district that are listed as federally threatened include the Coho salmon, Steelhead, Chinook salmon, and Pacific eulachon.

1.2.6 Water Resources

Mill Creek flows through the study area and outfalls into the Pudding River north of the City. As of the most recent listing in 2012, the Pudding River is 303(d) listed by DEQ for biological criteria, dissolved oxygen, Guthion, and lead. The Pudding River is classified (OAR 690-502-0120) for domestic, livestock, irrigation, municipal, industrial, agricultural, commercial, power, mining, fish life, wildlife, recreation, pollution abatement, wetland enhancement and public instream uses from October 1 through April 30 and only for domestic, commercial use for customarily domestic purposes not to exceed 0.01 cfs, livestock and public instream uses from May 1 through September 30. There are no wild or scenic rivers in the study area.

1.2.7 Coastal Resources

There are no coastal areas within the study area.

1.2.8 Socio-Economic Conditions

According to the US Census Bureau, the median household income is $72,656, 10.3% of people are in poverty, 10.9% are without health insurance, and 93% of people attained a high school diploma or higher. The median male income is $40,568, and the median female income is $30,673.

Effective on January 1, 2008, Oregon Senate Bill 420 established an environmental justice task force and requires the natural resources agencies to follow prescribed steps to provide greater public participation and to ensure the involvement of persons who may be affected by agency actions. Passing of this law places greater emphasis on inclusive public outreach for state agency projects. Environmental justice aims to take appropriate steps to identify and address any disproportionately high and adverse human health or environmental effects of potential projects on minority and low-income populations to the greatest extent practicable and permitted by law. The wastewater facilities plan addresses deficiencies and makes recommendations for the wastewater collection system and treatment plant. All areas of the City have equal access to the City collection system, which delivers the City designated level of service to all users. Recommended improvements presented in this plan are to be designed to achieve and maintain the desired level of service throughout the collection system for all users. The wastewater treatment plant does not impact one area of town more or less, therefore recommended improvements will benefit/impact all residents equally. City Council holds a public meeting to review and adopt the wastewater facilities planning study.

1.2.9 Miscellaneous Issues

Other environmental resources considered were air quality and soils. Aurora is not located in an area designated as an air maintenance or nonattainment area by DEQ. A soils map is provided in Figure 3 (Appendix A); soils in the area are generally various forms of silt loam.

1.3 POPULATION TRENDS

The official population projections and records of the City of Aurora are currently coordinated by collaborative efforts of the County and Portland State University (PSU). The collaborating agencies published a document in June 2017 establishing the official coordinated population projection rates for all the cities in Marion County. The document is titled “Coordinated Population Forecasts for Marion County, its Urban Growth Boundary (UGB), and Area Outside UGBs 2017-2067”, and also includes a summary of historical populations from the U.S. Census.

The historical populations presented in the referenced document are shown in Table 1-1. Each year, PSU establishes a certified population estimate. The population shown for 2017 in Table 1-1 is the most recent certified population at the time of these projections. This population was used as the base starting point for population projections. The projections shown in Table 1-1 were calculated using the growth rates presented in the referenced document. Growth rates are not anticipated to be consistent for the entire planning period, and decrease toward the end of the planning period. The overall estimated population annual average growth rate from 2018 to 2038 is 1.3% (from 994 to 1,281).

Table 1-1: Population History and Projections

Year	Population	Source
1970	306	2001 Comprehensive Plan
1980	523	2001 Comprehensive Plan
1990	597	U.S. Census
2000	655	U.S. Census
2010	918	U.S. Census
2015	950	PSU Certified population
2017	980	PSU Certified population
2018	994	Calculated using coordinated growth rate (1.4%)
2023	1065	Calculated using coordinated growth rate (1.4%)
2028	1142	Calculated using coordinated growth rate (1.4%)
2033	1224	Calculated using coordinated growth rate (1.4%)
2038	1281	Calculated using coordinated growth rate (1.4 and 0.6%)

The 2009 Comprehensive Plan for the City of Aurora, adopted by City Council, has not been updated since the recent publication of the PSU coordinated population forecasts. The Comprehensive Plan uses a growth rate of 2.8%. The City acknowledges the difference in the two population forecasts. The 2017 PSU coordinated population forecasts have been used for this facility’s planning study to align with DEQ requirements.

1.4 FLOWS

The wastewater flow analysis looks at historic wastewater flows, develops design flows, and provides flow projections for the planning period. The wastewater flow analysis was done in 2016. However, PSU’s Coordinated Population Forecast for Marion County was updated in

June 2017, after the initial Wastewater Facilities Planning Study (WWFPS) was completed. This WWFPS update was completed to reflect the 2017 PSU Population Forecast Report per discussions with the DEQ for funding eligibility. This report reflects the updated population projections and subsequent modification to the analysis based on the updated flow projections for the smaller populations. New or additional plant flow data are not included in this WWFPS update. This section summarizes the results of the flow analysis. Keller Associates used the method recommended by DEQ in "Guidelines for Making Wet-Weather and Peak Flow Projections for Sewage Treatment in Western Oregon" for determining design flows in the City's system.

Average Annual Daily Flow (AADF)

The average annual daily flow (AADF) is the average daily flow for the entire year. An AADF was calculated for each year of data. The years with a complete data set (2010-2015) were averaged to obtain the design AADF.

Average Dry-Weather Flow (ADWF)

The average dry-weather flow (ADWF) is the average daily flow for the period of May through October. An ADWF was calculated for each year of data. The years with a complete data set (2010-2015) were averaged to obtain the design ADWF.

Average Wet-Weather Flow (AWWF)

The average wet-weather flow (AWWF) is the average daily flow for the period of January through April, and November through December for each year. The years with a complete data set (2010-2015) were averaged to obtain the AWWF.

Max Month Dry-Weather Flow ($MMDWF_{10}$)

The max month dry-weather flow ($MMDWF_{10}$) represents the rainiest summer month of high groundwater. The DEQ method for calculating $MMDWF_{10}$ is to graph the January-May total monthly flows for each month of the most recent year against total precipitation for the month. A trend line is fit to the data, and the $MMDWF_{10}$ is read from the trend line at a precipitation equal to the May 90% precipitation exceedance value (3.46 in.) extrapolated from the 1981-2010 U.S Climate Normals[1]. Because Oregon DEQ states that May is typically the maximum month for the dry-weather period of May-October, selecting the May 90% precipitation exceedance most likely corresponds to the maximum month during the dry-weather period for a 10-year event. Data from 2010-2015 was analyzed.

The DEQ method for calculating $MMDWF_{10}$ yielded a max month flow that was lower than the subsequent average flow for dry weather. As this is impossible, the $MMDWF_{10}$ was bumped up from 0.057 MGD to 0.061 MGD to better fit in with the remaining DEQ calculated values.

[1] Produced by NOAA and the U.S. Department of Commerce

Max Month Wet-Weather Flow ($MMWWF_5$)

The $MMWWF_5$ represents the highest monthly average during the winter period of high groundwater. The DEQ method for calculating $MMWWF_5$ is to enter the graph of January-May average daily flows vs. monthly precipitation and read $MMWWF_5$ from the trend line at a precipitation equal to the January 80% precipitation exceedance value (8.40) extrapolated from the 1981-2010 U.S Climate Normals[1]. Because Oregon DEQ states that January is typically the maximum month for the wet-weather period of January-April, selecting the January 80% precipitation exceedance most likely corresponds to the maximum month during the wet-weather period for a 5-year event. Data from 2010-2015 was analyzed. This result is illustrated in Chart 1-2 and broken down in Table 1-2.

Data from 2012 showed the highest correlation between rainfall and flow, showed greater influence of rainfall on flow, and was therefore used to provide a more accurate and conservative estimate of $MMWWF_5$ than data from more recent years. Chart 1-2 shows the graph from the DEQ guidance for calculation of the $MMWWF_5$. Table 1-2 summarizes the data points illustrated in Chart 1-2.

Chart 1-2: Flow vs Rainfall ($MMDWF_{10}$ and $MMWWF_5$)

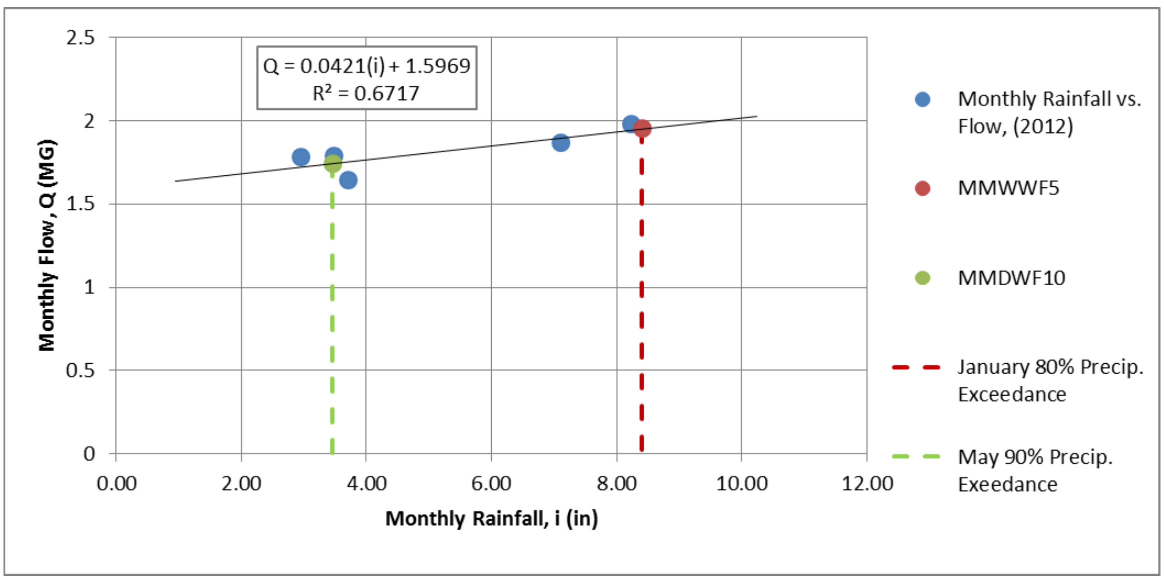


Table 1-2: Flow vs Rainfall ($MMDWF_{10}$ and $MMWWF_5$)

Month	Flow	Rainfall
	MG/month	(in. /month)
January	1.9	7.1
February	1.6	3.7
March	2.0	8.2
April	1.8	3.5
May	1.8	3.0
$MMDWF_{10}$	1.7	3.46
$MMWWF_5$	2.0	8.40

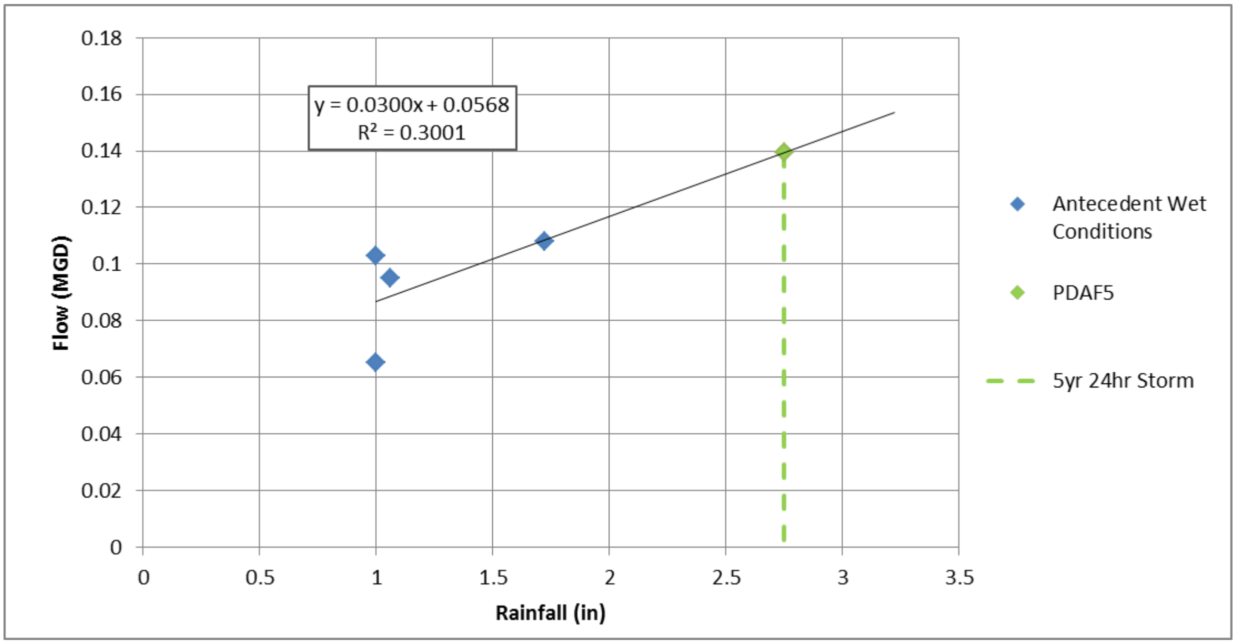
Peak Week Flow (PWkF)

A 7-day average flow was calculated for every day using the seven previous days of data (rolling average). Peak Week Flow (PWkF) was then calculated as the maximum of all weekly (7-day) rolling averages in a given year. The maximum week was selected as the PWkF. The years with a complete data set (2010-2015) were used to determine the PWkF. Oregon DEQ defines PWkF as the flowrate corresponding to a probability of 1/52 (1.9%) chance of occurrence as shown in Appendix B.

Peak Daily Average Flow ($PDAF_5$)

As outlined by Oregon DEQ, the $PDAF_5$ typically corresponds to the 5-year storm event, and therefore, is calculated as the flow resulting from a 5-year storm event during a period of likely high groundwater (January-April). The DEQ method for determining $PDAF_5$ is to plot daily plant flow against daily precipitation for large storm events over several years, only using data during wet-weather seasons when groundwater is high. A trend line is fitted to the data, and then $PDAF_5$ is read from the trend line at the 5-year, 24-hour storm event (2.75 inches per the NOAA isopluvial maps for Oregon). For the purpose of this analysis, a large storm event is considered more than 1 inch in 24-hours. Antecedent conditions are considered wet if any day in the preceding four had a storm event of 0.5 inches or larger, as long as there were not two or more days in a row between storm events with no precipitation. The years with a complete data set (2010-2015) were used for analysis. Those events meeting DEQ criteria were analyzed as shown in Chart 1-3.

Chart 1-3: Flow vs Rainfall ($PDAF_5$)



After analyzing the data, the peak flows for a storm event were determined to occur on the same or following day of the day the event. Rainfall for a specific day was associated with the largest flow within the next day following the rainfall record (including the day of the event). The exception to this is large, multi-day rain events, where more than one day in a two-day period individually met the previously listed conditions for a high rainfall event. In this case, the association was chronological. The first large rainfall event for one day was associated with the chronologically first large daily flows.

Peak Instantaneous Flow (PIF)

In the absence of hourly flow data, DEQ recommends obtaining the peak instantaneous flow (PIF) by extrapolation from their own chart titled Graph #3. On Graph #3, $PDAF_5$, $MMWWF_5$, PWkF, and AADF are all graphed (on specific log-probability graph paper) vs. their probability of occurrence as shown in Appendix B. Once those known flows are graphed, a line of best fit is drawn between the points. The PIF is located where that best fit line crosses the 0.011% probability.

Infiltration and Inflow (I/I)

I/I is not a significant problem for the Aurora collection system. Visual evidence of this can be seen in Chart 1-4, which shows October 2014 through October 2015 daily flows and precipitation recordings. These flows are representative of previous years which follow the same patterns. The large peaks in rainfall have little effect on peaks in daily flow. The largest peak in Chart 1-4 below corresponds to an increase in flow that is less than double. I/I can be caused by a variety of sources such as storm sewers connecting into the sanitary sewer, storm inflow into manhole lids, and groundwater infiltration into cracked/broken pipelines and services.

Chart 1-4: 2014/2015 Daily Flow and Precipitation

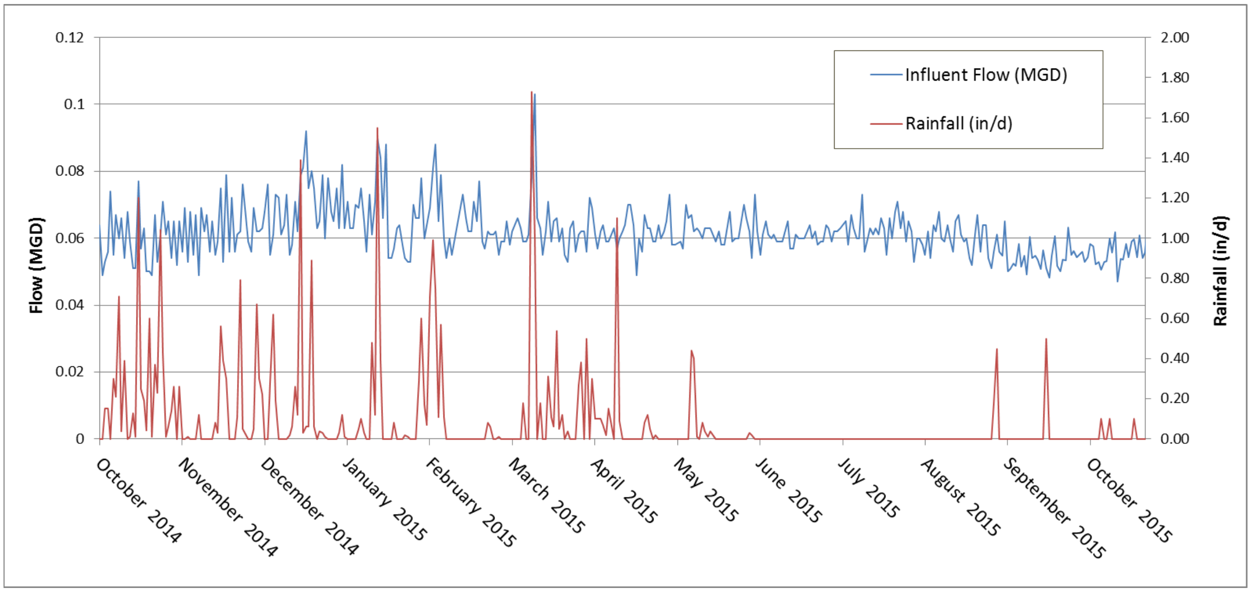


Table 1-3 summarizes annual average base flow and the ratio of peak flow to the base flow for the 2010-2015 data sets. The peak flow compared to the base flow is an indication of I/I influence in the system. In 2010-2015, the peak flow ranges from 1.4 to 2.4 times the base flow. I/I exists in the system but is not excessive. Some communities experience peak flows in excess of 10 times the base flow.

Table 1-3: Annual Peak Day Flow/Average Base Flow

Year	Avg Base Flow (MGD)	Peak Flow/Avg Base Flow	Pk flow (MGD)
2010	0.060	2.01	0.120
2011	0.055	1.43	0.079
2012	0.059	1.83	0.108
2013	0.057	1.39	0.079
2014	0.057	2.40	0.137
2015	0.062	1.90	0.118

While I/I is evident by the peaking factors represented in Table 1-3, it is not significant enough to warrant a rigorous I/I reduction program. In addition, future new construction should reduce I/I due to newer, more watertight sewer components. The flow projections in Table 1-4 conservatively assume that flows from the existing system will remain the same. While the flows may increase over time as a result of continued deterioration, a modest I/I reduction and sewer rehabilitation and replacement program could result in declines in wastewater flows. For this purpose, Keller Associates recommends that the system flows be evaluated on an annual basis against ongoing efforts to reduce I/I.

The design flows are summarized in Table 1-4. Details of how each design flow was derived are discussed in the preceding paragraphs.

Table 1-4: Projected Flows

	Design Flow (MGD)	Design Unit Flow (gpcd)	Projected Design Flow (MGD)	Projected Flows (MGD)			
Year	2015	2015	2018	2023	2028	2033	2038
Population	950	950	994	1,065	1,142	1,224	1,281
ADWF	**0.058**	61	0.061	0.065	0.070	0.075	0.079
$MMDWF_{10}$	**0.061**	64	0.064	0.068	0.073	0.079	0.082
AADF	**0.059**	62	0.062	0.067	0.071	0.076	0.080
AWWF	**0.060**	64	0.063	0.068	0.073	0.078	0.081
$MMWWF_5$	**0.065**	68	0.068	0.073	0.078	0.083	0.087
PWkF	**0.075**	79	0.078	0.084	0.090	0.096	0.101
$PDAF_5$	**0.139**	147	0.146	0.156	0.167	0.179	0.188
PIF_5	**0.180**	189	0.188	0.202	0.216	0.232	0.243

Notes:
1. Flows calculated based on DEQ methods, with exception of MMDWF. This flow was increased to be higher than ADWF.
2. 2018 population projected from the PSU certified 2017 population (980) and the growth rates presented in the Coordinated Population Forecast for Marion County, its Urban Growth Boundaries (UGB), and Area Outside UGBs 2017-2067.

1.5 NPDES PERMIT

The City of Aurora discharges treated effluent under NPDES Permit No. 101772 (Appendix C) into the Pudding River from November 1st through April 30th. Existing effluent limits are summarized in Table 1-5. The City's permit was recently renewed and went into effect on August 22, 2016, with an expiration date of July 31, 2021.

The Pudding River is a tributary of the Willamette River, and has the following designated beneficial uses:

- *Water Supply* – Domestic (public and private), industrial, irrigation, and livestock watering.
- *Aquatic Life* – Including salmon and steelhead rearing and migration.
- *Recreational* – Including fishing, boating, and water contact recreation.
- *Commercial* – Hydro-power, navigation, and transportation.
- *Other* – Wildlife, hunting, and aesthetic quality.

The Pudding River in the vicinity of the Aurora WWTP outfall was on the 2012 list of water quality limited streams for biological criteria, dissolved oxygen, Guthion, and lead.

Table 1-5: Existing NPDES Permit Limits

Parameter	Average Monthly	Average Weekly	Maximum Daily
Biochemical Oxygen Demand (BOD_5)	30 mg/L 30 ppd[1] 85% removal	45 mg/L 60 ppd	140 ppd
TSS	50 mg/L 47 ppd[1] 65% removal	80 mg/L 90 ppd	220 ppd
pH	Daily minimum and maximum between 6.0 and 9.0		
E. coli Bacteria	126/100 mL	--	406/100 mL
Total Chlorine Residual	0.07 mg/L	--	0.19 mg/L

[1]ppd = pounds per day

From May 1st through October 31st the City land applies the treated wastewater on fields within the WWTP grounds. During this time no discharge to the state waters is permitted. For land application the wastewater must receive at least Level II (Class C) treatment as defined in OAR 340-055 and the total coliform bacteria/100 ml shall not exceed a 7-day median of 23 organisms/100 ml with no two consecutive samples to exceed 240 organisms/100 ml. DEQ does not anticipate that the land application requirements will change in the near future. If modifications are made by the City to the land application system, a recycled water reuse plan must be filed with DEQ.

Keller Associates has communicated with DEQ regarding future permit conditions and there are a number of items that may be added as future discharge requirements. For example, ammonia is often found in sewage treatment plant effluent at levels that exceed the state of Oregon water quality standards for toxicity. Additionally, iron, manganese, and more stringent TSS limits may also be a part of a future permit. Phosphorus and temperature are not likely to be included in a future NPDES permit since the City does not discharge to the river during the summer. Also, ongoing work on toxic substances, including heavy metals, mercury, polychlorinated biphenyls (PCBs), DDT, feminine products, and pharmaceuticals could have future effects on wastewater treatment plants.

1.6 COMMUNITY ENGAGEMENT

The City provided opportunities for the community to engage in the planning process and provide comments or ask questions through the City website and City Council meeting. The City posted draft portions of the planning study on the City website for community review and comment. The community also had the opportunity to engage in the planning process by participating in a City Council meeting that was held before the Council voted to approve the planning study.

2. NEED FOR PROJECT

2.1 HEALTH, SANITATION, AND SECURITY

The Clean Water Act of 1972 provides the primary regulations for water quality in the waters of the United States. It requires that point source contributions to surface waters obtain a discharge permit (currently permits are issued from Oregon DEQ as NPDES permits). These permits determine the conditions for discharge into surface waters.

Compliance with the NPDES permit for Aurora is discussed in Section 3.6 of this report. The City of Aurora's WWTP has been in compliance with the NPDES effluent limits, with a few exceptions, since at least 2010 according to the records provided. The City reports that there has not been a lasting compliance issue.

Oregon DEQ provided information about other Clean Water Act items, including the status of receiving streams, beneficial uses, and waste load allocations from the TMDL in the NPDES Permit Evaluation Report for Aurora. The Permit Evaluation Report can be found in Appendix C.

Other issues regarding public health, sanitation and security involve events when untreated or undertreated effluent overflows onto the ground or is discharged to surface water. There have not been any recent overflows throughout the collection system, nor at the Aurora WWTP.

The treatment plant lagoons and headworks are secured by a chain link fence with a locked gate, and the controls are located inside the control building. The WWTP does not have intrusion alarms or key card security. There is no fence around the WWTP Office, disinfection buildings, Sludge Transfer Station, or pump stations. The four collection system pump stations are secured with locking, hinged, fiberglass covers and bollards where relevant. Wet well access is secured with locked metal hatches.

2.2 AGING INFRASTRUCTURE

The majority of the WWTP and collection system were constructed in 2000, so aging infrastructure is not a significant problem. Some of the equipment (such as the diffusers and pumps) are nearing the end of their useful life. City staff indicates all collection system pumps were rebuilt in 2014.

2.3 SYSTEM DEFICIENCIES

System deficiencies of the WWTP and collection system are listed in Sections 3 and 6.

