DRAFT

EAGLE SEWER DISTRICT

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Wastewater Lagoon Treatment Plant
Facility Plan Update

FINAL

January 2024

Jacobs

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Acronyms and Abbreviations

$/lb	dollar(s) per pound
$/MG	dollar(s) per million gallons
ADMM	average day maximum month
ATS	automatic transfer switch
BOD	biochemical oxygen demand
BOD_5	5-day biochemical oxygen demand
CIP	capital improvement plan
COD	chemical oxygen demand
District	Eagle Sewer District
DO	dissolved oxygen
EBPR	enhanced biological phosphorus removal
EPA	U.S. Environmental Protection Agency
ERU	equivalent residential unit
GHG	greenhouse gas
GPEPD	gallon(s) per equivalent residential unit per day
gpm	gallon(s) per minute
HDPE	high-density polyethylene
hp	horsepower
HRT	hydraulic residence time
I&I	infiltration and inflow
IDAPA	Idaho Administrative Procedure Act
IDEQ	Idaho Department of Environmental Quality
IPDES	Idaho Pollutant Discharge Elimination System
kV	kilovolt(s)
kW	kilowatt(s)
lb/day	pound(s) per day
MBBR	moving bed biofilm reactor
MBR	membrane bioreactor
mg	milligram(s)
MG	million gallon(s)

mg/L	milligram(s) per liter
mgd	million gallon(s) per day
MLSS	mixed-liquor suspended solid
N.A.	not available
N/L	nitrogen per liter
NH_3	ammonia
NH_3-N	ammonia-nitrogen
NPV	net present value
O&M	operations and maintenance
O&M	operations and maintenance
P/L	phosphorus per liter
PAO	polyphosphate accumulating organism
PO_4P	orthophosphate
psi	pound(s) per square inch
R&R	repair and replacement
RAS	return activated sludge
rpm	revolution(s) per minute
SCADA	supervisory control and data acquisition
scfm	standard cubic foot (feet) per minute
TDH	total dynamic head
TMDL	total maximum daily load
TP	total phosphorous
TSS	total suspended solid
UV	ultraviolet
VFD	variable frequency drive
WAS	waste activated sludge
WLA	waste load allocation
WLTF	Wastewater Lagoon Treatment Facility
WRF	Water Renewal Facility
WSL	water surface elevation
WWTP	wastewater treatment plant

1. Introduction

Eagle Sewer District (District) provides used water collection and cleaning services for the area that generally coincides with the City of Eagle's city limits and impact area. The District is not constrained to these boundaries, and other municipalities and agencies provide water collection and treatment services for adjacent areas. The District began a wastewater facility planning process to establish a system-wide guiding document that prioritizes needs, balances available resources, identifies specific actions, and identifies uncertainties regarding wastewater management and infrastructure. The purpose of this document is to provide a comprehensive compilation of the drivers for the development and results of the facility plan in alignment with the vision for the District as required by *Idaho Administrative Code* (Idaho Administrative Procedure Act [IDAPA] 58.01.16, Part 410).

This Facility Plan is consistent with the District's vision to complete a comprehensive strategic plan for a sustainable future that makes adequate provision for growth while protecting public health and the environment. This planning process also included stakeholder outreach to solicit input and feedback from patrons and leaders alike on where the water should go, and the resulting level of water cleaning required for each desired use. Leadership bodies including the District Board, Eagle City Council, the Eagle Urban Renewal District, and Eagle Chamber of Commerce were specifically invited to share their perspectives on where the District should focus time and attention to create a mutually beneficial future. In addition to leadership bodies, individual District patrons were invited to become educated and provide input via online surveys, at a booth at Eagle Fun Days, and at the open house to celebrate the District's 60th anniversary. The input leaders and individual patrons provided, helped to form the alternatives and ultimate direction this plan outlines.

The Idaho Department of Environmental Quality (IDEQ) has established rules in IDAPA 58.01.16, Part 410 requiring all new and existing municipal wastewater conveyance and treatment facilities in the process of modification or expansion to have a current facility plan. The facility plan must address hydraulic capacity, treatment capacity, project financing, and operations and maintenance (O&M) considerations sufficiently to determine the effects of a project on the overall wastewater infrastructure. A facility plan typically addresses the entire potential service area of the jurisdiction. A facility plan must be submitted to IDEQ for review and approval prior to submitting detail drawings and specifications for a specific project related to the facility plan. This facility plan satisfies these IDEQ requirements.

1.1 Purpose and Need

The District is a special use District in accordance with State of Idaho Statute (Title 42 Irrigation and Drainage – Water, Chapter 32) that was formed to provide wastewater collection and treatment services for the area that generally coincides with the City of Eagle's city limits and impact area. The District Wastewater Lagoon Treatment Facility (WLTF or wastewater treatment plant [WWTP]) provides wastewater treatment services to residents and businesses in the Eagle area of impact.

The District WWTP sends cleaned water to the City of Boise's West Boise Water Renewal Facility (WRF) for final cleaning before the water is released into the Boise River. The discharge agreement between the District and the City of Boise limits the service area to the City of Eagle area of impact. Locations outside the City of Eagle area of impact are not allowed to connect to the West Boise WRF and thus are required to have their own wastewater collection and treatment systems. This plan addresses the District wastewater treatment systems currently in operation. The Lakemoor Subdivision is not included in this plan because its used water is collected and pumped directly to Boise (because the development is adjacent to the West Boise WRF). Other wastewater planning documents, such as the plan for the Spring Valley/Valnova development prepared by J-U-B Engineers and amended by Keller Associates (2023), describe wastewater collection and treatment system for areas outside the City of Eagle area of impact, but still within city limits. The Avimor development has its own collection and treatment systems that are not connected to the District and are not expected to be connected in the future.

This plan describes the existing and future wastewater service needs of the Eagle wastewater system and the preferred alternatives for the District to meet those needs in the future. This plan identifies and evaluates alternatives for implementation of the expansions and upgrades and provides recommendations for specific near-term actions and long-term decisions.

1.1.1 Statement of Purpose

It is the District's vision to anticipate and support the needs of the growing community with a focus on reliable collection and cleaning of used water while maintaining a safe and financially responsible operation. The primary purpose of the plan is to prepare short- and long-term planning that will protect public health and the environment. A secondary purpose of the plan is to prepare the necessary planning and alternative evaluation documentation for regulatory agency approval. This will allow the District to proceed with designing and constructing facilities that meet current and future needs. This plan covers the planning period from 2023 to 2040.

1.1.2 Statement of Need

The main driver for this facility plan update was that the City of Boise recently completed its facility planning work that describes its direction for the next 20 years. The Boise plan also includes the cost allocations between its various customer classes for the upgrades and improvements its system requires. With the future cost to send water to Boise for further cleaning defined, the District could complete similar facility planning efforts to determine the preferred path forward regarding levels of water cleaning and where to send the water while comparing the cost of each alternative. The public outreach efforts further revealed that District patrons are interested in opportunities to view cleaned water as a resource that can be reused.

1.1.2.1 Future Treatment Plant Utilization

The District's WLTF will continue to be the singular WLTF serving the majority of the City of Eagle area of impact through the planning period. A second WWTP facility plan has been developed by J-U-B Engineers and amended by Keller Associates for the Spring Valley/Valnova development located north of Beacon Light Road and east of Highway 16 (2023). That plan calls for a completely separate wastewater treatment system with all of the water being reused. Similarly, the Avimor development has its own wastewater systems and facility plan.

1.1.2.2 Water Reuse

Public outreach events were held as part of the facility planning process and stakeholder input was collected. During the multiple outreach events, a common theme emerged: District patrons desired that the water be cleaned to irrigation water quality and sent to irrigation canals to be reused either in pressurized irrigation systems for landscaping or by farmers to irrigate crops. There was also interest in groundwater recharge with the cleaned water. The interest in reusing the cleaned water for irrigation and groundwater recharge prompted the District to include these as alternatives in the evaluation of where the water should go once it is cleaned. More information can be found in Chapter 4: Screening of Alternatives.

1.1.2.3 Growth and Expansion of the Service Area

Future growth planning included considerations of population projections, area of impact, and land use changes. The City of Eagle planning department was consulted on the population projections for build-out of the city south of Homer Road, the area Boise allows to be connected to its system. The majority of the undeveloped land in city limits south of Homer Road has had initial development plans prepared. Although these proposed developments are subject to change, and do change from time to time, they frequently remain largely similar and reflect the neighboring developments in function and density. With this information available, the build-out conditions were prepared and are being planned for in this effort. The quantity of future used water the District expects to collect and clean was calculated as part of the Collection System Master Plan work completed in 2023 (Keller Associates).

1.2 Eagle Sewer District Infrastructure Planning

1.2.1 Coordination with City of Eagle Comprehensive Planning

The City of Eagle's 2017 comprehensive plan (City of Eagle) includes intentions to work collaboratively with the District on topics like land use and water reuse for irrigation. The District has benefited from this partnership and has coordinated population projections, land use, and water reuse desires with Eagle City Council and staff during this planning process.

1.2.1.1 Coordination with the Eagle Sewer District Vision

The District established level of service goals to guide decision making. These level of service goals were developed and refined based on District Board and patron input during the facility planning process. The level of service goals are listed as follows in order of priority. More information on how these goals were used in the decision-making process can be found in Chapter 4.

- **Safety**: Protect public and employee health relating to wastewater collection, treatment, and cleaned water use.
  - Create a safe working environment for employees and the public as they interact with wastewater collection, treatment, and cleaned water systems.
- **Reliability**: Maintain continual collection and treatment of wastewater.
  - Keep service interruptions to a minimum by proactively maintaining and monitoring collection, treatment, and cleaned water systems.
- **Affordability**: Keep rates and fees competitive while providing high levels of service.
  - Maintain competitive rates and fees with neighboring utilities while keeping rates below U.S. Environmental Protection Agency (EPA) guidelines of 2 percent of median household income.
- **Water Self-reliance**: Recognize cleaned water as a resource to be used to support patron desires.
  - Improve water self-reliance for District patrons by moving toward beneficial reuse of water cleaned by the District to augment local water supplies.
- **Public partnership**: Actively engage with stakeholders.
  - Foster partnerships with patrons and stakeholders to advance their interests and District goals relating to wastewater collection, treatment, and cleaned water use.

1.2.2 Coordination with Surface Water Discharge Requirements

Cleaned water from the District WLTF is pumped to the City of Boise's West Boise WRF for final cleaning before being released to the Boise River. Consequently, the District does not maintain an Idaho Pollutant Discharge Elimination System (IPDES) permit.

1.3 Scope of Study

This scope of work for the WLTF planning includes the following:

- Description and condition of the existing WLTF
- Hydraulic capacity and organic capacity analysis of the existing WLTF
- Prediction of future conditions including population and flows
- Alternative analysis to meet future system needs and District level of service goals
- Creation of an implementation plan with a funding strategy to complete the investments required to put the preferred alternative into practice

1.3.1 Development of Initial Treatment Alternatives

Stakeholder and public outreach were instrumental in developing the list of alternatives to investigate during this facility planning process. District patrons and city leadership told the District that they wanted the water to be used for the following purposes (in order of preference):

1. Pressurized irrigation for parks and lawns
2. Farmers' use in irrigating crops
3. Filtered through the soil to replenish the groundwater
4. Released to the Boise River
5. Cleaned further to make drinkable water

These alternatives were used as the basis for the alternative analysis. Many of the pressurized irrigation systems in the District service area receive water from irrigation canals. Therefore, putting clean water in a canal would serve both the first and second preferences for water usage. Given the cost and complexity of directly connecting to pressurized irrigation systems, this method has generally been less effective than putting the water in the canals where multiple subdivisions can use the water on their schedules.

The main difference between water cleaned for use in a canal versus the higher standards required for the Boise River is the amount of nitrogen and phosphorus allowed to stay in the water. Nitrogen and phosphorus are the principle ingredients of fertilizer. Large amounts of fertilizer in the Boise River result in an abundance of aquatic plants that choke the river and increase the potential for toxic algal blooms. This results in lower quantities of nitrogen and phosphorus being allowed to be released to the river, which means utilities need to implement costly processes to remove these nutrients. Alternatively, nitrogen and phosphorous in water in the irrigation canals benefits those water users because they can potentially add less fertilizer to their plants. The nutrients could result in some aquatic plant growth in the canals, but this is typically not a large concern because the canals more directly deliver water to plants that require nitrogen and phosphorus. The irrigation water is required to have a higher level of virus and pathogen removal than the river, so the risk of getting sick from the water is less in a canal than in a river. IDEQ establishes these requirements for the use of the water. Class A reuse water was used as the basis for this planning study. No lesser treated reuse water qualities were contemplated.

1.3.2 Evaluation of Alternatives

Planning-level process designs for each treatment alternative were prepared to determine the infrastructure required to meet the water quality and quantity planning objectives. Water quality refers to the level of treatment and subsequent discharge concentration of the various wastewater constituents. Water quantity addresses the volume of wastewater in the treatment systems. Each alternative was evaluated to determine its ability to treat the wastewater constituent concentrations as well as its effects on the ability of the system to handle increasing wastewater volumes. The advantages and disadvantages of each process were then identified to differentiate the nonmonetary benefits. A planning-level cost estimate was prepared for each alternative. Alternatives were compared against the status quo of sending all the mostly cleaned water to Boise for further cleaning. The status quo alternative does not have any additional capital projects or upgrades included, it is merely maintaining existing systems and facilities.

The results of the alternatives analysis were presented at the Alternatives Evaluation Workshop. The information was entered into a decision tool spreadsheet during the workshop in collaboration with the District. The decision tool provides a benefit-to-cost score of each alternative based on monetary and nonmonetary criteria. At the conclusion of the meeting, a recommendation on the preferred treatment alternative was made based upon the results of the decision tool. The preliminary results were presented to stakeholders and the public at an open house where feedback was received. The input was used to form an implementation plan for the preferred alternative.

1.4 Report Organization

Chapter 1 – Introduction, is a brief introduction and background that includes the purpose and need for this document. The scope of the study is presented along with the report organization.

Chapter 2 – Evaluation of Existing Treatment Facilities is a detailed description of the existing WLTF, existing flows, and water quality. The conditions of existing treatment processes and infrastructure are assessed and detailed. Hydraulic and unit treatment processes are presented as well.

Chapter 3 – Future Conditions is a discussion of the population forecasts and the increase in wastewater flows and loads based on the population forecasts. Planning criteria used to evaluate wastewater management scenarios are presented.

Chapter 4 – Screening of Alternatives is a summary of the initial development and screening of the secondary treatment, tertiary treatment, and biosolids handling alternatives. This broad group of potential alternatives was narrowed down to include final screening alternatives presented in the second half of Chapter 4. The final screening of alternatives is an evaluation of the required infrastructure for each treatment alternative and their advantages and disadvantages. The alternative evaluation and screening process methodology is presented with the nonmonetary and monetary criteria. Alternatives to meet planning criteria for the wastewater treatment system are presented in this chapter.

Chapter 5 – Capital Improvement Plan describes the projects selected for implementation, outlines an approach for future studies, and presents long-term strategies.

Chapter 6 – References contains the references this plan cites.

Appendixes provide supporting information for the plan, including technical memoranda developed in preparation of this wastewater facility plan.

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2. Evaluation of Existing Treatment Facilities

This chapter documents the existing wastewater treatment facilities owned and operated by the District. It describes the unit processes, along with their capacities and current condition. Work previously completed by district staff and others was used to compile and update this chapter from the previous facility plan.

2.1 Current City of Eagle Area of Impact Planning Boundary

The District service area generally corresponds to the City of Eagle limits. This plan covers the portion of the service area located within the City of Eagle area of impact and the City of Eagle limits. It specifically excludes the Spring Valley development, which is not connected to the existing system and has its own facilities and facilities plan. These areas are not allowed to combine with the District WLTF effluent that is discharged to the City of Boise's West Boise WRF for final treatment per the Discharge Agreement between the City of Boise and the District. The 2015 *City of Eagle Comprehensive Plan* (City of Eagle 2015) states that it is the intention of both parties that the District provide wastewater collection and treatment for the city's area of impact.

Figure 2-1 presents the current service area boundaries for this plan. The City of Eagle area of impact includes agricultural area, much of which is expected to be developed in the next 17 years.

2.2 Existing Wastewater Treatment Facility Description

The District WLTF provides initial wastewater treatment prior to discharging to the City of Boise's West Boise WRF for additional treatment and disinfection before discharging to the Boise River. The District does not maintain an IPDES permit. The existing facility includes a Headworks with influent pumps, screening, grit removal, and flow monitoring followed by treatment with aerated lagoons and settling lagoons. This chapter includes details of the major equipment currently used at the facility, their capacities, and their condition. Additional aerated and settling lagoons (Cells 3, 4, 5, and 6) were constructed in 2021 to provide system redundancy and additional treatment capacity. Transfer Pump Station discharges treated effluent from Lagoon Cell 1 and Cell 2 to Effluent Pump Station. Effluent Pump Station pumps treated combined effluent to the West Boise WRF. An Operations Building and several maintenance buildings are located at the District's WLTF site. Figure 2-2 shows the aerial view of the WLTF.

Table 2-1 summarizes the unit processes, along with the major equipment used to provide treatment at the District WLTF.

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Table 2-1. Eagle Sewer District Wastewater Lagoon Treatment Facility: Summary of Existing Unit Processes

Unit Process	Existing Facilities	Treatment Criteria	Equipment Capacity	Remarks
Headworks				
Influent pumps	Number = 4 Type = screw centrifugal	Hydraulically pass peak instantaneous flow	Design: 4,000 gpm each @32 feet TDH, 1,200 rpm, 50 hp	Current capacity for pumps 1 through 3: 3,600 gpm, each pump Three pumps were installed in 2010 One shelf spare was purchased in 2021
Screen	Number = 2 Type = continuous belt grid, with washer/compactor (each)	Hydraulically pass peak instantaneous flow	5.8 mgd (each)	Screens replaced in 2023 Clear spacing = ¼ inch Bypass channel with 2-inch manual bar screen available
Grit chamber	Number = 1 Type = Vortex	Hydraulically pass peak flow with a velocity slow enough to settle grit	20 mgd maximum	2010 construction Bypass channel available
Grit pump	Number = 1 Type = Vortex		250 gpm @25 feet, 7.5 hp, 1,800 rpm	2010 construction
Grit separator/ classifier	Number = 1	Must match capacity of the largest grit pump	250 gpm	2010 construction
Secondary Treatment				
Lagoon Cell 1	10 feet deep normal water depth 3.8-acre surface area	< 60 mg/L BOD_5	11.9 MG nominal volume	Treatment volume assumes no sludge buildup; sludge last removed in 2008 1982 construction; liner replaced in 2008; 60-mil HDPE liner
Submerged aerator/mixer	Number = 2 Type = mechanical		Two 20-hp mixers	Sparge ring mixers/aerators were installed in 1982 and receive air from the blowers for the submerged diffused aeration system
Submerged diffused aeration system	Number of diffusers= 84		Air supply range per diffuser: 25-65 scfm	Air supplied by two 200-hp blowers, 3,500 scfm @ 7.3 psi
Lagoon Cell 2	10 feet deep normal water depth 1.3-acre surface area	< 60 mg/L TSS	3.2 MG nominal volume	Treatment volume assumes no sludge buildup; sludge last removed in 2021 1982 construction; liner replaced in 2008; 60-mil HDPE liner
Effluent recycle pump	Number = 1 Type = submersible		700 gpm	Not in current operation; recycle piping is not continuous

Unit Process	Existing Facilities	Treatment Criteria	Equipment Capacity	Remarks
Lagoon Cell 3	11.5 feet deep normal water depth 2.2-acre surface area	< 60 mg/L BOD_5	5.9 MG nominal volume	2021 construction; 60-mil HDPE liner
Submerged diffused aeration system	Number of diffusers = 90		Air supply range per diffuser: 15 to 60 scfm	Air supplied by two 250-hp blowers, 4,200 scfm @ 8 psi
Lagoon Cell 4	10.4 feet deep normal water depth 2.4-acre surface area	< 60 mg/L BOD_5	5.9 MG nominal volume	2021 construction; 60-mil HDPE liner
Submerged diffused aeration system	Number of diffusers = 30		Air supply range per diffuser: 15 to 60 scfm	Air supplied by two 250-hp blowers, 4,200 scfm @ 8 psi
Lagoon Cell 5	10.3 feet deep normal water depth 1.3-acre surface area	< 60 mg/L TSS	3.1 MG nominal volume	Assumes no sludge buildup; 2021 construction; 60-mil HDPE liner
Lagoon Cell 6	11.8 feet deep normal water depth 1.3-acre surface area	< 60 mg/L TSS	3.35 MG nominal volume	Assumes no sludge buildup; 2021 construction; 60-mil HDPE liner
Effluent Transfer				
Transfer Pump Station	Number = 2 Type = submersible nonclog		1,950 gpm @21 TDH, 15 hp	Variable speed Replaced in 2021
Effluent Pump Station	Number = 3 Type = submersible nonclog		(2) – 3,000 gpm @ 45 TDH, 160 hp (1) – 2,800 gpm @ 45 TDH, 45 hp	Variable speed;

< = less than
BOD_5 = 5-day biochemical oxygen demand
gpm = gallon(s) per minute
HDPE = high-density polyethylene
hp = horsepower
MG = million gallon(s)
mgd = million gallon(s) per day
mg/L = milligram(s) per liter
psi = pound(s) per square inch
rpm = revolution(s) per minute
scfm = standard cubic foot (feet) per minute
TDH = total dynamic head
TSS = total suspended solid

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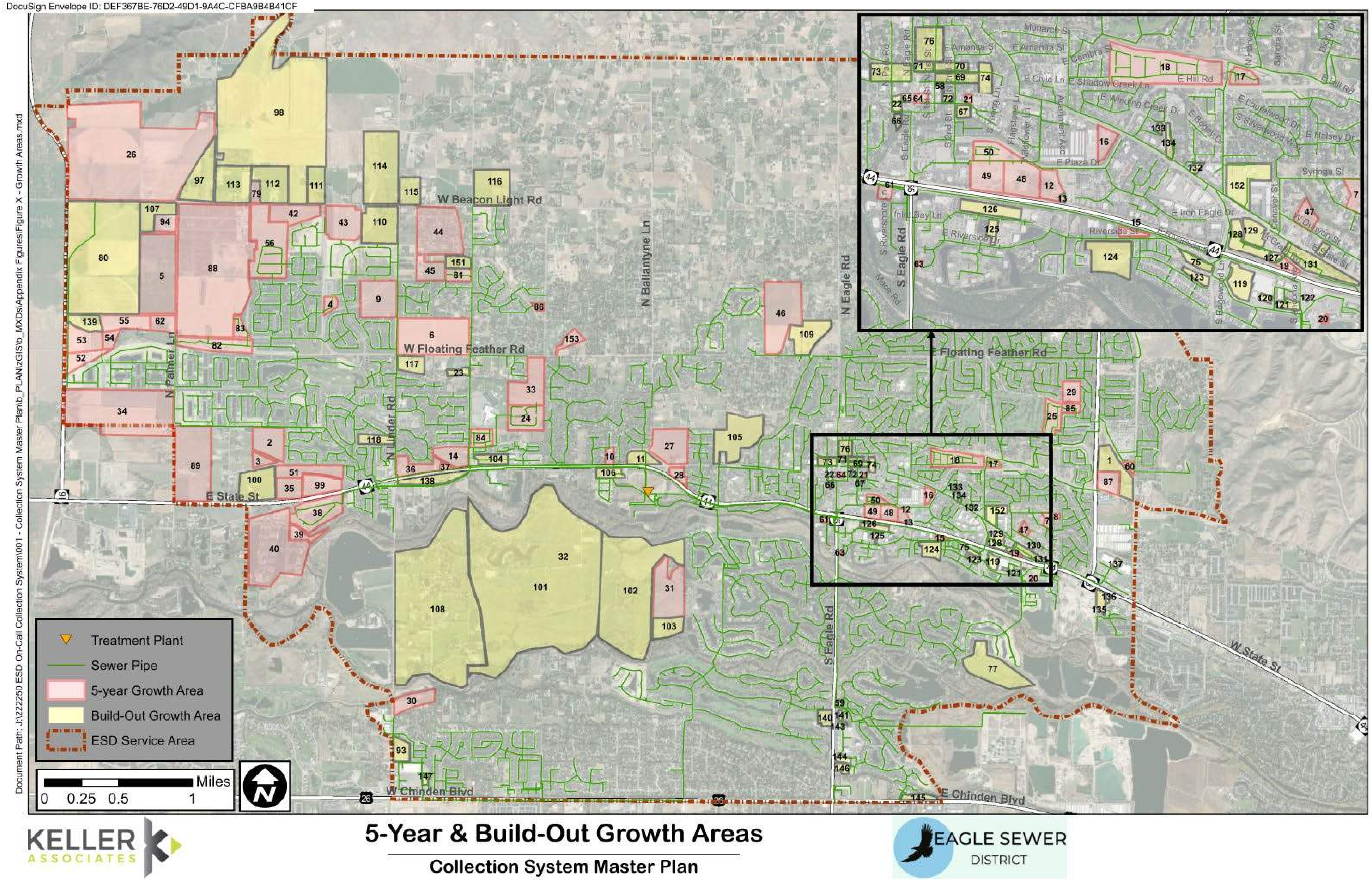

Figure 2-1. Eagle Sewer District Service Area

Developed in the Collection System Master Plan (Keller Associates)

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Figure 2-2. Eagle Sewer District Wastewater Lagoon Treatment Facility

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2.2.1 Headworks

The Headworks facility lifts raw wastewater and removes screenings and grit, and then directs the screened and degritted flow to the treatment lagoons. The Headworks constructed in 2010 consists of an Influent Pump Station with three screw centrifugal pumps, a flowmeter, two mechanical step screens, one manual bar screen, and one vortex grit chamber. Grit and screenings are treated prior to discharge to trash receptacles, where they are bagged and transported to the local landfill for disposal. The building is served with potable water from the District Well 2. An odor control system treats foul air from the Headworks Building. The building is equipped with an auxiliary 600-kilowatt (kW) generator that has an integral 1,000-gallon diesel fuel tank. In 2023, the two existing mechanical bar screens were replaced with two new HydroDyne Bull Shark Screens, along with new washing compactors.

2.2.1.1 Influent Collection

Raw wastewater enters the influent collection box/wet well through one 30-inch-diameter gravity line from the south. The wet well is a self-cleaning type. The influent is pumped from the collection box to the influent screening structure through two 18-inch-diameter pipes that combine to one 24-inch-diameter line before discharging to the screening channels. The current operation calls for the influent collection box to be vacuumed out every fall and spring to remove rocks and debris.

2.2.1.2 Influent Pumping

The raw wastewater influent is pumped using three screw centrifugal-type pumps operating in parallel located in a dry pit opposite the wet well (Figure 2-3). Table 2-2 lists the details for each of these pumps.

Table 2-2. Influent Pump Details

Pump Number	Type	Make/Model	Capacity (gpm)	TDH (feet)	Drive Type	Control
1	Screw centrifugal	Wemco Hydrostal	4,000	32	Variable	SCADA/level switch
2	Screw centrifugal	Wemco Hydrostal	4,000	32	Variable	SCADA/level switch
3	Screw centrifugal	Wemco Hydrostal	4,000	32	Variable	SCADA/level switch
4	Screw centrifugal (shelf spare)	Wemco Hydrostal	4,000	32	Variable	SCADA/level switch

Note:

Pumps 1 through 3's current capacity is 3,600 gpm because of impeller wear.
SCADA = supervisory control and data acquisition

Influent pumps can be removed from the dry pit with the use of an overhead portable crane to move the pumps to below a roof hatch, where a second crane lifts them to the exterior grade level. There is space for an additional influent pump to be installed. The fourth pump is onsite near the existing influent pumps as a shelf spare. Installing the fourth pump would increase the current firm capacity of 5.2 mgd to 8.3 mgd.

Figure 2-3. Influent Pumps

With current flow rates, it is the standard operating procedure to only run one pump at a time, at full speed, to lower the wet-well level. A pump will cycle through twice before resting. The plant operators have witnessed a loss of capacity of 30 to 40 gpm per year because of impeller wear. District staff has confirmed that pump discharge flow rates at full speed are around 3,600 gpm, or 400 gpm less than their rated capacity when compared to their pump curve.

2.2.1.3 Influent Flow Measurement

Each influent pump discharges raw influent wastewater to a common manifold where a magnetic flowmeter measures the total pumped influent flow rate. The common manifold is divided into two lines, each with its own flowmeter to allow continuous flow measurement in the event one meter is removed from service.

2.2.1.4 Influent Screening

The purpose of screening is to remove rags and large items that are not biodegradable and therefore cannot be treated by the lagoons. These items can also cause clogging and undue wear of downstream mechanical equipment.

The influent screening structure consists of three channels. Two of the channels contain newly installed screens with 0.25-inch openings together with mechanical washer/compactors for each (Figure 2-4). The third channel is used as a bypass channel and is equipped with a manual bar screen with 2-inch openings. Each mechanical screen is rated for 5.8 mgd. Normally only one mechanical screen is operated, with the second screen serving as a backup.

Figure 2-4. Influent Screens

Screenings from each mechanical step screen are discharged to corresponding mechanical washer/compactors that wash the screenings to reduce the organic loading and compact them to remove water. Screw conveyors then discharge them into a 3-yard dumpster through a bagging system to limit odors. Screenings from the disposal bin are currently taken to the Ada County landfill as they are able to pass the paint filter test (EPA Method 9095B).

2.2.1.5 Grit Removal and Handling

Grit is removed using a Smith and Loveless vortex grit basin rated at 20 mgd. The basin is equipped with a recessed-impeller centrifugal pump for removing grit that accumulates in the bottom of the basin (Table 2-3). If the existing grit chamber is taken offline, flow is simply bypassed directly to the lagoon treatment system.

Table 2-3. Grit Pump Details

Pump Number	Make/Model	Capacity (gpm)	Drive Type	Control
1	Wemco 3x3C	50	Continuous	SCADA/level switch

The collected grit is pumped to a single grit separator/classifier that washes organic material from the grit and returns the wash water to the grit basin effluent channel. Figure 2-5 shows the grit classifier. Potable water is used for grit washing. When a density meter at the bottom of the vortex chamber reads a density of 92 percent, the grit pump starts and runs until the density is reduced to 88 percent. Currently, the grit pump starts once every 3 hours. Once washed to reduce screening organic load, the grit drops down into a 3-yard dumpster and is disposed of at the Ada County landfill. The grit separator/classifier has a hydraulic capacity of 250 gpm.

Figure 2-5. Grit Classifier

2.2.1.6 Influent Flow Splitter Box

The screened and degritted wastewater flows to an influent splitter box, which is located in the northern end of the Headworks Building. The flow split structure was constructed in 2010 along with the Headworks Building and further expanded in 2021 during the Lagoon Expansion Project. The box consists of two weir gates to split the wastewater going to the lagoon cells. The wastewater flows by gravity through 24-inch-diameter pipelines to the respective lagoon systems. The ratio of the flow split is operator adjustable. Typically, the District sends one third of the flows to Lagoon Cell 1 and Cell 2 and the remaining flows to Lagoon Cells 3 through 6.

In addition, during the 2017 Improvements Project, a 24-inch-diameter bypass line was installed that conveys screened and degritted wastewater toward Lagoon Cells 3 through 6 from the splitter box to the Effluent Pump Station, from which it is then pumped to West Boise WRF.

2.2.2 Secondary Treatment

The secondary treatment consists of two separate treatment trains with aerated and settling cells. Treatment Train 1 is aerated Cell 1 and settling Cell 2. Treatment Train 2 includes aerated Cells 3 and 4 along with settling Cells 5 and 6. The aerated lagoons are designed to reduce carbon (for example, BOD_5 and chemical oxygen demand [COD]) and settling lagoons settle out solids, decreasing suspended solids in the effluent going to West Boise WRF. Seasonal levels of nitrification occur within the aerated lagoons. Lagoon Cells 1 and 2 were constructed in 1982. Cell 1 is an aerated lagoon, followed by Lagoon Cell 2, which is used for settling out TSS. Transfer Structure 1 controls the water level between these lagoons. Effluent from Lagoon Cell 2 flows by gravity to the Transfer Pump Station, where it is pumped to the Effluent Pump Station.

A second lagoon system and second treatment train were constructed in 2021. Lagoon Cells 3 and 4 serve as aerated lagoons, whereas Lagoon Cells 5 and 6 settle out solids. Transfer Structure 2 controls the water level between the lagoons. The effluent from this system combines with the effluent from Lagoon Cell 2 and is then pumped to West Boise WRF for further treatment, disinfection, and discharge.

Air supply to the aerated lagoons is provided by blowers housed in the Blower Building, located west of the Headworks Building.

2.2.2.1 Treatment Train 1

Treatment Train 1 consists of Lagoon Cells 1 and 2, Transfer Structure 1, and the Transfer Pump Station. Figure 2-6 presents an aerial view of this treatment train. Table 2-4 provides the capacities of these lagoons.

Figure 2-6. Treatment Train 1 (Looking South)

Table 2-4. Lagoon Train 1 Capacity

Lagoon	Normal Water Depth (feet)	Average Sludge Depth (feet)	Water Surface Area (acres)	Nominal Volume (MG)	Usable Volume (MG)
1	10	1	3.4	11.9	10.7
2	10	2	1.3	3.2	2
		Total	4.7	15.1	12.7

The 2022 average day flow during the maximum month was 2.50 mgd (Keller Associates 2023). With both treatment trains online, the flows are split between the two treatment trains, with flow to Treatment Train 1 being one third of the total influent flow. Therefore, the hydraulic retention time at the combined usable lagoon volume of 12.7 MG was 15 days.

2.2.2.1.1 Lagoon Cell 1

Lagoon Cell 1 provides the majority of the BOD_5 reduction for this treatment train. The submerged diffused aeration system was installed during the 2017 Improvements Project. The air supply to this system was also upgraded with two new high-speed turbo blowers, housed in the Blower Building. Air is delivered via a 24-inch welded steel piping buried in the lagoon dike.

Historically, Lagoon Cell 1 has had a stable, accumulated sludge layer approximately 1 foot thick, which reduces the usable volume. Sludge in Lagoon Cell 1 was last removed in 2008, when the liner was replaced. The water surface elevation (WSL) of Lagoon 1 is measured using a pressure transducer attached to the westernmost walkway.

The effluent from Lagoon Cell 1 can be sent directly to Transfer Pump Station via a 24-inch gravity bypass line. This is used when Lagoon Cell 2 needs to be bypassed either for solids removal, maintenance, or seepage testing. The pipeline can also be used to bypass Lagoon Cell 1, but the wastewater is then directly sent to the Effluent Pump Station via the Transfer Pump Station in this scenario.

2.2.2.1.2 Transfer Structure 1

This transfer structure is located at the southwest corner of Lagoon Cell 1. A 24-inch-diameter pipe connects Lagoon Cell 1 to this transfer structure, which is equipped with stoplogs to maintain the desired level of Cell 1 regardless of the level of Cell 2. A 24-inch-diameter pipe exits Transfer Structure 1 and routes effluent from Lagoon Cell 1 to Lagoon Cell 2.

2.2.2.1.3 Lagoon Cell 2

The majority of the TSS reduction occurs in Lagoon Cell 2, which primarily functions as a settling and storage basin. Solids depth measurements are taken monthly. When solids are approximately 7 feet deep, they are removed by a mobile dewatering contractor. A 24-inch-diameter pipe routes from Lagoon Cell 2 into the Transfer Pump Station.

2.2.2.1.4 Transfer Pump Station

The Transfer Pump Station was modified in 2021 and now pumps Treatment Train 1 effluent to the Effluent Pump Station. The Transfer Pump Station includes two low-head nonclog submersible centrifugal pumps whose details are listed in Table 2-5.

Table 2-5. Effluent Pump Details

Pump Number	Type	Make/Model	Capacity (gpm)	TDH (feet)	Drive Type	Motor Size (hp)	Control
1	Nonclog submersible	Flygt NP-3153	1,950	21	Variable	15	Level control: pressure transducer Pump control: VFD
2	Nonclog submersible	Flygt NP-3153	1,950	21	Variable	15	Level control: pressure transducer Pump control: VFD

VFD = variable frequency drive

The effluent pumps are operated to maintain 2 feet of freeboard in Lagoon Cell 2.

2.2.2.2 Treatment Train 2

Treatment Train 2 consists of Lagoon Cells 3 through 6 and Transfer Structure 2. Figure 2-7 presents an aerial view of this treatment train. Table 2-6 and Table 2-7 present the capacities of these lagoons.

Figure 2-7. Treatment Train 2 (Looking North)

Table 2-6. Treatment Train 2 Aerated Lagoon Capacity

Aerated Lagoon	Normal Water Depth (feet)	Average Sludge Depth (feet)	Water Surface Area (acres)	Nominal Volume (MG)	Usable Volume (MG)
3	11.5	1	2.2	5.9	5.6
4	10.4	1	2.4	5.9	5.5
		Total	4.6	11.8	11.1

Table 2-7. Treatment Train 2 Settling Lagoon Capacity

Settling Lagoon	Normal Water Depth (feet)	Average Sludge Depth (feet)	Water Surface Area (acres)	Nominal Volume (MG)	Usable Volume (MG)
5	10.3	2	1.3	3.1	2.5
6	11.8	2	1.3	3.35	2.8
		Total	2.6	6.45	5.3

The 2022 average day flow during the maximum month was 2.50 mgd (Keller Associates 2023). With both treatment trains online, the flows are split between the two treatment trains, with flow to Treatment Train 2 being two thirds of the total influent flow. Therefore, the hydraulic retention time at the combined usable aerated lagoon volume of 11.1 MG was 6.7 days. Similarly, the hydraulic retention time for the combined usable settling lagoon volume of 6.45 MG was 3.9 days.

2.2.2.2.1 Lagoon Cell 3

Lagoon Cell 3 was constructed in 2021 and provides the majority of the BOD_5 reduction. This lagoon uses a submerged diffused aeration system. The air supply to this lagoon is provided by two high-speed turbo blowers in the Blower Building. Air is delivered via a 24-inch welded steel piping buried in the lagoon dike. The water level of Lagoon Cell 3 and Cell 4 is measured using a level element and transmitter installed in a stilling well at each lagoon.

2.2.2.2.2 Lagoon Cell 4

Lagoon Cell 4 is similar to Lagoon Cell 3, helping to reduce any remaining BOD_5 in the effluent coming from Cell 3. This lagoon also includes a submerged diffused aeration system and air is supplied by high-speed turbo blowers in the Blower Building. Lagoon Cells 3 and 4 are typically operated in series configuration, but piping is provided to be able to operate the lagoons in parallel. Additionally, a small fraction of the influent can also be diverted to Lagoon Cell 4 in the series configuration. This step feed option is available for use if the WLTF decides to carry out a level of nitrogen removal in the future. Each lagoon can be easily isolated for maintenance or seepage testing with minimal impact to treatment performance.

2.2.2.2.3 Transfer Structure 2

Transfer Structure 2 is located east of Lagoon Cell 5. A 24-inch-diameter pipe collects the effluent from Lagoon Cell 3 and Cell 4 and connects to Transfer Structure 2. The transfer structure includes two weir gates, which are used to distribute flows to Lagoon Cell 5 and Cell 6 via 24-inch-diameter pipes. Lagoon Cell 5 and Cell 6 can be operated either in series or parallel configuration by adjusting the weir gates. Similar to the aerated lagoons, the Lagoon Cell 5 and Cell 6 can be easily isolated for maintenance or seepage testing.

2.2.2.2.4 Lagoon Cell 5

The majority of the TSS reduction occurs in Lagoon Cell 5. It is smaller the Lagoon Cells 3 and 4 and primarily functions as a settling and storage basin. A 24-inch-diameter pipe routes from Lagoon Cell 5 either to Lagoon Cell 6 or Effluent Pump Station 2.

2.2.2.2.5 Lagoon Cell 6

Lagoon Cell 6 is similar to Lagoon Cell 5 and helps polish the effluent coming from Lagoon Cell 5. Additional TSS reduction occurs here along with solids storage. A 24-inch pipe routes the effluent from Lagoon Cell 6 to the Effluent Pump Station.

2.2.3 Effluent Pump Station

The wet well for the Effluent Pump Station was constructed during the 2017 Improvements Project. The wet well was upgraded in the Lagoon Expansion Project to include permanent pumps. A 24-inch diameter line conveys water from both treatment trains. The discharge from the pump station is connected to both the 14-inch diameter forcemain and the 24-inch-diameter forcemain going to West Boise WRF. The District mainly uses the 24-inch forcemain because it requires less energy than pumping the water through the 14-inch forcemain.

Table 2-8 provides Effluent Pump Station details for the current configuration.