2.4 REASONABLE GROWTH

Wastewater system improvements are needed to stay ahead of growth due to potential increased population and new construction. Section 1 of this report discussed population growth projections including customers served, and the wastewater flows associated with this growth. The collection system does not need to be expanded to accommodate the potential growth in the planning period based on the evaluation in this study.

The SDC percentage was calculated using the capacity that can be utilized for future connections divided by the 2038 capacity. For projects that did not have an increase in flows, the percent SDC eligible is derived from the percent growth in population over the 20-year planning period.

3. WWTP EXISTING FACILITIES

This section contains a description and evaluation of the existing wastewater treatment plant (WWTP) for the City of Aurora.

3.1 LOCATION MAP

Maps of the existing WWTP facilities are included in Figure 5 (Appendix A). A schematic process layout of the WWTP is located in Figure 6 (Appendix A).

3.2 HISTORY

The WWTP and collection system were constructed in the fall of 1999 through the winter of 2001. Prior to this time the City of Aurora depended on septic tanks and drain fields for wastewater treatment. The WWTP includes a multi-cell lagoon (three aerated cells followed by two settling cells), an effluent storage lagoon, chlorine disinfection and de-chlorination, and an effluent pump station. An influent screen, adjacent to the aerated lagoon, was added in 2007. Also, all but one of the floating aerators in the lagoon were replaced by diffusers and blowers in 2012.

3.3 WWTP DESCRIPTION

The wastewater influent flow is measured using a magnetic flow meter in a vault near the WWTP. Inside the WWTP fence, the wastewater is sampled and screened adjacent to the aerated lagoon. The screenings are placed in a 55-gallon barrel or rolling garbage container until they are periodically taken to the landfill. Following the influent mechanical fine screen the wastewater flows by gravity into the aerated lagoon where it is aerated in three (3) aeration cells and the solids are settled in two (2) settling cells. Following treatment in the aerated lagoon, the wastewater is stored in a 7.2 million gallon effluent storage lagoon. If there is a process upset, the wastewater can be diverted and temporarily stored in this effluent storage lagoon. When the wastewater leaves the effluent storage lagoon it flows by gravity through a magnetic flow meter, modulating valve to control the flow, and enters a chlorine contact basin where it can be chlorinated and then dechlorinated.

Following the disinfection process the flow is sampled in accordance with NPDES Permit No. 101772. From May 1st to October 31st the treated wastewater is pumped by the River Pump Station/Irrigation Pump Station and land applied on approximately 6 acres of City land adjacent to the WWTP. From November 1st to April 30th the effluent is pumped by the River Pump Station/Irrigation Pump Station to the Pudding River. In the river, the effluent discharges through a single-port diffuser, which helps distribute and mix the effluent with the river channel flow.

Solids generated in the aerated lagoon are pumped out of the settling cells to the new Sludge Holding Tanks in the Sludge Transfer Station area of the treatment plant. Solids are held in these tanks, periodically removed using a vacuum truck, and hauled to the City of Salem for treatment. As the solids are held in the tanks some additional consolidation of the solids will take place. Some of the water can be removed from these tanks and drained to the Return Pump Station, where it can be recycled to the aerated lagoon. The bathroom in the WWTP Office and the drain for the Chlorine Contact Basin are also connected to the Return Pump Station.

The WWTP does not currently accept septage. Also the WWTP does not treat a significant amount of industrial wastewater as there are no major industrial facilities connected to the collection system. Septage and industrial discharges can be significant sources of load to a plant, so the City should carefully consider each case before allowing septage or industrial discharge into the WWTP.

3.4 CONDITION OF EXISTING FACILITIES

3.4.1 Pump Stations

The River Pump Station/Irrigation Pump Station conveys the treated WWTP effluent to the Pudding River during the winter and in the summer the effluent is land applied on City land near the WWTP. The Return Pump Station pumps the water from the Sludge Holding Tanks (Sludge Transfer Station) to the aerated lagoon. The bathroom in the WWTP Office and the drain for the Chlorine Contact Basin are also connected to the Return Pump Station.

River Pump Station / Irrigation Pump Station

River Pump Station / Irrigation Pump Station

The River Pump Station/Irrigation Pump Station is located near the chlorine contact basin. The pump station has two (2) 20 HP Hydromatic Model S4LVX submersible centrifugal pumps for river discharge and one (1) 7.5 HP PACO Model 1570-5 surface mounted centrifugal pump for irrigation. The pump station was constructed in 2000 and includes a 6 ft. diameter wet well, a pressure transducer level sensor, valves, pressure gauges, and a control panel. The surface mounted centrifugal pump, pump valves and control panel are adjacent to the wet well under a fiberglass hinged hood manufactured by Hydronix. The surface mounted PACO irrigation pump was installed in 2016. Valves were also installed in 2016 that allow the river discharge pumps to be used for irrigation as well.

In order to discharge to the Pudding River, the wastewater is pumped approximately 1,400 ft. in a 6 in. diameter pipe and then travels an additional 850 ft. in an 8 in. diameter gravity line before discharging through a single-port diffuser. Temporary piping is used for land application at the WWTP. An AMIAD SAF-3000 irrigation filter was installed in 2000. The City cleans the filter periodically to maintain proper operation.

The submersible pumps are controlled by the pressure transducer level sensor using a lead on, lag on, and pump off operational strategy. The City has tested the level sensor. There have been no known issues with the pump station overflowing or with pumps running continually for an extended period of time. The pumps are being throttled to prevent the pumps from cycling too frequently. However, replacing the existing starters with variable frequency drives (VFDs) may be more energy efficient. Another option would be to replace the river discharge pumps with smaller horsepower pumps. The irrigation pump was replaced with a smaller horsepower pump, which has reduced the pump's cycle frequency. An autodialer is used to send alarms to the City. The permanent diesel generator powers the pump station whenever the power goes out. The facility is not fenced, but the City has not had problems with security or vandalism with the pump station.

Deficiencies

- There is no fence to secure the area.
- There is no fall protection for the wet well.
- There is no sign reading, "Confined space, entry by authorized personnel only".
- Pumps are cycled on/off, which increases power use, rather than ramping up/down with a VFD.
- The irrigation system uses temporary piping, which has had issues.

Recommendations

- Add to the fence around the plant to include the pump station.
- Provide a fall protection system for the wet well to prevent falls when the cover is open.
- Add warning signs stating that the wet well is a confined space and a permit is required to enter.
- A cost-benefit analysis for adding VFDs should be completed prior to replacing the pump starters with VFDs. If verified by the analysis to have a greater benefit, replace the pump starters with VFDs.
- Install a permanent irrigation system.

Return Pump Station

Return Pump Station

The Return Pump Station is also located near the chlorine contact basin. The pump station consists of two (2) Pentaire Hydromatic Model HPGX 200 grinder pumps. The pump station was constructed in 2000 and consists of a 6 ft. diameter wet well, a pressure transducer level sensor, submersible chopper pumps, valves, and a control panel. The Return Pump Station pumps through a 2 in. PVC line to the head of the WWTP. Previously, this line may have connected with the influent line upstream of the influent screen and WWTP influent sampling. The City has modifed the return piping so that it enters directly into the aerated lagoon and no longer impacts the influent sample results.

Both of the original pumps were replaced in 2016 with the Pentaire pumps. The pumps are controlled by the pressure transducer level sensor using a lead on, lag on, and pump off operational strategy. The City has tested the level sensor. The pumps are being throttled to prevent the pumps from cycling too frequently. Per City staff, the pump station runs approximately once a day. Energy savings from replacing the existing starters with VFDs would be negligible.

There have been no known issues with the pump station overflowing or with pumps running continually for an extended period of time. It is unclear if the control panel is receiving gases from the pump station. An autodialer is used to send alarms to the City. The permanent diesel generator powers the pump station whenever the power goes out. The facility is not fenced, but the City has not had problems with security or vandalism with the pump station.

Deficiencies

- There is no fence to secure the area.
- There is no fall protection for the wet well.
- There is no sign reading, "Confined space, entry by authorized personnel only".
- There is no way to measure the amount of water being pumped from this station into the treatment process.

Recommendations

- Add to the fence around the plant to include the pump station.
- Provide a fall protection system for the wet well to prevent falls when the cover is open.
- Add warning signs stating that the wet well is a confined space and a permit is required to enter.
- Evaluate vent system and make sure it avoids gases escaping into the control panel so that electrical equipment meets NFPA 820.
- Add a flow meter to this line to measure the amount of return flow.

3.4.2 Headworks

Wastewater flows into the WWTP through a 6 in. sewer line. The influent is measured with a MAG 3100 magnetic flow meter near the influent screen, but outside of the WWTP fence. An ISCO Model 3700FR refrigerated composite sampler is located in a control building inside the WWTP fencing, adjacent to the aerated lagoon. The sampler pulls samples from near the influent screen and it is programmed to collect influent samples based on the influent flow measurements.

Influent Screen

A WesTech CleanFlo™ Spiral Screen Model FST2 influent screen was installed in 2007. The screen has 0.25 in. perforated plate openings. Screenings from the unit are automatically washed, bagged and deposited into a barrel or rolling garbage can adjacent to the screen. If the influent screen malfunctions, the wastewater will automatically overflow into a bypass with a manual bar rack that is connected to the influent screen. The WWTP does not have a grit removal system following the influent screen, which would provide additional solids removal. The influent screen is not covered, so freezing can be a problem. Also, there is limited space between the screen and the lagoon for maintenance.

Deficiencies

- Grit continues to accumulate in the aerated lagoon.
- There is no freeze protection on the screen.
- There is limited room for maintenance.
- There is no fall protection between the screen and the lagoon.

Recommendations

- Add grit removal downstream of the influent screen.
- Add a cover over the influent screen and also freeze protection.
- Install fall protection between the screen and lagoon.

3.4.3 Aerated Lagoon – Aeration Cells

The lagoon was constructed in 2000 and is an HDPE-lined lagoon basin. From the surface, the lagoon appears to be in relatively good condition. The cells in the lagoon are separated by polypropylene floating baffles. The lagoon has approximate dimensions of 200 ft. long x 50 ft. wide x 10 ft. deep, and has a total volume (including settling cells) of approximately 356,000 gallons. The aerated portion of the lagoon is approximately 313,000 gallons. There is no fall protection around the outside of the aerated lagoon to protect operators. See Figures 5 and 6 in Appendix A for the lagoon layout and process flow diagram.

Two (2) 10 HP Tuthill PneuMaxII™ rotary positive displacement blowers and 56 fine bubble diffusers provide oxygen for the lagoon system in the aeration cells. There are 28 diffuser lines with ball valves, which can be turned off to decrease the air in that cell for process control. According to the operators the diffusers appear to be in good shape (no major leaks), but they have not been able to take the lagoon down to inspect them. Also, one of the original 7.5 HP Aeration Industries Aire-O2® aerator remains in the first aeration cell, primarily to provide mixing. Historically, two (2) HACH LDO™ dissolved oxygen (DO) probes monitor the DO concentrations in the aeration cells. The DO measurements were sent to the SCADA system in the WWTP Office. Currently, the DO probes are not operational. The City takes grab samples from the lagoon and measures DO concentrations at the WWTP office with a handheld DO probe. The blowers can be manually turned off/on depending on the DO measurements in the aerated cells. The aerator, however, is generally left on in order to provide mixing. Algae and solids deposition have been observed on the sides of the aeration cells, so the mixing is likely limited on the sides.

The aerated lagoon, based on the 2018 design maximum month wet weather flow, has an average hydraulic retention time in the aerated portion of the lagoon of approximately 4.6 days.

Aerated Lagoon

While Aurora does not currently have an ammonia river discharge permit limit, as discussed in Chapter 1, one may possibly be added in the future. For this reason, the ability of the WWTP to continually achieve nitrification was evaluated. It is normally desirable to maintain 2.0 mg/l DO in the aerated lagoon to ensure adequate oxygen is available for metabolism of the influent organic matter (BOD) by the microorganisms in the process and for nitrification. The surface aerator and the blowers/diffusers have a combined firm capacity (with one of the 10 HP blowers out of service) of approximately 370 lbs. oxygen (O2)/day. Assuming influent concentrations of BOD_5 of 276 mg/L and TKN of 60 mg/L, and a peaking factor of 1.25, and aeration requirements of 1.2 lbs. O_2/lb. BOD_5 and 4.6 lbs. O_2/lb. total Kjeldahl nitrogen (TKN), the existing aeration system has firm capacity to handle a maximum flow of approximately 0.058 MGD, which means that the aeration system is currently under capacity.

Additionally, although there are several cells, there is only one aerated lagoon. If maintenance is required on the diffusers or if there is a process upset, then the wastewater will be transferred directly into the effluent storage lagoon. If there is a power loss, the aerator and blowers will be automatically powered through a permanent 100 kW, diesel generator with automatic transfer switch located next to the WWTP Building. The City periodically uses temporary pumps to recycle the water in the aerated lagoon to keep the scum off the surface.

See Section 3.6 for a discussion on the treatment performance of the aerated lagoon.

Deficiencies

- The lagoon aeration is currently under capacity.
- With only one aeration lagoon, maintenance can be difficult.
- The DO probes are not operational and do not connect with the SCADA system.
- There is no fall protection around the aerated lagoon.

Recommendations

- Increase the aeration capacity by either adding aerators or blowers/diffusers.
- Place fall protection around the aerated lagoon.
- Install new DO probes, mounts, and controller.
- Add permanent pumps, piping, and valves to recycle the aerated lagoon water for scum control.

3.4.4 Aerated Lagoon – Settling Cells

There are two (2) settling cells in the aerated lagoon, which operate in series. Wastewater from the aerated cells flows through windows in the baffle walls into the first settling cell and then into the second settling cell. There are no diffusers in the settling cells, so there is little to disturb the solids settling process. At the end of the second settling cell, the wastewater exits through submerged pipes into an aerated lagoon outlet structure, where it travels through an 8 in. pipe to the effluent storage lagoon. There are three (3) effluent pipes with valves located at different levels in the settling cell, which allow the operator the ability to control the level in the aerated lagoon. Solids and scum that accumulate in the settling cells are periodically removed using temporary submersible pumps and pumped to the Sludge Holding Tanks.

Deficiencies

- The sludge pumps and piping are temporary and require manual operation.
- There is no measurement on the amount of solids being wasted to the Sludge Holding Tanks; however, a timer is being installed to allow a rough solids volume to be calculated based on the estimated sludge pump rate.
- There is no emergency overflow if the effluent pipe plugs.

Recommendations

- Permanent sludge pumps, piping, and flow monitoring should be installed for recycling to the front of the aerated lagoon and for wasting to the Sludge Holding Tanks.
- An emergency overflow should be installed.

3.4.5 Effluent Storage Lagoon

The Effluent Storage Lagoon is HDPE lined and was constructed in 2000. The storage lagoon has a net storage capacity of approximately 7.2 million gallons. It appears to be in relatively good condition although there is no fall protection around the lagoon to protect the operators. There are three (3) submerged effluent pipes with valves located at different levels in the effluent lagoon outlet structure, which allow the operator the ability to control the level in the storage lagoon. The wastewater exits the storage lagoon through the effluent lagoon outlet structure, where it travels through an 8 in. pipe to the WWTP Building. Solids and scum that accumulate in the lagoon are periodically removed using portable submersible pumps and pumped to the Sludge Holding Tanks. During the summer months, the portable pumps are used in conjunction with portable sprinklers to evaporate and aerate the water in the Effluent Storage Lagoon. Evaporation concentrates the total dissolved solids in the water, making it typically less desirable to plants, so this should be performed only as needed, such as to avoid overflowing the storage lagoon.

Land application can take place during the growing season at an agronomic uptake rate, which is approximately 15.5 inches per acre per year on a grass seed crop (Oregon Crop Water Use and Irrigation Requirements, 1992, OSU ext. Pub. 8530). The 2038 theoretical irrigated farmland needed to land apply the effluent during the growing season, (based on the 2038 ADWF and assuming 75% irrigation efficiency), is approximately 26 acres. Currently the City performs land application on approximately 6 acres using a temporary sprinkler system.

A water balance for the existing WWTP was developed using 2038 average dry-weather design flow, 2010 monthly precipitation data from the City's rain gauge, and evaporation data from the Western Regional Climate Center – North Willamette Research and Extension Station. The water balance, (located in Appendix B), showed that the Effluent Storage Lagoon is at capacity without land application. Approximately 8 million gallons of additional storage capacity is needed to store the 2038 average dry-weather design flow without land application. If land application continued to take place on the 6-acre land application site, the amount of additional storage necessary would decrease to approximately 5 million gallons.

Although not clearly shown in the 2010-2015 data in Section 3.6, achieving the TSS and BOD_5 percent removal at certain times during 2016 was a challenge. a. This has been speculated to be due to algae. Since 2018, operators have not experienced difficulty meeting the percent removals. Should meeting TSS and BOD_5 percent removal requirements become challenging again, tertiary treatment should be investigated to achieve greater TSS and BOD_5 percent removal.

Deficiencies

- There is insufficient storage volume and/or land application area for the 20-year design flows.
- There is no fall protection around the Effluent Storage Lagoon.
- There is no emergency overflow if the effluent pipe plugs.
- The Effluent Storage Lagoon has not been inspected recently.

Recommendations

- Increase the storage volume and/or land application area to provide for the future design flows.
- Place fall protection around the Effluent Storage Lagoon.
- An emergency overflow should be installed.

- The Effluent Storage Lagoon basin integrity (liner and walls) should be investigated, especially since the lagoon is reaching capacity.

3.4.6 Chlorination and Dechlorination Systems

After water leaves the Effluent Storage Lagoon it travels to the WWTP Building. In the WWTP Building, the flow is measured using a Siemens Sitrans F M MAG 5000/6000 magnetic flow meter. A butterfly valve downstream of the flow meter is modulated to control the effluent flow. The flow to the chlorine contact basin is currently controlled to around 100-120 gallons per minute (gpm). Through controlling the effluent flow, the chlorine and dechlorination chemicals are being conserved and contact time extended for better disinfection.

Chlorine Dosing System

The chlorine contact basin, (constructed in 2000), is located adjacent to the WWTP Building. Based on the 1999 plans for Aurora's Wastewater Treatment Plant, the chlorine contact basin has approximate dimensions of 26 ft. x 10 ft. x 5 ft. deep for a total volume of approximately 7,800 gallons. At the beginning of the chlorine contact basin, sodium hypochlorite is added using a Stenner Pump Model 85MJH2A1STAA pump. The dosing changes are made manually. An improvised, inline, static mixer is used to mix the chlorine with the effluent. When discharging to the river, the wastewater is dechlorinated at the end of the chlorine contact basin with sodium bisulfite. The sodium bisulfite is added using a Stenner Pump Model 85MJH2A1STAA pump; dosing changes are made manually. The treated effluent enters the River Pump Station/Irrigation Pump Station wet well prior to being pumped.

The chlorine and dechlorination pumps are both located in the chlorine storage building, since the corrosion in the sodium bisulfate building is extreme. Neither building has adequate ventilation and both have had problems with freezing. A spare dosing pump is stored at the WWTP in case a dosing pump fails.

Because there is storage in the effluent storage lagoon and the effluent flow can be halted while the channel is cleaned or repaired, the City proposes that no redundant chlorine contact basin be required. The chlorine contact basin is cleaned several times a year.

An ISCO Model 3700FR refrigerated composite sampler is programmed to collect effluent samples from the River Pump Station/Irrigation Pump Station based on the effluent flow measurements.

Deficiencies

- There is no reliable ventilation system in the chemical storage buildings, so fumes can become trapped inside. Excessive corrosion was observed on the buildings.
- Freezing has been observed by the operators in the chemical storage buildings despite the use of temporary heaters.
- The inline, static mixer is improvised and needs to be replaced.
- There is no fall protection around the chlorine contact basin.
- There is currently no alarm sent to the SCADA system if the dosing pump fails.

Recommendations

- Replace the existing chemical storage buildings and install exhaust fans and heaters.
- Replace the inline, static mixer.
- Install fall protection around the chlorine contact basin.
- Add alarm for dosing pump failure.
- Add a chlorine monitor and connect it to an alarm if the chlorine residual increases.

3.4.7 Solids Handling

The solids in the settling cells of the aerated lagoon are periodically removed using temporary pumps and piping. The solids are pumped to four (4) 3,000 gallon, polypropylene, Sludge Holding Tanks in the Sludge Transfer Station installed in 2015. Water in the sludge is periodically removed and drained to the Return Pump Station. The solids in the Sludge Holding Tanks are pumped by a vacuum truck periodically and hauled to the City of Salem for treatment. The Return Pump Station pumps to the aerated lagoon.

The Sludge Transfer Station drain is connected to the Return Pump Station, so any precipitation in the area drains to the Return Pump Station. There is also a small wall on three sides of the Sludge Transfer Station that helps collect and funnel the storm and wash water.

There is limited solids treatment occurring prior to disposal. If the City of Salem no longer accepts the solids, treatment for land application may be desired by the City. There are currently no solids dewatering capabilities at the plant, and hauling costs for wetter solids can be higher than those for dewatered solids.

Deficiencies

- The Sludge Transfer Station is uncovered and the drain is connected to the Return Pump Station, so rain water will also be pumped to the aerated lagoon.
- The walls are only on three sides, so it is possible for solids to flow out of the Sludge Transfer Station and onto the ground.
- The solids likely cannot be land applied (EPA Part 503-Standards for the Use or Disposal of Sewage Sludge) without further treatment.
- There is no mechanical dewatering to decrease hauling costs.

Recommendations

- If the Sludge Transfer Station continues to be used, a cost-benefit analysis for adding a cover versus treating rainwater should be completed prior to adding a cover to avoid pumping and treating rain water.
- If the Sludge Transfer Station continues to be used, add walls around all sides to avoid solids flowing onto the ground, and install a float sensor to notify the operators of high water in the Sludge Transfer Station.
- Add solids treatment and investigate dewatering options.

3.4.8 SCADA

The SCADA system in the WWTP Office controls the pump stations, displays flow measurements, and receives alarms from motors throughout the plant. The autodialer is also connected to the SCADA system. The control panel for the influent screen is located under an overhang of a building near the influent screen. The control panel for the blowers and aerator is located in a building near the aerated lagoon. The only deficiency noted for the SCADA system is the difficulty to incorporate new functions, due to the programming language.

3.4.9 Electricity

All of the electricity at the WWTP is provided by Portland General Electric. A permanent 100 kW diesel generator located near the WWTP Building powers the WWTP equipment if the electricity goes out and an autodialer notifies the operator of a power outage. The generator is exercised periodically. No deficiencies were noted for the electrical system.

3.4.10 Plant Water

The WWTP uses potable City water for general cleaning/use. There is currently no use of WWTP effluent for plant water. It is recommended that the City investigate installing a plant water system – using treated and disinfected effluent rather than potable water – to reduce City water usage. Backflow pressure reducing devices, pumps, and additional piping would be necessary.

3.4.11 WWTP Office

The WWTP Office was constructed in 2000. It currently houses a laboratory, shop, office, and bathroom. No deficiencies were noted for the WWTP Office.

3.4.12 Site Security and Roads

There is a gate on Millrace Road. Although the lagoons at the WWTP are fenced, the WWTP Office, the chlorine contact basin, and the pump stations are not fenced. It is recommended that the remainder of the WWTP be fenced. The gate can remain open during business hours.

The stormwater detention basin near the WWTP Office washed out and bank stabilization is urgently needed in this area. The road into the WWTP is gravel and has periodically been washed out. It is recommended that the road be paved to prevent washout and that storm drains be installed to collect and disperse the stormwater.

3.5 INFLUENT QUALITY

3.5.1 Analysis of Plant Records

A plant record analysis was originally completed in 2016. As stated in Section 1.4, population projections from PSU have since been updated. This WWFPS update reflects the 2017 PSU Population Forecast Report per discussions with the DEQ for funding eligibility. This report reflects the updated population projections and subsequent modification to the analysis based on the updated flow projections for the smaller populations. New or additional plant data from Discharge Monitoring Reports (DMRs) are not included in this WWFPS update.

The plant influent data taken from the Discharge Monitoring Reports (DMRs) were analyzed from January 2010 to December 2015. The influent constituents monitored by the City included pH, BOD_5 and TSS. The effluent constituents included E. coli, total chlorine residual, quantity of chlorine used, pH, BOD_5 and TSS. The City collected composite samples at least once every two weeks of both the influent and effluent for BOD_5 and TSS. The City collected grab samples of the influent and effluent pH twice per week. The City collected an effluent grab sample for E. Coli once every two weeks. The effluent total chlorine residual grab sample and quantity of chlorine used were measured daily. The City also measured influent and effluent flow daily.

When the WWTP was land applying, it also measured the daily amount of effluent flow (inches/acre), total chlorine residual by grab sample, and quantity of chlorine used. The City collected grab samples for the effluent pH (twice per week) and effluent total coliform (once per week). Nutrients such as total Kjeldahl nitrogen, nitrite and nitrate, ammonia, and total phosphorus were measured quarterly with a grab sample.

3.5.2 BOD_5 Loading

The influent BOD_5 concentrations and loads into the WWTP from January 2010 to December 2015 are provided in Charts 3-1 and 3-2. The influent BOD_5 concentrations generally range from 100 to 300 mg/L, which are within the range of typical domestic wastewater values. For Aurora, these concentrations equate to BOD_5 loadings of approximately 50 to 150 pounds/day (ppd). The waste strength has been fairly constant during the reporting period.