Table 2-8. Current Effluent Pump Details

Pump Number	Type	Make/Model	Capacity (gpm)	TDH (feet)	Drive Type	Motor Size (hp)	Control
1	Nonclog submersible	Flygt NP 3315	3,000	45	Variable	160	Level control: pressure transducer Pump control: VFD
2	Nonclog submersible	Flygt NP 3202	2,800	45	Variable	45	Level control: pressure transducer Pump control: VFD
3	Nonclog submersible	Flygt NP 3315	3,000	45	Variable	160	Level control: pressure transducer Pump control: VFD

2.2.4 Blower Building

Air supply to the aerated lagoons (Lagoon Cells 1, 3, and 4) is provided by blowers in the Blower Building, located west of the Headworks Building. The Blower Building was constructed in 2017 as part of the Improvements Project. Two high-speed turbo blowers (Blower 1 and Blower 2) were installed in 2017 to supply air to Lagoon Cell 1. Typically, only one blower is operated and the other serves as a standby, providing complete system redundancy. Two additional high-speed blowers (Blower 3 and Blower 4) were installed in 2021 and supply air to Lagoon Cell 3 and Cell 4. These blowers are also operated in duty standby configuration, providing complete system redundancy. The blowers serve their respective lagoon systems with no interconnections. Space is provided for a fifth blower, which can be installed in the future when required. This fifth blower will act as a swing blower to serve either lagoon system.

Table 2-9 presents the design criteria for the blowers.

Table 2-9. Blower Design Criteria

Blower Number	Type	Make/Model	Motor Size (hp)	Capacity (scfm)	Pressure (psi)	Drive Type
1	High-speed turbo	Sulzer HST 20-6000-1-U200	200	3,500	7.3	Variable
2	High-speed turbo	Sulzer HST 20-6000-1-U200	200	3,500	7.3	Variable
3	High-speed turbo	Sulzer HST 30-36-1-U250-48	250	4,200	8.0	Variable
4	High-speed turbo	Sulzer HST 30-36-1-U250-48	250	4,200	8.0	Variable

Figure 2-8 presents the process flow diagram for the WLTF.

2.2.5 Utilities and Support Systems

The following section describes the utilities that support the regular operation and maintenance of the WLTF.

2.2.5.1 Operations Building

The Operations Building houses multiple offices, a conference room, workstations, and SCADA front-end operator screens.

2.2.5.2 Maintenance and Storage Buildings

Five vehicle storage and maintenance buildings house the collection system maintenance equipment and supplies. A covered storage area also provides a storage space for equipment and materials.

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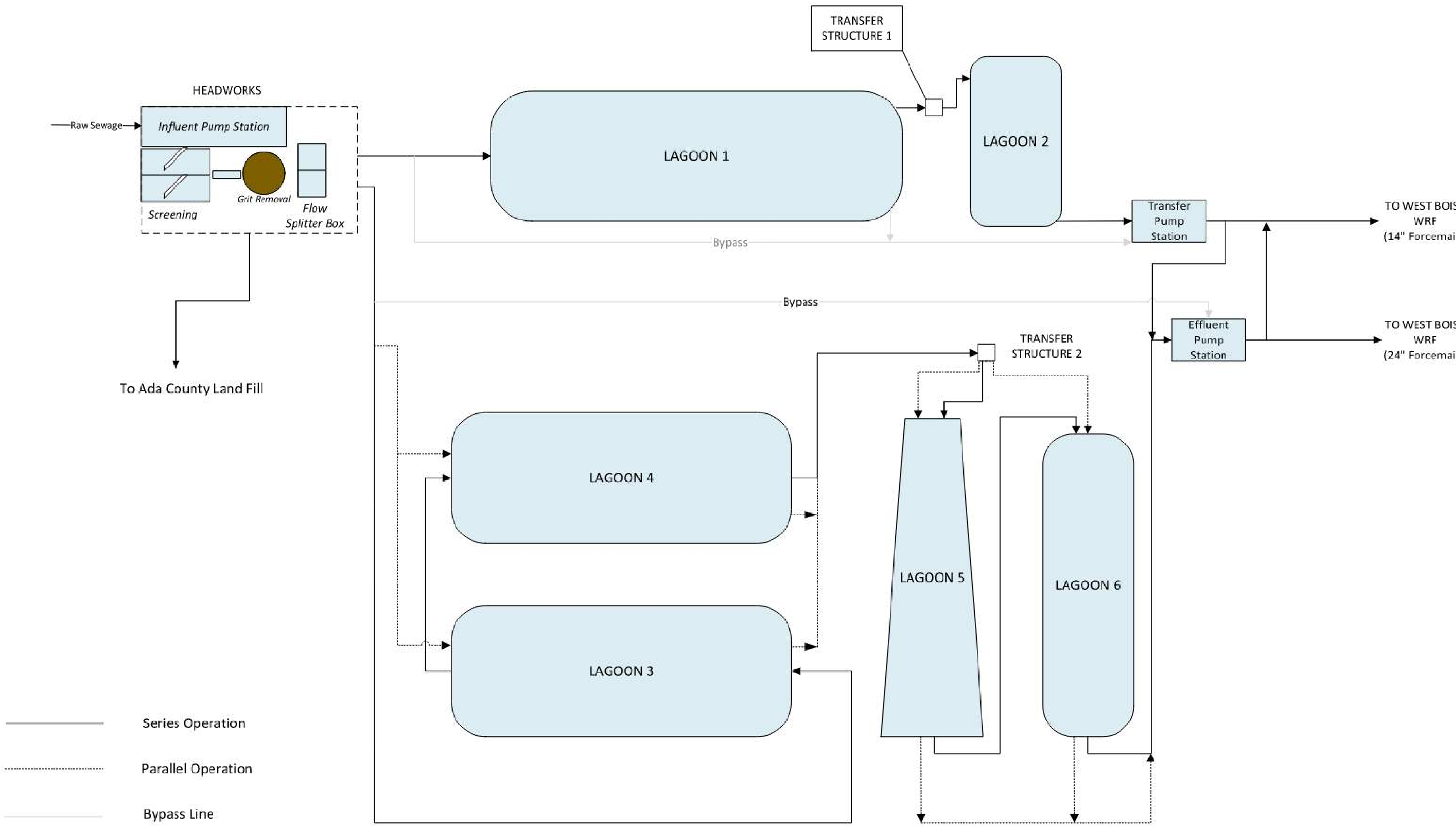

Figure 2-8. Eagle Sewer District Wastewater Lagoon Treatment Facility Process Flow Diagram

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2.2.5.3 Potable Water Service

The Operations Building and Headworks Building are supplied with potable water by District Well 2, which was constructed in 2020. Veolia Water has an 8-inch water line from Highway 44 that provides fire protection water and acts as a redundant water supply to the Blower Building and Headworks. The Plant Operations Building also has its own well east of the building that was constructed in 1982 with the lagoon system. Supply pressures for all these potable water sources are typically in the range of 60 to 80 psi. The screens, grit classifier, and Headworks odor control are the processes that use potable water.

2.2.5.4 Electrical Power Supply

The electrical distribution system at the District WLTF is currently served by Idaho Power from a single tap coming from State Highway 44. The District accepts power at 12.5 kilovolts (kV) routed to the main switchgear located on the plant entrance road west of the Headworks Building where the power is metered. From the switchgear, the Headworks Building is served by a 12.5-kV 600-amp breaker, then a building transformer located southeast of the Headworks Building that reduces the voltage to 480-volt 3-phase. A second transformer adjacent to the Headworks transformer was installed in the 2017 Improvements Project. This transformer serves the Blower Building, including the effluent pumps and blowers. The Plant Operations Building is fed from a 300-amp breaker in the switchgear and then a 400-kilovolt-ampere transformer south of the building.

The Operations Building and Vehicle Storage Buildings are served by a separate Idaho Power feed from S. Urban Gate Avenue and are metered separately from the medium voltage system at the switchgear.

2.2.5.5 Standby Electrical Power

The Headworks generator was installed as part of the 2010 Headworks Project and was extended to the Blower Building during the 2017 Improvements Project. The subbase diesel tank was sized to provide 24 hours of generator run time at full load. The generator and its enclosure were designed to minimize noise to the surrounding neighbors. The primary purpose of the generator is to provide power to critical influent pumping and screening facilities, followed by the effluent pump, blowers, and other building needs. The blowers are the largest loads and should be started after the influent and effluent pumps and the screens. The blowers can then be brought online one at a time based on remaining generator capacity. The generator is not sized to run all the pumps, screens, and blowers at the same time. When utility power is interrupted upstream of the automatic transfer switch (ATS), the ATS signals the generator to start, then switches to standby power supplied by the generator. A timing delay on the ATS switch prevents unnecessary switching that may occur during short power disruptions.

The Plant Operations Building houses an auxiliary generator, a Caterpillar 3306 diesel rated at 200-kW that serves the building and Transfer Pump Station. The 1,000-gallon diesel fuel tank is located outside, south of the mechanical room.

The Operations Building is equipped with an 80-kW natural gas generator that serves the building loads.

Table 2-10 presents generator data and facilities served.

Table 2-10. Standby Power Sizing

Name	Kilowatt Rating	Voltage	Facilities Fed	Location
GEN-1	200	480, 3-phase	Plant Operations Building	West of Lagoon Cell 2
GEN-2	600	480, 3-phase	Headworks Blower Building	North of Headworks
GEN-3	80	120/240, 1-phase	Operations Building	Northwest plant site

These backup power systems are effective in short-lived power outages. The Idaho Power utility power system has proven to be quite reliable in the past and outages are very infrequent and short lived. In the event of a longer outage, supplemental diesel reserve storage would be helpful, or an alternate power supply like solar. Diesel storage could also be helpful for supplying the lift stations with diesel generator fuel.

2.2.5.6 Supervisory Control and Data Acquisition System

All plant processes are monitored on SCADA. The Headworks Building houses the main SCADA system. In addition to treatment plant processes, all the District lift stations are monitored on the WLTF SCADA system. SCADA control and monitoring stations are available in the Operations and Plant Operations Buildings.

2.3 Treatment and Hydraulic Capacity

2.3.1 Hydraulic Capacity Analysis Methods

Hydraulic analyses were performed to evaluate the existing hydraulic capacity of the District WLTF under different flow conditions. The hydraulic computer model WinHydro, developed by Jacobs, was used for this hydraulic analysis. The model produces a hydraulic profile by calculating the head loss through the treatment plant hydraulic structures at a given flow rate. WinHydro is a steady-state model in that the flow rate at any point in the system is held constant. Steady-state modeling is used to evaluate hydraulic structures for the WLTF as it yields a conservative result because it assumes a constant flow rate through the entire system.

The hydraulic analysis begins with the water level at the downstream end of the plant. The hydraulic calculations proceed upstream from this elevation, one element at a time. In this evaluation, the water level in the Effluent Pump Station wet well of each lagoon system was used as the downstream datum.

2.3.1.1 Design Criteria and Assumptions

The design criteria for this hydraulic analysis are based on existing conditions at the District WLTF. The evaluation identifies hydraulic bottlenecks where improvements are required to reduce or eliminate the hydraulic constraint. The design criteria and assumptions for this hydraulic evaluation are as follows:

- Maintain at least 1 foot of freeboard in all hydraulic structures except for Lagoon Cell 1, Cell 3, Cell 4, Cell 5, and Cell 6 (refer to the text in the following bullet points).
- Optimize the operating level of Lagoon Cell 2. Keeping the depth as high as possible increases the hydraulic residence time and improves treatment. Also, increased water depth above the effluent pipe prevents a vortex from forming.
- Maintain a WSL of 2547.0 feet in Lagoon Cell 1, leaving 2 feet of freeboard.
- Maintain a WSL below 2555.0 feet in lagoon Cell 3, Cell 4, Cell 5, and Cell 6, leaving at least 3 feet of freeboard based on the Idaho Administrative Code (IDAPA 58.01.16) requirements for new lagoons.
- For all the scenarios evaluated, one third of the plant flow goes through Lagoon Cells 1 and 2 and two-thirds of the flow goes through Lagoon Cells 3, 4, 5, and 6.
- Lagoon Cells 1 and 2 are operated in series (original treatment train). Lagoon Cells 3, 4, 5, and 6 are operated in series as the second treatment train.
- There is enough attenuation in the lagoons that the effluent pumps can operate at almost a constant discharge flow rate over a 24-hour period while maintaining the level in the lagoons to within 1 inch of the setpoint.
- Influent and Effluent Pump Station performance was not analyzed as part of this evaluation.

Table 2-11 presents the existing and future design flow conditions used in the hydraulic analysis.

Table 2-11. Eagle Sewer District Wastewater Lagoon Treatment Facility: Existing and Future Design Influent Flow Conditions

Scenario	Flow	Influent Flow (mgd)	Condition
1	Year 2022	4.4	Peak hour Flow
2	Build-out[a]	4.08	Maximum month flow
3	Build-out[a]	7.17	Peak hour flow

[a] Refer to Chapter 3 for future flows.

2.3.1.2 Hydraulic Capacity Analysis Conclusions

Evaluations of the system showed that the lagoons provide a significant levels of flow attenuation, the 2016 Facilities Plan (CH2M 2016). The attenuation that the lagoons can provide will depend on the normal operating level of the lagoons and the duration of a hydraulic event. The following hydraulic limitations were identified during the hydraulic evaluation:

- Hydraulic capacity of the overall facility
  - Currently, the hydraulic capacity of the facility is limited by the capacity of the Effluent Pump Station pumps. The Effluent Pump Station has a firm capacity of 8.65 mgd. If the pumps are replaced by larger pumps, the facility could pass 10.1 mgd before the velocity in the 24-inch pipes (piping between lagoons and forcemain) exceeds 5 feet per second, which is the recommended maximum velocity.
- Treatment Train 1
  - The capacity of the Transfer Pump Station pumps limits the hydraulic capacity of Treatment Train 1 to 2.8 mgd.
  - If the pumps are replaced by larger pumps, this treatment train could pass up to 6.5 mgd. Under this scenario, the WSL of Cell 2 is 2541.88 feet, which significantly reduces the treatment volume of the cell.
- Treatment Train 2
  - The hydraulic capacity of this treatment train is limited by the minimum submergence required for the effluent pump.
  - This treatment train can pass up to 6.47 mgd based on the minimum pump submergence for the effluent pumps. Depending on the flow being pumped, the minimum submergence changes. The minimum submergence required also depends on the type of pump installed, if the pump can operate dry or it is required to be fully submerged. For this evaluation, it was assumed that the minimum level at the Effluent Pump Station is 2550.5 feet, which provides over 5 feet of submergence and keeps the influent pipe into the pump station submerged, minimizing the potential for air entrainment.
- Hydraulic capacity within the Headworks
  - The mechanical screens have a rating capacity of 5.8 mgd each. The Headworks can pass all peak hour flows shown in Table 2-11 if both screens are in operation. If only one screen is in operation during the build-out peak hour condition, the screens' bypass channel is required.

These limitations are based on the steady state analysis using the WinHydro computer model where flow attenuation in the system is not taken into consideration.

2.3.1.3 Hydraulic Profiles

Figure 2-9 presents a hydraulic profile showing water surface levels for scenarios 1 and 2 (defined in Table 2-11).

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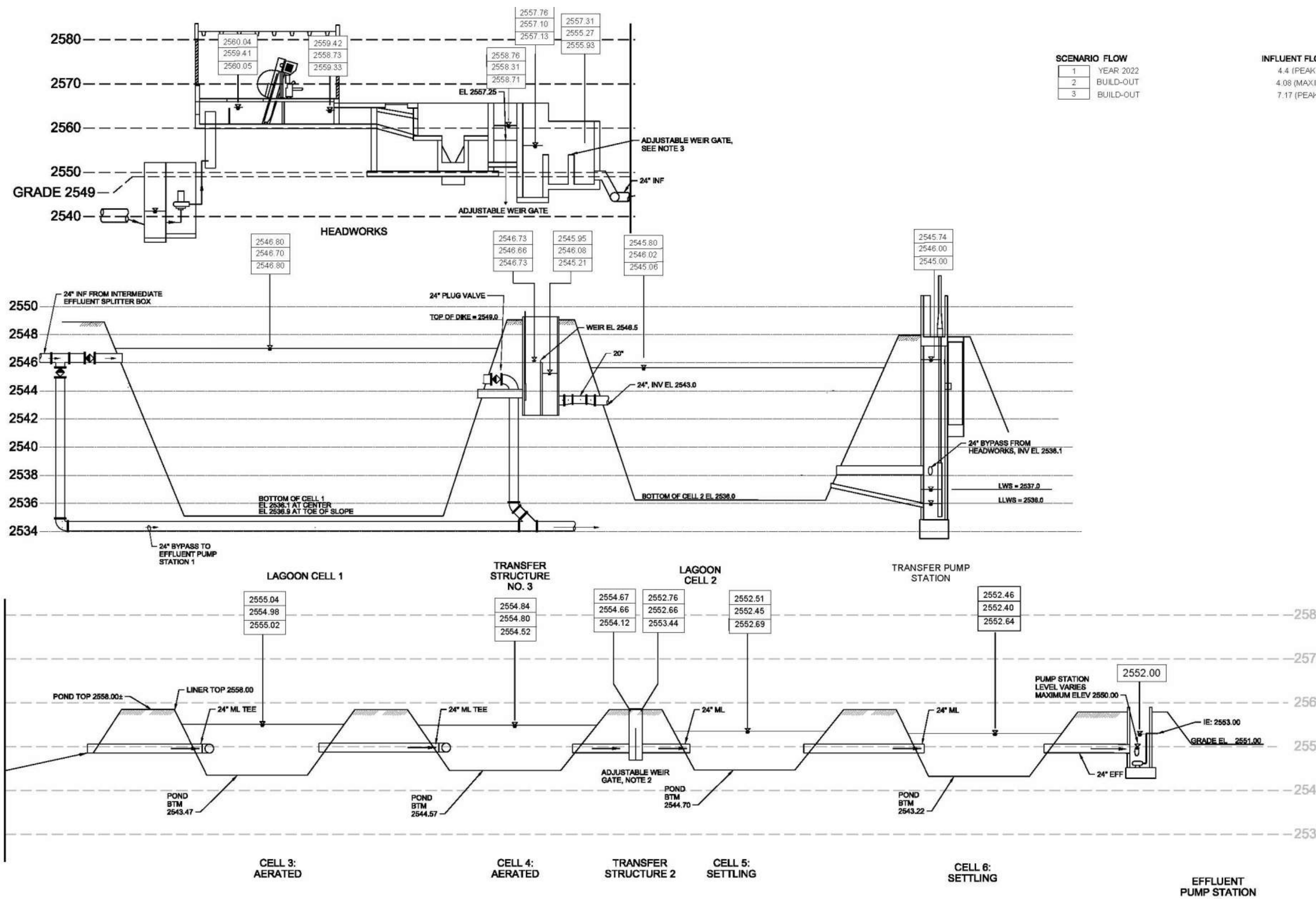

Figure 2-9. Eagle Sewer District Wastewater Lagoon Treatment Facility Hydraulic Profile Diagram

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2.3.2 Treatment Capacity Rating

A Dynamita Sumo (commercially available whole-plant treatment modeling software, version 22) process simulation was developed and calibrated to simulate the existing District WLTF, define existing performance, and evaluate proposed system improvements. The model was first calibrated against March 2022 data to compare the predicted and effluent measured quality values. The predicted versus measured effluent quality values were close to or within an acceptable tolerance. The model was then validated by simulating January 2023 where the predicted and measured effluent quality values were close to or were within an acceptable tolerance.

The calibrated and validated Sumo model was used to determine the capacity of overall WLTF as well as individual treatment trains. The effluent criteria of less than 60 mg/L for BOD_5 and for TSS are the primary objectives of all modeling runs. Average day maximum concentration of 250 mg/L BOD_5 and 230 mg/L of TSS with varying influent flows were used to determine the capacity. The model predicted an effluent BOD_5 and TSS concentrations around 60 mg/L, which correspond to a treatment capacity of 6.6 mgd, average day maximum month. Average day maximum month treatment capacities of Treatment Train 1 and Treatment Train 2 are estimated to be 2.6 mgd and 4.0 mgd, respectively.

Appendix A presents details on the approaches of the Sumo modeling.

2.3.3 Wastewater Lagoon Treatment Facility Capacity Summary

Table 2-12 summarizes the treatment and hydraulic capacity of the WLTF. The ratio of peak hourly flow of 10.1 mgd to the average day maximum month flow of 6.6 mgd is 1.53. This value is lower than the peaking factor used for the flow projections in the Collection System Master Plan (Keller Associates 2023). The existing lagoons have the capacity to attenuate this peak hour event, which would allow the WLTF to pump the effluent at a lower rate, matching the capacity of the existing effluent pumps.

Table 2-12. Summary of Treatment and Hydraulic Capacity at the Wastewater Lagoon Treatment Facility

	Treatment Capacity	Hydraulic Capacity	Notes
Overall WLTF	6.6 mgd, ADMM	8.65 mgd	The hydraulic capacity can be increased if the pumping capacity at the Effluent Pump Station is increased.
Treatment Train 1	4.0 mgd, ADMM	6.45 mgd	
Treatment Train 2	2.6 mgd, ADMM	6.47 mgd	

ADMM = average day maximum month

2.4 City of Boise Discharge Agreement

The 2005 agreement between the District and the City of Boise that allows the District to discharge treated effluent to the West Boise WRF for further treatment, disinfection, and river discharge consists of two separate charges: a capacity charge and a monthly O&M charge. The capacity charge represents the capital cost of constructing assets to treat the wastewater. The monthly O&M charge represents the ongoing monthly cost associated with O&M of the capital assets. Appendix B contains a sample bill from the City of Boise.

2.4.1 West Boise Water Renewal Facility Capacity Charge

The capacity charge is a one-time charge for the next increment of treatment capacity above a threshold value. These thresholds represent the capacity that the District has historically purchased in the West Boise WRF. This charge is not levied unless the current threshold has been exceeded, at which time a bill for the difference in the threshold exceedance minus the existing threshold is sent to the District for additional capacity. Once the additional capacity has been purchased, this new capacity becomes the new threshold. This capacity does not represent any physical ownership of assets in the West Boise WRF; it merely allows the District to discharge the threshold amount to the West Boise WRF without incurring additional capacity charges.

The following are the current (April 2023) threshold capacities:

- Flow: 2,580,000 gallons per day
- Biochemical oxygen demand (BOD): 1,861 pounds per day (lb/day)
- TSS: 2,248.83 lb/day
- Ammonia-nitrogen (NH_3-N): 711.79 lb/day
- Total phosphorus (TP): 143.00 lb/day

The following are the current (April 2023) charges to purchase increased treatment capacity at the West Boise WRF:

- Flow (per 1,000 gal/day): $2,280
- BOD (per lb/day): $1,395
- TSS (per lb/day): $765
- NH_3-N (per lb/day): $4,325
- TP (per lb/day): $20,000

For example, if the District NH_3-N quantity increased from its current level of 711 lb/day to 721 lb/day, an increase of 10 lb/day, The District would incur a one-time capacity threshold charge of 10 lb/day multiplied by $4,325, which equals $43,250, and the new threshold would be 721 lb/day. The difference between the threshold amounts and the wastewater constituents actually discharged is compared monthly to determine whether additional capacity must be purchased. City of Boise treatment rates increase each October.

2.4.2 West Boise Water Renewal Facility Operations and Maintenance Charge

The monthly O&M charge is calculated based on the actual quantities of flow, BOD, TSS, NH_3–N, and TP that are discharged to the City of Boise. The O&M charges are calculated for the listed parameters using the following formulas:

- Flow: flow charge = flow (mgd) × flow O&M fee
- BOD: BOD charge = BOD (lb/day) × BOD O&M fee
- TSS: TSS charge = TSS (lb/day) × TSS O&M fee
- NH_3-N: NH_3-N charge = NH_3-N (lb/day) × NH_3-N O&M fee
- TP: TP charge = TP (lb/day) × TP O&M fee

The total monthly O&M fee is the sum of all five charges. Refer to Table 2-13 for historical annual charges and monthly O&M unit rates.

Table 2-13. Actual Average Annual Eagle Sewer District Operations and Maintenance Rates

	Flow ($/MG)	BOD ($/lb)	TSS ($/lb)	NH_3-N ($/lb)	TP (($/lb)
2018	$804,871 ($1,111)	$137,623 ($0.96)	$142,294 ($0.40)	$32,391 ($0.22)	NA
2019	$916,211 ($1,170)	$257,360 ($0.86)	$415,096 ($0.40)	$34,119 ($0.23)	NA
2020	$1,024,594 ($1,255)	$290,428 ($0.90)	$298,851 ($0.46)	$48,591 ($0.24)	NA
2021	$997,323 ($1,239)	$409,976($0.93)	$249,952 ($0.43)	$41,984 ($0.25)	NA
2022	$1,091,372 ($1,295)	$170,405 ($0.87)	$98,007 ($0.55)	$40,833 ($0.36)	$29,962 ($3.52)

Note:

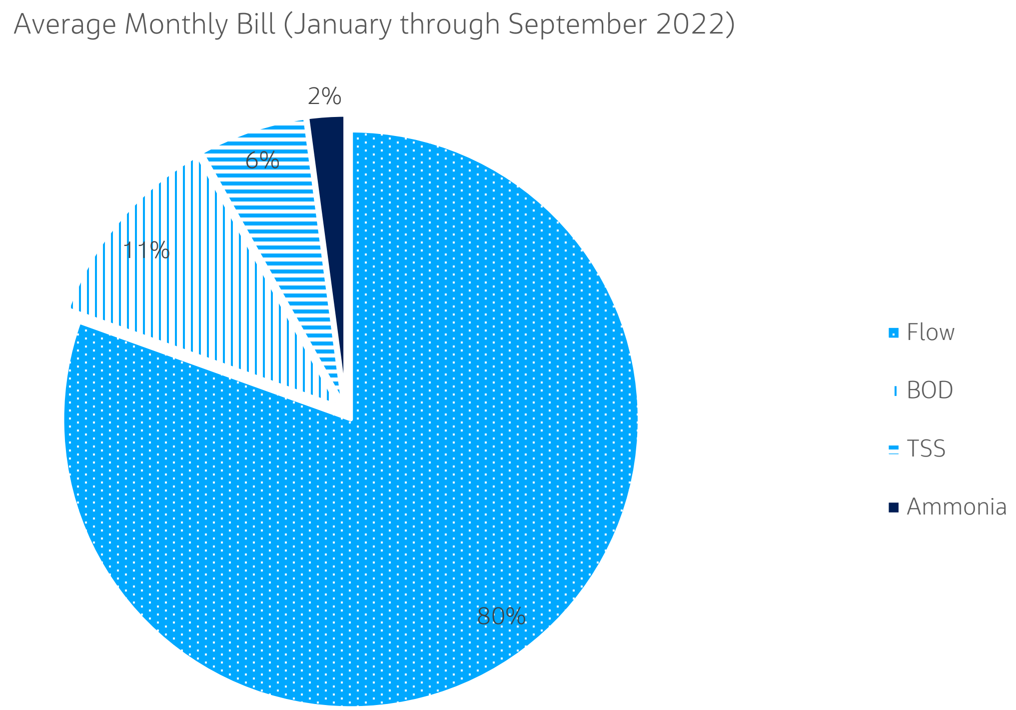
Actual monthly costs are listed in parentheses. These charges do not include the Lakemoor Subdivision or any direct connections to the City of Boise collection system.

$/lb = dollar(s) per pound
$/MG = dollar(s) per million gallons
NA = not available as TP was not charged until Q4 of 2022.

Figure 2-10 shows the portion of the total O&M charge for January 2022 through September 2022 and then from October 2022 through February 2023, for each constituent. In October 2022, West Boise WRF introduced an O&M charge on TP. It is apparent that the majority of the monthly O&M charge is for the West Boise WRF to treat the wastewater flow from the District. Alternatives that address flow will have a much larger financial impact versus alternatives that address the other constituents.

Under the O&M charges, there are two separate rates, one for wastewater discharged from the WLTF and the other for direct connections to the West Boise WRF without any treatment. The Lakemoor Subdivision does not pass through the WLTF; it is located adjacent to the West Boise WRF and has a lift station that pumps directly to the West Boise WRF where the wastewater is measured and sampled. There are other additional direct connections to the City of Boise collection system including the Lakeland Estates and Eagle City Marketplace connections, which are not monitored or sampled. For the purposes of this plan, the cost of the direct connections that do not pass through the District WLTF are not included because any improvements at the District WLTF would not affect the charges from these connections.

In the future, the City of Boise may impose other rates because the agreement with the District states: "If Boise implements other charges for wastewater constituents such as, but not limited to, nitrogen, phosphorous, sulfur, and fluoride during the period of this agreement, the District shall pay said Charges." Should these charges be applied, they would be calculated similarly to the other constituents that are currently assessed. The City of Boise is currently contemplating shifting from charging for ammonia-nitrogen to a total nitrogen charge. This is expected to occur in the next 2 years, but details have not been published as to how the current ammonia-nitrogen threshold translates to total nitrogen capacity.



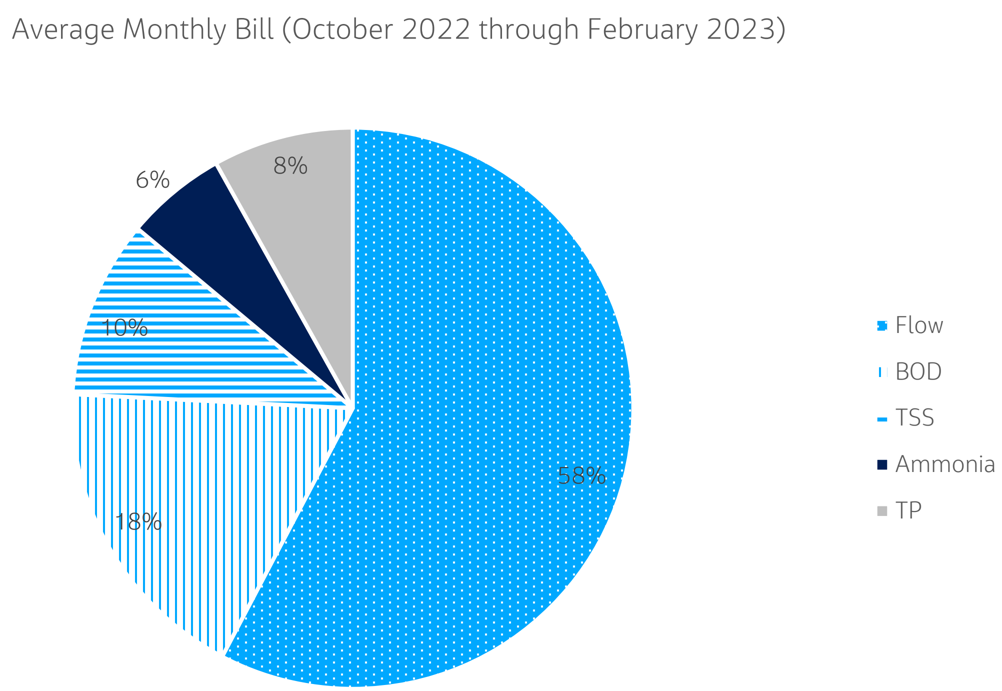


Figure 2-10. Percent of Average Monthly Bill by Constituent, January through September 2022 and October 2022 through February 2023

2.5 Wastewater Treatment Plant Performance

2.5.1 Effluent Characteristics

Table 2-14 presents the effluent water quality from 2021 and 2022. Additional years of data are not included because the construction period of the 2021 Lagoon Expansion resulted in higher levels of treatment.

Table 2-14. Eagle Sewer District Wastewater Lagoon Treatment Facility Effluent Water Quality, 2021 to 2022

	Flow (mgd)	BOD (lb/day)	BOD (mg/L)	TSS (lb/day)	TSS (mg/L)	NH_3-N (lb/day)	NH_3-N (mg/L)	TP (lb/day)	TP (mg/L)
2021	2.18	1,219	67	1,585	87	463	25	101	5.6
2022	2.29	456	24	488	26	311	16	95	5.0
Average	2.23	837	46	1036	56	387	21	98	5.3

Notes:

All values are maximum month discharges from the District WLTF and do not include flow from the Lakemoor Lift Station, which is pumped directly to the West Boise WRF.

All values are summarized based on effluent data West Boise WRF collected, except for TP. The District did not include capacity charges for TP until September 2022. TP was analyzed using the data the District collected.

Figure 2-11 shows that there can be some variations in the influent BOD_5, TSS, NH_3-N, and TP, which are somewhat dampened by the lagoon treatment system. The effluent BOD_5 and effluent TSS concentration remained low, especially in 2022. This decrease is likely due to the operation of Lagoons 3 through 6 in late 2021. Effluent NH_3-N concentrations were also lower in summer 2022, indicating nitrification occurred in the lagoon systems. Nitrification was not observed in winter conditions. Effluent TP was relatively similar to the influent concentrations, which indicated little to no removal occurring in the lagoons. During the summer months, the lagoons may see some buildup of algae and duckweed, which may affect the solids and nutrient concentrations in the effluent leaving the District WLTF.

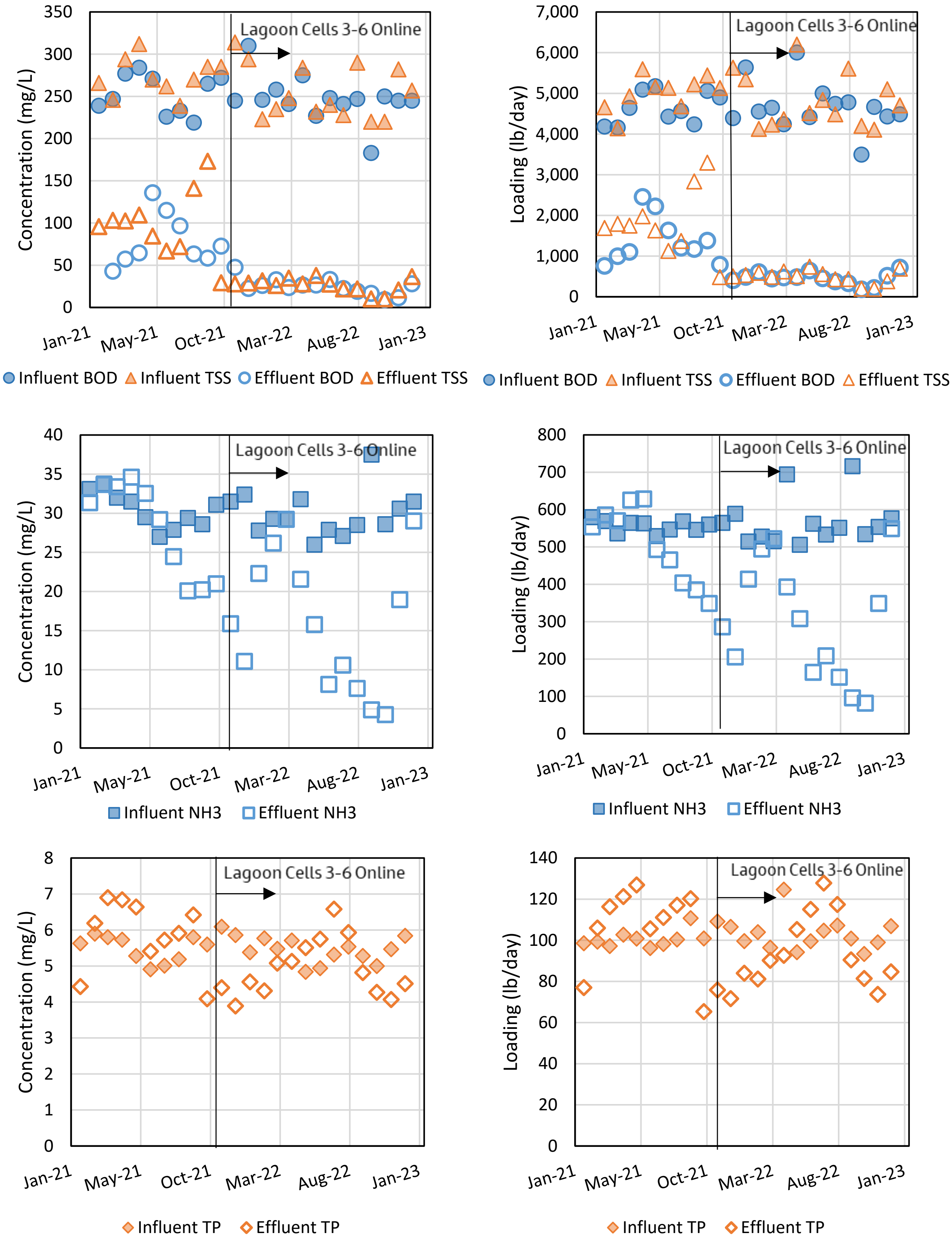


Figure 2-11. Wastewater Lagoon Treatment Facility Performance in 2021 and 2022

2.6 Extent of Flow Reduction Measures

As most of the District charges are flow based, reducing flow discharged to the City of Boise could reduce cost incurred from the City of Boise.

2.6.1 Water Conservation

Two different water purveyors serve the City of Eagle, and neither has reportedly conducted a water conservation program. The 2015 *City of Eagle Comprehensive Plan* (City of Eagle 2015) includes details for a general water conservation program, but no coordinated approach has been initiated. Conserving potable water used indoors would reduce the wastewater flow, resulting in lower charges by the City of Boise to treat the wastewater.

2.6.2 Infiltration and Inflow Reduction

Most of the District service area has high groundwater levels, causing the majority of the collection system lines to be submerged in groundwater throughout the year. In response, the District has an extensive program to reduce infiltration and inflow, including cleaning and inspecting the collection system and repairing issues encountered. Even though very little of the WLTF flow is attributed to infiltration and inflow, the inspection program is continued to further reduce what infiltration and inflow remain.

2.7 Existing System Flows

This section presents historical usage in equivalent residential units (ERUs), wastewater flow, and influent wastewater characteristics. The flow-based planning criteria in usage per ERU was developed during the Collection System Master Plan update in 2023.

2.7.1 Population

The population of the City of Eagle more than tripled between 1999 and 2010, from approximately 7,500 to nearly 20,000 residents (Table 2-15). Population growth slowed down between 2010 and 2022 but is almost double the 2010 estimate. The 2020 U.S. Census estimate for the City of Eagle was 30,346 residents. A slight dip in population was observed in 2022. However, the Treasure Valley economy is expected to continue to grow, creating demand for housing throughout Ada and Canyon Counties, which includes the City of Eagle and other surrounding areas the District serves.

Table 2-15. 2007 through 2022 City of Eagle Population

Year	Population Estimate
2007	20,095
2008	21,090
2009	21,370
2010	19,908
2011	20,140
2012	20,550
2013	21,350
2014	23,460
2015	24,600
2016	25,510
2017	26,930
2018	29,910
2019	31,270
2020	30,346
2021	34,470
2022	33,960
2023	35,360

Source: COMPASS 2023.

Although the COMPASS population estimates capture the total population of the City of Eagle, the population the District serves is not well represented. There are a number of developments and areas within city limits that are not connected to the District collection system. Some of these developments are anticipated to connect in the future, whereas others are never expected to connect.

2.7.2 Flow and Loadings

This section includes a discussion of the existing wastewater flow and loadings and statistical analysis to develop peaking factors used in subsequent analyses in the wastewater facility plan. Historical flows were analyzed during the Collection System Master Plan update in 2023, and Chapters 2.7.2.1 through 2.7.2.4 only present a brief summary of the results. More details on the flow projection development can be found in the Collection System Master Plan.

2.7.2.1 Wastewater Flow Baseline Conditions

To approximate baseline flow parameters, historical WLTF data were summarized and reported in the Collection System Master Plan (Keller Associates 2023). Table 2-16 shows the annual average flow data and gallons per ERU per day (GPEPD) for the years 2018 through 2022. For the past 5 years, the overall wastewater flows steadily increased, whereas the flow per ERU decreased. The decrease of GPEPD was likely due to a reduction of infiltration and inflow and the increased efficiency of home appliances and plumbing fixtures.

Table 2-16. Eagle Sewer District Wastewater Lagoon Treatment Facility Historical Flow Data

		Average Annual		Average Annual Dry Weather		Average Annual Wet Weather		Maximum Month	
Year	ERUs	Flow (mgd)	GPEPD	Flow (mgd)	GPEPD	Flow (mgd)	GPEPD	Flow (mgd)	GPEPD
2018	11,901	2.01	169	2.12	178	1.89	158	2.16	181
2019	12,742	2.11	165	2.21	174	1.99	156	2.25	177
2020	13,296	2.19	165	2.37	178	2.03	153	2.41	181
2021	13,859	2.20	158	2.32	167	2.08	150	2.35	169
2022	14,218	2.25	158	2.35	165	2.17	153	2.42	170
Final Planning Criteria	14,218	2.32	163	2.45	172	2.19	154	2.50	176

Note:

Final planning criteria are equal to 5-year average flow per ERU. The total flow is equal to the GPEPD multiplied by the 2022 ERUs (14,218).