Chart 3-1: WWTP Influent BOD_5 Concentrations

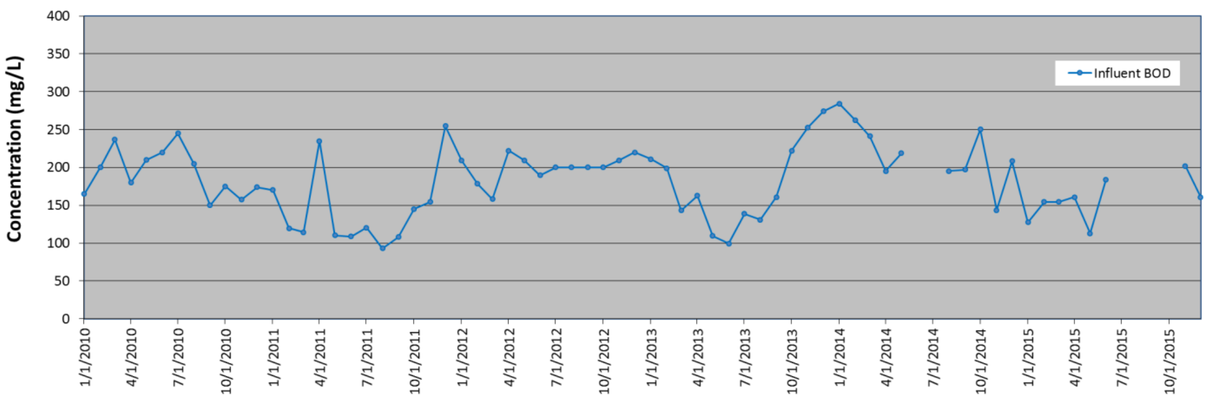
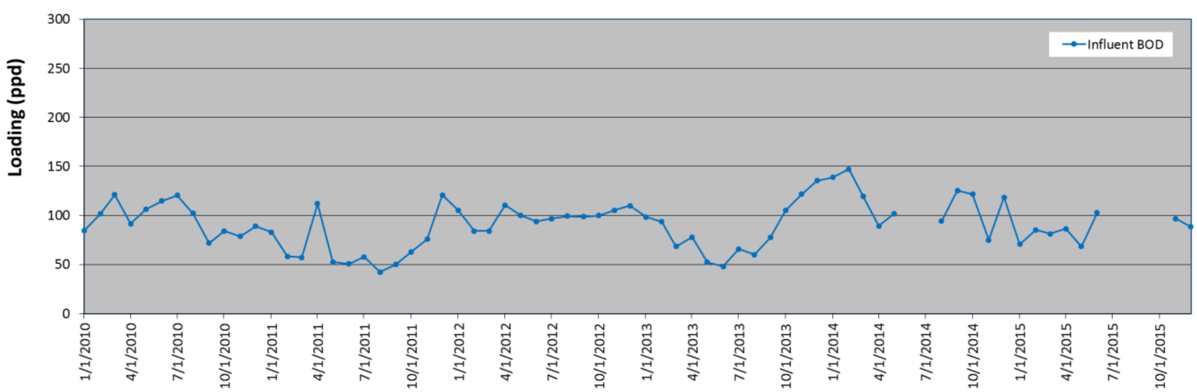


Chart 3-2: WWTP Influent BOD_5 Loading



The BOD_5 loading rates are shown in Table 3-1. The BOD_5 loading rates are normalized for the population to provide units of BOD_5 pounds per capita per day (ppcd) using the Table 1-1 population estimates. The typical range for BOD_5 is shown in the table footnote. The design values for this study are also shown in Table 3-1. Since the loading rates have remained fairly constant, the maximum value for each flow was selected for the design values.

Table 3-1: Summary of Influent BOD_5 Data

	2010	2011	2012	2013	2014	2015	Avg.	Max.	Design
Population	918	925	931	937	944	950	950	950	
AADF (PPD)	93	66	98	82	111	84	89	111	
ADWF (PPD)	92	53	97	68	106	79	83	106	
MMDWF (PPD)	121	63	100	105	126	103	103	126	
AWWF (PPD)	94	79	98	95	114	85	94	114	
MMWWF (PPD)	121	121	111	135	147	97	122	147	
AADF (ppcd)	0.101	0.071	0.105	0.087	0.117	0.088	0.095	0.117	**0.117**
ADWF (ppcd)	0.101	0.057	0.105	0.073	0.112	0.083	0.088	0.112	**0.112**
MMDWF (ppcd)	0.131	0.068	0.108	0.112	0.133	0.108	0.110	0.133	**0.133**
AWWF (ppcd)	0.102	0.086	0.105	0.101	0.120	0.090	0.101	0.120	**0.120**
MMWWF (ppcd)	0.132	0.131	0.119	0.145	0.156	0.102	0.131	0.156	**0.156**

* Industry typical values BOD_5 (Metcalf & Eddy): 0.130 - 0.260 ppcd

3.5.3 TSS Loading

Influent TSS concentrations from January 2010 to December 2015 are provided in Charts 3-3 and 3-4. The TSS concentrations generally range between 100 and 350 mg/L, which are within the range of typical domestic wastewater values. These concentrations equate to TSS loadings between 50 and 180 ppd.

Chart 3-3: WWTP Influent TSS Concentrations

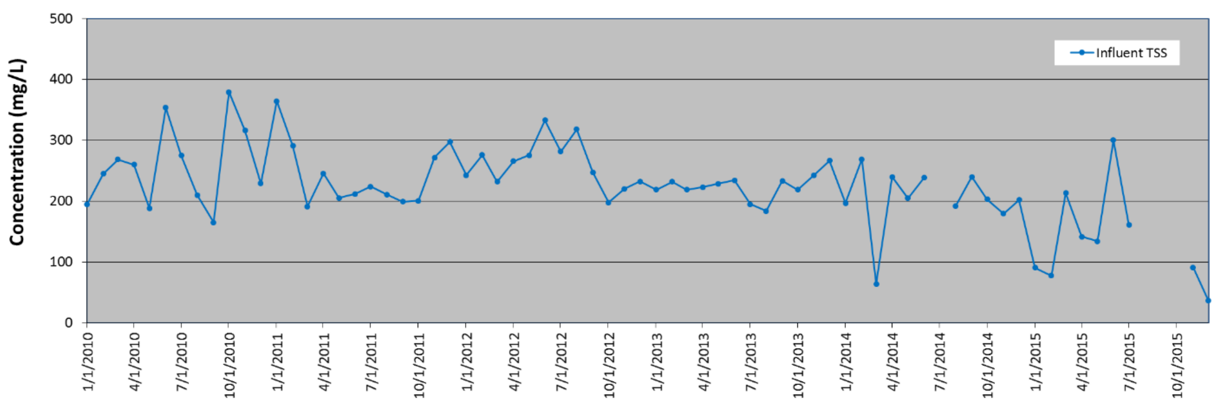


Chart 3-4: WWTP Influent TSS Loading

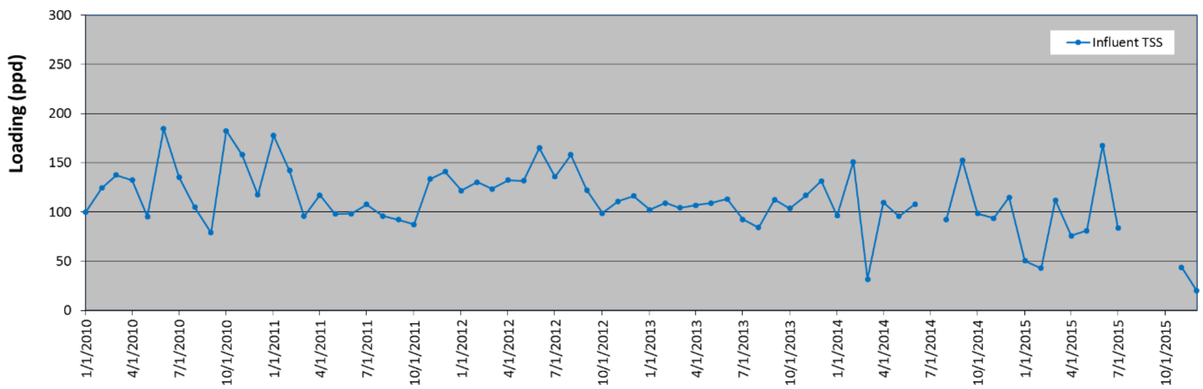


Table 3-2 shows the TSS ppcd summary. The typical range for TSS is shown in the table footnote. The design values for this study are also shown in Table 3-2. Since the loading rates have remained fairly constant, the maximum value (with one exception) was selected for the design values. The maximum month dry weather flow had an exceptionally high value in 2010, which appears to be an outlier as normally TSS and BOD_5 have a more consistent correlation. The second highest monthly value was used instead (0.177 ppcd from 2012).

Table 3-2: Summary of Influent TSS Data

	2010	2011	2012	2013	2014	2015	Avg.	Max.	Design
Population	918	925	931	937	944	950	950	950	
AADF (PPD)	131	111	126	104	99	67	106	131	
ADWF (PPD)	130	97	133	100	104	103	111	133	
MMDWF (PPD)	185	108	165	113	153	168	148	185	
AWWF (PPD)	132	126	119	107	96	51	105	132	
MMWWF (PPD)	158	178	132	132	151	112	144	178	
AADF (ppcd)	0.142	0.121	0.136	0.111	0.105	0.071	0.114	0.142	**0.142**
ADWF (ppcd)	0.141	0.104	0.143	0.107	0.110	0.108	0.119	0.143	**0.143**
MMDWF (ppcd)	0.201	0.116	0.177	0.121	0.162	0.176	0.159	0.201	**0.177**
AWWF (ppcd)	0.144	0.137	0.128	0.115	0.102	0.053	0.113	0.144	**0.144**
MMWWF (ppcd)	0.172	0.192	0.142	0.140	0.160	0.118	0.154	0.192	**0.192**

* Industry typical values TSS (Metcalf & Eddy): 0.130 - 0.330 ppcd

The same design ppcd values in Tables 3-1 and 3-2 were also used to estimate the design pounds per day for the years 2018, 2023, 2028, 2033, and 2038 based on the population projections in Table 3-3. Table 3-3 shows the estimated BOD_5 and TSS plant loadings for these design years.

Table 3-3: Influent Loading Projections

	Planning Criteria (ppcd*)	Loading Projections (PPD)				
	Year	2018	2023	2028	2033	2038
	Est. Population	994	1,065	1,142	1,224	1,281
BOD_5						
AADF	0.117	116	125	134	143	150
ADWF	0.112	111	119	128	137	144
MMDWF	0.133	132	142	152	163	170
AWWF	0.120	120	128	137	147	154
MMWWF	0.156	155	166	178	191	200
TSS						
AADF	0.142	142	152	163	174	183
ADWF	0.143	143	153	164	175	184
MMDWF	0.177	176	189	202	217	227
AWWF	0.144	143	153	164	176	184
MMWWF	0.192	191	205	219	235	246

3.6 WWTP OPERATIONS

3.6.1 WWTP Performance

This section evaluates the effluent quality from the existing plant relative to current effluent limits for BOD_5, TSS, E. coli bacteria, pH, chlorine residual, and total coliform.

BOD_5

Monthly and weekly effluent BOD_5 data from January 2010 to December 2015 are shown in Charts 3-5 and 3-6, along with discharge limits per the current permit. Three exceedances were noted during this period (March 2010, November 2015 and December 2015). The March 2010 event was brought on by warm weather and an increase in algae in the Effluent Storage Lagoon. The November and December 2015 results were caused by drawing water from the bottom of the Effluent Storage Lagoon. Once this was corrected, (switched to a higher pipe in the spring of 2016), the BOD has been within discharge limits. As shown in Chart 3-7, the plant met the current 85% BOD_5 removal requirement for all but November 2015 and December 2015 during the reporting period. As shown in Chart 3-8, the maximum average monthly load was higher than the permitted limit in March 2010 and November 2015. The effluent BOD_5 load was consistently lower than the permitted average weekly and daily maximum loads, as shown in Charts 3-9 and 3-10.

Chart 3-5: WWTP Effluent BOD_5 Concentrations (Monthly)

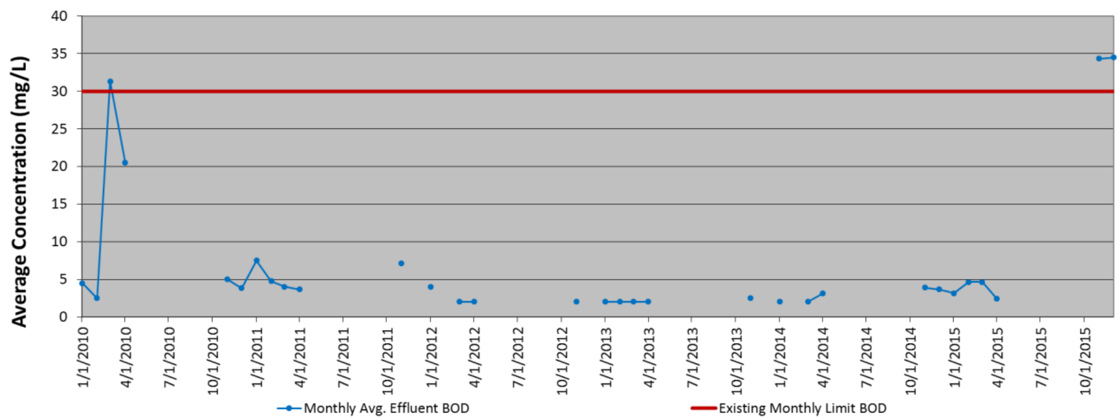


Chart 3-6: WWTP Effluent BOD_5 Concentrations (Weekly)

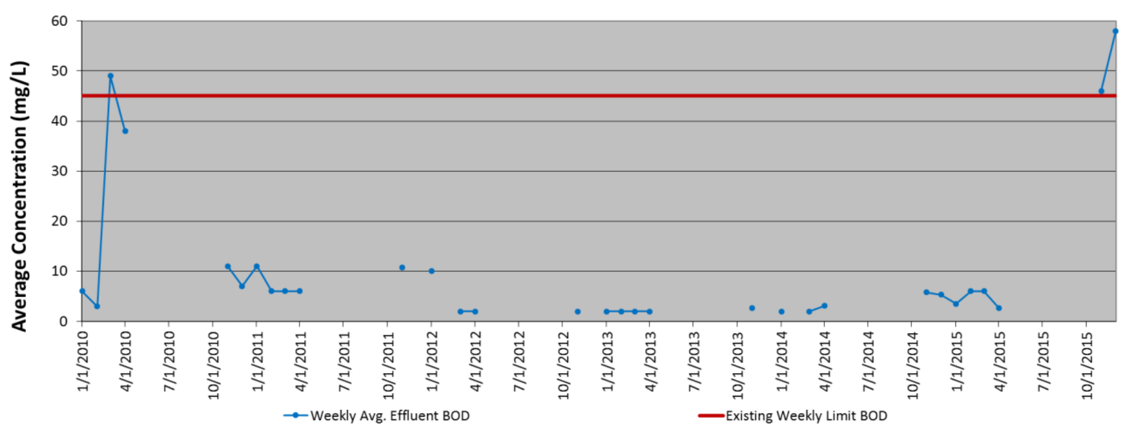


Chart 3-7: WWTP Effluent BOD_5 Percent Removal (Monthly)

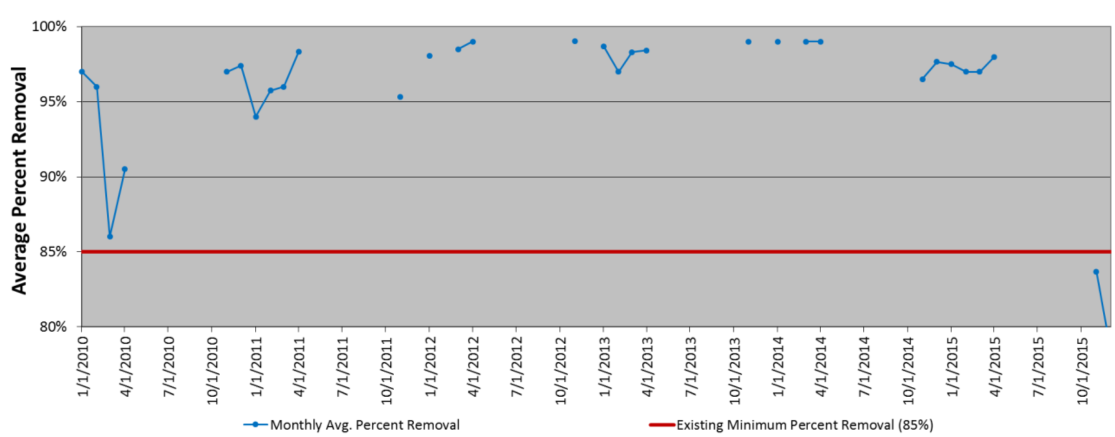


Chart 3-8: WWTP Effluent BOD_5 Loading (Average Monthly)

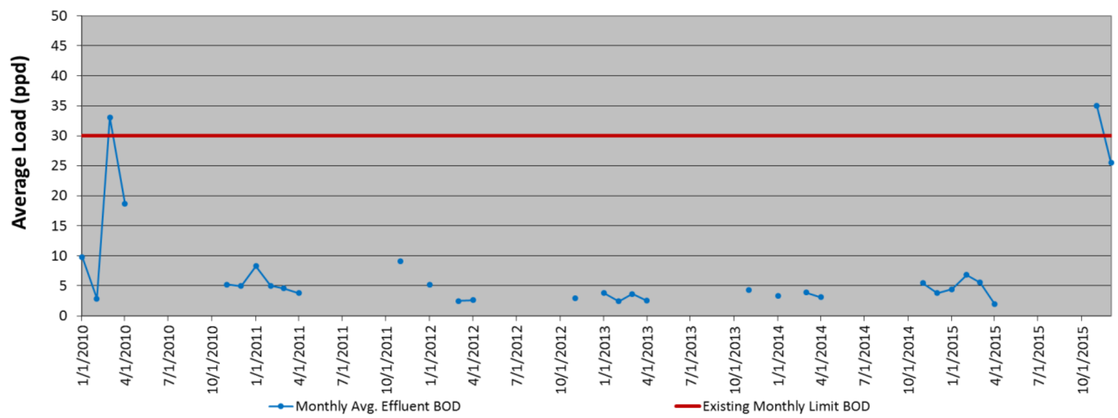


Chart 3-9: WWTP Effluent BOD_5 Loading (Average Weekly)

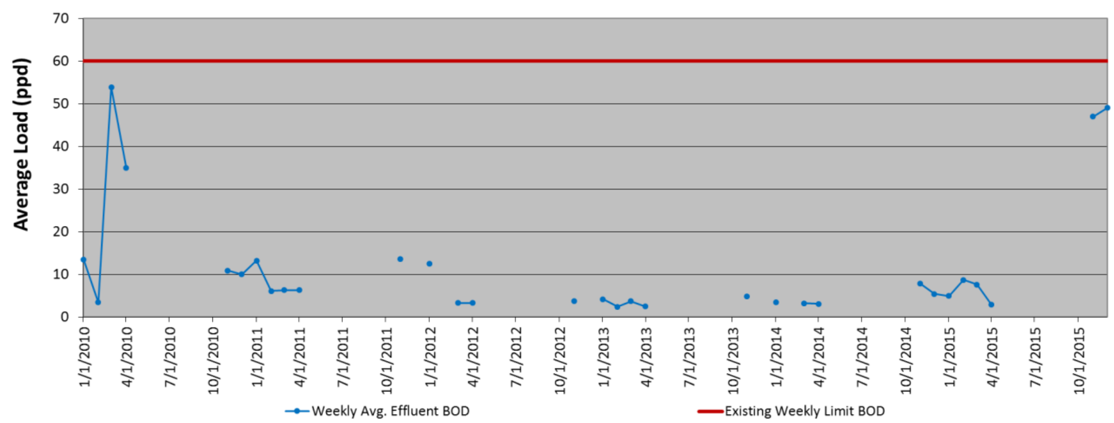
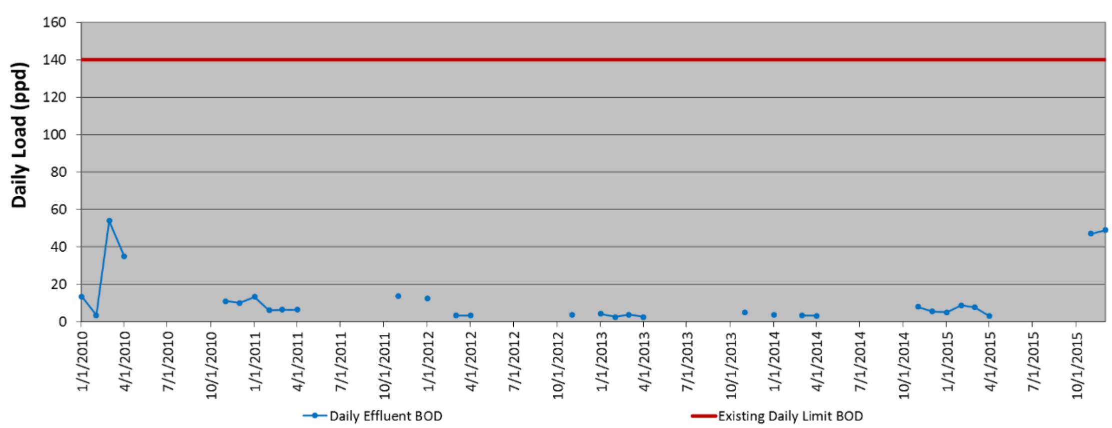


Chart 3-10: WWTP Effluent BOD_5 Loading (Daily Maximum)



TSS

Monthly and weekly effluent TSS data from January 2010 to December 2015 are shown in Charts 3-11 and 3-12 with discharge limits per the current permit. The wastewater treatment plant has not experienced TSS permit violations during the period analyzed. Additionally, TSS removals have consistently been above the anticipated permit requirement of 65% (Chart 3-13). Also, the effluent TSS loads have been consistently lower than the permitted maximum average monthly, average weekly, and daily maximum loads as shown in Charts 3-14, 3-15 and 3-16. In November and December 2016 however, TSS removals were less than 65%. The City believes this was partially due to longer sampling tubing (the sample tube was recently shortened) and also to algae in the effluent. The City has not experienced difficulty achieving removal percentage since 2018.