The final planning criteria were used to calculate peaking factors. The average annual daily flow, average annual dry-weather flow, average annual wet-weather flow, and maximum month flow peaking factors were calculated based on the past 5-year data.

Daily influent flows between 2015 and 2022 were reviewed for peak day flow analysis. The peak day flow of 2.87 mgd was selected from June 5, 2022, by screening out daily flows with extreme weather conditions such as snowfall and atypical inflows.

Diurnal flows between January 28, 2022, and January 30, 2022, were analyzed for peak hour flow analysis. The peak hour flow of 4.40 mgd was selected based on the analysis of 3-day average data.

For each flow scenario, the final planning criteria are obtained by multiplying the 5-year average GPEPD and ERU of year 2022. Table 2-17 summarizes peaking factors for each flow scenario. The Collection System Master Plan contains additional details on the existing flows and peaking factors.

Table 2-17. Eagle Sewer District Wastewater Lagoon Treatment Facility Existing Flows and Correlated Peaking Factors

Criteria	Average Annual Daily Flow	Average Annual Dry-weather Flow	Average Annual Wet-weather Flow	Maximum Month Flow	Peak Day Flow	Peak Hour Flow
Total Flow (mgd)	2.32	2.45	2.19	2.50	2.87	4.40
GPEPD	163	172	154	176	202	310
Peaking Factor	1.00	1.06	0.94	1.08	1.24	1.90

2.7.2.2 Influent Biochemical Oxygen Demand and Total Suspended Solids Loading

BOD and TSS loads for 2021 and 2022 were analyzed based on influent sampling results the District recorded. The same statistical analysis that was completed for historical flows was performed for the BOD and TSS loads to establish historical average and peak loads.

Statistical analysis was used to estimate the average annual loads, maximum month loads, maximum week loads, and peak daily loads based on the previous 2 years of data. The probability of influent loads occurring was used to establish average and peak flows and loads (Metcalf and Eddy 2014). The percentile method can be used because wastewater flows are typically log-normally distributed. The following percentiles apply to flow and load conditions:

- Annual average = Based on historical data
- Maximum month = 91.7th percentile (11/12th percentile)
- Maximum week = 98.1st percentile (51/52nd percentile)
- Peak day = 99.7th percentile (364/365th percentile)

Using a statistical program in Microsoft Excel, these percentiles were calculated from the actual monthly average data provided. The statistics were calculated for each year, providing average and peak loads for 2021 and 2022.

Table 2-18 provides the monthly average influent chemical oxygen demand (COD), BOD, and TSS loads. Figure 2-12 presents the monthly average influent BOD, COD, and TSS loadings from 2021 through 2022.

The loads presented represent primarily residential and limited commercial discharges to the District. Little influent loading is attributed to industrial discharges.

Table 2-18. Historical Biochemical Oxygen Demand, Chemical Oxygen Demand, and Total Suspended Solid Influent Loads Based on Statistical Analysis

Year	Units	Annual Average	Maximum Month	Maximum Week	Peak Day
BOD					
2021	lb/day	4,707	5,216	5,540	5,621
2022	lb/day	4,623	5,087	5,794	5,971
COD					
2021	lb/day	10,887	12,412	12,708	12,782
2022	lb/day	10,729	13,909	16,388	17,007
TSS					
2021	lb/day	5,090	5,598	5,623	5,629
2022	lb/day	4,708	5,662	6,078	6,181

Note: A COD to BOD ratio of 2.3 was determined from the historical data.

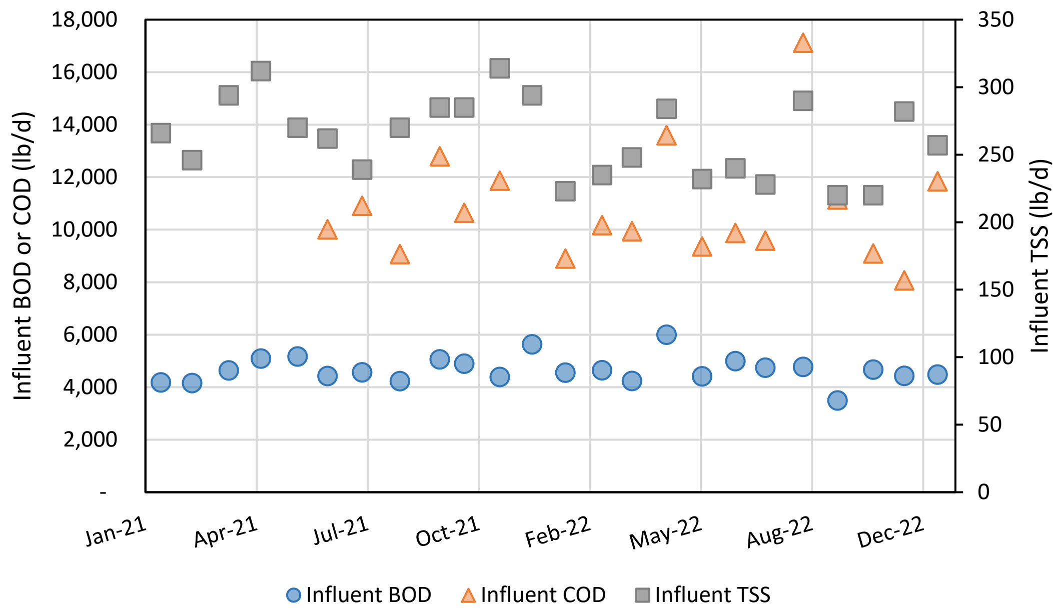


Figure 2-12. Monthly Average Influent Biochemical Oxygen Demand Load, Chemical Oxygen Demand Load, and Total Suspended Solid Load from January 2021 through December 2022

Table 2-19 presents the peaking factors for the maximum month, maximum week, and peak day conditions. These factors were calculated by dividing the maximum month, maximum week, or peak day loads by the corresponding average loading for each year.

Table 2-19. Biochemical Oxygen Demand, Chemical Oxygen Demand, and Total Suspended Solid Peaking Factors

Year	BOD Peaking Factor			COD Peaking Factor			TSS Peaking Factor		
	Maximum Month	Maximum Week	Peak Day	Maximum Month	Maximum Week	Peak Day	Maximum Month	Maximum Week	Peak Day
2021	1.11	1.18	1.19	1.14	1.17	1.17	1.10	1.10	1.11
2022	1.10	1.25	1.29	1.30	1.53	1.59	1.20	1.29	1.31
Average	1.10	1.22	1.24	1.22	1.35	1.38	1.15	1.20	1.21

2.7.2.3 Influent Nutrient Loading

Influent wastewater characteristics, including NH_3-N and TP, were evaluated based on District WLTF data. Figure 2-13 presents monthly average nutrient loadings from 2021 through 2022. Table 2-20 and Table 2-21 present the historical NH_3-N and TP average and peak loads, respectively.

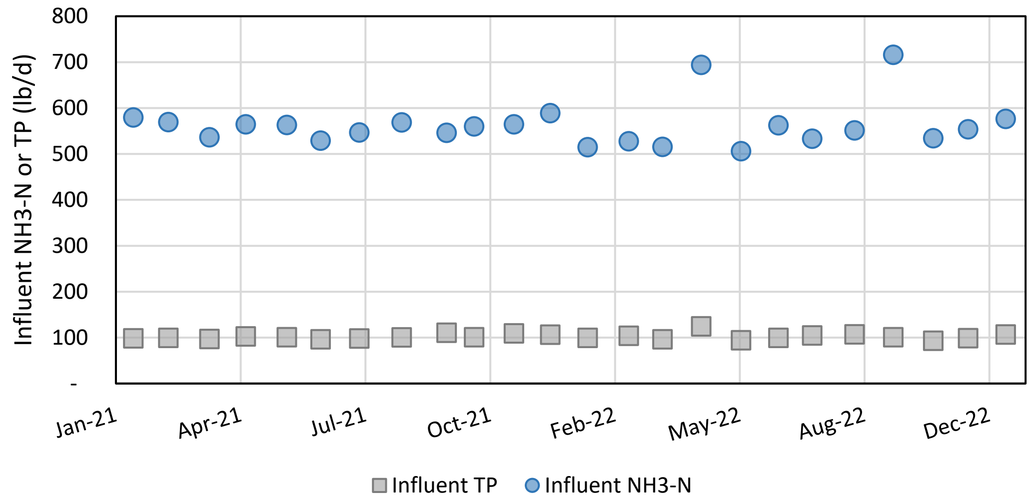


Figure 2-13. Monthly Average Influent Ammonia-Nitrogen Load and Total Phosphorous Load from January 2021 through December 2022

Table 2-20. Historical Ammonia-Nitrogen Influent Loads Based on Statistical Analysis

Year	Units	Annual Average	Maximum Month	Maximum Week	Peak Day
2021	lb/day	560	581	587	589
2022	lb/day	566	696	712	715

Table 2-21. Historical Total Phosphorus Influent Loads Based on Statistical Analysis

Year	Units	Annual Average	Maximum Month	Maximum Week	Peak Day
2021	lb/day	102	109	110	111
2022	lb/day	103	109	121	124

Table 2-22 presents the peaking factors for the maximum month, maximum week, and peak day conditions. These factors were calculated by dividing the maximum month, maximum week, or peak day loads by the corresponding average loading for each year.

Table 2-22. Influent Ammonia-Nitrogen and Total Phosphorus Peaking Factors

Year	NH_3 Peaking Factor			TP Peaking Factor		
	Maximum Month	Maximum Week	Peak Day	Maximum Month	Maximum Week	Peak Day
2021	1.04	1.05	1.05	1.07	1.09	1.09
2022	1.23	1.26	1.27	1.06	1.18	1.21
Average	1.13	1.15	1.16	1.07	1.13	1.15

2.7.2.4 Industrial Flows and Loadings

The District currently has no significant industrial users and there are no immediate plans for adding industrial users. However, allowances for future industrial discharges are included in future planning efforts to coincide with the *City of Eagle Comprehensive Plan* (City of Eagle 2015).

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3. Future Conditions

This chapter documents flow and load projections for the District WLTF. The WLTF receives flows and loads from both residential and commercial establishments. Approximately 90 percent of the flows and loads received from the ERUs serviced are residential, and the rest of the flows are from commercial establishments.

Establishing realistic flow and loading projections is critical in defining the necessary wastewater facilities to meet future conditions. This chapter presents projected population, wastewater flow, and influent wastewater characteristics. This information is used to establish the basis of planning for future facilities. These flows and loadings do not include connections made directly to the City of Boise collection system or the Lakemoor Subdivision located adjacent to the West Boise WRF because the subdivision is equipped with its own lift station and pumps directly to the West Boise WRF.

3.1 Wastewater Flow Projections

Table 3-1 presents the estimate of current and future ERU and flow projections. The District currently serves 14,218 ERUs. The projected 5-year and build-out growths are 19,465 ERUs and 23,217 ERUs, respectively. Future flows were calculated by multiplying the projected ERUs by the historical gallons per ERU per day (GPEPD. The detailed analysis for the population and flow projections is found in the Collection System Master Plan (Keller Associates 2023).

Table 3-1. Eagle Sewer District Wastewater Lagoon Treatment Facility Projected Flow Rates

		Flow (mgd)			
Scenario	ERUs	Annual Average	Maximum Month	Peak Day	Peak Hour
Existing (Year 2022)	14,218	2.45	2.50	2.87	4.40
2028 (5-year)	19,465	3.36	3.42	3.93	6.01
2040 (Build-out)	23,217	4.00	4.08	4.68	7.17

3.2 Wastewater Load Projections

Load projections were calculated using the January 2021 through December 2022 averaged per capita loading values, the projected ERUs, and peaking factors presented in Chapter 2.7.2.2 and Chapter 2.7.2.3. The average persons per household value of 2.64 between 2017 and 2021 (U.S. Census Bureau n.d.) was used for a conversion of ERU to total population in the District service area.

Table 3-2 presents estimated average annual, maximum month, maximum week, and peak day values for flow, BOD_5, COD, TSS, NH_3-N, and TP for the 5-year scenario and build-out scenario. Annual average per capita-day loading values were calculated from 2021 and 2022 data separately. Subsequently, the averaged values were calculated and applied to the population projection (from projected ERUs and an average household size of 2.64 persons per household) to determine annual average values. The peaking factors presented in Chapter 2 were then applied to determine the maximum month, maximum week, and peak day loadings.

Table 3-2. Projected Flow and Loads for 5-year and Build-out

Constituent	Average Annual	Maximum Month	Maximum Week	Peak Day
2028 (5-year)				
Flow	3.17 mgd	3.42 mgd	N.A.	3.93 mgd
BOD_5	6,470 lb/day (245 mg/L)	7,144 lb/day (250 mg/L)	7,862 lb/day	8,042 lb/day
COD	14,989 lb/day (567 mg/L)	18,261 lb/day (580 mg/L)	20,196 lb/day	20,680 lb/day
TSS	6,797 lb/day (257 mg/L)	7,825 lb/day (274 mg/L)	8,142 lb/day	8,221 lb/day
NH_3-N	780 lb/day (30 mg/L)	885 lb/day (31 mg/L)	900 lb/day	904 lb/day
TP	142 lb/day (5 mg/L)	151 lb/day (5.3 mg/L)	160 lb/day	163 lb/day
2040 (Build-Out)				
Flow	3.78 mgd	4.08 mgd	N.A.	4.68 mgd
BOD_5	7,717 lb/day (245 mg/L)	8,521 lb/day (250 mg/L)	9,378 lb/day	9,592 lb/day
COD	17,878 lb/day (567 mg/L)	21,781 lb/day (580 mg/L)	24,089 lb/day	24,666 lb/day
TSS	8,108 lb/day (257 mg/L)	9,333 lb/day (274 mg/L)	9,711 lb/day	9,805 lb/day
NH_3-N	931 lb/day (30 mg/L)	1,055 lb/day (31 mg/L)	1,074 lb/day	1,078 lb/day
TP	169 lb/day (5 mg/L)	180 lb/day (5.3 mg/L)	191 lb/day	194 lb/day

N.A. = not available

3.3 Wastewater Lagoon Treatment Facility Performance at Varying Flow Conditions

The projected maximum month flows developed in Chapter 3.2 were further divided into several different scenarios. This was done to analyze any decrease in treatment performance of the WLTF, which would help determine the trigger points for upgrades needed in the future. Table 3-3 presents the flow scenarios. Flow of 2.6 mgd represents current flows to the WLTF, whereas flow of 4.0 mgd represents the build-out condition (reference Table 3-2, build-out scenario maximum month). Influent loads for each scenario were computed by multiplying the flow with each constituent concentration found in Table 3-2. Loading rates to the WLTF under these scenarios are also presented in Table 3-3.

Table 3-3. Projected Influent Loads for Various Flow Rate Scenarios

Maximum Month Flow (mgd)	Influent BOD_5 (lb/day)	Influent TSS (lb/day)	Influent NH_3-N (lb/day)	Influent TP (lb/day)
2.6	5,435	5,953	673	115
3	6,271	6,869	777	133
3.5	7,316	8,013	906	155
4	8,361	9,158	1,036	177

The calibrated and validated Sumo model developed in Chapter 2 was used to simulate the different flow scenarios. All model runs were carried out at a winter temperature of 10 degrees Celsius. The analysis assumed that flows are split one third to Treatment Train 1 and two thirds to Treatment Train 2, matching existing operations. Additionally, all lagoons were assumed to be online and operating in the series configuration. Effluent targets for BOD_5 and TSS were set at 60 mg/L for both constituents.

Table 3-4 presents simulated effluent water quality for the different scenarios. The results show an increase in effluent BOD_5 and TSS with increasing flows and loads. No nitrification was observed in the lagoons for all scenarios because of low water temperatures during winter conditions. Effluent TP concentration is slightly lower than the influent because of biological assimilation.

Table 3-4. Simulated Effluent Quality for Various Flow Rate Scenarios

Maximum Month Flow (MGD)	Effluent BOD_5 (mg/L)	Effluent TSS (mg/L)	Effluent NH_3-N (mg N/L)	Effluent TP (mg P/L)
2.6	11	29	29	4.3
3	20	37	29	4.3
3.5	35	45	29	4.3
4	47	54	29	4.3

mg/L = milligram(s) per liter
N = Nitrogen
P = Phosphorus

3.4 Reference Land Use Plans

The City of Eagle Planning Department has developed a comprehensive plan as well as land use plans for the area of impact and beyond. Future land use mapping and planning extend to the Gem County and Boise County lines. Current and future land uses include low-, medium-, and high-density residential, commercial, and several mixed-use areas. The City of Eagle’s Comprehensive Plan includes details and definitions for each of these land use types. No significant industrial dischargers to the wastewater system have been specifically identified at this time. If a significant industrial discharger approaches the District with intentions to be connected to the collection and treatment systems, a thorough evaluation of the impacts should be conducted.

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4. Screening of Alternatives

4.1 Initial Screening of Alternatives

This chapter documents the initial list of wastewater treatment system alternatives developed and presented to the District.

4.1.1 Development of Wastewater Management Options

An initial list of wastewater treatment system alternatives, including lagoon upgrades, secondary treatment, tertiary treatment, and biosolids handling, was developed and presented to the District at a workshop for preliminary screening. This initial list of alternatives also included the feedback and ideas received from the survey of District patrons, multiple outreach events, and targeted stakeholder outreach informing what they wanted the cleaned water to be used for. The purpose of the workshop was to present an extensive list of alternatives, conduct a preliminary evaluation, and narrow down the alternatives to a better defined set of treatment alternatives to be further evaluated. Criteria used in part for the evaluation of alternatives includes the District's five level of service goals:

- Protect public and employee health and safety
- System reliability
- Affordability
- Water self-reliance
- Public partnership

This chapter provides a brief discussion and tables that summarize the initial list of alternatives developed for the District in the workshop.

4.2 Treatment Enhancements

This section summarizes the unit processes that were developed and evaluated as enhancements to the treatment process. The following sections summarize the major liquids process technologies that can achieve the long-term wastewater treatment objectives of the District. The unit processes are categorized based on their respective impacts to the parameters charged by the City of Boise for treatment at the West Boise WRF.

4.2.1 Flow Reduction

One of the biggest components of the O&M charges paid to the City of Boise are for the flows discharged to the West Boise WRF. The initial alternatives considered three different options to reduce the effluent flow going to West Boise WRF and presented in Table 4-1.

Table 4-1. Potential Flow Reduction Technologies

Manufacturer/ Equipment Type	Description	Explanation
Resource West, Inc. Apex 2.0 Floating Evaporator	Uses evaporation to reduce the water going to West Boise WRF	The evaporators are installed to float in the lagoons and include nozzles to disperse tiny droplets of water into the atmosphere. The efficiency of the evaporators is largely dependent on sunlight, temperature, and humidity. Therefore, evaporators will only operate for a limited time. A minimum of 8 evaporators is required to achieve an evaporation goal of 40,000 gallons per day.
I&I Improvements	Decrease in I&I reduces the influent flow to the WLTF and thereby reduces the flows going to West Boise WRF	The Collection System Master Plan (Keller Associates 2023) includes a high-level review of the I&I impacts to the District's collection system. The results from the review indicated minimal impacts from I&I to the flows going to the WLTF.
Water Reuse	Treat lagoon effluent to meet Class A recycled water per *Idaho Administrative Code* (IDAPA 58.01.17)	The District has identified several nearby canals that could be used for discharge of Class A recycled water during the irrigation season. Two irrigation companies have expressed interest to the District for receiving the District's WLTF's treated effluent, including Farmer's Union Ditch Company and Pioneer Irrigation District (refer to the expression-of-interest letters included in Appendix C). For one concept the Class A recycled water will be used for crop irrigation during the summertime by local irrigation districts and discharged into the groundwater during winter. The concept for groundwater infiltration is to use the canals during the winter months when no irrigation is required, as the Class A recycled water will percolate from the canal and recharge the groundwater. Another option is to provide Class A recycled water to the irrigation districts during the summer (irrigation season) and then return to discharging lagoon effluent to the West Boise WRF during the non-irrigation season. Another option that was initially looked at but quickly dismissed was the use of rapid infiltration basins. These would require 40 acres per MGD, making them unrealistic for the current service area, and they are too costly to pump to and acquire the required acreage offsite. Lastly, poplar farms are sometimes irrigated with Class A wastewater effluent. This was initially considered, but the amount of land required based on the average day flows is great. Water consumption requirements for poplar farms are typically 1 MGD per acre per day, which would equate to 365 acres per year per MGD, or 183 acres per year per MGD for a typical dry weather season.

I&I = infiltration and inflow

By reusing the water, the District could not only lower the O&M charges for flow but also likely reduce charges for BOD_5, TSS, and nutrient loadings.