Chart 3-11: WWTP Effluent TSS Concentrations (Monthly)

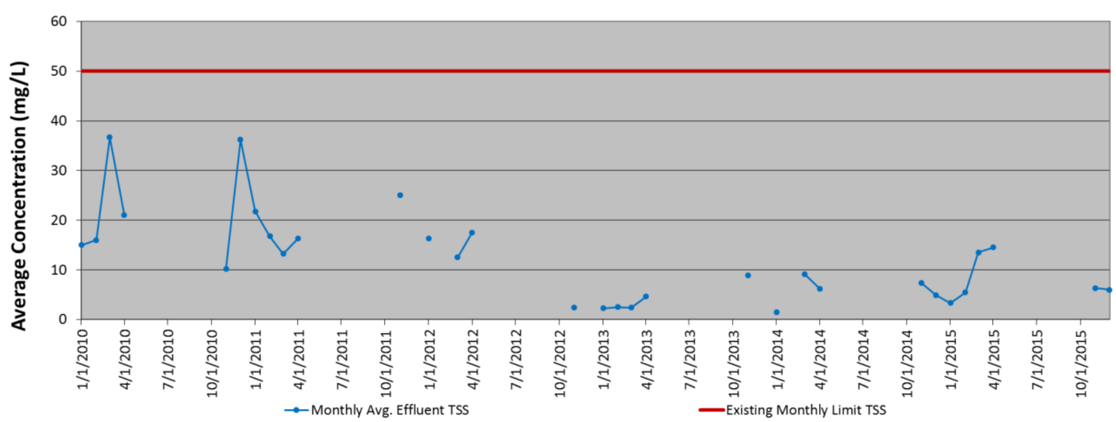


Chart 3-12: WWTP Effluent TSS Concentrations (Weekly)

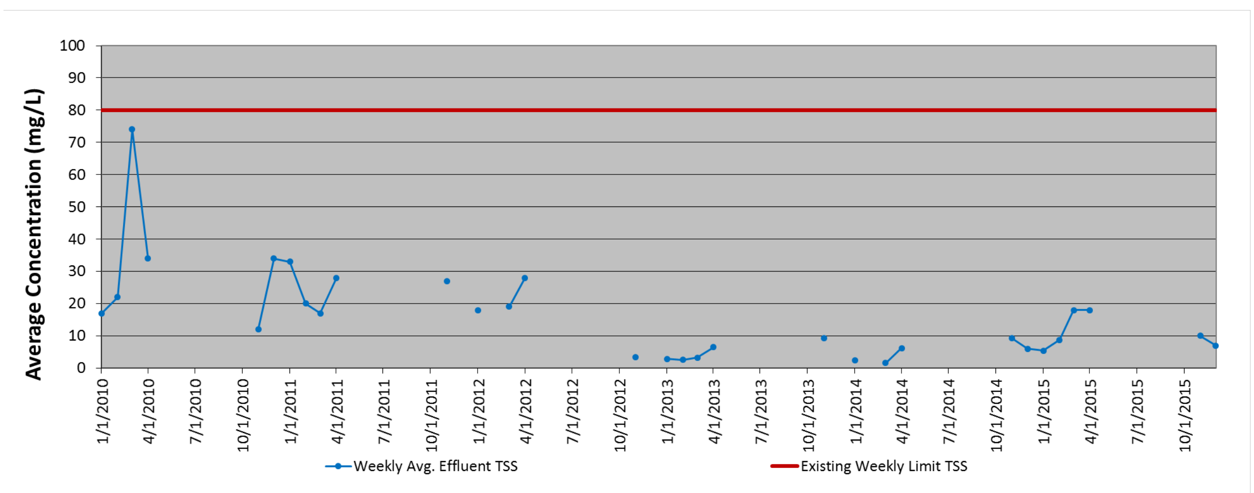


Chart 3-13: WWTP Effluent TSS Percent Removal (Monthly)

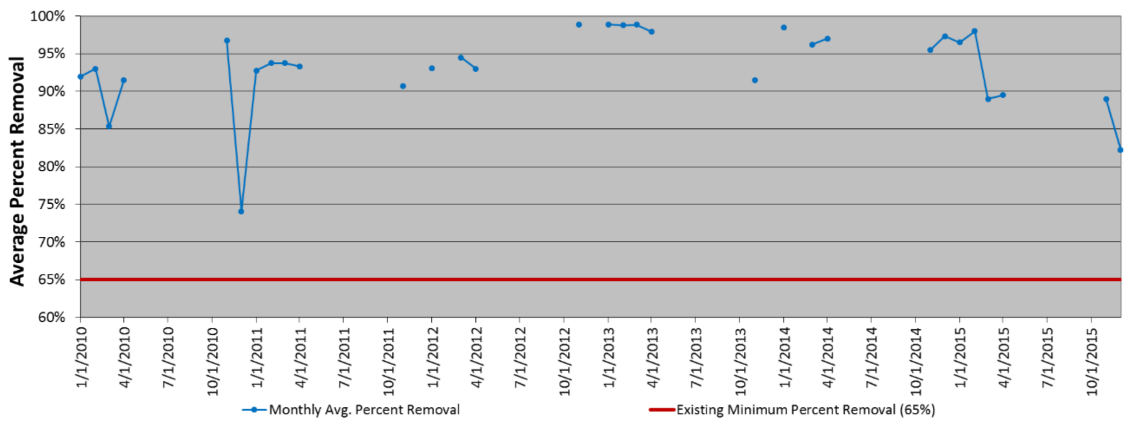


Chart 3-14: WWTP Effluent TSS Loading (Average Monthly)

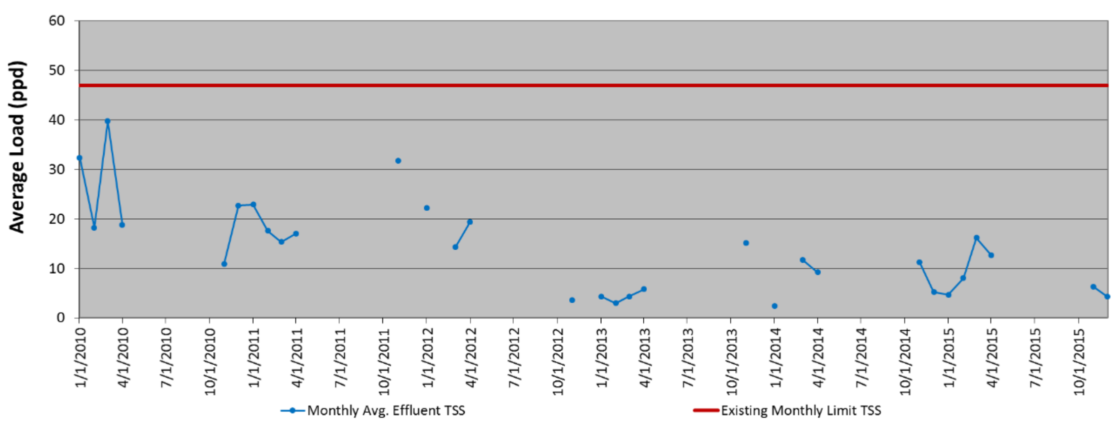


Chart 3-15: WWTP Effluent TSS Loading (Average Weekly)

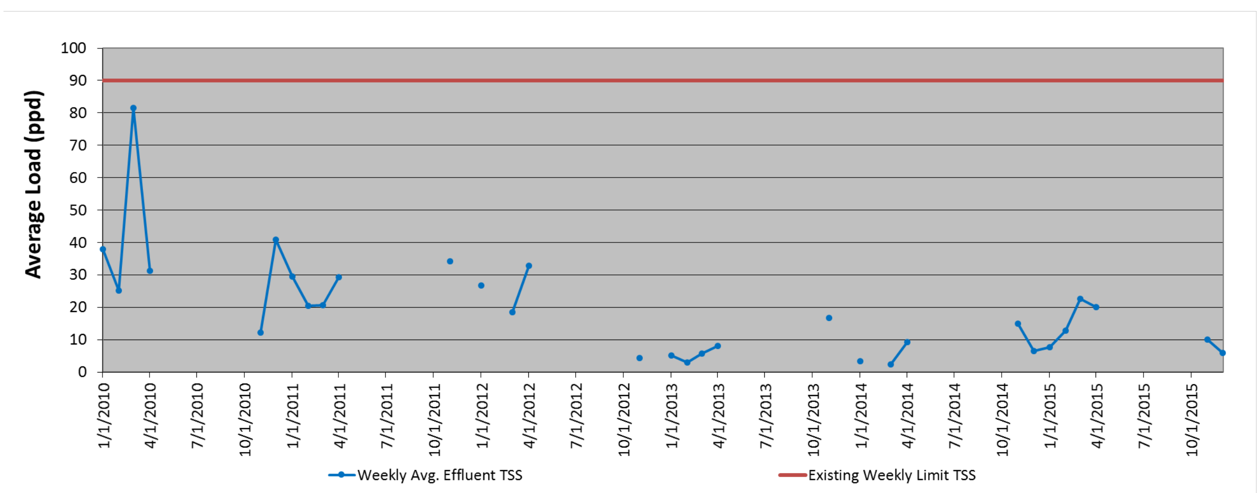
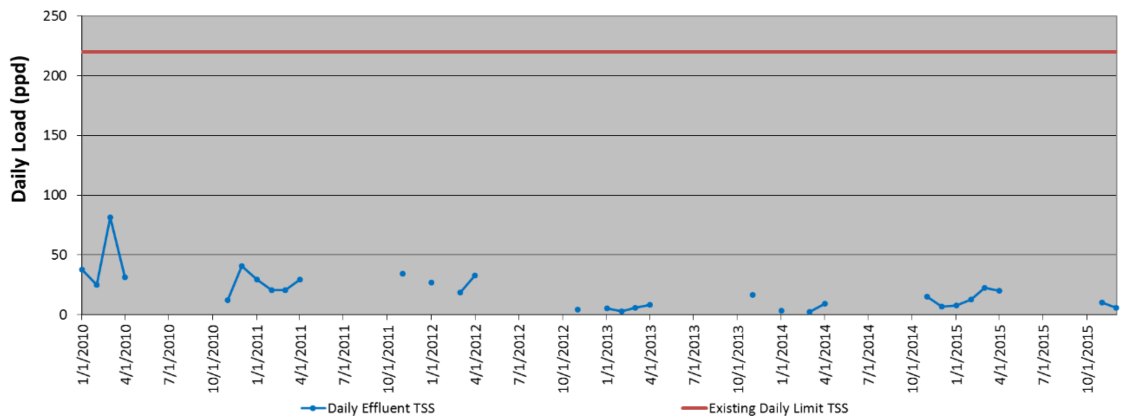


Chart 3-16: WWTP Effluent TSS Loading (Daily Maximum)



<u>E. coli Bacteria</u>

E. coli bacteria effluent data from January 2010 to December 2015 are shown in Charts 3-17 and 3-18. No violations were noted during this period.

Chart 3-17: WWTP Effluent E. coli Bacteria (Monthly)

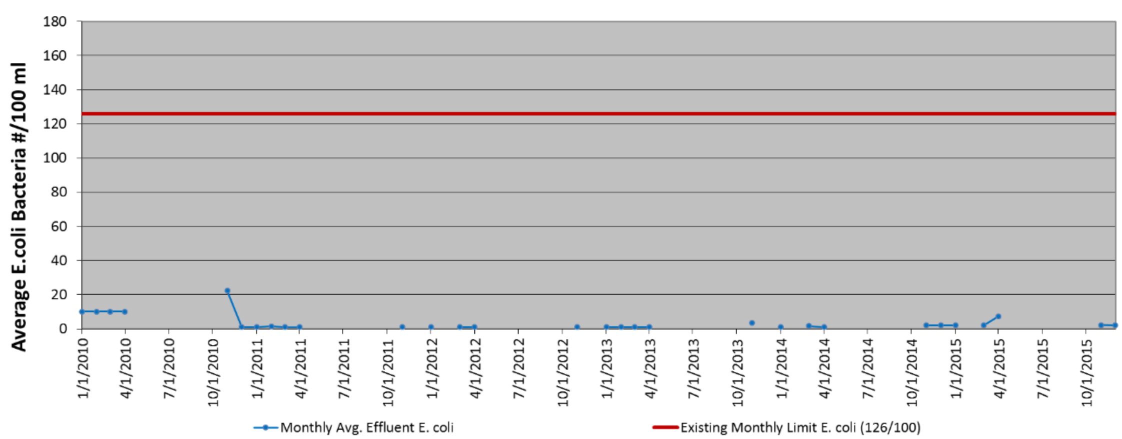
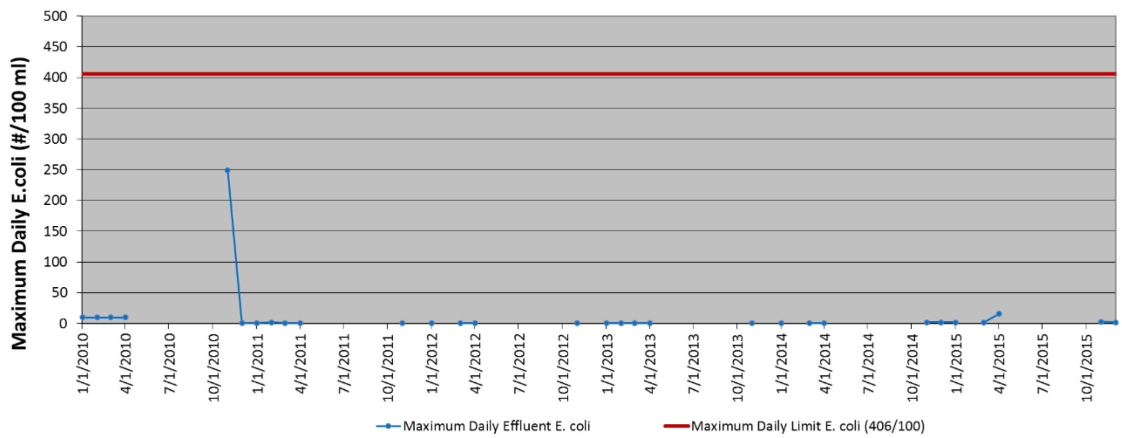


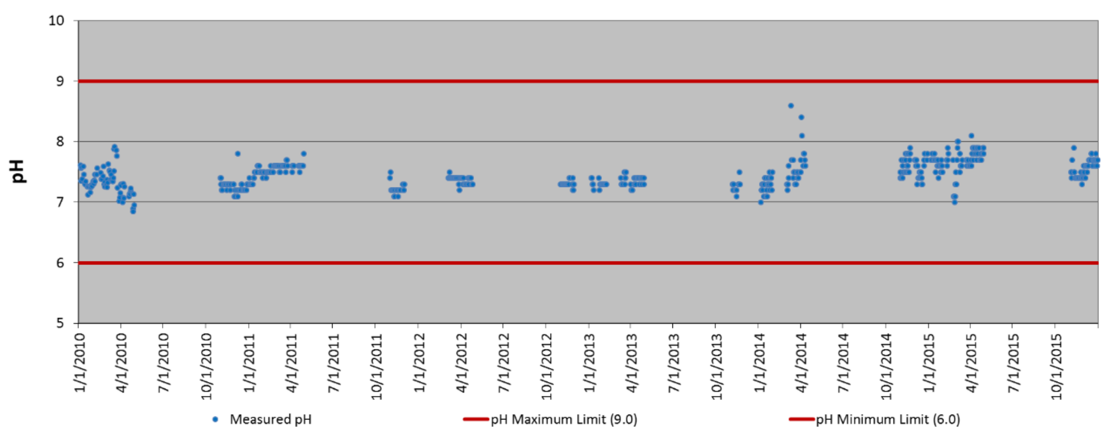
Chart 3-18: WWTP Effluent E. coli Bacteria (Daily)



pH

The daily maximum and minimum pH effluent data from January 2010 to December 2015 are shown in Chart 3-19. No pH limit violations were noted during this period.

Chart 3-19: WWTP Effluent pH (Daily)



Total Residual Chlorine

Chlorine residual data from January 2010 to December 2015 are shown in Charts 3-20 and 3-21. One violation in April 2014 was noted during this period; however, the City provided DEQ with a letter and identified that this result was a typographical error (the daily result was actually 0.10 mg/L rather than 1.0 mg/L, which means both the daily and monthly average results were less than the limits).

Chart 3-20: WWTP Effluent Total Chlorine (Monthly)

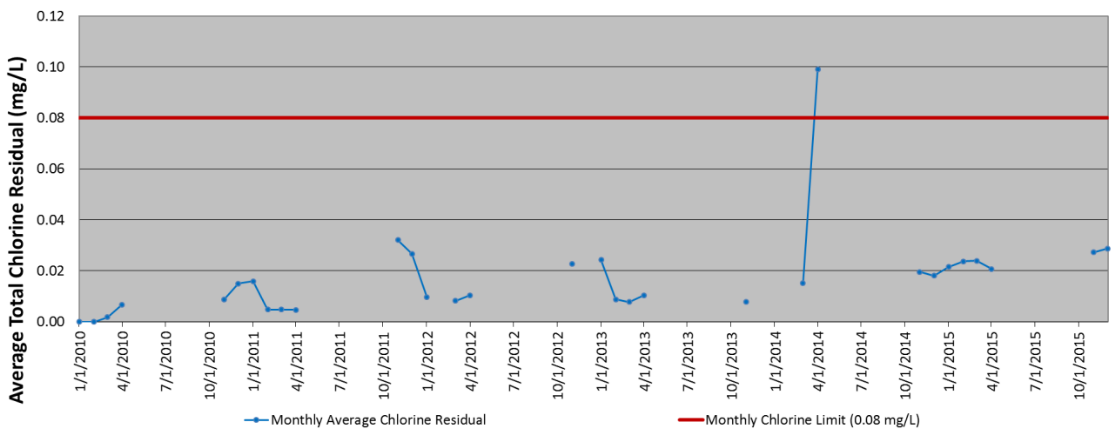
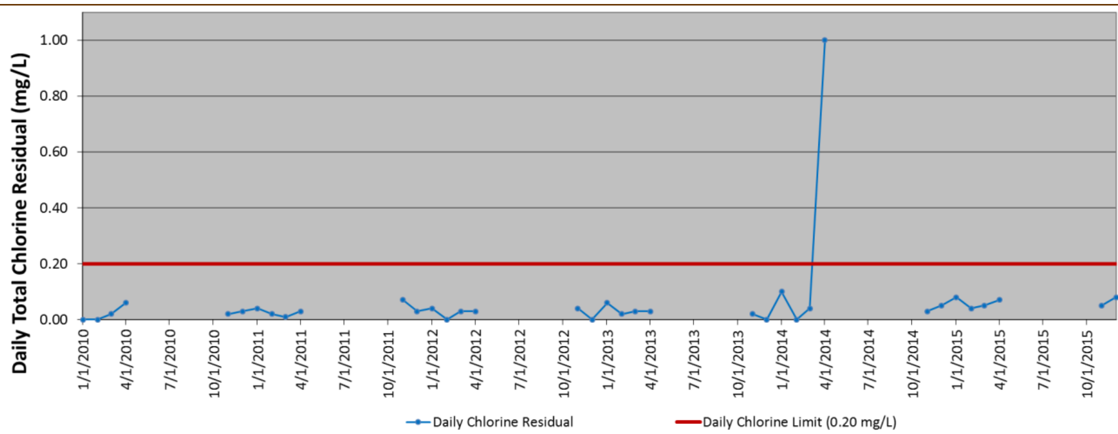


Chart 3-21: WWTP Effluent Total Chlorine (Daily)



Total Coliform

When the WWTP is land applying, the effluent is analyzed for total coliform. Charts 3-22 and 3-23 show the total coliform measurements from January 2010 to December 2015. There were a few total coliform violations during this period; however, the City provided a letter to DEQ that these were due to laboratory errors.

Chart 3-22: WWTP Effluent Daily Total Coliform

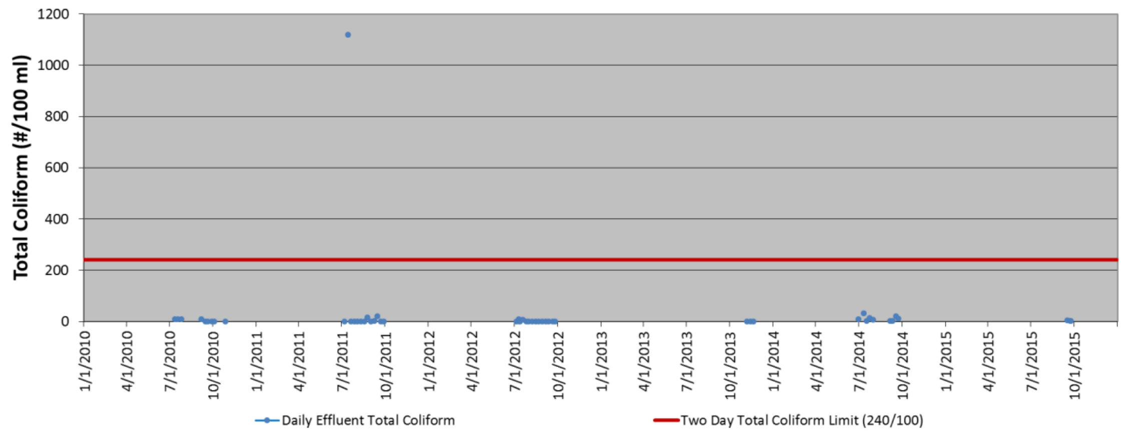
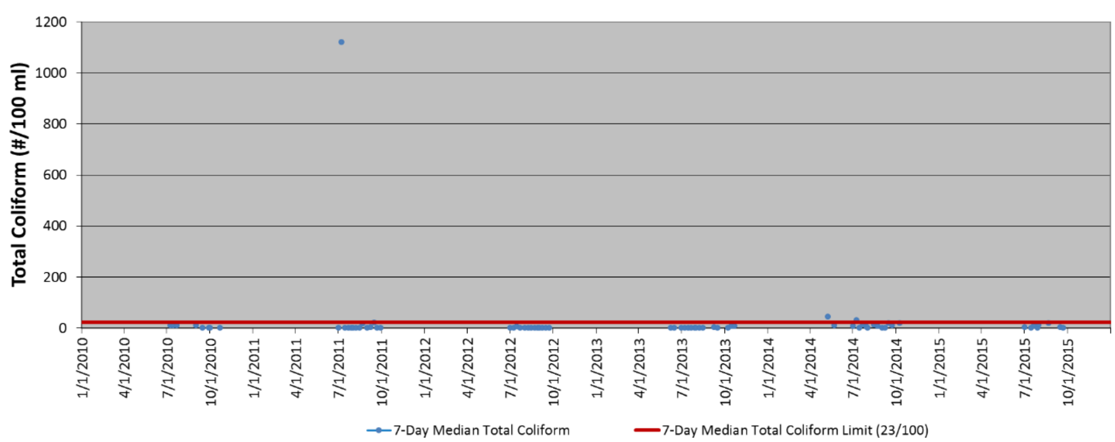


Chart 3-23: WWTP Effluent 7-Day Median Total Coliform



3.6.2 Reliability Evaluation

A summary of the reliability evaluation completed in 2015 is provided in Table 3-4. This includes ratings for redundancy, criticality, and equipment condition.

Table 3-4: Unit Process Reliability Evaluation

Equipment	Backup Rating	Criticality Rating	Equipment Condition Rating
Influent Screen	4	S/H, EQ, PF, CC	LN
Aerated Lagoon	4	S/H, EQ, PF, CC	M
Aerated Lagoon Aeration	1	S/H, EQ, PF, CC	W
Effluent Storage Lagoon	4	S/H, EQ, PF	M
Chlorine Feed Pump	1	S/H, EQ, PF	M
Dechlorination Feed Pump	1	S/H, EQ, PF	M
Chlorine Contact Basin	5	EQ, PF	M
River Pump Station/Irrigation Pump Station	1	EQ, PF	M
Return Pump Station	1	EQ, PF	M

Backup Rating	
1	**One level of "in kind" redundancy** (Identical piece of equipment is available to replace primary unit)
2	**Two or more levels of "in kind" redundancy** (More than one piece of equipment is available for replacement)
3	**Equipment alternative** (An alternative piece of equipment is provided)
4	**Procedural alternative** (An alternative operating procedure is required to provide redundancy)
5	**No Backup** (Failure of equipment will shut entire process down)
Criticality Rating	
S/H	**Safety and Health Risk** (Loss would create risk to safety and health of plant personnel and others)
EQ	**Effluent Quality Risk** (Loss would create risk to WWTP effluent quality and could result in NPDES permit violations
PF	**Process Functionality Risk** (Loss would affect the function and/or efficiency of the affected processes)
CC	**Cost Critical** (Loss would have a significant cost impact in short term or long term)
Equipment Condition Rating	
N	**New** (Equipment is new, or replaced in last 12 months)
LN	**Like New** (Equipment is operated very little or recently overhauled to a condition like new)
M	**Used But Maintained** (Equipment showing expected wear, but is adequately maintained and functions well)
W	**Heavily Worn** (Equipment close to end of useful life, needs overhaul, difficulty in performing intended functions)
R	**Needs Replacement** (Equipment does not acceptably perform, beyond cost-effective repair)

3.7 CAPACITY LIMITATIONS

3.7.1 Pump Stations

River Pump Station / Irrigation Pump Station

Each of the two (2) river discharge pumps is designed for a flow rate of 300 gpm (0.43 MGD) at 65 feet total dynamic head (TDH). To be able to remove at least 6 inches of water depth per day from the Effluent Storage Lagoon (Ten States' Standards for a controlled-discharge system), the River Pump Station/Irrigation Pump Station needs to pump at least approximately 195 gpm (0.28 MGD).Pumping capacity may be desirable in order to avoid overflows in the event that the Effluent Storage Lagoon is full when sustained peak flows occur (e.g. peak instantaneous design flows of 0.243 MGD, or 169 gpm). The existing pumps are capable of providing this capacity with the largest pump out of service.

The irrigation pump is designed for a flow rate of approximately 175 gpm (0.25 MGD) at 120 feet TDH. This capacity is greater than the 2038 peak week flow (0.101 MGD), so the capacity of the irrigation pump should be adequate when considering the Effluent Storage Lagoon is holding the treated wastewater that is not land applied and the river discharge pumps should be able to discharge the complete volume in the Effluent Storage Lagoon plus the influent flow to the river during the winter.

The capacity of the 4-inch effluent flow meter is approximately 1.6 MGD. The future 2038 peak instantaneous flow rate is 0.243 MGD, so the effluent flow meter should be adequate.

The wastewater is pumped approximately 1,400 ft. in a 6 in. diameter pipe and then travels an additional 850 ft. in an 8 in. gravity line before discharging to the Pudding River through a single-port diffuser. Oregon Standards for Design and Construction of Wastewater Pump Stations specify a maximum force main velocity of 8 feet per second (fps), which for a clean 6-inch pipeline represents a capacity of approximately 700 gpm (1.0 MGD). The 2038 peak instantaneous flow rate is 0.243 MGD, so the effluent pipe should be adequate.

Return Pump Station

The two (2) return pump station pumps are each designed for a flow rate of approximately 34 gpm at 27 feet TDH. Flow into the Return Pump Station is from the sludge handling area, clean out of the chlorine contact tank, and from the WWTP office bathroom. The Return Pump Station would also receive backwash from the irrigation filter if it were operating. The Return Pump Station has a 6-foot diameter wet well with pump on/off set-points of 1.6 feet. The pump discharges through a 2 in. PVC line, which for a clean 2-inch pipeline represents a capacity of approximately 78 gpm. Based on the expected daily return flow rates, the return station pumps and pipeline should be adequate. However, the return flows going to the Return Pump Station should be controlled, so that they do not overwhelm the Return Pump Station wet well, pumps, and discharge line.

3.7.2 Headworks

The capacity of the City's magnetic influent flow meter is 0.43 MGD (300 gpm), which is greater than the future 2038 peak instantaneous flow rate of 0.243 MGD (169 gpm).

The capacity of the influent screen (according to the screen manufacturer) is approximately 0.5 MGD, which is sufficient for the future 2038 peak instantaneous flow rate of 0.243 MGD. There is only one automatic mechanical influent screen. If the influent screen malfunctions, the wastewater will automatically overflow into a bypass with a manual bar rack.

3.7.3 Aerated Lagoon – Aeration Cells

The surface aerator and the blowers/diffusers have a combined firm capacity (with one of the 10 HP blowers out of service) of approximately 370 lbs. oxygen (O2)/day. Assuming influent concentrations of BOD_5 of 276 mg/L and TKN of 60 mg/L, and a peaking factor of 1.25, and aeration requirements of 1.2 lbs. O2/lb. BOD_5 and 4.6 lbs. O2/lb. total Kjeldahl nitrogen (TKN), the existing aeration system has firm capacity to handle a maximum flow of approximately 0.058 MGD, which means that the aeration system is currently under capacity.

Although there are several cells, there is only one aerated lagoon. If maintenance is required on the diffusers or if there is a process upset, then the wastewater will be transferred directly into the Effluent Storage Lagoon and then will likely need to be sent back to the aerated lagoon once the repairs are made.

3.7.4 Aerated Lagoon – Settling Cells

The combined volume of the settling cells is approximately 60,000 gallons and the combined surface area is approximately 1,160 ft^2. At 2018 maximum month wet weather design flows the detention time is approximately 21 hours, and the detention time is approximately 7 hours at the peak instantaneous flow rate. In addition to the settling capacities in these cells, the water flows to the 7.2 million gallon Effluent Storage Lagoon where solids continue to settle (for an additional 90 days at the 2038 ADWF). The combined capacity of the settling cells and Effluent Storage Lagoon is sufficient for the 20-year planning period; however, this long of a detention time can result in increased algae production.

3.7.5 Effluent Storage Lagoon

A water balance showed that the Effluent Storage Lagoon is at capacity without land application. Approximately 8 million gallons of additional storage capacity is needed to store the 2038 average dry-weather design flow during the non-discharge season without land application. The theoretical irrigated farmland needed to land apply the influent during the growing season, based on the 2038 AADF is approximately 26 acres. Currently the City performs land application on 6 acres. If land application continued to take place on the 6-acre land application site, the amount of additional storage necessary would decrease from 8 million gallons to approximately 5 million gallons.

3.7.6 Chlorination and Dechlorination System

The estimated chlorine contact basin volume is approximately 7,800 gallons. The required contact times by Oregon guidelines are 20 minutes at the peak daily flow, 15 minutes at peak hourly flow, and 1 ppm after 60 minutes at average dry-weather flow. The 2038 peak daily flow rate is 0.188 MGD (131 gpm), the peak instantaneous flow rate is 0.243 MGD (169 gpm), and the average dry-weather flow is 0.079 MGD (55 gpm). At these future design flows, the chlorine contact basin will meet the 20 minute, 15 minute, and 60 minute requirements.

The existing sodium hypochlorite chemical feed pump is rated to a maximum pump rate of approximately 0.71 gph (17 gpd). At a concentration of 2.5%, this would provide a chlorine dose of 5 mg/L to a flow of 0.085 MGD, or a dose of 1 mg/L to a flow of 0.425 MGD. The existing sodium bisulfite chemical feed pump is rated with the same capacity (0.71 gph (17 gpd)).

The flow to the chlorine contact basin is currently controlled to around 100-120 gpm to conserve chemicals and extend the contact time for better disinfection. However, there may be some issues limiting the actual disinfection capacity as the flows increase, which are not currently apparent. Further evaluation of the disinfection capacity is recommended. Baffles and/or mixer modifications may be necessary for future flows.

3.7.7 Sludge Handling

The solids in the settling cells of the aerated lagoon are periodically removed using temporary pumps and piping. The solids are pumped to four (4) 3,000 gallon, polypropylene, Sludge Holding Tanks in the Sludge Transfer Station installed in 2015. As the solids settle in the tanks, water in the tanks is periodically decanted and drained to the Return Pump Station. The solids in the Sludge Holding Tanks are pumped by a vacuum truck periodically and hauled to the City of Salem for treatment. The Return Pump Station pumps to the head of the WWTP. Based on future anticipated solids production, the Sludge Holding Tanks may not be large enough (require multiple disposals each week). This could be reduced if aerobic digestion (solids treatment) were incorporated at the plant. Aerobic digestion could also assist the City with disposal options, for example if the City of Salem no longer accepts the sludge. Another item to consider is solids dewatering. Hauling costs for wetter solids are typically higher than dewatered solids.

3.7.8 Summary

A summary of the existing treatment capacity at the plant is provided in Table 3-5.

Table 3-5: Plant Capacity Summary

Component	Capacity[1] (MGD)	2018 Capacity Needed (MGD)	2038 Capacity Needed (MGD)	Limiting Factor
Influent Screen	0.50	0.188 (PIF)	0.243 (PIF)	Hydraulic
Aerated Lagoon	0.20	0.068 (MM)	0.087 (MM)	Basin Integrity
Aerated Lagoon Aeration	0.058	0.068 (MM)	0.087 (MM)	One blower is redundant
Effluent Storage Lagoon	0.060	0.061 (ADWF)	0.079 (ADWF)	Non-Discharge Period
Chlorine Feed Pump	0.43	0.188 (PIF)	0.243 (PIF)	Maximum Dose
Dechlorination Feed Pump	0.43	0.188 (PIF)	0.243 (PIF)	Maximum Dose
Chlorine Contact Basin	0.75	0.188 (PIF)	0.243 (PIF)	Hydraulic Retention Time
River Pump Station/ Irrigation Pump Station	0.43 / 0.25	0.188 (PIF) / 0.078 (PWkF)	0.243 (PIF) / 0.101 (PWkF)	Hydraulic
Return Pump Station	0.05	0.02	0.04	Hydraulic

1 -Capacity flow numbers are used only for comparative purposes. MGD – million gallons per day, PIF – Peak Instantaneous Flow, MM – Max Month Flow, ADWF – Average Dry-Weather Flow, PWkF – Peak Weekly Flow.

3.8 FINANCIAL STATUS OF EXISTING FACILITIES

The financial information for the City of Aurora sewer utility is located in Appendix D. Sewer revenue during the 2015-2016 fiscal year was $284,709. The annual costs to operate and maintain the wastewater system, separated by type of expense, are also shown in Appendix D. In the 2015-2016 fiscal year, the total spent from the sewer fund was $270,927 (excluding transfers).

The City created a bond fund to account for debt service on the construction of their treatment plant. The annual debt service is approximately $323,000 and it is funded by a property tax levy. There are no other existing sewer system debts. Aurora does not have any required reserve accounts; however, they have established a sewer reserve fund for replacement and/or upgrade of the existing wastewater facility.

3.9 WATER/ENERGY/WASTE AUDITS

No water, energy or waste audits have been created at this time.

4. ALTERNATIVES CONSIDERED

This section describes the alternatives considered to meet the wastewater facility deficiencies. It also includes design criteria and environmental and constructability considerations.

4.1 PLANNING CRITERIA

The characteristics of the influent and effluent that form the basis for sizing the treatment plant facilities are summarized in Table 4-1. Flow criteria that will be used for sizing various potential treatment components are summarized in Table 4-2.

Table 4-1: 20-Year (2038) WWTP Planning Criteria

Parameter	Influent	Average Monthly Limit	Average Weekly Limit	Maximum Daily Limit
Average Annual Daily Flow (AADF)	0.080 MGD			
Max Month Wet-Weather Flow ($MMWWF_5$)	0.087 MGD			
Peak Instantaneous Flow (PIF_5)	0.243 MGD			
BOD_5 [1,2] (May 1 – October 31)	249 mg/L 170 ppd -	-	-	-
TSS [2,3] (May 1 – October 31)	332 mg/L 227 ppd -	-	-	-
BOD_5 (November 1 – April 30)	276 mg/L 200 ppd -	30 mg/L 30 ppd 85% removal	45 mg/L 60 ppd -	140 ppd
TSS (November 1 – April 30)	339 mg/L 246 ppd -	50 mg/L 47 ppd 65% removal	80 mg/L 90 ppd -	220 ppd
pH		Daily minimum and maximum between 6.0 and 9.0		
E. coli Bacteria		126/100 mL	-	406/100 mL
Total Chlorine Residual		0.07 mg/L	-	0.19 mg/L
Total Kjeldahl Nitrogen	60 mg/L	-	-	-

[1] BOD_5 = 5-Day Biochemical Oxygen Demand

[2] ppd = pounds per day

[3] TSS = Total Suspended Solids

Table 4-2: Criteria for Component Sizing

Treatment Component	Sizing Criteria	Flow (MGD)
Headworks	PIF_5	0.243
Aerated Lagoon	$MMWWF_5$	0.087
Effluent Storage Lagoon	ADWF	0.079
Chlorination and Dechlorination Systems	PIF_5	0.243
River Pump Station / Irrigation Pump Station	PIF_5	0.243

4.2 DESCRIPTION

The alternatives considered were based on the following goals:

- Provide facilities capable of reliably meeting current permit limits into the future.
- Maximize use of existing facilities.
- Find solutions that are practical and cost-effective.
- Utilize equipment and materials that are readily available.
- Select facilities that can be constructed without unacceptably impacting effluent quality.

Regionalization

Due to the political complexity, physical distance, and pipeline cost between Aurora and a city with larger wastewater facilities, developing a partnership with another community to share wastewater facilities is not cost-effective and not of interest to the City at this time.

WWTP Disposal Alternatives

The requirements for agricultural recycling of effluent may be more or less stringent than for discharge to the Pudding River.

There are three main alternatives for disposal:

1. Summer Farmland Application and Winter Surface Water Discharge (No Action): This option is to continue to dispose of the water as is currently done. It is possible that future discharge limits may become more stringent than current requirements, requiring upgrades to the WWTP. As mentioned in Section 3, there are storage volume and/or land application area deficiencies that would need to be addressed with this option. Three sub-options were developed:

    a. Increase the effluent storage capacity and maintain the existing land application. This sub-option would include using the existing Effluent Storage Lagoon and 6-acre land application site and adding approximately 5 million gallons of additional storage to provide the estimated required storage capacity during the summer (non-discharge period) for the 20-year planning flows. It is presumed that this would require the purchase of land for the new storage lagoon and also the construction of a new pump station.

b. Increase the effluent storage and minimize land application. This sub-option would use the existing land application site for the new storage lagoon, so no land would need to be purchased. The new additional effluent storage lagoon would add approximately 8 million gallons of storage capacity. It is presumed that this would require the addition of a new pump station.

c. Increase land application area. This sub-option would use the existing Effluent Storage Lagoon and 6-acre land application site and add more land application area. There is an additional 3 acres at the WWTP that has been approved for land application and potentially 5 additional acres that could potentially be approved. For this option, it was assumed that the City would have a total of 14 acres of land at the WWTP for land application and approximately 12 acres of land would be purchased (total of 26 acres). This would provide the estimated land application area required during the summer (non-discharge period) for the 20-year planning flows. This sub-option would require the purchase of land and an irrigation system for the existing and new land application areas. The existing Effluent Storage Lagoon would continue to be used during shoulder periods where land application and surface water discharge are not possible. It is assumed that the existing irrigation pump station can be used to pump to the different land application areas.

2. Year-round River Discharge: Year-round discharge to the Pudding River would eliminate the need to increase the storage and/or land application area. However, more stringent permit limits would be required to protect the Pudding River during the dry season (currently the non-discharge season). These permit limits would likely include ammonia, phosphorus, and temperature. The cost for the additional treatment facilities to achieve ammonia, phosphorus, and temperature limits would likely be significant. In order to meet the required treatment levels consistently, a sophisticated mechanical plant would be needed, including tertiary treatment and cooling.

3. Summer Farmland Application and Winter Storage (No Surface Water Discharge): The City could look at farmland application for all of the effluent. This could involve the City purchasing additional land or working with farmers to utilize reuse water. The treatment requirements for recycled water may be less stringent than continued discharge to the Pudding River.

   This alternative would require storage during the winter (non-growing season). Based on the 2038 average wet-weather design flow, 2010 monthly precipitation data from the City's rain gauge, and evaporation data from the Western Regional Climate Center – North Willamette Research and Extension Station, the required total storage volume during the non-growing season is approximately 25 million gallons. The existing Effluent Storage Lagoon has a capacity of only 7.2 million gallons. Thus, an additional approximately 18 million gallons of storage would need to be constructed.

Use of treated wastewater outside of the WWTP is governed by recycled water regulations, as outlined in Oregon Administrative Rules (OAR) 340-055. The April 2008 revisions to Oregon's Recycled Water Use Rules allow the use of recycled water for beneficial purposes if the use provides a resource value, and protects public health and the environment. Replacing another water source that would be used under the same circumstances, or supplying nutrients to a growing crop are considered as resource values and beneficial purposes. OAR 340-055 defines five categories of effluent, identifies allowable uses for each category, and provides requirements for treatment, monitoring, public access, and setback distances. Irrigation of fodder, fiber, and seed crops not for human consumption is allowed for any class of effluent. Fewer restrictions are imposed for higher quality effluent, as shown in Table 4-3.

Table 4-3: Requirements for Reuse of Effluent by Category

	Class A	Class B	Class C	Class D	Non-disinfected
Treatment[1]	O,D,F	O,D	O,D	O,D	O
Total coliform, 7-day median #/100 mL	2.2 [2]	2.2 [2]	23 [3]	-[4]	Per permit
Turbidity, NTU	2	-	-	-	
Public access[5]		Limited	Limited	Controlled	Prevented
Setback to property line[6]		10 feet	70 feet	100 feet	Per RWUP[1]
Setback to water supply source		50 feet	100 feet	100 feet	150 feet

[1] O = oxidized, D = disinfection, F = filtration, RWUP = Recycle Water Use Permit
[2] Must not exceed 23 total coliform organisms per 100 milliliters (ml) in any single sample
[3] Must not exceed 240 total coliform organisms per 100 ml in any two consecutive samples
[4] Rather than total coliform, Class D Recycled Water is required to sample for E. coli. E. coli is a subgroup of the total coliform organisms, so a total coliform analysis includes the E. coli organisms. For Class D Recycled Water, the 30-day log mean must not exceed 126 E. coli organisms per 100 ml; and must not exceed 406 E. coli organisms per 100 ml in a single sample
[5] Limited public access: no direct contact during irrigation cycle
[6] Sprinkler irrigation assumed

Aurora's effluent meets Class C requirements. Upgrades would be necessary to meet Class A or B requirements.

For recycled water use, groundwater must be protected in accordance with the requirements of OAR 340-040. For agricultural use, this typically translates to irrigating at agronomic rates to match the net irrigation requirements of the crops. Water application can take place during the growing season at a rate of approximately 15.5 inches per acre per year on a grass seed crop (Oregon Crop Water Use and Irrigation Requirements, 1992, OSU ext. Pub. 8530). The theoretical irrigated farmland needed to irrigate the entire year's flow during the growing season, based on the 2038 AADF and assuming 75% irrigation efficiency, is approximately 44 acres.

With typical effluent total nitrogen and total phosphorus concentrations of 15 mg/L and 3 mg/L, respectively, the nutrients applied would amount to approximately 70 pounds per acre nitrogen and 14 pounds per acre phosphorus. Oregon State University fertilizer recommendations for typical Willamette Valley grass seed crops are 180-230 pounds per acre of nitrogen and 30 pounds per acre P_2O_5 (about 13 pounds per acre of phosphorus). Thus, application on 44 acres would provide approximately 30-40% of the nitrogen and 100% of the phosphorus recommended for grass seed crops.

It should be noted that, if the farmland used for effluent disposal is privately owned, the City may have limited control over when the effluent is used. Many farmers in the area grow crops without irrigation. In order to have control over the irrigation, the City may need to own the land.

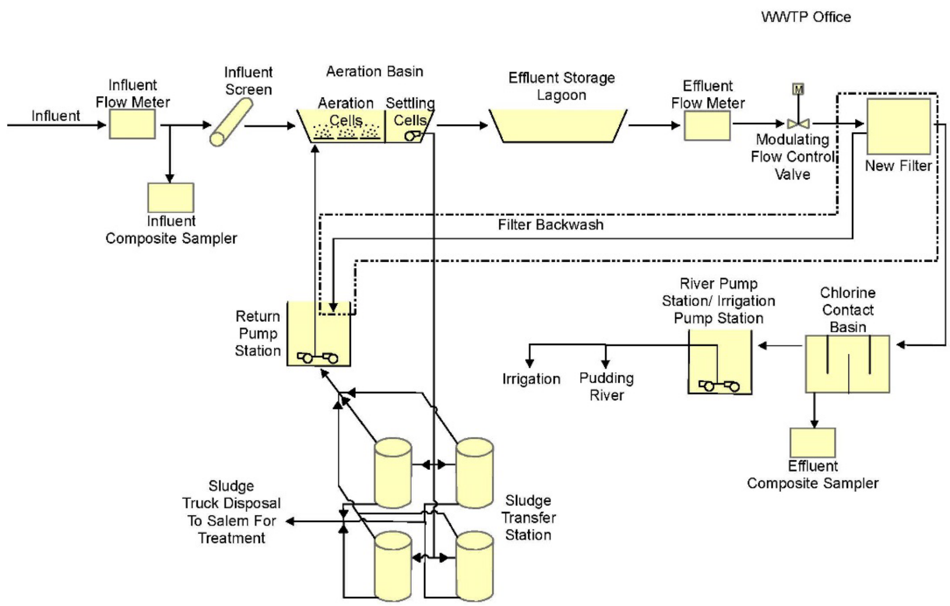
WWTP Treatment Alternatives

Options for addressing certain deficiencies of the existing wastewater treatment are shown below. If a WWTP deficiency had only a single solution (such as fencing, railing, VFDs, etc.), then the solution is discussed in individual project summary sheets found in Appendix G.

1. Aerated Lagoon: The aeration system (surface aerator and the blowers/diffusers) is currently under capacity. There are three main options to address this deficiency.
    a. Surface aerators. This option would include adding one (1) new 7.5 HP surface aerators to the aerated lagoon to provide the estimated oxygen required for the 20-year planning period. The existing aeration equipment (aerator and blowers/diffusers) would remain in service.
    b. Expand diffused aeration. This option would remove the existing surface aerator and replace it with 116 diffusers and two (2) 10 HP blowers to provide the estimated oxygen for the 20-year planning period. The existing diffusers and blowers would continue to be used and the new blowers and diffusers would be a similar type as the existing.
    c. Replace aeration system. This option would include removing the existing aeration equipment and replacing it with new diffusers and blowers. The new diffusers would be more easily removable for inspection and maintenance. The aeration system would be sized for the 20-year planning period.
2. Land Application and Effluent Storage Lagoon: There is insufficient land application area and/or storage volume for the 20-year design flow. The options for these deficiencies were discussed previously in the WWTP Disposal Alternatives. Regardless of which disposal option is selected, the WWTP will need to treat the influent flow during the design period.
3. Tertiary Treatment: TSS and BOD_5 percent removal was a challenge at certain times during 2016. Since 2018, there have not been difficulty meeting the required TSS and BOD_5 percent removals. Should this become an issue again for the plant, there are three main options to address this deficiency.
    a. Filtration. This option would add filtration downstream of the Effluent Storage Lagoon to provide additional TSS and BOD_5 removal. This option assumed a cloth filter would be used. The filter consists of cloth-covered disks mounted in a fabricated steel tank. Solids are removed by filtering through the individual cloth-covered disks. As solids build up on

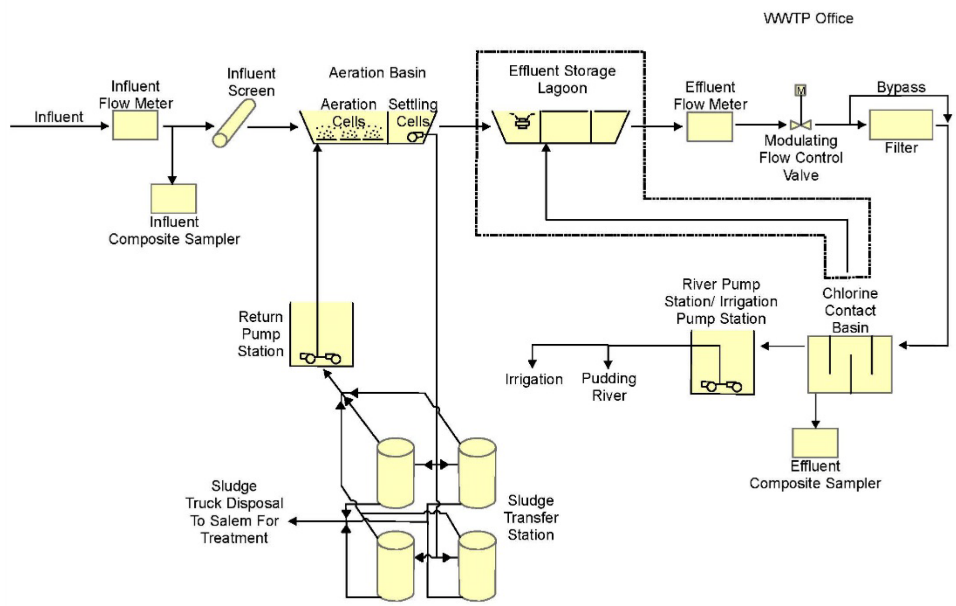
the disks, a vacuum-assisted shoe or spray moves over the disks, cleaning the disks while filtration continues. This option should be pilot tested prior to investing to ensure it can achieve algae removal (algae can increase the TSS and BOD_5 in the effluent). A schematic for this option (inside the dashed lines) is shown in Schematic 4-1.

Schematic 4-1: Filtration



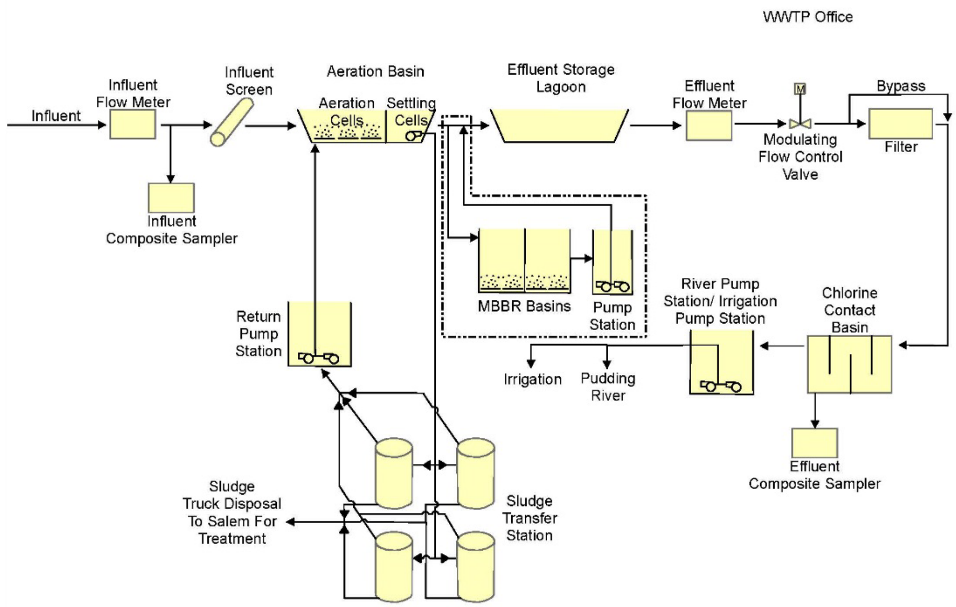
b. Aeration, Baffles, Cover and Chlorine. This option would add aeration in the Effluent Storage Lagoons to add dissolved oxygen and mixing, which can increase the BOD_5 removal and also reduce the likelihood of algae formation. (For this comparison it was assumed that two Effluent Storage Lagoons would be used). A couple of baffles would also be installed in the Effluent Storage Lagoon to create 3 zones. The first zone would have aeration, the second zone would include a floating cover, and the third zone would also have a floating cover, but the baffle would be located around the outlet structure to help the solids to settle prior to being discharged. Piping from the chlorine disinfection system would also be laid to allow seasonal chlorine addition to prevent algae blooms. A schematic for this option (inside the dashed lines) is shown in Schematic 4-2.

Schematic 4-2: Aeration, Baffles, Cover and Chlorine



c. Moving Bed Biofilm Reactor (MBBR). This option would add an MBBR downstream of the Aerated Lagoon to provide additional TSS and BOD_5 removal. An MBBR uses attached growth media to provide additional removal primarily for BOD_5 and ammonia, (which can reduce algae formation), as well as some TSS removal. The MBBR is typically aerated and mixed with blowers and coarse bubble diffusers. Effluent from the MBBR would be pumped to the Effluent Storage Lagoon. Solids that slough off of the MBBR media would settle out in the Effluent Storage Lagoon and would need to be removed periodically. A schematic for this option (inside the dashed lines) is shown in Schematic 4-3.

Schematic 4-3: MBBR



4. Chlorination and Dechlorination Systems: Several deficiencies were noted in Section 3 for the existing disinfection system. There are three (3) main alternatives to address the disinfection deficiencies.
    a. Upgrade the chlorination and dechlorination systems to address deficiencies.
    b. Convert the systems to peracetic acid (PAA) disinfection. Although PAA has been approved for use by the environmental protection agency (EPA), it is still a fairly new technology and would require pilot testing.
    c. Switch to ultraviolet (UV) disinfection. It should be noted that algae can interfere with UV light, so a filter may be required prior to UV disinfection.
5. Solids Handling: The WWTP currently hauls their liquid sludge (solids) to the City of Salem for treatment and disposal. The City would have limited options for the minimally treated solids should the City of Salem stop accepting municipal solids. Three (3) main alternatives were developed concerning solids handling.
    a. Sludge Holding. Continue to hold the solids in the polypropylene tanks and make the recommended improvements outlined in Section 3. The solids would continue to be sent to the City of Salem for disposal.
    b. Sludge Treatment. Construct an aerobic digester to treat the solids to meet Class B (EPA Part 503) requirements. The solids would then be land applied by farmers or sent to the City of Salem for disposal.
    c. Sludge Treatment and Dewatering. Construct an aerobic digester to treat the solids to meet Class B (EPA Part 503) requirements and add mechanical dewatering. The dewatered solids would then be stored under a cover and be land applied by farmers or could be sent to a landfill for disposal.

4.3 MAP

A flow schematic of the existing WWTP is in Figure 6 in Appendix A.

4.4 ENVIRONMENTAL IMPACTS

A comparison of potential environmental impacts of the alternatives is summarized in Table 4-4.

4.4.1 Land Use / Prime Farmland / Formally Classified Lands

It is not anticipated that a project will disrupt prime farmland.

4.4.2 Floodplains

As shown in Figure 2, some portions of the study area are located inside the 100-year and 500-year floodplains. None of the alternatives would create new obstructions to the flood plain.

4.4.3 Wetlands

None of the alternatives are located in wetland areas (Figure 4 in Appendix A).