4.2.2 Biochemical Oxygen Demand Removal

Several processes were evaluated for BOD_5 reduction, including increase of lagoon biomass inventory, lagoon intensification, tertiary treatment processes (moving bed biofilm reactors, membrane bioreactors [MBRs]), primary treatment processes (primary clarifier, A-stage [biologically enhanced primary treatment], primary filtration). A number of these technologies can also be expanded to provide levels of NH_3-N or total nitrogen removal as well, which is discussed in more detail in Chapter 4.2.2.4. Table 4-2 lists a preliminary screening of alternatives.

Table 4-2. Potential BOD_5 Removal Technologies

Unit Process	Description	Explanation
Increase of Lagoon Biomass Inventory	Increase solids concentration with sludge recirculation, sludge collection techniques, or adding secondary clarifier with RAS/WAS pump stations	The key component of this alternative is to collect the sludge and then return it to the front of the aerated lagoon system to provide additional biomass in the system. Collection of sludge can be accomplished with a new secondary clarifier with the associated return sludge piping or sludge collections within the existing settling lagoons. Additional solids handling unit processes are required if sludge collection together with a concentrated sludge return stream is implemented.
Lagoon Intensification	Use biofilm-based technologies (Entex Webitat or WavTex) in aerated lagoons	This alternative involves biomass growth achieved on the media, which allows greater BOD_5 and NH_3-N removals. Additional aeration is needed to scour the media and provide the oxygen needed for removals.
MBBR	Attached growth process using free-moving biofilm carriers to promote biomass inventory	Proves to be an efficient technology for BOD_5 removal and can be configured for various levels of total nitrogen removal. Promotes nitrification at lower water temperatures, potentially resulting in year-round nitrification.
MBR	Tertiary process using anoxic tank, pre-aerated tank coupled with MBR tank for BOD_5 and NH_3-N removal	This alternative achieves a high MLSS concentration, allowing for greater BOD_5 and nitrogen removals.
Primary Clarifier	Install primary clarifier upstream of lagoons	This alternative achieves additional BOD_5 removal upstream from the lagoon treatment system, lowering the loading to the treatment trains. Solids handling facilities are required with the use of a primary clarifier to help manage the generation of primary sludge.
Biologically Enhanced Primary Clarification (A-stage)	Biologically enhanced primary treatment coupling a high-rate bioreactor and primary clarifier	A bioreactor with a low solids residence time and low DO increases BOD_5 removal across primary treatment, reducing the loading to the treatment trains. This requires solids handling.
Additional Aeration	Installation of additional submerged diffusers and blower	Maintaining the ability to have the required level of DO concentration in the aerated lagoons will enhance the ability of the existing lagoon system to treat future flows and loading. An additional blower will provide redundancy for both treatment trains. The addition of aeration alone will not meet future treatment criteria but will complement other proposed components to maximize treatment efficiency.

DO = dissolved oxygen
MBBR = moving bed biofilm reactor
MLSS = mixed-liquor suspended solid
RAS = return activated sludge
WAS = waste activated sludge

4.2.2.1 Increase of Lagoon Biomass Inventory

Lagoon wastewater treatment differs from a conventional activated sludge process where the MLSS (TSS measuring the biomass) concentration is much higher (e.g., 1,500 to 5,000 mg/L), providing a comparatively larger biomass inventory. Conventional activated sludge includes the physical separation of solids, typically through secondary clarifiers, and a return of the concentrated solids to the treatment process (RAS). This increase of MLSS allows the system to treat higher influent flows and loads. Excess mixed liquor (WAS) is continuously or intermittently removed from the process and dewatered before disposal to maintain the desired biomass inventory.

The increase of lagoon biomass inventory (measured as the concentration of TSS in the lagoon) requires efficient sludge collection in the settling lagoons or the addition of secondary clarifiers for sludge separation and collection. Sludge recirculation of the concentrated sludge to the aerated lagoons is required for biomass retention. There are challenges in efficiently concentrating and collecting the sludge from the settling lagoons. Potential technologies such WesTech's ZICKERT Shark solids collection system could be investigating further, but these have not been proven in full-scale settling-lagoon applications. Secondary clarifiers can be constructed to separate the solids from the liquids, concentrating them for return to the aerated lagoons. Secondary clarifiers use clarifier mechanisms together with RAS/WAS pump stations for collection and conveyance of sludge to the aerated lagoons.

4.2.2.2 Lagoon Intensification

Lagoon intensification is a general term for increasing the treatment capacity or improving the treatment performance of the lagoon system within the existing footprint of the facility. This alternative includes the application of biofilm-based technologies in lagoons. Examples of biofilm-based treatment enhancements include Entex Technologies WavTex or Webitat. Both systems consist of plastic media within a fixed structure that allows additional biomass to grow. An increased concentration of biomass can be achieved in the lagoon, providing additional BOD_5 removal. Depending on the desired effluent criteria, the modules can be easily installed phases (e.g., additional modules could be installed to provide levels of NH_3-N removal).

4.2.2.3 Moving Bed Biofilm Reactor

The proposed MBBR unit process for the District works as a tertiary treatment process to provide additional removal of BOD_5. The aerated tank in the MBBR includes media that provide a large surface area for the biomass to grow. With a high concentration of biofilm-based organisms attached to the biofilm media, biomass would be significantly increased without solids recirculation. MBBRs are not very sensitive to temperature variations between the summer and winter, making this technology ideal to be used for lagoon treatment systems in northern climates, where the water is substantially colder in the winter given the longer hydraulic residence time in the system.

4.2.2.3.1 Primary Treatment Processes

Primary treatment can include primary clarification, A-staged enhanced primary clarification, or primary filtration. Primary treatment removes a portion of the particulate loadings (including BOD_5 and TSS), which decreases the associated loading to the lagoon systems. With primary treatment, solids handling facilities are required to manage the primary sludge generated.

4.2.2.4 Ammonia-Nitrogen Reduction

The removal of BOD_5 generally relies on the heterotrophic biomass in the system, and nitrification (removal of NH_3-N) requires an established biomass populated with autotrophic bacteria. In general terms, once the BOD_5 has been consumed, the autotrophic bacteria (nitrifying bacteria) will begin to oxidize NH_3-N to nitrite-nitrogen and then to nitrate-nitrogen in the presence of additional oxygen. Nitrifying bacteria grow slowly and are very sensitive to cold temperatures. Their activity decreases as temperatures decrease to where little nitrification occurs. It is common for lagoon systems in colder climates to construct fixed-film (biofilm) processes for nitrification, when required, to give the bacteria a protected environment to grow. Fixed-film processes typically used for nitrification from lagoon systems include MBBR systems, rock filters, and trickling filters. Table 4-3 presents a preliminary screening of alternatives. The alternatives for NH_3-N removal are similar to some of the BOD_5 reductions because the same technology can be used to remove both constituents.

Table 4-3. Ammonia-Nitrogen Reduction Technologies

Manufacturer/ Equipment Type	Description	Explanation
Lagoon Intensification	Use biofilm-based technologies (Entex Webitat or WavTex) in aerated lagoons	Biomass growth is achieved on the media, which allows greater BOD_5 and ammonia-nitrogen removals. Additional aeration is needed to scour the media and provide the oxygen needed for removals.
Increase of Lagoon Biomass Inventory	Increase solids concentration with sludge recirculation, sludge collection techniques, or adding secondary clarifier with RAS/WAS pump stations	This involves sludge collections with scrapers/pipes and pumps installed in settling lagoons. Solids handling is also required for the sludge recirculation. These technologies need to be further evaluated for lagoon systems.
MBBR	Attached growth process using biofilm carriers to provide environment for nitrifying bacteria	MBBRs are proven to nitrify at low temperatures.
MBR	Tertiary process using anoxic tank, pre-aerated tank coupled with MBR tank for BOD_5 and ammonia-nitrogen removal	A high MLSS concentration is achieved, allowing for a greater BOD_5 and nitrogen removals. With an MBR installation, additional filtration is not needed.

4.2.2.5 Phosphorus Removal

The City of Boise has charged the District for phosphorus loading since October 2022. The removal of TP requires both the soluble fraction of phosphorus (measured as orthophosphate [PO_4-P]) and particulate fraction of phosphorus (that tied up in the TSS) be treated. The soluble fraction of phosphorus, PO_4-P, can be removed either biologically using the enhanced biological phosphorus removal (EBPR) or using chemical methods. Chemical methods often use metal salt additions such as ferric chloride or alum for the absorption of PO_4-P into the metal hydroxide floc. The metal hydroxide floc will settle with the solids in the settling lagoons.

Tertiary filtration such as cloth disk filters, sand filters, and membrane filters are also considered for phosphorus removal, removing the particulate fraction of phosphorus tied up in the TSS. These technologies can be coupled with chemical addition to both reduce phosphorus and enhance TSS removal. Implementation of coagulation and flocculation unit process prior filtration systems are typically used, improving the efficiency of the removal process.

Watershed-based approaches for managing phosphorus removal may be an option for the District to consider. Phosphorus load trading or offsets from other discharges within the service area in the future may have potential to reduce the overall impacts to the watershed. The respective load removed from an alternative discharge would then offset the load conveyed to the City of Boise.

Table 4-4 summarizes potential alternatives for phosphorus removal.

Table 4-4. Phosphorus Removal Technologies

Unit Process	Description	Explanation
Metal Salt Addition	Addition of metal salts for absorption of soluble phosphorus into solids in the settling lagoons	Usually, ferric chloride or aluminum sulfate (alum) is used as a metal salt for phosphorus removal. Polyaluminum chloride and rare earth metals are less commonly used in the wastewater industry because of their high costs.
Tertiary Filtration and Metal Salt Addition	Using filtration technology along with metal salt addition to remove TP	Filtration removes absorptive metal hydroxide/phosphate complexes formed by the metal salt addition. This process can typically reduce phosphorus values less than 0.35 mg P/L.
Enhanced Biological Phosphorus Removal	Develop an anaerobic environment favorable to develop a population of PAOs in the biomass. The PAOs can absorb additional PO_4-P, assuming the right anaerobic, aerobic, and soluble carbon conditions are available.	An anaerobic zone would need to be created in the lagoons to provide conditions necessary for the growth of PAOs, together with an increase in biomass so that the required population of PAOs is established and maintained. It would be challenging to implement EBPR without a significant increase in lagoon inventory (Chapter 4.2.2.1).

PAO = polyphosphate accumulating organism

4.2.2.6 Total Suspended Solids Removal

TSS is primarily removed using physical and chemical methods. Several options were evaluated for reducing the effluent TSS from the lagoon system, including covering the settling lagoons, filtration technologies, and tertiary clarification.

The presence of algae in the settling lagoons is commonly observed during the summer months. The increased temperature and nutrients in the water provide an environment for the growth of algae. Algae can increase the TSS concentrations because algae do not settle out easily in the lagoons. The District is currently carrying out trials to see the impacts of covering the settling lagoons. The covers decrease the amount of light reaching the surface, thereby reducing the growth of algae. The goal of the trials is to see if there is a noticeable reduction of effluent TSS leaving the covered settling lagoons when compared to historical performance.

Methods to remove TSS are similar to those used for phosphorus removal. Tertiary filtration will remove an additional level of suspended solids from the system. Another option is to install a tertiary clarifier after the settling lagoons to settle out any remaining suspended solids present in the lagoon effluent. Chemical addition, coagulation, and flocculation can enhance the TSS removal performance of these tertiary applications.

Table 4-5 summarizes potential alternatives for TSS removal.

Table 4-5. Total Suspended Solid Removal Technologies

Unit Process	Description	Explanation
Metal Salt Addition	Addition of metal salts to achieve coagulation and flocculation for the removal of suspended particles	Usually, metal salt such as ferric chloride or aluminum sulfate (alum) are used as a coagulant. These agglomerate fine particles that are difficult to settle otherwise in the settling lagoons, reducing the effluent TSS.
Tertiary Filtration	Using filtration technology along with metal salt addition to remove TSS. This will also remove TP from the lagoon effluent.	Tertiary filtration can easily remove residual suspended solids from the lagoon effluent. A clarification system may be needed upstream of filtration if the effluent TSS from the settling lagoons is beyond 35 mg/L. Additionally, including metal salts aids in the removal of suspended solids.
Lagoon Covers	Installation of covers on the settling lagoons	Covering the settling lagoons reduces the growth of algae during summer months, decreasing the effluent TSS. The District is carrying out trials to observe the impacts of covered lagoons.

4.2.2.7 Disinfection

Disinfection is a critical component of wastewater treatment for protection of public health because it inactivates viruses and pathogens in the water, with specific criteria established based on the associated effluent disposal or reuse location. Table 4-6 summarizes the different technologies available for disinfection.

Table 4-6. Disinfection Technologies

Unit Process	Description	Explanation
Chlorination	Use chlorine, which hydrolyses in water to produce hypochlorous acid and hypochlorite ions. These compounds act as oxidizing agents that provide disinfection	Gaseous chlorine, a hypochlorite compound such as sodium hypochlorite, or chlorine dioxide are the most commonly used chemicals in chlorination. Dechlorination using sulfur dioxide or sulfite salts may be needed to reduce the chlorine concentrations in the effluent prior to discharge.
UV Disinfection	UV light is used to damage the genome of the microorganisms, preventing them from reproducing; the water is then considered disinfected	Mercury vapor lamps are the most commonly used tool for UV disinfection. The systems can be configured as an open channel, as a modular design, or through pressurized systems. UV disinfection provides chemical-free disinfection.
Ozone	Ozone is a powerful oxidant that produces hydroxyl radicals when in contact with water. The hydroxyl radicals can break down cell walls and damage nucleic acids, preventing further growth of microorganisms.	Ozone is not commonly used at wastewater plants because of the onsite generation requirements and increased O&M requirements. However, ozone is capable of oxidizing micropollutants and odor- and color-causing compounds, which can be used in applications of water reuse.
Peracetic Acid	Peracetic acid is another strong oxidant, which is created when acetic acid is mixed with hydrogen peroxide.	Like ozone, peracetic acid has to be generated onsite because of the unstable nature of the mixture. Despite this drawback, the interest in using peracetic acid as a disinfectant is increasing because of its bacterial disinfection effectiveness.

UV = ultraviolet

For this analysis, only UV disinfection and chlorination using sodium hypochlorite were considered during the initial alternatives screening. Chlorine gas was not considered because of its toxic and corrosive nature, making it difficult to handle and requiring high levels of safety features. There is a risk to the areas surrounding treatment facilities with the use of chlorine gas. Ozone and peracetic acid were also not considered because of the onsite generation requirements, and the technologies are still in the nascent stage for wastewater applications.

4.2.2.8 Emerging Wastewater Constituents

Although the District does not maintain an IPDES permit and therefore is not required to meet surface water quality limits, it is beneficial for the District to be aware of the effects their discharge could have on the City of Boise's IPDES permit at the West Boise WRF. Additionally, the City of Boise could choose to charge the District at a future date for any new constituent that the EPA includes in the Boise River total maximum daily load (TMDL). This chapter lists the most likely emerging and potential constituents that could affect effluent limitations for wastewater facilities, including the City of Boise. This facility planning included evaluating wastewater treatment options for various discharge limits set by federal and state regulations. Ultimately, the wastewater facility plans must consider alternatives that not only meet today's regulatory environment but provide sufficient flexibility to meet future anticipated requirements.
The following are key water quality issues that may be included in a future IPDES permit:

- Temperature
- Heavy metals (e.g., arsenic, copper, mercury, and lead)
- Per-and polyfluoroalkyl substances

This facility plan update did not review technologies in detail that target these emerging contaminants of concern constituents specifically; however, consideration was given for the potential cost to treat them. The "cost per gallon" for treatment technologies is typically not used because of the widely varying conditions at treatment facilities. However, without completing a site-specific analysis for the District facility, the use of a cost-per-gallon factor will at least provide a range of potential costs for tertiary treatment. Tertiary treatment, including membrane treatment (microfiltration), reverse osmosis, and UV advanced oxidation unit processes, can remove key emerging contaminants of concern. The capital cost range for these tertiary treatment unit processes could approach $30 per gallon of treated effluent. Annual O&M costs for this tertiary treatment concept could approach $3.50 per gallon of treated effluent. Cost ranges are adapted from *Alternative Treatment for Indirect Potable Reuse* (CH2M 2008) and updated to reflect 2023 pricing.

Temperature mitigation at treatment facilities is completed either through a watershed-based approach or incorporation of additional tertiary treatment processes. Watershed approaches investigate additional shading or improvement to riparian corridors to mitigate temperature impacts in receiving streams. In-plant unit processes include chillers or heat exchangers, which can be cost prohibitive because of the high energy demands required.

4.2.2.9 Solids Handling

Solids were removed from the treatment system for the first time in 2007 when the lagoon liners were replaced. A solids removal contractor dredged solids from the lagoons and used dewatering equipment such centrifuges or belt filter presses to dewater the sludge, and the solids were disposed of at the Ada County landfill. A solids removal contractor removed solids again from the Lagoon Cell 2 in 2019, 2020, and 2021. As flows and loads increase, the solids will need to be removed more frequently, as often as every 2 years.

The solids generated by the WLTF can be dredged, dewatered, and sent to the Ada County landfill as unstabilized solids (no pathogen reduction). Conversations with Ada County landfill management in 2023 confirmed that they expect to receive solids from the District for the foreseeable future (Jenkins, pers. comm. 2023). If the District desires Class A or Class B biosolids (as per the EPA 503 Regulations), then the solids can be stabilized (reduce pathogens) using technologies such as anerobic digestion (mesophilic/thermophilic), aerobic digestion, lime stabilization, or thermal hydrolysis process. Biosolids are nutrient rich and can be used beneficially as soil amendments.

4.2.3 Summary of Treatment Enhancements

Several different treatment options were evaluated as part of the initial alternatives screenings for removing BOD_5, TSS, NH_3-N, total nitrogen, and phosphorus and are summarized in Table 4-7).
The treatment options in bold were further evaluated and used to develop the five different alternatives outlined in Chapter 4.3, Final Screening of Alternatives.

Table 4-7. Summary of Treatment Options Considered for Different Wastewater Constituents

Flow	BOD_5	TSS	Nitrogen	Phosphorus	Disinfection	Solids Handling
Evaporators	Increase of lagoon biomass inventory	**Cover settling lagoons**	Increase of lagoon biomass inventory	Metal salt addition	Chlorination	**Solids dredging and dewatering**
Improve I&I	**Lagoon intensification**	**Tertiary filtration**	**Lagoon intensification**	**Tertiary filtration and metal salt addition**	**UV disinfection**	Anaerobic digestion
Water reuse	MBBR	Tertiary clarification	MBBR	Biological removal (EBPR)	Ozone	**Aerobic digestion**
	Primary clarifier		MBR	Primary treatment with metal salt addition	Peracetic acid	Drying
	Enhanced primary clarification (A-stage)					
	Additional aeration					

Note:

Unit processes in bold were further evaluated and used to develop the five different alternatives in Chapter 4.3, Final Screening of Alternatives.

4.2.4 Existing Wastewater Treatment Facility Capacity or Rehabilitation Considerations

As alternatives were evaluated for the District WLTF to meet treatment goals, the associated capacity improvements, redundancy, and operability were considered. Chapter 2 provides detailed information on the existing capacities of the unit processes and associated equipment at the WLTF. The overall WLTF capacity is determined through a combination of treatment capacity, hydraulic capacity, and system redundancy. The following sections detail the expansion required to provide the necessary capacity at the WLTF as the various alternatives are implemented throughout the 2040 planning period.

4.2.4.1 Equipment Replacement

As the WLTF expands throughout the identified planning period, equipment at the WLTF will need to be replaced because of service life or unit capacity concerns. For planning purposes, all mechanical equipment is assumed to have a 20-year lifespan, whereas concrete structures are assumed to have a 50-year lifespan. The facilities may be able to operate beyond the lifespan assumed in this analysis with proper maintenance and rehabilitation.

Table 4-8 identifies some of the key equipment planned for replacement during the planning period. The timeframes listed for different facilities are based on the assumptions mentioned previously, and the replacement year may be different depending on the actual condition of the equipment.

Table 4-8. Wastewater Lagoon Treatment Facility Equipment Replacement

Unit Process	Description	Explanation
Headworks	Grit chamber Grit classifier influent pumps	Fine screens were replaced in 2023 and are anticipated, for planning purposes, to have a 20-year lifespan. Grit chamber components will likely need to be replaced in 2030. The grit pump and classifier also need to be replaced in 2030. A second grit classifier and vortex chamber should be considered to improve unit process redundancy.
Secondary Treatment	Submerged diffusers Blowers	The diffusers and blowers for Treatment Train 1 were installed in 2017 and have a lifespan of 20 years. These will likely need to be replaced in 2037. The diffusers and blowers for Treatment Train 2 were installed in 2021 and do not need to be replaced in the planning period.
Secondary Treatment	Lagoons	The 60-mil HDPE liner was replaced in 2008 for Lagoon Cells 1 and 2 and likely will need to be replaced in 2028. A 60-mil HDPE liner was installed for Lagoon Cells 3, 4, 5, and 6 in 2021 and does not need to be replaced in the planning period.
Secondary Treatment	Transfer Pump Station	New transfer pumps were installed in 2021 to pump effluent from Treatment Train 1 to Treatment Train 2. These pumps do not need to be replaced in the planning period.
Secondary Treatment	Effluent Pump Station	Two effluent pumps were purchased in 2019 and will likely need to be replaced in 2039. A third shelf spare was purchased in 2021 and does not need to be replaced in the planning period.
Support	Standby power	An existing standby generator provides backup power to the Headworks and Blower Building. With upgrades at the WLTF, the capacity of the standby generator may not be sufficient and additional generators may be needed.
SCADA	SCADA	SCADA may require upgrades to remain functional and serviceable as technology advances.

4.2.4.2 Hydraulic Bottleneck Improvements

Currently, the WLTF has the hydraulic capacity to meet the projected 2040 flows, up to the existing Effluent Pump Station. As wastewater flow increases, new, larger effluent pumps will be required to convey the plant effluent to West Boise WRF. All the hydraulic bottlenecks identified in the 2016 Facility Plan (CH2M Hill) have been addressed during the last two construction projects (2017 District WLTF Improvements Project and 2020 District Lagoon Expansion Project).

Table 4-9 presents key hydraulic modifications required at the WLTF.

Table 4-9. Eagle Sewer District Wastewater Lagoon Treatment Facility Hydraulic Improvements

Description of Proposed Improvement	Urgency
Inspect and clean all pipelines in the lagoon system	As part of a regular maintenance program
Addition or modification of pump stations	Depending on the alternative selected, the existing pump stations might need to be modified and additional pump stations may be required. Larger effluent pumps will be required in the existing Effluent Pump Station as the flows increase

4.2.4.3 Redundancy

Redundancy requirements at wastewater treatment facilities are key to providing overall plant performance. Guidance for reliability and redundancy at WWTPs is provided through EPA (1974) and the IDEQ (IDAPA – 58.01.06 – Wastewater Rule, 2006). The reliability and redundancy requirements are included in all the alternative evaluations. Table 4-10 presents the reliability and redundancy requirements for various unit processes cited by these guidance documents.

Table 4-10. Wastewater Lagoon Treatment Facility Equipment Replacement

Unit Process	EPA	IDEQ
Mechanically Cleaned Screens	One backup screen (manual or mechanical)	Where two or more mechanically cleaned screens are used, the design will provide for taking any unit out of service without sacrificing the capability to screen the design peak instantaneous flows.
Pumping Systems	One backup pump for each system performing the same function	With any pump out of service, the remaining pumps have capacity to treat the peak hourly flow.
Grit Removal	None	None listed.
Lagoons	None	None listed, although seepage testing requires isolation of the respective lagoon cell (requiring a level of redundancy).
Blowers	Sufficient number of blowers to meet the oxygen requirements with largest unit out of service. At least two units shall be installed.	Sufficient number of blowers to meet the oxygen requirements with largest unit out of service. At least two units shall be installed.

4.2.4.4 Operability

During the review of the existing conditions and development of alternatives, a review of the operability of the existing WLTF was completed. Operability is used to describe the features included at the WLTF that allow staff to monitor, operate, and maintain unit processes and associated equipment to provide the required system performance. As the WLTF is expanded through the planning period identified in the facility plan, improvements to the operability of the system will be incorporated. Improvements to the operability warranted at the WLTF were developed and are listed in Table 4-11.

Table 4-11. Wastewater Lagoon Treatment Facility Operability Improvements

Unit Process	Control Philosophy/Operations Issues	Near-term Actions Recommended
SCADA System	The Headworks Building is controlled and monitored via a SCADA system. The District's lift stations are also connected to the WLTF SCADA system. If there is a failure at a lift station, an autodialer calls the operator. Although this is generally effective, more information could be gathered about the issue via the SCADA system to allow the operator to be more prepared when responding.	Expand the SCADA system to include any new lift stations and new WLTF unit processes.

4.2.4.5 Administration, Operations, Laboratory, and Maintenance Buildings

The administration and operations buildings have been updated and expanded over the years and are reported to be sufficient for current and future operations. Recently, a new Operations Building and Vehicle Storage Building, to house a water truck and a sewer truck, were constructed to provide additional support for the operations of the WLTF. The evaluation in this facility plan assumes no new administration and operations building will be needed.

The existing maintenance facilities are sufficient for current operations but should be reevaluated depending on the upgrades carried out at the WLTF.

Currently, limited treatment system testing is performed onsite and water quality samples are taken to a commercial laboratory for analysis. Any upgrades to the existing treatment system that require more frequent testing or monitoring would most likely result in the need to construct a space for laboratory testing, or potentially expand the agreement with the City of Boise to cover lab testing.

4.2.4.6 Energy and Sustainability Projects

The District is committed to energy efficiency and plans to incorporate energy reduction in its criteria for future projects. As an example of its commitment, the District has invested in high-efficiency blowers to meet the process air demands. Furthermore, controlling the aeration system based on DO levels has the potential to save additional energy costs by providing the minimum required DO for treatment. Any new pumps installed should also be controlled via VFDs to reduce energy costs.

4.3 Final Screening of Alternatives

This section documents the evaluation of the final list of wastewater treatment system alternatives developed with the District.

4.3.1 Summary of the Wastewater Management Alternatives

4.3.1.1 Liquids Treatment Enhancement Alternatives

Based on the District's level of service goals, vision, and future flows and loads, five wastewater treatment alternatives were developed from the list of treatment technologies presented in Chapter 4.2.3. These five alternatives allow the District to treat the anticipated wastewater flows and loads during the planning period (2023 to 2040). The ADMM 2040 flow is estimated to be 4.08 mgd. Chapter 2 describes the influent loadings to the WLTF. The five alternatives are summarized as follows:

- **Alternative 1: Do Nothing/Status Quo.** No capital investment would be undertaken as part of this alternative. As equipment reaches the end of its useful life, it would be replaced in kind without any additional investment or capacity increase made. As flows and loads increase, the existing lagoon system effluent water quality would degrade over time as capacity of the system is reached. This alternative would incur substantial capacity and O&M charges from the City of Boise and subsequently increase cost to the District.
- **Alternative 2: Improved Water Quality to West Boise WRF.** This alternative considers discharging 100 percent of the District's treated wastewater to West Boise WRF, but with investment in unit processes for improved water quality. Lagoon intensification using Entex Technologies WavTex modules (or equivalent) is considered to increase treatment capacity for BOD_5 and NH_3-N. TSS from the lagoon system is reduced by a new tertiary clarification process followed by tertiary filtration. Metal salt addition (alum or ferric chloride addition) with two possible injection points is considered for TP removal. Effluent BOD_5, TSS, NH_3-N, and TP loads would be reduced to a large extent with the various upgrades. However, as the flows increase because of growth, the BOD_5, TSS, and nutrient loadings would increase, requiring additional capacity purchases and incurring more O&M costs from the City of Boise.
- **Alternative 3: Summer Canal Reuse and Winter Discharge to West Boise WRF.** In this alternative, wastewater will be treated to meet Class A reuse criteria and conveyed to a nearby canal during irrigation season. Treated wastewater from the lagoon system would be discharged to West Boise WRF during non-irrigation season (winter months). Similar to Alternative 2, treatment capacity would be improved by the combination of lagoon intensification, metal salt addition, tertiary clarification, and tertiary filtration. For the water reuse option, disinfection is required to achieve Class A reuse criteria. An agreement with a local canal or ditch company is required for this alternative in order to discharge into the receiving body of water. Additionally, a pipeline will be needed to convey the flow to the canal or ditch.
- **Alternative 4: Summer Canal Reuse and Winter Canal Infiltration.** This alternative considers sending the effluent to the nearby canal for water reuse in irrigation season with groundwater infiltration in non-irrigation season. No treated wastewater would be sent to West Boise. An MBBR would be constructed for BOD_5 polishing and total nitrogen removal from the lagoon effluent. Tertiary clarification and tertiary filtration, together with metal salt addition, would help with TSS and TP removal. Disinfection would be implemented to meet the pathogen limits for Class A reuse. An agreement with a local canal or ditch company is required for this alternative in order to discharge into the receiving body of water. Additionally, a pipeline will be needed to convey the flow to the canal or ditch.
- **Alternative 5: MBR with IPDES Discharge and Solids Handling.** This alternative considers discharging 100 percent of the effluent directly to the Boise River, requiring the District to obtain its own IPDES permit. A new MBR facility would be incorporated at the WLTF to achieve the treatment criteria. This would take the place of the lagoon system, but one lagoon would be used for a level of equalization upstream from the MBR. New unit processes include fine screening, MBR (bioreactor and membrane tanks), UV disinfection, and solids handling. This system would reduce BOD_5, TSS, NH_3-N, and phosphorus to levels that would meet Boise River IPDES permit requirements.

Figure 4-1 shows a site plan with the locations of all the facilities for all alternatives.

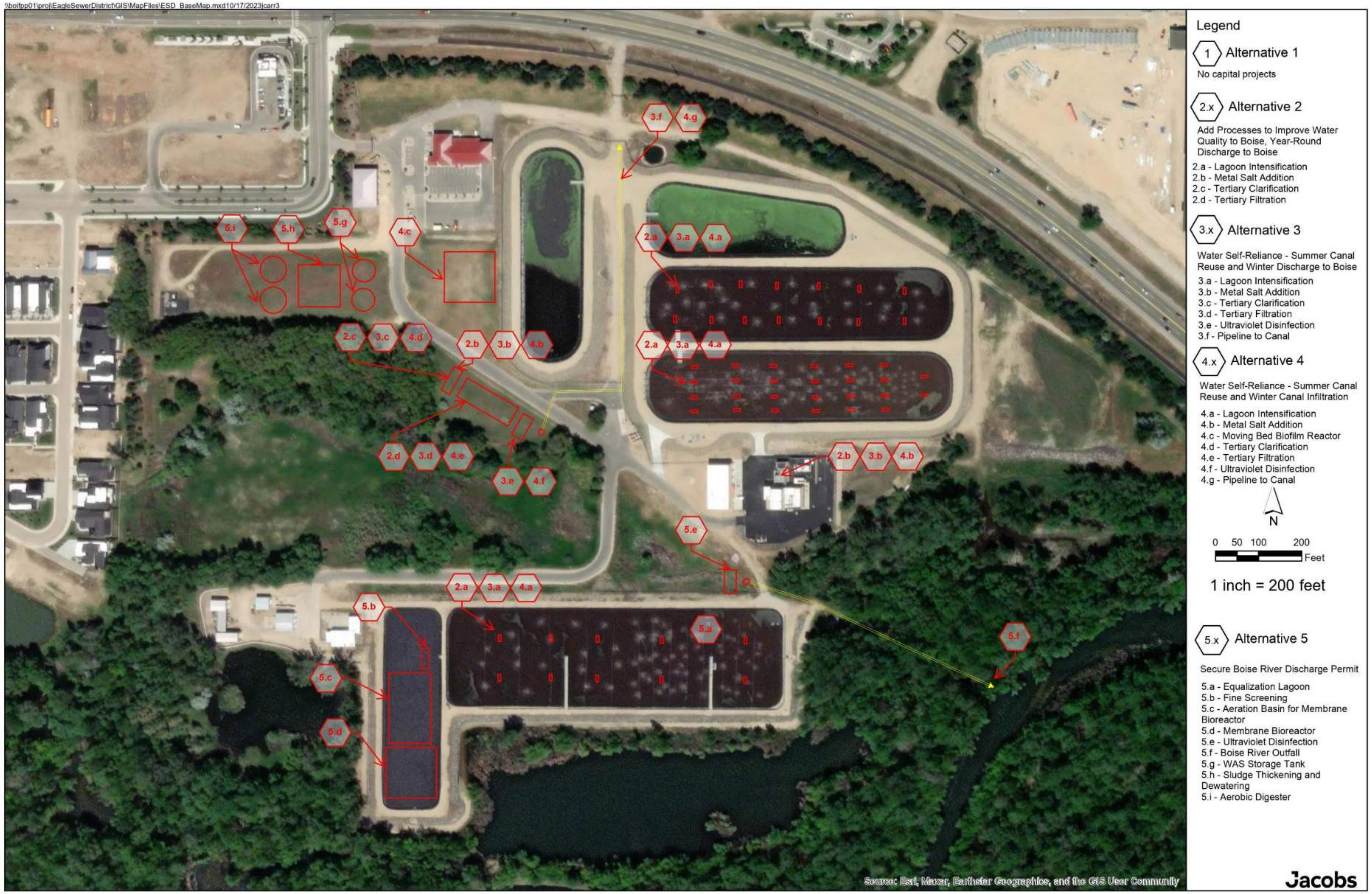

Figure 4-1. Site Plan showing the New Facilities for All Alternatives

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4.3.1.2 Solids Treatment Enhancement Alternatives

Three different solids treatment handling alternatives were developed and evaluated. They are summarized as follows:

- **Alternative A: Solids Dredging by a Contractor.** In this alternative, third-party contractors would remove the solids from the settling lagoons. The District has removed solids this way in the past. The process involves dredging the solids from the settling lagoons and then pumping to dewatering equipment (a trailer-mounted centrifuge or belt press). The dewatered solids are hauled and disposed of in the Ada County landfill.
- **Alternative B: Solids Dredging and Dewatering by the District.** In this alternative, the District would purchase dredging equipment and install a permanent dewatering facility at the WLTF. District staff would dredge and dewater the solids. Similar to Alternative A, solids would be dredged from the settling lagoons and pumped to the dewatering equipment. The dewatered solids would then be hauled and disposed of in the Ada County landfill.
- **Alternative C: Aerobic Digestion and Dewatering by the District.** This alternative includes constructing a new aerobic digester, along with thickening and dewatering facilities. The solids generated by the lagoon process would be stabilized using the aerobic digester to produce Class B biosolids.

In the following analysis, Liquids Treatment Alternatives 1 through 4 include the costs for Solids Treatment Alternative A. Separate digestion costs are included in the capital costs for Liquids Treatment Alternative 5.

Alternative B, Solids Dredging and Dewatering by the District, and Alternative C, Aerobic Digestion and Dewatering by the District, were evaluated to see if capital investment carried out by the District would result in lower overall costs when compared to Alternative A. This analysis is only applicable for solids generated in Liquids Treatment Alternatives 1 through 4.

4.3.2 Alternative Selection and Decision-making Process

The wastewater treatment system alternatives, including liquids treatment and biosolids, were developed by Jacobs with direction from the District. Jacobs conducted workshops for the District to discuss each alternative. Jacobs then facilitated the evaluation and ranking of each alternative together with the District.

This section lists the different evaluation criteria used in assessing each alternative. Evaluation criteria are broken into two main criteria categories: nonmonetary and monetary.

To support evaluation and strategic plan alignment, District staff and Jacobs developed the following nonmonetary evaluation criteria based on the objectives in the District's Statement of Purpose (Chapter 1.1.1) and discussions at the workshop:

- Safety
- System reliability
- Affordability
- Water self-reliance
- Public partnership

The following chapters present definitions for the five nonmonetary criteria (quantity metrics were also developed for each criterion).

4.3.2.1 Safety

Safety was evaluated as a planning criterion. This factor considers protecting public and employee health relating to wastewater collection, treatment, and clean water use. Chemical use increases the chemical hazards. Some mechanical or electrical equipment increases electrical hazards and fire hazards. The complexity of equipment also brings up the safety risk to employees. Overall, safety is the primary priority for any design and associated unit process being constructed. All alternatives will provide a safe environment for District employees and the public, but the levels of risk and associated safety requirements will be higher from one alternative to another.

4.3.2.2 System Reliability

A qualitative examination of how common and historically predictable each treatment system operates was performed to evaluate this planning criterion. Additionally, the propensity of each system for upsets (typically represented by the degradation of WLTF effluent) and the ramifications of those upsets were considered for the planning criteria.

4.3.2.3 Affordability

Affordability relates to keeping competitive rates and fees with neighboring utilities while providing high levels of service. More advanced unit processes typically have higher capital costs but lower O&M costs for the District, whereas lower capital investments ultimately result in higher O&M charges. This is because increased capital costs typically results in better treatment, thereby lowering O&M costs to the City of Boise. However, District O&M will increase as more advanced treatment unit processes are added to their system, albeit lower in comparison to O&M charges from the City of Boise. A balance between capital investments and O&M charges is needed to ensure affordability for the ratepayers.

4.3.2.4 Water Self-reliance

The ability to increase community water self-reliance was evaluated. Water self-reliance recognizes clean water as a resource to be used to support patron desires. Beneficial reuse of water cleaned by the District to augment existing water supplies improves water self-reliance.

4.3.2.5 Public Partnership

Future opportunities of partnership with stakeholders as a community resource is considered as a planning criterion. This will include providing Class A reuse water to District patrons or clean water to nearby waterbodies.

4.3.3 Comparison of Technical Features of Wastewater Management Alternatives

This section describes the technical aspects of the final wastewater alternatives while considering the level of treatment for the various wastewater constituents. Advantages and disadvantages of each system are also presented.

4.3.3.1 Alternative 1 – Do Nothing/Status Quo

The existing wastewater treatment process at the District WLTF is a lagoon system. When first constructed in 1982, the hydraulic residence time (HRT) was typical for a typical lagoon system. However, as flows have increased, the HRT had decreased to about 6 days and was operating much less like a true lagoon system and more like a pretreatment system. The treatment capacity of the lagoons had decreased as the HRT was reduced. Additional lagoons were built in 2021, which increased the HRT, providing the necessary treatment capacity to meet the increasing population growth in the service area.

For this alternative, no additional wastewater treatment process upgrades would be implemented. As the HRT continues to be reduced because of increasing flows and loads, treatment is degraded and more BOD_5, TSS, and nutrient loads are sent to the West Boise WRF for final treatment. Under this approach, equipment is only replaced as it reaches the end of its service life without any upgrades.

Figure 4-2 shows the existing facilities at the WLTF.

BOD_5 Removal. As the HRT decreases, the effluent BOD_5 will increase as the treatment performance of the lagoon system is reduced. The anticipated average effluent BOD_5 concentration in 2040 is estimated to be approximately 80 mg/L.

TSS Removal. As the HRT decreases, the effluent TSS will increase to where the average effluent TSS concentration in 2040 is estimated to be approximately 60 mg/L.

Ammonia-nitrogen Removal. A level of NH_3-N is removed in the existing lagoons during summer, but it is not removed during winter. NH_3-N is not intentionally reduced under this alternative and is anticipated to be approximately 30 mg/L in 2040. As the flow increases, leading to a decrease of HRT, the ability of the system to provide a level of nitrification in the summer will be reduced.

Phosphorus Removal. Phosphorus is not specifically removed in the current system and will not be intentionally reduced in this alternative, with the anticipated effluent values being approximately 7 mg/L in 2040.

Required Infrastructure. Equipment will be replaced when it reaches the end of its service life, but no additional infrastructure is required.