4.4.4 Cultural Resources

It is not anticipated that any of the alternatives will interfere with cultural resources. None of the projects will interfere with above ground resources identified by the State Historic Preservation Office.

4.4.5 Biological Resources

Several fish in Marion County are listed as sensitive or threatened; however, no in-stream work is anticipated with any of the alternatives, so no fish species will be disturbed. Endangered species include Bradshaw's desert parsley and the Willamette Valley daisy. It is not likely that any of the plants exist on the proposed project sites because the areas have previously been disturbed. If the species is found, further investigation would be undertaken to determine the necessary measures.

4.4.6 Water Resources

Modifications to the WWTP to improve treatment reliability should have a beneficial impact on the Pudding River. There are no alternatives that involve stream crossings.

4.4.7 Socio-Economic Conditions

None of the alternatives would have a disproportionate effect on any segment of the population. Equitable wastewater facilities would be provided to all people within the City, limited only by physical geography and overall City budget - not by economic, social, or cultural status of any individual or neighborhood.

TABLE 4-4: Affected Environment / Environmental Consequences Summary for Alternatives

Environmental Criteria	WWTP Alternatives							
	WWTP Disposal					Aerated Lagoon		
	Summer Farm/Winter Discharge - Increase Storage	Summer Storage/ Winter Discharge	Summer Farm/Winter Discharge - Increase Land	Year-Round River	Summer Farm/ Winter Storage	Surface Aerators	Expand Diffused Aeration	Replace Aeration System
Land Use/ Important Farmland/Formally Classified Lands	City purchase and construct storage. Likely undeveloped land.	Construct storage at WWTP.	City purchase and irrigate prime farmland.	No Impact	City purchase and construct storage. Likely undeveloped land.	No Impact	No Impact	No Impact
Floodplains	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Wetlands	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Cultural Resources	None Known	None Known	None Known	No Impact	None Known	No Impact	No Impact	No Impact
Biological Resources	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Water Quality Issues	No Impact	No Impact	No Impact	More Loading	No Loading	Improved effluent quality	Improved effluent quality	Improved effluent quality
Coastal Resources	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Socio-Economic/ Environmental Justice Issues	No Impact	No Impact	No Impact	More Loading	No Loading	No Impact	No Impact	No Impact
Miscellaneous Issues	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	Easier O&M

TABLE 4-4: Affected Environment / Environmental Consequences Summary for Alternatives (cont'd)

Environmental Criteria	WWTP Alternatives Cont'd.								
	Tertiary Treatment			WWTP Disinfection			Sludge Handling		
	Filtration	Aeration, Baffle, and Chlorine	MBBR	Chlorine/ Dechlorination	PAA	UV	Sludge Holding	Sludge Treatment	Sludge Treatment and Dewatering
Land Use/ Important Farmland/Formally Classified Lands	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Floodplains	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Wetlands	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Cultural Resources	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Biological Resources	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Water Quality Issues	Improved effluent quality	Improved effluent quality	Improved effluent quality	None Known	None Known	None Known	None known	None known	None known
Coastal Resources	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Socio-Economic/ Environmental Justice Issues	More energy used	More energy used	More energy used	More chemicals used	More chemical used	More energy used	More energy used	More energy used	More energy used
Miscellaneous Issues	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact

4.5 LAND REQUIREMENTS

The City would purchase land during the 20-year planning period for additional storage and/or land application.

4.6 POTENTIAL CONSTRUCTION PROBLEMS

The depth of the water table and subsurface rock may affect the construction of the alternatives. However, subsurface investigations were not within the scope of this project.

The project area's soil is typical for the area, and would require construction techniques normally used to effectively manage excavation, dewatering, and sloughing issues that may arise in Marion County. Construction plans for any of the alternatives would also include provisions to control dust and runoff.

4.7 SUSTAINABILITY CONSIDERATIONS

Sustainable utility management practices include environmental, social, and economic benefits that aid in creating a resilient utility.

4.7.1 Water and Energy Efficiency

The farmland disposal, because of the nutrients, would be beneficial to the farmland and would reuse the treated wastewater.

The further treatment options such as UV disinfection, would require additional energy but reduce disinfection byproducts in the effluent. Upgrading the chlorination/dechlorination systems or adding a PAA disinfection system would continue or increase the use of chemicals.

4.7.2 Green Infrastructure

Using WWTP effluent for farmland irrigation helps protect the Pudding River and uses the nutrients for crop growth.

4.7.3 Other

Replacement of diffusers will facilitate improved maintenance.

4.8 COST ESTIMATES

Cost estimates for this report were prepared using estimated construction costs with 15% contractor overhead and profit, plus a contingency of 30%, and soft costs including engineering, admin, legal, etc., of 25% (based on total construction cost). Present worth analyses are based on a real discount rate of 1.2% and a 20-year time period. An average rate of $0.085 per kWh was used for estimating power costs and a price of $40,000 per acre was used for estimating land costs. Cost estimates for each alternative are presented in Section 5.

5. SELECTION OF A TREATMENT ALTERNATIVE

Alternatives were considered to address the deficiencies noted in the previous chapters. Advantages, disadvantages, and comparative costs (where applicable) are presented for evaluating each process alternative (comparative cost estimates do not include costs common to all alternatives). Annual O&M costs are included in the cost estimates to arrive at a present value for comparison of alternatives. The present value analysis was conducted using a real discount rate of 1.2% and a 20-year time period. The equipment (unless a short-lived asset) is assumed to have a 20-year useful life, so no salvage value is included for comparing the alternatives.

5.1 COMPARATIVE ANALYSIS (COSTS AND NON-MONETARY FACTORS)

5.1.1 WWTP Disposal Alternatives

1. Summer Farmland Application and Winter Surface Water Discharge (No Action): Three sub-options were developed and evaluated to solve the storage volume and/or land application area deficiencies.

    a. Increase the effluent storage and maintain the existing land application. The City primarily land applies on approximately 6 acres. Using the 6 acres and applying the recycled water at agronomic rates, the total storage volume required during the summer is approximately 11 million gallons. The Effluent Storage Lagoon has a capacity of 7.2 million gallons, so this sub-option would add approximately 5 million gallons of storage capacity. This sub-option also includes land for the additional storage lagoon and a pump station. It also includes upgrading the irrigation system on the 6 acres to a permanent system. It is presumed that the new effluent storage lagoon may be located approximately 0.5 miles from the WWTP. A preliminary cost estimate is shown in Table 5-1.

TABLE 5-1: Additional Effluent Storage / Maintain Land Application

Item	Cost (2019)
Site Work	$ 10,000
Property	$ 160,000
Storage Lagoon	$ 710,000
Pump Station	$ 190,000
Piping/Valves and Instrumentation*	$ 370,000
Electrical/Controls	$ 50,000
Permanent Irrigation System	$ 90,000
Mobilization (10%)	$ 160,000
Overhead and Profit (15%)	$ 240,000
Contingency (30%)	$ 480,000
Construction Subtotal	**$ 2,460,000**
Soft Costs (25%)	$ 620,000
Total Project Cost	**$ 3,080,000**
Estimated Annual O&M	$ 22,000
Total Present Value	**$ 3,470,000**

* Assumes new storage lagoon would be located within 0.5 miles of the WWTP.

b. Increase effluent storage and minimize land application. Water would be stored in effluent storage lagoons during the summer until it can be discharged to surface water in the winter. This sub-option would use the existing land application area for the new storage lagoon, so no land would need to be purchased. The land application area that is not used for the storage lagoon could still be used for land application in case of emergency. The total storage volume required during the summer (without land application) is approximately 15 million gallons. This sub-option would add approximately 8 million gallons of storage capacity to the 7.2 million gallon capacity of the existing Effluent Storage Lagoon. This sub-option also includes a pump station and an upgrade of the remaining irrigation system to a permanent system (approximately 2 acres). A preliminary cost estimate is shown in Table 5-2.

TABLE 5-2: Additional Effluent Storage / Limited Land Application

Item	Cost (2019)
Site Work	$ 10,000
Storage Lagoon	$ 920,000
Pump Station	$ 190,000
Piping/Valves and Instrumentation*	$ 370,000
Electrical/Controls	$ 50,000
Permanent Irrigation System	$ 30,000
Mobilization (10%)	$ 160,000
Overhead and Profit (15%)	$ 240,000
Contingency (30%)	$ 480,000
Construction Subtotal	**$ 2,450,000**
Soft Costs (25%)	$ 620,000
Total Project Cost	**$ 3,070,000**
Estimated Annual O&M	$ 8,000
Total Present Value	**$ 3,220,000**

* Assumes new storage lagoon would be located in the existing land application area.

c. Increase land application. This sub-option would use the existing 7.2-million-gallon Effluent Storage Lagoon and 14 acres of potential land at the WWTP, and purchase approximately 12 acres of land in order to provide the estimated land application during the summer (non-discharge period) for the 20-year planning flows. This sub-option also includes a permanent irrigation system for the existing and new land. It is presumed that the land for this sub-option can be purchased within one mile of the WWTP. A preliminary cost estimate is shown in Table 5-3. The O&M estimate is for the additional costs of this sub-option (additional irrigation).

TABLE 5-3: Additional Land Application

Item	Cost (2019)
Site Work	$ 40,000
Property	$ 480,000
Piping/Valves*	$ 560,000
Permanent Irrigation System	$ 380,000
Mobilization (10%)	$ 150,000
Overhead and Profit (15%)	$ 220,000
Contingency (30%)	$ 440,000
Construction Subtotal	**$ 2,270,000**
Soft Costs (25%)	$ 570,000
Total Project Cost	**$ 2,840,000**
Estimated Annual O&M	$ 44,000
Total Present Value	**$ 3,620,000**

* Assumes new land would be located within 1 mile from the existing Irrigation Pump Station.

2. Year-Round River Discharge:

   In order to meet the required treatment levels needed for year-round river discharge (including ammonia, phosphorus, and temperature), a mechanical plant would be needed. It was assumed that the mechanical plant would be constructed in the vicinity of the 6-acre land application area. A preliminary cost estimate for this option is summarized in Table 5-4. The O&M estimate is for the additional costs of using the new treatment system. In addition to the costs shown, the required operator classification would also be increased with this option.

TABLE 5-4: Mechanical Plant

Item	Cost (2019)	
Site Work	$	63,000
Headworks and Influent Pump Station	$	360,000
SBR Equipment and Basins	$	690,000
Filter Equipment	$	510,000
Cooling/Chilling Equipment	$	280,000
UV Equipment	$	230,000
Control Building	$	630,000
Piping/Valves and Instrumentation	$	110,000
Electrical/Controls	$	440,000
Mobilization (10%)	$	340,000
Overhead and Profit (15%)	$	500,000
Contingency (30%)	$	1,000,000
Construction Subtotal	**$**	**5,153,000**
Soft Costs (25%)	$	1,290,000
Total Project Cost	**$**	**6,443,000**
Estimated Annual O&M	$	122,000
Total Present Value	**$**	**8,610,000**

3. Summer Farmland Application and Winter Storage (No Surface Water Discharge):

   The permit requirements for farmland application are less stringent than for discharge to the Pudding River. This is likely to be a trend that will continue into the future, so farmland application can help ensure continued compliance with permit requirements.

   In evaluating this alternative, it was assumed that the City would purchase land for farmland application, in order to control the land application. Approximately 44 total acres of land are needed for a complete year of wastewater based on the 2038 AADF. For this evaluation it was assumed that 14 acres of land would be available at the WWTP, and an additional 30 acres would be purchased. A storage volume of approximately 18 million gallons (in addition to the existing Effluent Storage Lagoon) is included to store the water over the winter. This alternative also includes a permanent irrigation system. A preliminary cost estimate for this option is summarized in Table 5-5. The O&M estimate is for the additional costs of this sub-option (maintenance of the new pump station, storage lagoon, and irrigation).

Table 5-5: Summer Farmland Application and Winter Storage

Item	Cost (2019)
Site Work	$ 110,000
Property	$ 1,600,000
Storage Pond	$ 1,240,000
Pump Station	$ 190,000
Piping/Valves and Instrumentation*	$ 1,670,000
Electrical/Controls	$ 50,000
Permanent Irrigation System	$ 670,000
Mobilization (10%)	$ 560,000
Overhead and Profit (15%)	$ 830,000
Contingency (30%)	$ 1,660,000
Construction Subtotal	**$ 8,580,000**
Soft Costs (25%)	$ 2,150,000
Total Project Cost	**$ 10,730,000**
Estimated Annual O&M	$ 63,000
Total Present Value	**$ 11,850,000**

* Assumes new land is located within 2 miles from existing Irrigation Pump Station.

Disposal Recommendation

The recommended alternative is the construction of new effluent storage lagoon and continued winter discharge to surface water (Option 5.1.1.1.b; see Table 5-2), as it has the lowest present value.

5.1.2 Aerated Lagoon

Three options were evaluated to address the insufficient aeration system capacity.

1. Surface Aerators:

   This option would include adding one (1) new 7.5 HP surface aerator to the aerated lagoon to provide the estimated oxygen required for the 20-year planning period. The existing aeration equipment (surface aerator and blowers/diffusers) would remain in service. A preliminary cost estimate for this option is summarized in Table 5-6. The estimated annual O&M costs include the existing aeration equipment. In order to maintain the efficiency of the existing diffusers, it is assumed that the Aerated Lagoon would be taken down once a year and the contents of the basin pumped to the Effluent Storage Lagoon and then transferred back to the Aerated Lagoon.

Table 5-6: Surface Aerators

Item	Cost (2019)
Surface Aerator	$ 14,000
DO Probes and Controller	$ 9,000
Electrical/Controls	$ 4,000
Mobilization (10%)	$ 3,000
Overhead and Profit (15%)	$ 5,000
Contingency (30%)	$ 9,000
Construction Subtotal	**$ 44,000**
Soft Costs (25%)	$ 11,000
Total Project Cost	**$ 55,000**
Estimated Annual O&M	$ 29,000
Total Present Value	**$ 570,000**

2. Expand Diffused Aeration:

This option would remove the existing surface aerator and replace it with 116 diffusers and two (2) 10 HP blowers to provide the estimated oxygen for the 20-year planning period. The existing blowers and diffusers would remain in use. The new blowers and diffusers would be a similar type to the existing. The diffusers have a higher oxygen transfer efficiency than surface aerators, which reduces power usage. A preliminary cost estimate to expand the diffused aeration system is summarized in Table 5-7. In order to maintain the efficiency of the diffusers, it is assumed that the Aerated Lagoon would be taken down once a year and the contents of the basin pumped to the Effluent Storage Lagoon and then transferred back to the Aerated Lagoon.

Table 5-7: Expand Diffused Aeration

Item	Cost (2019)
Diffusers and Blowers	$ 53,000
Blower Shed	$ 11,000
DO Probes and Controller	$ 9,000
Electrical/Controls	$ 10,000
Mobilization (10%)	$ 9,000
Overhead and Profit (15%)	$ 13,000
Contingency (30%)	$ 25,000
Construction Subtotal	**$ 130,000**
Soft Costs (25%)	$ 33,000
Total Project Cost	**$ 163,000**
Estimated Annual O&M	$ 24,000
Total Present Value	**$ 590,000**

3. Replace Aeration System:

   This option would include removing the existing aeration equipment (surface aerator and diffusers) and replacing it with new diffusers and blowers. The new diffusers would be more easily removable for inspection and maintenance than the existing diffusers, such that the Aerated Lagoon would not need to be taken down once a year. The diffusers have a higher oxygen transfer efficiency than surface aerators, which reduces power usage. The aeration system would be sized for the 20-year planning period. A preliminary cost estimate for the new aeration system is summarized in Table 5-8.

Table 5-8: Replace Aeration System

Item	Cost (2019)	
Diffusers and Blowers	$	53,000
Blower Shed	$	11,000
DO Probes and Controller	$	9,000
Electrical/Controls	$	10,000
Mobilization (10%)	$	9,000
Overhead and Profit (15%)	$	13,000
Contingency (30%)	$	25,000
Construction Subtotal	**$**	**130,000**
Soft Costs (25%)	$	33,000
Total Project Cost	**$**	**163,000**
Estimated Annual O&M	$	24,000
Total Present Value	**$**	**590,000**

Aerated Lagoon Recommendation

All of the three options have similar present values over a 20-year period. The City prefers to replace the aeration system with new diffusers (Option 5.1.2.3; see Table 5-8) since this option has the lowest estimated annual O&M of the three options.

5.1.3 Effluent Storage Lagoon

There is insufficient storage volume and/or land application area for the 20-year design flow. The options for this deficiency are discussed in Section 5.1.1 (WWTP Disposal Alternatives). The recommendation is to construct an additional effluent storage lagoon ((Option 5.1.1.1.b; see Table 5-2); approximately 8-million-gallon capacity) and continue surface water discharge in the winter.

5.1.4 Tertiary Treatment

TSS and BOD_5 percent removal was a challenge at certain times during 2016. Since 2018, this has not been an issue. Three main options were evaluated should the plant have difficulty reaching required percent removals in the future.,.

1. Filtration:

   This option would add filtration downstream of the Effluent Storage Lagoon. Filtration would provide additional TSS and BOD_5 removal. For this option it was assumed a cloth filter would be used. The advantages of cloth filters are a low backwash volume (which is sent to the return pump station), small footprint, ease of maintenance, and low power usage. The size of the filter units depends on the flow rate. For this evaluation it was assumed the filters would handle the higher flows associated with holding through the summer and discharging during the winter. Two filters were assumed, with one filter designed as a backup. The filters would be covered. A preliminary cost estimate for this option is shown in Table 5-9.

Table 5-9: Filtration

Item	Cost (2019)	
Site Work	$	21,000
Filters	$	400,000
Cover	$	10,000
Electrical/Controls	$	90,000
Mobilization (10%)	$	60,000
Overhead and Profit (15%)	$	80,000
Contingency (30%)	$	160,000
Construction Subtotal	**$**	**821,000**
Soft Costs (25%)	$	210,000
Total Project Cost	**$**	**1,031,000**
Estimated Annual O&M	$	5,000
Total Present Value	**$**	**1,120,000**

2. Aeration, Baffles, Cover and Chlorine:

   This option would include adding the following to the Effluent Storage Lagoons an aerator, two (2) baffle walls, floating covers in the last 2 cells, and chlorine piping. (For this comparison it was assumed that two Effluent Storage Lagoons would be used). The aeration would be used to add dissolved oxygen and mixing, which can improve the biological removal of the TSS and BOD_5 in the lagoon and also reduce the likelihood of algae formation. The baffles would help the solids to settle prior to being discharged. The floating covers would help block the sunlight, which inhibits algae growth. Evaporation would be decreased by the floating covers in the last 2 cells; however, the required Effluent Storage Lagoon capacity would remain as described in Section 3.4.5. Solids would still need to periodically be removed from the Effluent Storage Lagoon. The chlorine piping would allow for seasonal chlorine doses to be added to prevent algae blooms from occurring. A preliminary cost estimate for this option is shown in Table 5-10.

Table 5-10: Aeration, Baffles, Cover and Chlorine

Item	Cost (2019)
Surface Aerators	$ 21,000
Baffles	$ 21,000
Floating Covers	$ 210,000
Chlorine Dosing Pipes	$ 32,000
Electrical/Controls	$ 30,000
Mobilization (10%)	$ 40,000
Overhead and Profit (15%)	$ 50,000
Contingency (30%)	$ 100,000
Construction Subtotal	**$ 504,000**
Soft Costs (25%)	$ 130,000
Total Project Cost	**$ 634,000**
Estimated Annual O&M	$ 11,000
Total Present Value	**$ 830,000**

3. Moving Bed Biofilm Reactor (MBBR):

This option would add an MBBR downstream of the Aerated Lagoon to provide additional treatment, primarily for BOD_5 and ammonia, (which can reduce algae formation), as well as some TSS removal. Solids that slough off of the MBBR media would settle out in the Effluent Storage Lagoon and would need to be removed periodically. A preliminary cost estimate for this option is shown in Table 5-11.

Table 5-11: MBBR

Item	Cost (2019)
MBBR Equipment	$ 380,000
Concrete Basins	$ 94,000
Pump Station	$ 160,000
Piping and Valves	$ 210,000
Electrical/Controls	$ 130,000
Mobilization (10%)	$ 100,000
Overhead and Profit (15%)	$ 150,000
Contingency (30%)	$ 300,000
Construction Subtotal	**$ 1,524,000**
Soft Costs (25%)	$ 390,000
Total Project Cost	**$ 1,914,000**
Estimated Annual O&M	$ 37,000
Total Present Value	**$ 2,570,000**

Removal Percentages Recommendation

The City would prefer to further investigate two options in the predesign (filtration and aeration, baffles, cover and chlorination; Options 5.1.4.1 and 5.1.4.2) prior to selecting a preferred tertiary treatment option.

5.1.5 WWTP Disinfection

Three (3) main alternatives were evaluated.

1. Upgrade Chlorination and Dechlorination Systems:

   This alternative was to upgrade the existing chlorination and dechlorination systems to address the deficiencies described in Section 3. A preliminary cost estimate, including O&M, is summarized in Table 5-12.

TABLE 5-12: Chlorination/Dechlorination Systems Upgrade

Item	Cost (2019)
Storage Buildings	$ 90,000
Chlorine Monitoring Equipment	$ 21,000
Evaluation; Baffles/Mixer Modifications	$ 21,000
Electrical/Controls	$ 30,000
Mobilization (10%)	$ 17,000
Overhead and Profit (15%)	$ 25,000
Contingency (30%)	$ 49,000
Construction Subtotal	**$ 253,000**
Soft Costs (25%)	$ 64,000
Total Project Cost	**$ 317,000**
Estimated Annual O&M	$ 10,000
Total Present Value	**$ 500,000**

2. Convert to Peracetic Acid (PAA):

   This alternative would include reusing the old chlorine contact basin. Although PAA has been approved for use by the Environmental Protection Agency (EPA), it is still a fairly new technology and may not have full approval by the DEQ. Pilot testing would be required. A preliminary cost estimate for converting the disinfection systems to PAA is shown in Table 5-13.

TABLE 5-13: Peracetic Acid (PAA)

Item	Cost (2019)
Storage Buildings	$ 90,000
PAA Equipment	$ 80,000
Evaluation; Baffles/Mixer Modifications	$ 21,000
Electrical/Controls	$ 40,000
Mobilization (10%)	$ 24,000
Overhead and Profit (15%)	$ 35,000
Contingency (30%)	$ 70,000
Construction Subtotal	**$ 360,000**
Soft Costs (25%)	$ 90,000
Total Project Cost	**$ 450,000**
Estimated Annual O&M	$ 11,000
Total Present Value	**$ 650,000**

3. Switch to UV Disinfection:

   Ultraviolet light at the proper wavelength alters the genetic material (DNA) in cells so that bacteria, viruses, molds, algae and other micro-organisms can no longer reproduce. This inactivation of the micro-organisms achieves the required disinfection to satisfy environmental requirements as well as protect the river habitat. The equipment could be in stainless steel reactors and housed to provide better working conditions for cleaning or could be installed in the existing contact channels and be outside. It should be noted that DEQ has not approved the use of UV downstream of lagoons and that DEQ approval would be required prior to this alternative being selected. The interference caused by the algae on the UV light has so far made the technology unreliable. A filter might be required prior to the UV disinfection. A preliminary cost estimate for the UV system, installed in steel reactors in the WWTP Office, is summarized in Table 5-14.

TABLE 5-14: UV System

Item	Cost (2019)
UV Equipment	$ 210,000
Electrical/Controls	$ 40,000
Mobilization (10%)	$ 25,000
Overhead and Profit (15%)	$ 40,000
Contingency (30%)	$ 75,000
Construction Subtotal	**$ 390,000**
Soft Costs (25%)	$ 98,000
Total Project Cost	**$ 488,000**
Estimated Annual O&M	$ 19,000
Total Present Value	**$ 830,000**

The following table is a summary of the advantages and disadvantages of each disinfection technology:

TABLE 5-15: Summary of Disinfection Advantages and Disadvantages

Technology	Advantages	Disadvantages
Chlorination/ Dechlorination	• Same technology as used currently at WWTP • Can be more cost-effective than UV disinfection (dechlorination and fire code requirements can make it cost more than UV disinfection). • Chlorine residual remaining in the effluent can prolong disinfection even after initial treatment, and can be measured to evaluate effectiveness. • Reliable and effective against a wide spectrum of pathogenic organisms. • Effective in oxidizing certain organic and inorganic compounds. • Beneficial for recycled water to have a chlorine residual for pipeline maintenance. • Flexible dosing control. • Can eliminate certain noxious odors during disinfection.	• Chlorine residual, even at low concentrations, is toxic to aquatic life and will require a well-controlled de-chlorination system. • All forms of chlorine are highly corrosive and toxic, so storage, shipping, and handling pose a risk, requiring increased safety regulations. • Oxidizes some organic matter in wastewater to create more hazardous compounds (disinfection byproducts such as trihalomethanes [THMs] are regulated and would require additional treatment). • Level of total dissolved solids is increased in the treated effluent. • Chlorine residual is unstable in the presence of high concentrations of chlorine-demanding materials, thus requiring higher doses to effect adequate disinfection. • Some parasitic species have shown resistance to low doses of chlorine. • Long-term effect of discharging de-chlorinated compounds into the environment is unknown.
Peracetic Acid (PAA)	• Newer technology for wastewater disinfection in the US. • Lower dose and less contact time is needed for PAA when compared to chlorination/dechlorination. • Not as prone to freezing and more stable than chlorine. • Enhances UV effectiveness and reduces cleaning frequency when combined with UV.	• Less corrosive and toxic than chlorine, so storage, shipping, and handling are less hazardous. • Less likely to form hazardous byproducts than chlorine. • Although it has been approved by EPA, it may not have full approval by the DEQ. • Does not maintain a residual in the effluent. • Increases effluent BOD concentration. • Piloting is recommended.
Ultraviolet (UV)	• Well-established technology. • Eliminates the need to generate, handle, transport, or store toxic/hazardous or corrosive chemicals. • No residual effect that can be harmful to humans or aquatic life. • Requires shorter contact time compared to other disinfectants (approximately 20 to 30 seconds with low-pressure lamps). • Requires less space than other methods.	• Low dosage may not effectively inactivate some viruses, spores, and cysts. • Organisms can sometimes repair and reverse the destructive effects of UV. • A preventive maintenance program is necessary to control fouling of tubes. • Algae, turbidity and total suspended solids (TSS) in the wastewater can render UV disinfection ineffective. Low-pressure lamps are not as effective for secondary effluent with TSS levels above 30 mg/L. • Not as cost-effective as chlorination, but costs are competitive when chlorination and de-chlorination is used and fire codes are met.

Disinfection Recommendation

Upgrading the existing chlorination and dechlorination systems is the recommended option (Option 5.1.5.1; see Table 5-12) as it has the lowest total present value. It is also beneficial for the land application system to have chlorine to keep the system clean.

5.1.6 Solids Handling

The WWTP currently hauls their solids to the City of Salem for treatment and disposal. Three main options were evaluated concerning solids handling.

1. Sludge Holding (No Action):

   Continue to hold the solids in the polypropylene tanks and make the recommended improvements outlined in Section 3. The solids would continue to be sent to the City of Salem for disposal. A preliminary cost estimate for this option is shown in Table 5-16. This option has a higher risk and does not provide the WWTP with flexibility if the City of Salem chose to not accept the untreated solids.

Table 5-16: Sludge Holding (Current)

Item	Cost (2019)
Cover and Walls	$ 16,000
Electrical/Controls	$ 3,000
Mobilization (10%)	$ 2,000
Overhead and Profit (15%)	$ 3,000
Contingency (30%)	$ 6,000
Construction Subtotal	**$ 30,000**
Soft Costs (25%)	$ 8,000
Total Project Cost	**$ 38,000**
Estimated Annual O&M	$ 40,000
Total Present Value	**$ 750,000**

2. Sludge Treatment:

   This option was to construct an aerobic digester to treat the solids to meet Class B (EPA Part 503; 60-day SRT in winter) requirements. The solids could then be land applied by farmers or continued to be sent to the City of Salem for disposal. For the cost estimate, it was assumed that the digester basin would be a concrete structure and diffused aeration would be used. The assumed size of the digester was 20 ft. square with a 15 ft. water level. It was also assumed that the solids would continue to be sent to Salem, which is likely more expensive than land application. A preliminary cost estimate for this option is shown in Table 5-17.

Table 5-17: Sludge Treatment (Class B)

Item	Cost (2019)
Site Work	$ 10,000
Digester Basin (including guardrails, grating)	$ 90,000
Digester Equipment	$ 63,000
Digester Blower Building	$ 40,000
Piping/Valves and Instrumentation	$ 42,000
Electrical/Controls	$ 40,000
Mobilization (10%)	$ 30,000
Overhead and Profit (15%)	$ 50,000
Contingency (30%)	$ 90,000
Construction Subtotal	**$ 455,000**
Soft Costs (25%)	$ 120,000
Total Project Cost	**$ 575,000**
Estimated Annual O&M	$ 56,000
Total Present Value	**$ 1,570,000**

3. Sludge Treatment and Dewatering:

   This option was to add mechanical dewatering to the above option (solids treatment with an aerobic digester (20 ft. square concrete basin with 15 ft. water level) to meet Class B requirements (EPA Part 503; 60-day SRT in winter)). The dewatered solids would then be stored under a cover and land applied by farmers or sent to a landfill for disposal. The hauling costs were assumed to be lower since the volume of the dewatered solids is less than the wetter solids. A preliminary cost estimate for this option is shown in Table 5-18.

Table 5-18: Sludge Treatment and Dewatering

Item	Cost (2019)
Site Work	$ 10,000
Digester Basin (including guardrails, grating)	$ 90,000
Digester Equipment	$ 63,000
Digester Blower Building	$ 40,000
Piping/Valves and Instrumentation	$ 42,000
Screw Press	$ 340,000
Cover and Concrete Storage	$ 63,000
Electrical/Controls	$ 100,000
Mobilization (10%)	$ 80,000
Overhead and Profit (15%)	$ 120,000
Contingency (30%)	$ 230,000
Construction Subtotal	**$ 1,178,000**
Soft Costs (25%)	$ 300,000
Total Project Cost	**$ 1,478,000**
Estimated Annual O&M	$ 50,000
Total Present Value	**$ 2,370,000**

Solids Handling Recommendation

The City prefers to add solids treatment using an aerobic digester to meet Class B requirements (Option 5.1.6.2; see Table 5-17), which would provide flexibility for future disposal options. Dewatering could then be phased into future plans if liquid sludge hauling costs become excessive.

6. EXISTING FACILITIES

This section contains a description and evaluation of the existing wastewater collection system, including lift stations and pipelines, for the City of Aurora.

6.1 LOCATION MAP

A map of the existing wastewater collection system is included in Figure 7 (Appendix A).

6.2 HISTORY

The WWTP and collection system were constructed in the fall of 1999 through the winter of 2001. Prior to this time the City of Aurora depended on septic tanks and drain fields for wastewater treatment and disposal.

6.3 SYSTEM DESCRIPTION

The wastewater collection system consists of approximately 5.7 miles of 8-inch and 10-inch gravity sewer mains, 1.5 miles of force main, and four lift stations. The influent lift station and force main discharges into the headworks of the WWTP. The gravity main pipe material is all PVC D-3034. The force main pipe material could not be confirmed.

6.4 CONDITION OF EXISTING FACILITIES

6.4.1 Lift Stations and Force Mains

There are four lift stations and approximately 1.5 miles of force main operated and maintained by the City in its wastewater collection system (Figure 7 in Appendix A). Lift stations are numbered one through four, with Lift Station 4 being the influent lift station to the WWTP. An onsite facility evaluation was completed in November 2018 with City operations personnel to review conditions of the lift stations, current maintenance activities, and operational problems encountered by City staff. Pump drawdown tests were conducted to observe wet well conditions and to check pump operation.

All lift stations are duplex systems with submersible pumps. In addition to the lift station evaluations, O&M manuals from the City were used to complete a general inventory of these facilities. Table 6-1 contains summary information for each lift station. Appendix E includes pump curves. Lift station observations and recommendations follow.

Table 6.1: Lift Station Inventory

	LS1	LS2	LS3	LS4
LIFT STATION				
Type	Wet-well, submersible, duplex pump system	Wet-well, submersible, duplex pump system	Wet-well, submersible, duplex pump system	Wet-well, submersible, duplex pump system
Pump Type	Submersible, centrifugal (Hydromatic S4LVX)	Submersible, centrifugal (Hydromatic S4LVX)	Submersible, centrifugal (Hydromatic S4LVX)	Submersible, centrifugal (Flygt FP3085)
Capacity[1] (gpm)	Each pump: 140 gpm @ approx. 116 ft. TDH	Each pump: 140 gpm @ approx. 90 ft. TDH	Each pump: 140 gpm @ approx. 110 ft. TDH	Each pump: 289 gpm @ approx. 18 ft. TDH
Pump (each)	25 hp @ 1,750 rpm (460V, 3 ph)	20 hp @ 1,750 rpm (460V, 3 ph)	25 hp @ 1,750 rpm (460V, 3 ph)	3 hp @ 1,700 rpm (460V, 60 Hz, 3 ph)
Level Control Type	Pressure transducer	Pressure transducer	Pressure transducer	Pressure transducer
Overflow Point	Inlet MH	Inlet MH	Inlet MH	Inlet MH
Overflow Discharge	To storm drain in road	To storm drain in road	To storm drain in road	To storm drain in road
Generator Auxiliary Power Type	Portable diesel generator	Portable diesel generator	Portable diesel generator	Permanent diesel generator
Generator Storage Location	At WWTP	At WWTP	At WWTP	At pump station
Generator Size (kW)	10	10	10	60
Generator Fuel Tank Capacity (gal)	Approx. 50	Approx. 50	Approx. 50	Approx. 50
Generator Transfer Switch	Manual	Manual	Manual	Automatic
Alarm Telemetry Type	Radio, operator call-out	Radio, operator call-out	Radio, operator call-out	Radio, operator call-out
Originally Constructed	2000	2000	2000	2000
Year Installed/Upgraded	2014	2014	2014	2014
Wet Well Diameter (ft)	6	6	6	6
Wet Well Net Storage (gal)	1,020	1,210	1,050	1,120
FORCE MAIN				
Length, Size	Est. 2,350 ft; 4 in	Est 1,775 ft; 4 in	Est. 2,075 ft; 4 in	Est. 1,640 ft; 6 in
Profile, Continuously Ascending (Yes/No)	Yes	Yes	Yes	No
Discharge Location	MH at Filbert and Ottaway	MH at 99 E and 4th Street	MH at 99 E and 4th Street	Headworks at WWTP
Combination Air Release/Vaccuum Valves	None	None	None	Yes
Valve Location	N/A	N/A	N/A	Unknown

[1]Capacity as reported in O&M manuals

A. General Observations

Sites

The lift station sites are easily accessible from streets or roads throughout the City. None of the lift stations are fenced. The City has not had problems with security or vandalism at the lift stations. For each lift station, the pump valves, gauges, and control panel are adjacent to the wet well under a green fiberglass hinged hood manufactured by Hydronix. This hood must be propped open on two sides when operations staff access the lift stations. The adjacent wet wells are accessed through locked metal hatches.

Instrumentation

Instrumentation consists of pressure gauges, pressure transducers for transmission of incremental levels in the wet well, and one magnetic flow meter. The magnetic flow meter is located at LS 4 and was not working at the time of the facilities evaluation. Monitoring flow at lift stations is recommended for maintenance and operational benefits. A record of flow from a lift station can also provide information on pump, sewer, and inflow conditions; unauthorized inflow; and future planning for expansion or replacement. Air compressors are located in each lift station. They were initially installed for odor and corrosion control but have not been used by operations staff for many years.

Telemetry

All sites have radio-based telemetry systems with communication to the WWTP. The telemetry systems are currently functioning adequately and use SCADA programmable logic controller (PLC) systems. Pump starts and stops are relayed to a computer at the WWTP, where operators can view (but not record) data for a 12-hour period. Operations staff would like to be able to retain this information permanently. An upgrade of the SCADA system would meet this need. The stations are programmed with call-out alarms for high wet well levels and communication failure, which trigger a notification at the WWTP and after a 5-minute delay, a call to the on-call operator phone.

Drawdown Tests

During the site visit, drawdown pump tests were completed to review wet well conditions and determine approximate pump flow rates. Each pump and pumping combination were tested at all lift stations. Each lift station had depth readouts on their PLCs that were used to record depths during the tests. Estimates for average pump flow rates were calculated using the pump test data. These estimated flow rates, along with the rated pump capacities, are shown in Table 6-2.

Table 6-2: Measured Pump Flow Rates

	Avg Field Test Flow Rate (gpm)	Reported Pump Capacity (gpm)
LS1	110	140
LS2	190	140
LS3	130	140
LS4	140	289

The calculated flow rates for Lift Stations 1, 2, and 3 are relatively close to the reported pump capacities. A minimum scour velocity in the discharge force mains of 2.0 fps would be achieved at both design and field-tested flow rates. The calculated flow rate for Lift Station 4 is less than half the reported pump capacity. Based on issues related to the PLC and pump gauges in Lift Station 4 (discussed in further detail below), it is recommended that pump station drawdown tests be performed by City staff again at this lift station and that the pumps be serviced as soon as possible to ensure that they are operating correctly. If Lift Station 4 pumps are operating at 140 gpm, then the discharge force main is not achieving a scour velocity (2.0 fps) and both pumps should be run concurrently. Additionally, operations staff were unaware that the Lift Station 4 discharge force main has an air release/vacuum valve. It is recommended that operations staff find the air release/vacuum valve and exercise it to verify that the force main is functioning properly.

Lift Station 1 (LS1)

Lift Station 1 is located in a residential neighborhood, at the corner of Park Avenue NE and Cody Lane NE. The pump station has two (2) 20 HP Hydromatic Model S4LVX submersible centrifugal pumps. The lift station was constructed in 2000 and includes a 6 ft diameter concrete wet well, a pressure transducer level sensor, valves, pressure gauges, and a control panel. Wastewater is pumped from LS 1 through a 4-inch force main to a manhole at the intersection of Ottaway Road NE and Filbert Road NE.

Lift Station 1

Both pumps were rebuilt in 2014 and are controlled by the pressure transducer level sensor using a lead on, lag on, and pump off operational strategy. Currently, the lead on and lag on pumps are manually switched on a monthly basis, but this will be changed to an automatic system in the future. Based on SCADA screen shots of a 12-hour period, there were approximately two pump starts per hour at LS1. There have been no known issues with the pump station overflowing or with pumps running continually for an extended period.

A portable diesel generator stored at the WWTP is used for backup power (as well as LS2 and LS3). A portable heater is placed in the lift station and turned on in the winter. Operations staff will be replacing the lift station lights with LED bulbs.

Deficiencies

- There is no fall protection for the wet well.
- There is no sign reading, "Confined space, entry by authorized personnel only".
- The following items are excessively rusty: Anchors for the pump guard rails, the wet well door chains, and the piping inside the wet well.
- The yard hydrant appears to be missing a reduced pressure backflow device.

Recommendations

- Provide a fall protection system for the wet well to prevent falls when the cover is open.
- Add warning signs stating that the wet well is a confined space and a permit is required to enter.
- Replace or coat the pump guide rail anchors, the wet well door chains, and the piping inside the wet well.
- Install a permanent generator onsite.
- Remove unused air compressor system and plug piping.
- Install a reduced pressure backflow device on the yard hydrant.

Lift Station 2 (LS2)

Lift Station 2 is located at the end of 1st Street NE, near industrial buildings, and adjacent to a wooded area and Highway 99 E. The lift station has two (2) 20 HP Hydromatic Model S4LVX submersible centrifugal pumps. The lift station was constructed in 2000 and includes a 6 ft diameter concrete wet well, a pressure transducer level sensor, valves, pressure gauges, and a control panel. Wastewater is pumped from LS 2 through a 4-inch force main to a manhole at the intersection of Highway 99 E and 4th Street NE.

Lift Station 2 Wet Well

Per City staff, both pumps were rebuilt in 2014. The pumps are controlled by the pressure transducer level sensor using a lead on, lag on, and pump off operational strategy. Currently, the lead on and lag on pumps are manually switched on a monthly basis, but this will be changed to an automatic system in the future. Based on SCADA screen shots of a 12-hour period, there was approximately one pump start per hour at LS2. There have been no known issues with the pump station overflowing or with pumps running continually for an extended period.

A portable diesel generator stored at the WWTP is used for backup power (as well as LS1 and LS3). A portable heater is placed in the lift station and turned on in the winter. Light fixtures inside the lift station were not working during the facility evaluation and will be replaced by operations staff.

Deficiencies

- There is no fall protection for the wet well.
- There is no sign reading, “Confined space, entry by authorized personnel only”.
- Lower parts of pump guide rails appear to be rusty and are likely galvanized instead of stainless steel.
- The following items are excessively rusty: Anchors for the pump guide rails, the wet well door chains, the lower wet well ladder rungs, and the piping inside the wet well.
- One of the pressure gauges appeared to be plugged and not functional.
- The yard hydrant appears to be missing a reduced pressure backflow device.

Recommendations

- Provide a fall protection system for the wet well to prevent falls when the cover is open.
- Add warning signs stating that the wet well is a confined space and a permit is required to enter.
- Replace guide rails with stainless steel guide rails to make removing pumps easier.
- Replace or coat the pump guide rail anchors, the wet well door chains, the lower wet well ladder rungs, and the piping inside the wet well.
- Replace the pressure gauges and annular seals and calibrate.
- Install a permanent generator onsite.
- Remove the unused air compressor system and plug the piping.
- Install a reduced pressure backflow device on the yard hydrant.

Lift Station 3 (LS3)

Lift Station 3 is located at the corner of Ehlen Road NE and Airport Road NE. Three bollards are installed between Ehlen Road NE and the lift station and adjacent electrical utility vault. The lift station has two (2) 20 HP Hydromatic Model S4LVX submersible centrifugal pumps. The lift station was constructed in 2000 and includes a 6 ft diameter concrete wet well, a pressure transducer level sensor, valves, pressure gauges, and a control panel. Wastewater is pumped from LS 3 through a 4-inch force main to a manhole at the intersection of Highway 99 E and 4th Street NE.

Lift Station 3

Per City staff, both pumps were rebuilt in 2014. The pumps are controlled by the pressure transducer level sensor using a lead on, lag on, and pump off operational strategy. Currently, the lead on and lag on pumps are manually switched on a monthly basis, but this will be changed to an automatic system in the future. Based on SCADA screen shots of a 12-hour period, there was approximately one pump start per hour at LS3. There have been no known issues with the pump station overflowing or with pumps running continually for an extended period.

A portable diesel generator stored at the WWTP is used for backup power (as well as LS1 and LS2). A portable heater is placed in the lift station and turned on in the winter. At the time of the facility evaluation, one of the lights was not working and the portable heater was leaking heating oil. Both items will be replaced by operations staff.

Deficiencies

- There is no fall protection for the wet well.
- There is no sign reading, “Confined space, entry by authorized personnel only”.
- Lower parts of pump guide rails appear to be rusty and are likely galvanized instead of stainless steel.
- The following items are excessively rusty: Anchors for the pump guide rails the wet well door chains, and the piping inside the wet well.
- The wet well had a notable amount of debris accumulated in it.
- One of the pump gauge annular seals appeared to be leaking.
- The yard hydrant appears to be missing a reduced pressure backflow device.

Recommendations

- Provide a fall protection system for the wet well to prevent falls when the cover is open.
- Add warning signs stating that the wet well is a confined space and a permit is required to enter.
- Replace guide rails with stainless steel guide rails to make removing pumps easier.
- Replace or coat the pump guide rail anchors, the wet well door chains, and the piping inside the wet well.
- Remove the accumulated debris in the wet well.
- Replace the pressure gauges and annular seals and calibrate.
- Install a permanent generator onsite.

- Remove the unused air compressor system and plug the piping.
- Install a reduced pressure backflow device on the yard hydrant.

Lift Station 4 (LS4)

Lift Station 4 is located off Highway 99 E, adjacent to a field and near industrial facilities. It is the influent lift station to the WWTP. The lift station has two (2) 3 HP Flygt FP3085 submersible pumps. The lift station was constructed in 2000 and includes a 6 ft diameter concrete wet well, a pressure transducer level sensor, valves, pressure gauges, and a control panel. Wastewater is pumped from LS4 through a 6-inch force main to the headworks of the WWTP.


Lift Station 4

Per City staff, both pumps were rebuilt in 2014. The pumps are controlled by the pressure transducer level sensor using a lead on, lag on, and pump off operational strategy. The Integra radio, transducer, and touch panel were replaced in 2015, and the expansion module was replaced in 2016. The PLC was replaced in December 2018 due to an overheating issue with one of the pumps, and the replacement has resolved the issue. Currently, the lead on and lag on pumps are manually switched on a monthly basis, but this will be changed to an automatic system in the future. Based on SCADA screen shots of a 12-hour period, there were approximately two pump starts per hour at LS4. There have been historical issues with the pumps running continually for an extended period, although this has not been an issue for operators within the past year.

A permanent diesel generator adjacent to the lift station is available for backup power. At the time of the facility evaluation, one of the lights was not working, the high-level floats were broken, and the portable heater was absent. Both items will be replaced by operations staff.

<u>Deficiencies</u>

- There is no fall protection for the wet well.
- There is no sign reading, “Confined space, entry by authorized personnel only”.
- Lower parts of pump guide rails appear to be rusty and are likely galvanized instead of stainless steel.
- The following items are excessively rusty: Anchors for the pump guide rails the wet well door chains, and the piping inside the wet well.
- The wet well had a notable amount of debris accumulated in it.
- One of the pump gauge annular seals appeared to be leaking.
- The magnetic flow meter was not working.
- Due to the topography around LS4, sewage overflow could potentially flow onto adjacent private property.

- The yard hydrant appears to be missing a reduced pressure backflow device.

Recommendations

- Provide a fall protection system for the wet well to prevent falls when the cover is open.
- Add warning signs stating that the wet well is a confined space and a permit is required to enter.
- Replace guide rails with stainless steel to make removing pumps easier.
- Replace or coat the pump guide rail anchors, the wet well door chains, and the piping inside the wet well.
- Remove the accumulated debris in the wet well.
- Replace the pressure gauges and annular seals and calibrate.
- Repair magnetic flow meter.
- Remove the unused air compressor system and plug the piping.
- Perform pump tests with the new PLC and have the pumps serviced.
- Check that the air release/vacuum valve on the discharge force main is in operable condition. Replace if necessary.
- Install an overflow pipe from the wet well to the nearby storm sewer ditch.
- Install a reduced pressure backflow device on the yard hydrant.

6.4.2 Gravity Mains

Based on conversations with City staff, the gravity mains appear to be in good condition. There are no reported issues with inflow and infiltration (I/I), blockages, grease, or leaks. This part of the collection system currently does not require additional maintenance actions from operations staff.

6.5 HYDRAULIC EVALUATION

This section summarizes the wastewater collection system model development process and existing collection system analysis. It outlines the model construction and model calibration process, and documents existing deficiencies. Improvements to address these deficiencies are presented in Section 7.

6.5.1 Model Construction

InfoSWMM Suite 14.6, Update #21 (InfoSWMM) was selected as the modeling software for this project. InfoSWMM is a fully dynamic model which operates in conjunction with Esri ArcGIS and allows for evaluation of complex hydraulic flow patterns.

Information from a June 1999 construction plan set of the collection system and record drawings of developments added to the system since 1999 informed pipe diameter, invert elevations, and ground elevations in the model. The June 1999 plan set does not include survey-grade elevations and survey data was not acquired to inform this study. The 1999 construction plan set was referenced as a vertical control on record drawings for developments added to the system. When discrepancies in invert elevations arose between the plan set, elevation adjustments of up to 1.8 feet were made to maintain consistency with the 1999 construction plan set. Invert elevations for a section of pipeline connecting the Keil Park development on Yosemite Street SE to Ottaway Road NE were missing from City plans. After discussions with City staff, an assumed pipeline route and minimum slope were added to the model. The Lift Station 4 force main was also missing from the plan set. Its route was approximated based on plans and WWTP information. Keller Associates recommends that the City obtain a survey of the entire system.

All 8-inch and 10-inch gravity mains were modeled. Figure 7 in Appendix A shows the modeled lines in the system. After all manholes and pipes were created, and data populated in the model, several queries were conducted to reveal anomalies in the data. These included reverse slope pipes and uncommon configurations in the pipe network. Plan sets provided by the City were used to make corrections.

All four lift stations are included in the model. Lift station wet well diameter and operational set points were recorded during the facilities evaluation described above. Lift station depths were approximated based on the 1999 construction plan set, except for Lift Station 4, whose depth was recorded during the facilities evaluation. Operational set points were adjusted in the model to ensure that the operating depth excluded the inlet pipe. Average pump capacities were verified by field tests and O&M manual pump curves were used to characterize the lift station pumps in the model. All lift stations were modeled with their firm capacities (capacity with largest pump offline).

It is important to note that one of the basic assumptions of the hydraulic model is that all pipelines are free from physical obstructions such as roots and accumulated debris. Such maintenance issues, which certainly exist, must be discovered and addressed through consistent inspection and maintenance efforts. The modeled capacities discussed in this chapter represent the capacity assuming the sewer lines are in good working order.

6.5.2 Model Loading and Evaluation

Model loads refer to the wastewater flows that enter the collection system. These loads are comprised of wastewater collected from individual services (base flows). Each developed property represents a load. Commercial loads were estimated based on water consumption data. Each commercial load was assigned to the nearest manhole in the collection system. Since inflow and infiltration (I/I) was found to be minimal in the system based on analysis of WWTP flows, I/I was not included in the base load allocation.

No flow monitoring was completed to calibrate the model. Thus, other methods were used to determine if the model results were feasible and practical. Minor adjustments in flows and pipe roughness were made in the model to target flows at the WWTP, and to account for modeling anomalies.

This process was completed for 2018 and 2038 dry weather and wet weather design flows. Wet weather was modeled using a factor to increase the average dry weather flow (ADWF) to the peak instantaneous flow (PIF_5). The factor was calculated by dividing the PIF_5 by the ADWF. Future residential loads were added in each three undeveloped areas in the City based on City staff input. Based on an average of 2.7 people per equivalent dwelling unit (EDU), additional loads were added to the existing system as infill to reflect the projected 2038 population growth discussed in Section 1.3. Two additional industrial sites, a linen cleaning facility and a marijuana processing facility, were also added to the system based on City input. Since little information was known about these facilities at the time of the study, loadings were approximated using industry standards.

Figure 8 of Appendix A shows area of anticipated growth. The actual distribution of future flows will depend on how growth occurs, and as such Keller recommends that impacts from new developments be evaluated with the computer model. Figure 9 in Appendix A shows the approximate number of additional EDUs that can be constructed in the area upstream of the pipe segment before the system needs to be upsized. Because some pipe segments may have more capacity than downstream pipeline segments, it is important to consider downstream bottlenecks when determining if adequate capacity is available for new development. Additionally, it is worth noting that actual remaining capacities can be refined with flow monitoring and a detailed survey of invert elevations.

6.5.3 Low Velocity Areas

The City's existing collection system model was used to evaluate the maximum velocity achieved during the peak instantaneous flow (PIF_5). This flow represents the flushing velocity of a 5-year, peak flow event. Figure 10 in Appendix A illustrates the resulting velocities for the existing gravity collection system. The recommended minimum velocity is 2.0 fps. Approximately 70% of the linear footage for the existing system has velocities below 2 fps for the 2018 PIF_5.

Low velocities can result in accumulation of material, increasing the risk of upstream surcharging and overflows. It is recommended that the City monitor the accumulation of debris in these areas to determine if a more aggressive sewer line cleaning schedule is warranted. It should be noted again that the velocities provided in Figure 10 are for the 2018 design peak instantaneous flows (PIF_5). Most of the time, velocities are likely much lower and more prone to accumulate material.

6.5.4 Remaining Capacity in Pipes

The model was exercised to determine the effects of a 2018 and a 2038 design peak instantaneous flow event on the system. Based on the model results for both scenarios, it appears that the collection system has sufficient capacity and no pipes experience surcharging. Figures 9 and 11 in Appendix A provide available capacities in terms of EDUs based on existing (2018) and future (2038) peak instantaneous flow events. The model results are consistent with City staff descriptions of the system and its relatively low maintenance requirements.

6.6 CAPACITY LIMITATIONS

6.6.1 Lift Stations

Modeling results indicate that there are no lift stations surcharging into the collection system. Comparison of peak instantaneous flow at each lift station indicates that the field-tested firm capacity for each pump at LS1, LS2, and LS3 meet flow requirements. Comparison of peak instantaneous flow at LS4 indicates that the design firm capacity for each pump would meet flow requirements, and that with both pumps running, the field-tested capacity would meet flow requirements. As discussed above, it is recommended that LS4 be retested with calibrated gauges to acquire more accurate flow measurements. For a more in-depth discussion of existing lift station conditions, see Section 6.4.1.

6.6.2 Gravity Mains

Modeling results indicate that there are no gravity mains surcharging in the collection system for both 2018 and 2038 PIF5 flow scenarios.

6.7 FINANCIAL STATUS OF EXISTING FACILITIES

See Section 3.8 for a summary of financial information for the City sewer utility.

6.8 WATER/ENERGY/WASTE AUDITS

No water, energy or waste audits have been created at this time.

7. ALTERNATIVES CONSIDERED

This section describes the alternatives considered to meet the collection system deficiencies.

7.1 PLANNING CRITERIA

The projected peak instantaneous flow rate (PIF_5) and projected population estimate for 2038, presented in Table 1-4, were used to model the existing system capacity. An average of 2.7 people per EDU was assumed in assessing per capita flows.

7.2 DESCRIPTION

Based on the model evaluation discussed in Section 6.5.2 and the design criteria, the collection system has no capacity related problems. Primary concerns include the prevalence of low velocity areas in the gravity mains. Recommendations for the collection system are summarized below. No alternatives were considered for these recommendations as they relate to operation and maintenance, not capital improvements on existing infrastructure.

- A full system survey should be completed to confirm manhole and pipe invert elevations, as well as pipe grades. This is specifically recommended for the section of gravity pipe connecting Yosemite Street NE to Ottaway Road NE and for the force mains, since the City does not have construction or record drawings of this area. After a survey has been completed, the model should be updated and rerun to confirm no new problems in the system.
- CCTV inspection and cleaning of the system to more fully assess the existing condition of the pipes, particularly the low velocity areas of the system.

Please see Section 6.4.1 for recommendations related to lift stations and force mains. These recommendations are considered minor and were not evaluated as alternatives.

7.3 MAP

A map of the wastewater collection system is presented in Figure 7 (Appendix A).

7.4 ENVIRONMENTAL IMPACTS

There are no foreseeable environmental impacts associated with the collection system recommendations because they relate to operation and maintenance. Since there are no collection systems alternatives to consider, the subsections Land Use, Floodplains, Wetlands, Cultural Resources, Biological Resources, Water Resources, and Socio-economic Conditions are not specifically addressed in this section.

7.5 LAND REQUIREMENTS

No additional land requirements are needed for the above recommendations.

7.6 POTENTIAL CONSTRUCTION PROBLEMS

There are no foreseeable construction problems associated with the collection system recommendations.

7.7 SUSTAINABILITY CONSIDERATIONS

There are no relevant sustainability considerations associated with the collection system recommendations because they relate to operation and maintenance. Since there are no collection systems alternatives to consider, the subsections Water and Energy Efficiency, Green Infrastructure, and Other are not specifically addressed in this section.

7.8 COST ESTIMATES

Cost estimates related to collection system operation and maintenance are discussed in Section 9. Preliminary cost estimates for the lift station improvement recommendations described in Section 6.4.1 are shown in Table 7-1.

TABLE 7-1: Lift Station Recommended Improvements

Lift Station	Item	Cost
LS1	Fall protection	$ 10,000
	Warning sign	$ 25
	Protective coats on metal surfaces	$ 100
	Permanent deisel generator	$ 12,000
	Overhead and Profit (15%)	$4,000
	Contingency (30%)	$7,000
	Construction Subtotal (rounded)	**$ 34,000**
	Soft Costs (25%)	$9,000
	Total Construction Cost	**$ 43,000**
LS2	Fall protection	$ 10,000
	Warning sign	$ 25
	Protective coats on metal surfaces	$ 200
	Permanent deisel generator	$ 12,000
	Guard rails	$ 2,100
	Pressure gauges w/annular seals	$ 400
	Overhead and Profit (15%)	$4,000
	Contingency (30%)	$8,000
	Construction Subtotal (rounded)	**$ 37,000**
	Soft Costs (25%)	$10,000
	Total Construction Cost	**$ 47,000**

TABLE 7-1: Lift Station Recommended Improvements (cont'd)

LS3	Fall protection	$	10,000
	Warning sign	$	25
	Protective coats on metal surfaces	$	200
	Permanent deisel generator	$	12,000
	Guide rails	$	2,100
	Pressure gauges w/annular seals	$	400
	Overhead and Profit (15%)	$4,000	
	Contingency (30%)	$8,000	
	Construction Subtotal (rounded)	**$**	**37,000**
	Soft Costs (25%)	$10,000	
	Total Construction Cost	**$**	**47,000**
LS4	Fall protection	$	10,000
	Warning sign	$	25
	Protective coats on metal surfaces	$	200
	Guide rails	$	2,100
	ARV/Vac valve assembly	$	4,200
	Pressure gauges w/annular seals	$	400
	Overflow piping	$	5,000
	Overhead and Profit (15%)	$3,000	
	Contingency (30%)	$6,000	
	Construction Subtotal (rounded)	**$**	**31,000**
	Soft Costs (25%)	$8,000	
	Total Construction Cost	**$**	**39,000**
	Lift Station Estimate	**$176,000**	

8. SELECTION OF AN ALTERNATIVE

8.1 COMPARATIVE ANALYSIS (COSTS AND NON-MONETARY FACTORS)

As discussed in Section 7, modeling results indicate that there are no collection system capacity problems associated with existing and 20-year projected flows. Alternatives were not considered since improvements to lift stations and force mains (Section 6.4.1) are relatively minor. Recommendations and cost estimates related to collection system operation and maintenance are discussed in further detail in Section 9.

9. PROPOSED PROJECT (RECOMMENDED ALTERNATIVES)

This section consists of the recommended plan to address the wastewater system deficiencies. A location map showing the changes to the wastewater treatment plant are shown in Figure 12 (Appendix A).

9.1 PRELIMINARY PROJECT DESIGN

9.1.1 Wastewater Treatment Plant

Detailed project summary sheets for the WWTP improvements are included in Appendix G. Each project summary sheet provides the objective, key issues, cost estimate, and project location map. The recommended improvements are summarized below.

- *Headworks* – The headworks should be upgraded to add a cover and freeze protection to the influent screen, add a shelter around the composite sampler and move it closer to the sample location, add grit removal to protect downstream equipment from wear, and add fall protection between the Headworks and the Aerated Lagoon.
- *Aerated Lagoon* – The aeration capacity should be increased. This would be done by replacing the aeration system with new diffusers and blowers that are also more easily removable for inspection and maintenance. Two, new DO probes and a controller should be installed with the aeration equipment upgrade. Permanent pumps, flow meters, piping, and valves should be installed for sludge wasting, scum removal, and recycling. Fall protection around the lagoon and an emergency overflow should be installed.
- *Effluent Storage Lagoon* – An additional storage lagoon and pump station should be constructed to continue to store the water during the summer (when the effluent cannot be discharged to the Pudding River). Fall protection around the lagoon and an emergency overflow should be installed.
- *Disinfection* – The chemical storage should be replaced with a well-ventilated, heated, and corrosion-resistant building. A chlorine monitor and an automatic alarm should be installed if a dosing pump fails or if the chlorine residual rises. Railing should be placed around the chlorine contact basin. Further evaluation of the disinfection capacity is recommended as baffles and/or mixer modifications in the chlorine contact basin may be necessary to disinfect future flows.
- *River Pump Station/Irrigation Pump Station* – The pump station should be secured with a fence. Warning signs and fall protection should be added. The pump starters should be replaced with VFDs.
- *Return Pump Station* – The pump station should be secured with a fence (can be combined with the River Pump Station/Irrigation Pump Station. Warning signs and fall protection should be added. The electrical conduit should be modified to prevent the control panel from being exposed to gases and a flow meter added to measure the amount of pumped return flow.

- *Solids Treatment* – Add a new aerobic digester to achieve Class B solids (60-day SRT in the winter). This would allow the City the flexibility to either be land applied by farmers or to continue to be sent to the City of Salem.
- *Other* – A new SCADA system should incorporate the improvements above and provide essential alarms and information to the City staff. A permanent irrigation system should be added to the existing 6 acres. Also, the existing lagoons should be structurally inspected (costs for any modifications are unknown at this time). Bank stabilization, site drainage, paving, and a fence around the unfenced part of the plant are also needed improvements. Tertiary treatment should be planned for near the end of the planning period to increase TSS and BOD_5 removals.

9.1.2 Collection System

The conveyance system needs a full system survey to verify manhole and pipe invert elevations, especially for parts of the system that are missing from City construction plans and record drawings (see discussion in Section 7.2). While information made available for this study was assumed to be accurate for the purpose of modeling the system, updating the model based on accurate survey data would provide a better understanding of existing and future conditions.

9.1.3 Pipeline Cleaning and CCTV Inspection

As a general recommendation, PVC pipelines should be CCTV inspected every ten years to assess whether any bellies or sags have formed, or whether pipeline joint separation has occurred. Problematic areas may be cleaned and inspected every one to two years. Model results indicate that a majority of the gravity mains are currently flowing below the ideal scour velocity of 2 fps (Figure 10 of Appendix A). Lower flows can result in solids deposition over time and can eventually lead to pipe obstruction. The City should try to inspect and clean approximately 3,000 linear feet of pipeline every year in order to complete the entire system on a 10-year rotation. This will allow the City to maintain updated records on defects and be proactive in anticipating potential problem areas in their system.

9.1.4 Pipeline Replacement Program

The current collection system appears to be in good condition as evident in the lack of observed surcharging and maintenance issues. As the pipeline and manholes age, replacement and rehabilitation needs are likely to increase. PVC pipe is assumed to have a lifespan of 100 years.

Keller Associates recommends that the City begin budgeting for replacement/rehabilitation based on an average of 375 feet of the collection pipeline system each year. This would allow for replacement of all gravity mains within the next 80 years. The linear feet of pipeline or number of manholes replaced each year is an average and should be adjusted based on future CCTV and other maintenance records.

The annual costs associated with funding an on-going replacement/rehabilitation and CCTV inspection program are summarized in Table 9-1.

TABLE 9-1: Collection System Annual Costs

Item	Lifespan (years)	Cost/Year
Pipelines	100	$70,000
Manholes	50	$11,000
Cleanouts	50	$200
Laterals/Cleanouts	50	$17,500
CCTV Inspection	10	$6,000
Total		$98,700

Manhole rehabilitation and service line repairs should be coordinated with pipeline rehabilitation work. Priority pipeline replacements/rehabilitation work identified in CCTV inspections could be funded from this program. Emphasis should be placed on areas where pipe conditions pose the largest threat of sanitary sewer surcharging or a more immediate threat of collapse. Wherever possible, coordinate construction activities with planned roadway projects to minimize construction costs.

9.1.5 Lift Station Upgrades

Modifications to the collection system lift stations are discussed in detail for each lift station in Section 6.4.1. Improvements include installation of fall protection, coatings to protect against rust, guide rail replacement, and onsite generators. These improvements deal with existing, short-term condition deficiencies that should be addressed in the next six years. The SCADA system recommendation discussed above in section 9.1.1 would encompass improvements to the lift stations.

9.2 PROJECT SCHEDULE

The specific schedule for each project will be determined at a later date by the City during the predesign phase for each proposed improvement. An estimated schedule for the first six years is shown in the 6-year CIP (Table 9-2). Costs presented here are planning-level estimates and include a planning level contingency of 30%. Actual costs may vary depending on market conditions and shall be updated as projects are further refined in the pre-design and design phases.

TABLE 9-2: 6-Year Capital Improvement Plan

ID#	Item	Cost	Opinion of Probable Costs (2019 Dollars)					
			2019	2020	2021	2022	2023	2024
Priority 1 Improvements (0-6 years)								
1.1	Aerated Lagoon Aeration	$ 200,000	$ 200,000					
1.2	Lagoon Overflow, Structural Inspection, and Bank Stabilization	$ 308,000		$ 308,000				
1.3	Additional Effluent Storage Lagoon	$ 3,020,000		$ 544,000	$ 2,476,000			
1.4	Chlorination/Dechlorination System Upgrade	$ 317,000			$ 58,000	$ 259,000		
1.5	Headworks Upgrade	$ 142,000					$ 142,000	
1.6	Aerobic Digester	$ 575,000					$ 575,000	
1.7	Site Work At WWTP	$ 308,000						$ 308,000
1.8	SCADA Upgrade	$ 205,000						$ 205,000
1.9	Lift Station Upgrades	$ 176,000				$ 88,000	$ 44,000	$ 44,000
	Total (rounded)	**$ 5,251,000**	**$ 200,000**	**$ 852,000**	**$ 2,534,000**	**$ 347,000**	**$ 761,000**	**$ 557,000**

* All costs in 2019 Dollars. Costs include engineering and contingencies (30%).

The cost estimate herein is concept level information only based on our perception of current conditions at the project location and its accuracy is subject to significant variation depending upon project definition and other factors. This estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures. This cost opinion is in 2019 dollars and does not include escalation to time of actual construction. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Keller Associates cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the cost presented herein.

9.3 PERMIT REQUIREMENTS

The City's NPDES discharge permit was recently renewed (went into effect on August 22, 2016) without many changes. The recommendations set forth in the CIP are flexible, and can be modified to allow the WWTP to deal with future permit requirements.

The City's NPDES permit, (in addition to the Influent, Effluent, and Recycled Water Monitoring Reports), included details on the following items:

- *Outfall Inspection Report* – In 2019 the City must inspect the integrity of the Pudding River Outfall and submit a written report to DEQ.
- *Quality Assurance and Quality Control (QA/QC) Program* – If not already developed, the City must create a QA/QC program to verify the accuracy of the sample analysis.
- *Wastewater Solids Annual Report* – Describes the quality, quantity and disposal of solids generated at the plant.
- *Recycled Water Use Plan* – Describes how the plant distributes the reuse water.
- *Annual Inflow and Infiltration Report* – Details of activities performed during the past year and activities planned for the coming year.
- *Significant Industrial User Survey* – Determine the presence of any industrial users that are subject to pretreatment.
- *Emergency Response and Public Notification Plan* – Ensures the contact information for the applicable public agencies is accessible and up to date.

Refer to the NPDES Permit for additional information on these items.

9.4 SUSTAINABILITY CONSIDERATIONS

9.4.1 Water and Energy Efficiency

Adding VFDs can decrease the pumping energy used at the WWTP.

9.4.2 Green Infrastructure

Recommendations of this report include a permanent irrigation system and modifications to the plant drainage. The irrigation system would improve the efficiency of the land application process and increase crop usage. Improving the drainage would decrease the sediment in the runoff and increase the use of stormwater by the vegetation at the WWTP.

9.4.3 Other

The proposed alternatives incorporate the use of SCADA into many aspects of the treatment system. This allows for better system resiliency and operation simplicity, as well as improved system optimization.

9.5 TOTAL PROJECT COST ESTIMATE (ENGINEER'S OPINION OF PROBABLE COST)

The summary of the Aurora wastewater facility improvement costs is in Table 9-3 (Capital Improvement Plan). The percent SDC eligible factored in the existing design flow, existing capacity, and improved capacity. The amount of capacity that can be utilized for future connections is divided by the future capacity in 2038. For projects that did not have an increase in flows, the percent SDC eligible is derived from the percent growth in population over the 20-year planning period. As it is unclear which tertiary treatment upgrade may be made, the cost for the filtration project is shown as it has a higher cost than the aeration, baffles, cover, and chlorine cost alternative. The City prefers to plan for further tertiary treatment investigation and upgrades near the end the planning period given that TSS and BOD_5 removals are not an immediate issue, although they have been historically. Costs shown are planning-level estimates and can vary depending on market conditions; they shall be updated as the project is further refined in the pre-design and design phases.

TABLE 9-3: 20-Year Capital Improvement Plan

ID#	Site	Total Estimated Cost (2019)	SDC Growth Apportionment		City's Estimated Portion
			%	Cost	
Priority 1 Improvements (0-6 years)					
1.1	Aerated Lagoon Aeration	$ 200,000	33%	$ 67,000	$ 133,000
1.2	Lagoon Overflow, Structural Inspection, and Bank Stabilization	$ 308,000	24%	$ 72,000	$ 236,000
1.3	Additional Effluent Storage Lagoon	$ 3,020,000	24%	$ 726,000	$ 2,294,000
1.4	Chlorination/Dechlorination System Upgrade	$ 317,000	24%	$ 74,000	$ 243,000
1.5	Headworks Upgrade	$ 142,000	24%	$ 33,000	$ 109,000
1.6	Aerobic Digester	$ 575,000	24%	$ 135,000	$ 440,000
1.7	Site Work At WWTP	$ 308,000	24%	$ 72,000	$ 236,000
1.8	SCADA Upgrade	$ 205,000	24%	$ 48,000	$ 157,000
1.9	Lift Station Upgrades	$ 176,000	24%	$ 41,000	$ 135,000
	Total Priority 1 Improvements (rounded)	**$ 5,251,000**		**$ 1,268,000**	**$ 3,983,000**
Priority 2 Improvements					
2.1	Fall Protection	$ 124,000	24%	$ 29,000	$ 95,000
2.2	Fencing	$ 104,000	24%	$ 24,000	$ 80,000
2.3	WWTP Pump Station VFDs	$ 175,000	24%	$ 41,000	$ 134,000
2.4	Aerated Lagoon Sludge Pumps	$ 140,000	24%	$ 33,000	$ 107,000
2.5	Permanent Irrigation System	$ 59,000	24%	$ 14,000	$ 45,000
2.6	Headworks Grit Removal	$ 1,013,000	24%	$ 238,000	$ 775,000
2.7	Paving Access Road	$ 365,000	24%	$ 86,000	$ 279,000
2.8	Tertiary Treatment	$ 1,031,000	24%	$ 242,000	$ 789,000
	Total Priority 2 Improvements (rounded)	**$ 3,011,000**		**$ 707,000**	**$ 2,304,000**
	TOTAL WASTEWATER PLANT IMPROVEMENTS COSTS (rounded)	**$ 8,262,000**		**$ 1,975,000**	**$ 6,287,000**

All costs in 2019 Dollars. Costs include contractor mobilization (10%), contractor overhead and profit (OH&P; 15%), contingency (30%), and soft costs (e.g. engineering and construction management services, legal, administrative, and permitting services) (25%).
The cost estimate herein is concept level information only based on our perception of current conditions at the project location and its accuracy is subject to variation depending upon project definition and other factors. This estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures. This cost opinion is in 2019 dollars and does not include escalation to time of actual construction.

9.6 ANNUAL OPERATING BUDGET

An itemized annual operating budget for the fiscal year 2015-2016 is provided in Appendix D. Additional information on budget specifics can be found in the following sections.

9.6.1 Income

Potential User Rate Impacts

The existing sewer rate schedule consists of a flat rate fee of $118.45 every two months per equivalent dwelling unit (EDU). After reviewing the City's sewer system budget with City staff, it appears that the Sewer Operating Fund generates approximately $275,400 in revenue for use to offset short-term asset replacement and O&M costs. The portion of the existing budget that can be used for capital improvement projects varies from year to year. With this in mind, the rate impacts assume that none of the existing revenue/budget can be used annually to offset future capital improvements.

Table 9-4 shows the existing and potential charges for sewer services every two months for one EDU. The user rate impacts can vary depending on the amount of SDC funds available, as shown in the table. Funding for the recommended system improvements may come from any number of sources. This section presents potential user rate impacts if priority improvements are funded only through a low interest loan with debt service payments (20 year, 1.6%) made through a user rate increase. The amounts shown in the table also assume that there is no surplus in the annual budget contributing to the annual debt service payment. Also grant funds, lower interest loans, or principal forgiveness may also be available which could further lessen the user rate impacts shown in Table 9-4. Keller Associates recommends that the City actively pursue these opportunities that would mitigate user rate impacts. A separate user rate study is recommended to complete a more detailed evaluation of potential user rate impacts.

TABLE 9-4: User Rate Impact

	Annual Payment (20 year, 1.6%)	Monthly User Rate without SDCs	Monthly User Rate including SDCs
Existing User Rates (2019)	-	$59.23	$59.23
Priority 1 Improvements	$308,872	$113.41	$100.33
Priority 2 Improvements	$177,112	$144.49	$124.10

It should be noted that all costs are in 2019 dollars, and that the City should plan on annual increases in user rates of 2-5% to account for cost-of-living adjustments.

System Development Charge

The City's current sewer System Development Charge (SDC) for a single-family home is $2,032. The scope of this study included estimating the SDC eligibility for each identified capital improvement. It is the intent that this information will be utilized by the City's financial consultant to update the City's SDCs. The estimated SDC eligibility for each identified capital improvement is shown in Table 9-2 and summarized in Section 9.5.

9.6.2 Annual O&M Costs

In addition to the capital improvement costs presented in Table 9-3 (Capital Improvement Plan), Keller Associates recommends including additional annual operation and maintenance costs associated with the Capital Improvement Plan (additional aerators, aerobic digestion, grit removal, etc.) in setting annual budgets. It is anticipated that this cost may be close to twice the current amount by year 2038, most of which is associated with increased power usage.

9.6.3 Debt Repayments

The City financed their Wastewater Treatment Plant with a long-term loan. Keller Associates recommends the duration of any new loan be representative of the average life-expectancy of the equipment.

9.6.4 Reserves

Depending on the source(s) of funding for improvements, there may be reserve requirements required.

9.6.5 Short-Lived Asset Reserve

A table of short-lived assets is shown in Table 9-5. This table includes replacement expenses for assets that are anticipated to wear out in the next 10 years.

TABLE 9-5: Short-Lived Assets

Equipment Description	Replacement Items	Unit Cost	Frequency (Yrs)	Annual Cost
River Pump Station / Irrigation Pump Station	Pumps	$ 32,000	10	$ 4,000
Return Pump Station	Pumps	$ 9,000	10	$ 1,000
Lift Station 1	Pumps	$ 8,000	10	$ 1,000
Lift Station 2	Pumps	$ 8,000	10	$ 1,000
Lift Station 3	Pumps	$ 8,000	10	$ 1,000
Lift Station 4	Pumps	$ 30,000	10	$ 3,000
Headworks	Motors and Parts	$ 32,000	10	$ 4,000
Aerated Lagoon	Motors and Pumps	$ 74,000	10	$ 8,000
Effluent Storage Lagoons	Miscellaneous	$ 37,000	10	$ 4,000
Chlorination/Dechlorination Systems	Pumps	$ 47,000	10	$ 5,000
Aerobic Digester	Motors and Pumps	$ 34,000	10	$ 4,000
SCADA	Instruments	$ 6,000	1	$ 6,000
Irrigation System	Miscellaneous	$ 6,000	1	$ 6,000
			Total Short Lived Assets (rounded)	**$ 48,000**

9.6.6 Financing Options

Financing and incentive options that may assist with offsetting costs associated with implementing the CIP include, but are not limited to: user rate increases, SDCs, DEQ State Revolving Fund Loan Program, Oregon Infrastructure Finance Authority grants and loans, USDA Rural Utilities Services loans and grants, direct state loans, revenue bonds, general obligation bonds, US Economic Development Administration grants, and Energy Trust of Oregon.

A "One-Stop" funding meeting is recommended for the City of Aurora where funding packages can be developed using the various funding sources described below:

- Oregon Department of Environmental Quality (Clean Water State Revolving Fund).
- Oregon Economics and Community Development Department (Community Development Block Grant Program). Availability dependent on the median household income and user rates. Priority given to cities with compliance infractions.

- U.S. Department of Agriculture (Rural Development Program). Grant and loans available to communities with less than 10,000 people. Eligibility based on user rates, average household income, and compliance issues.
- U.S. Economic Development Administration. Grant and loan funds available based on economic development potential.
- Oregon Economics and Community Development Department (Water/Wastewater Financing Program). State funded program (Oregon Lottery). Grant and loan funds generally provided on a 50/50 basis. Eligibility based on average household income and compliance issues.
- Oregon Economics and Community Development Department (Special Public Works Program). State funded program (Oregon Lottery). Loan funds only. Eligibility based on average household income and compliance issues.