Advantages and Disadvantages. The primary advantages and disadvantages of maintaining the existing system without upgrades or expansions are as follows:

- Advantages
  - Easy to operate
  - System is already constructed and only equipment reaching the end of its service life will need to be replaced.
- Disadvantages
  - Potential odors
  - There is no provision for solids handling, and at the anticipated 2040 loading rate, solids will need to be removed from the settling lagoons every 2 years
  - Increased City of Boise charges every year
  - Reuse-quality water not produced to meet District patron desires

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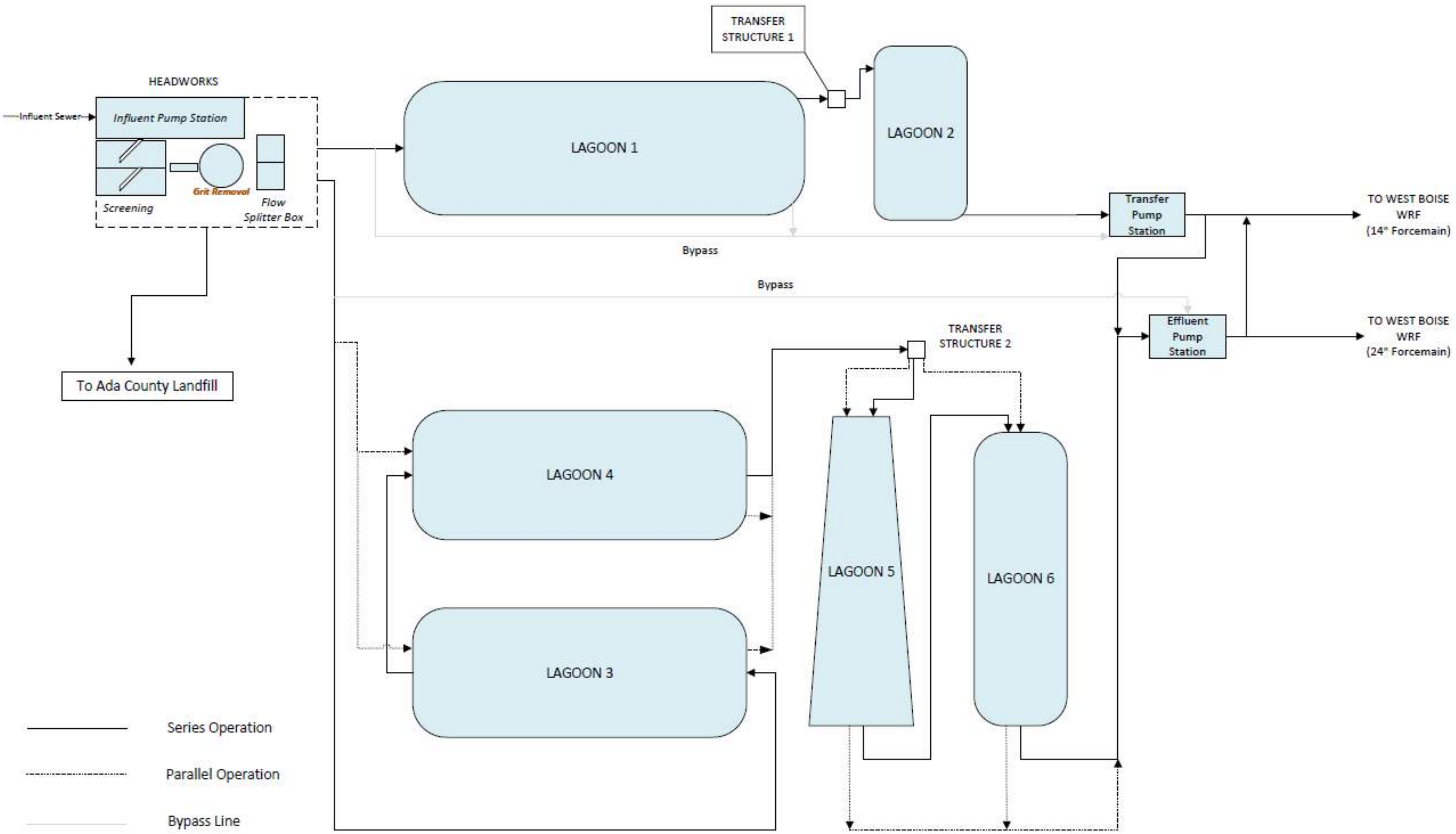

Figure 4-2. Alternative 1 – Do Nothing/Status Quo

4.3.3.2 Alternative 2 – Improved Water Quality to West Boise Water Renewal Facility

Water quality is improved to a certain level to reduce the capacity and O&M charges from the City of Boise, lowering the cost of treatment for the District. The lagoon system would be upgraded with the installation of lagoon intensification to enhance the BOD_5 and NH_3-N removal. Lagoon intensification will include installation of a biofilm-based treatment system that works in combination with the existing biomass in the lagoon system (e.g., Entex Technologies WavTex system). This increases the biomass inventories in the lagoons and provides further treatment. An additional blower and diffusers are added to meet the increased oxygen demand. Tertiary filtration (e.g., cloth disk filters or similar technology) is considered to provide the additional removal of TSS. Phosphorus removal is achieved with the addition of metal salts to form precipitate metal phosphate complexes, together with the filtration technology. Tertiary clarification upstream of the filter will ensure there is not a high solids loading rate on the filter and help with the removal of metal phosphate complexes.

To meet hydraulic requirements, the existing Effluent Pump Station will be used as Transfer Pump Station 2 with two new pumps. Transfer Pump Station 2 will pump lagoon effluent from the two treatment trains to the new unit processes. A new Effluent Pump Station would need to be constructed for discharge to West Boise WRF.

The capital improvement is planned in two phases. Because these processes do not need to be constructed at once, each unit process is added as its targeted constituent needs to be removed. This allows a great deal of flexibility in deciding when to add processes, helping the District meet their capital development funding strategy. For example, lagoon intensification media and tertiary filters will be added into the system in two phases to match the flow and load projections described in Chapter 2. One tertiary filtration train, metal salt addition, and the two pump stations could also be constructed in Phase 1. The existing generator will be repurposed to meet the Blower Building demands. A new standby generator is included in the first phase to provide backup power for the other critical systems.

In Phase 2, additional lagoon intensification media and tertiary filtration would be added. An additional blower and diffusers would be added to meet the aeration requirement. To ensure that the solids loading rate on the tertiary filtration does not exceed the design recommended limits, tertiary clarification will be constructed upstream of the tertiary filtration in this phase.

Figure 4-3 shows the Alternative 2 facilities that would be constructed at the WLTF.

BOD_5 Removal. BOD_5 reduction will be achieved with lagoon intensification. The 2040 effluent BOD_5 concentration is anticipated to be approximately 5 mg/L.

TSS Removal. TSS reduction will be achieved with the tertiary clarification and filtration. The 2040 effluent TSS concentration is anticipated to be less than 5 mg/L.

Ammonia-nitrogen Removal. NH_3-N will be reduced via lagoon intensification and is anticipated to be less than 2 mg/L in 2040.

Phosphorus Removal. Phosphorus removal will be achieved using multiple location addition of metal salts plus the tertiary clarification and tertiary filtration. The 2040 effluent phosphorus concentration is anticipated to be less than 0.5 mg/L.

Required Infrastructure. The following infrastructure would be required for this alternative:

- Lagoon intensification
- Additional blower and diffusers
- Tertiary filtration and clarification
- Metal salt addition system
- Hydraulic upgrades including new transfer pumps (installed in the existing Effluent Pump Station) and a new Effluent Pump Station

Advantages and Disadvantages. The primary advantages and disadvantages of upgrading the existing system under this alternative are as follows:

- Advantages
  - Improved water quality from the WLTF
  - Capital investment strategy is more manageable when compared with other alternatives
  - Reduced City of Boise charges
- Disadvantages
  - Additional investment required for water reuse
  - There is no provision for solids handling, and at 2040 loading, it is anticipated that solids will need to be removed from the lagoons every 2 years
  - Increased annual operating costs for the District
  - Additional staff are needed at WLTF

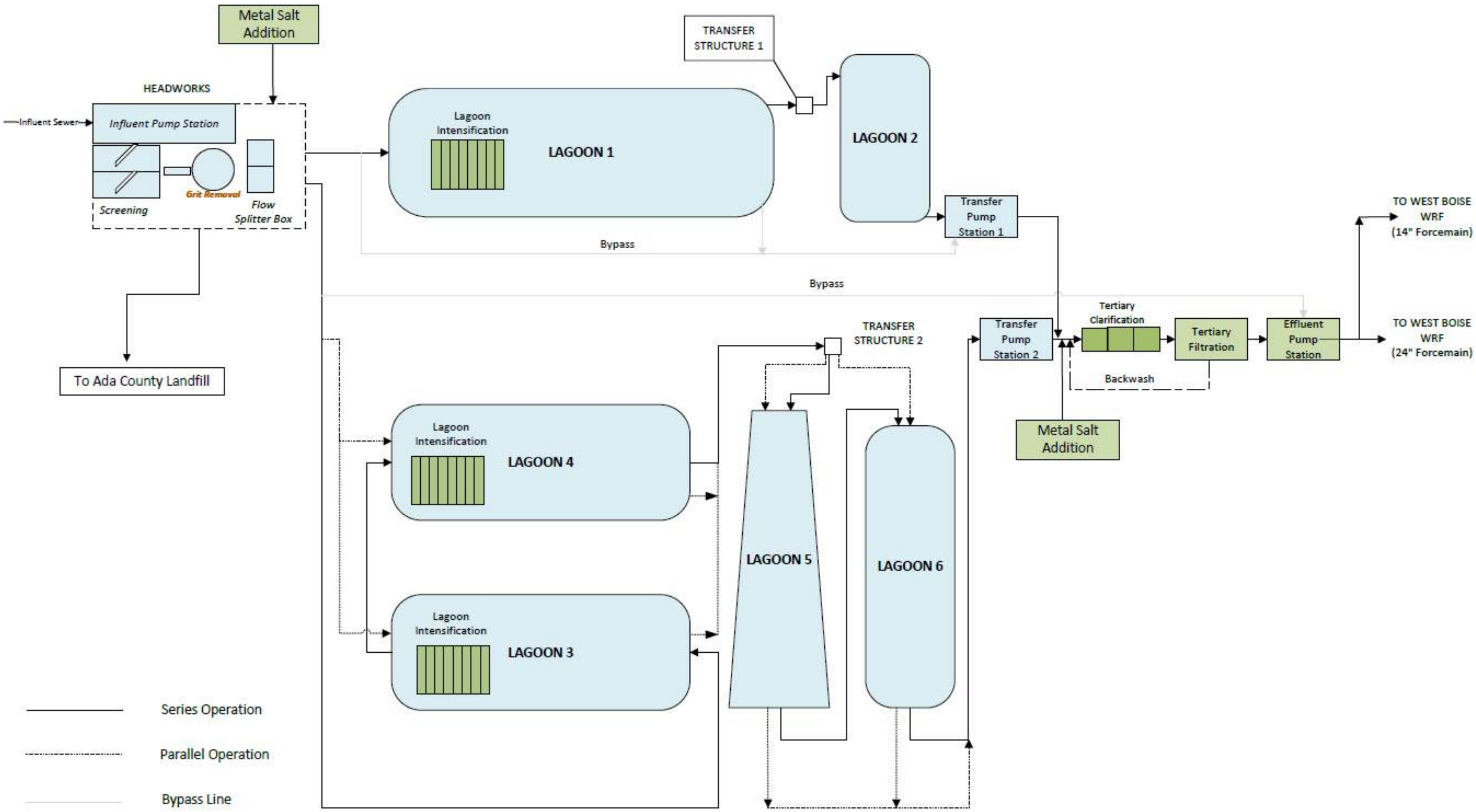

Figure 4-3. Alternative 2 – Improved Water Quality to West Boise Water Renewal Facility

Note:

Existing facilities are shown in blue and new facilities to be installed in this alternative are shown in green.

4.3.3.3 Alternative 3 – Summer Canal Reuse and Winter Discharge to West Boise Water Renewal Facility

In addition to the improvements mentioned in Alternative 2, this alternative includes UV disinfection, which provides the District with the ability to create reuse water. Treated and disinfected effluent that meets the Class A recycled water definition per the *Idaho Administrative Code* (IDAPA 58.01.17) will be discharged to a nearby canal during irrigations season. The hydraulic requirements to pump the reuse water to the canal cannot be satisfied with the existing effluent pumps, so an extra reuse pump station is added in this alternative, together with the conveyance pipeline and infrastructure to deliver reuse water to the irrigation canal.

Similar with Alternative 2, the capital improvement is planned in two phases. Lagoon intensification, tertiary filtration, metal salt addition, and UV disinfection will be incorporated in Phase 1 of the upgrades. The existing Effluent Pump Station will be converted to Transfer Pump Station 2 to pump to the new unit processes. A new Effluent Pump Station and Reuse Pump Station will also be constructed during Phase 1. A reuse pipeline will be constructed to convey the Class A recycled water from the WLTF to a canal for reuse. The existing generator will be repurposed to meet the Blower Building demands. A new standby generator is included in the first phase to provide backup power for the other critical systems.

Phase 2 includes tertiary clarification and additional intensification media in the lagoons. Additional trains for tertiary filtration and UV disinfection will also be constructed. An additional blower and diffusers would be added to meet the aeration requirement in Phase 2.

Figure 4-4 shows the Alternative 3 facilities that would be constructed at the WLTF.

BOD_5 Removal. BOD_5 reduction will be achieved with lagoon intensification. The 2040 effluent BOD_5 concentration is anticipated to be less than 5 mg/L.

TSS Removal. TSS reduction will be achieved with tertiary clarification and filtration. The 2040 effluent TSS concentration is anticipated to be less than 5 mg/L.

Ammonia-nitrogen Removal. NH_3-N will be reduced via lagoon intensification and is anticipated to be less than 1 mg/L in 2040.

Total Nitrogen Removal. The lagoon intensification process is used to reduce total nitrogen. The anticipated 2040 effluent concentration is estimated to be less than 30 mg/L.

Phosphorus Removal. Phosphorus removal will be achieved using two-point addition of metal salts plus the tertiary clarification and tertiary filtration. The 2040 effluent phosphorus concentration is anticipated to be 0.5 mg/L or less.

Required Infrastructure. Similar to the Alternative 2, the upgrades to be installed to satisfy the 2040 planning criteria include the following:

- Lagoon intensification
- Additional blower and diffusers
- Tertiary clarification and tertiary filtration
- Metal salt addition system
- UV disinfection
- Hydraulic upgrades including new transfer pumps, an Effluent Pump Station, and a Reuse Pump Station
- A new conveyance pipeline that discharges the treated effluent to the canal for reuse

Advantages and Disadvantages. The primary advantages and disadvantages of construction for this alternative are as follows:

- Advantages
  - Lower City of Boise charges when compared to Alternative 2
  - A high level of flexibility for sending the effluent to West Boise WRF or to water reuse
  - Better environment for water self-reliance
- Disadvantages
  - There is no provision for solids handling, and at 2040 loading, it is anticipated that solids will need to be removed from the lagoons every 2 years
  - Increased annual operating costs for the District when compared to Alternative 2
  - Additional staff are needed at the WLTF
  - Water reuse permit that requires sampling, monitoring, and reporting

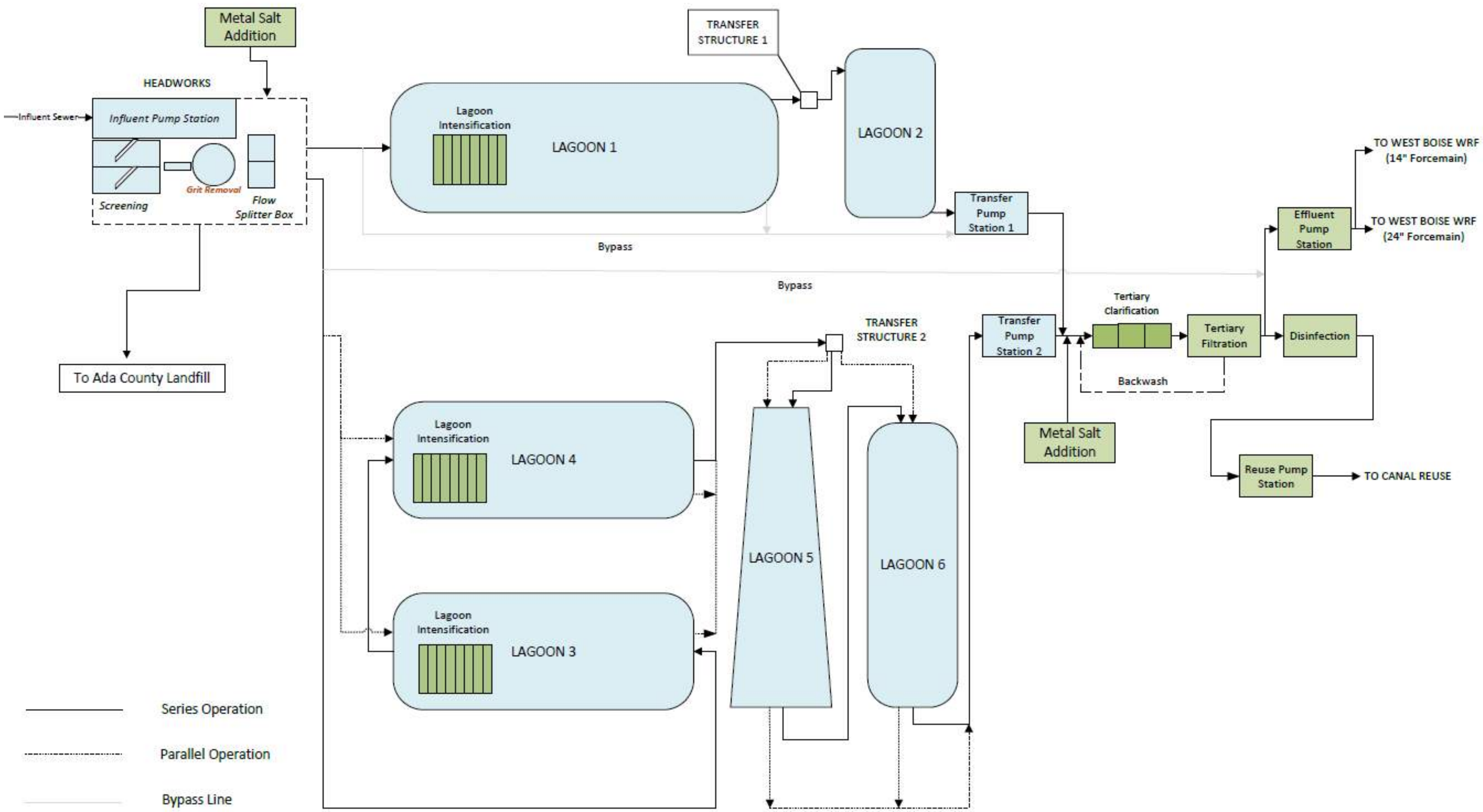

Figure 4-4. Alternative 3 – Summer Canal Reuse and Winter Discharge to West Boise Water Renewal Facility

Note:

Existing facilities are shown in blue and new facilities to be installed in this alternative are shown in green.

4.3.3.4 Alternative 4 – Summer Canal Reuse and Winter Canal Infiltration

Alternative 4 is designed to reduce BOD_5, TSS, NH_3-N, total nitrogen, and TP in the lagoon effluent, to meet the Class A recycled water quality set forth in *Idaho Administrative Code* (IDAPA 58.01.17). This system will be sending water to the canal for summer irrigation, and will continue sending water to the canal for winter infiltration for groundwater augmentation. An option to discharge effluent to the West Boise WRF is also included for redundancy. An MBBR will be added to reduce concentrations of BOD_5, NH_3-N, and total nitrogen. In an MBBR, nitrifying bacteria attached to suspended media in aerobic zones can reduce NH_3-N even at low water temperatures. Supplemental carbon will be added to drive the denitrification process in the anoxic zone of the MBBR, where denitrifying bacteria are dominant in the biofilm, to meet the total nitrogen requirements of IDAPA 58.01.17 for Class A recycled water. Tertiary clarification coupled with tertiary filters and metal salt addition significantly reduce the effluent TSS and phosphorus. A UV disinfection system is included to meet the pathogen requirements of Class A recycled water.

The capital improvement is planned in two phases. The MBBR, tertiary clarification, metal salt addition system, filtration system, and one UV disinfection channel would first be constructed. The MBBR reactors will be filled with up to 40 percent media fill. A Lab Building, pipeline for reuse, transfer pumps, Effluent Pump Station, and Reuse Pump Station would be constructed in Phase 1 as well. In the second phase, an additional 20 percent of MBBR media by bioreactor volume and an additional UV channel will be constructed. Similar to Alternative 3, the existing standby generator will be repurposed for the Blower Building. A new second standby generator will be installed to provide backup power for the other critical facilities.

Figure 4-5 shows the Alternative 4 facilities that will be constructed at the WLTF.

BOD_5 Removal. This alternative substantially reduces the effluent BOD_5 as described under Alternative 3; the MBBR leads to very low effluent BOD_5. The 2040 effluent BOD_5 concentration is estimated to be less than 5 mg/L.

TSS Removal. TSS will be significantly reduced to a 2040 effluent concentration estimated to be less than 5 mg/L.

Ammonia-nitrogen Removal. The MBBR significantly removes NH_3-N. The anticipated 2040 effluent concentration is estimated to be less than 1 mg/L.

Total Nitrogen Removal. The MBBR significantly removes total nitrogen. The anticipated 2040 effluent concentration is estimated to be less than 10 mg/L.

Phosphorus Removal. The tertiary clarification and filters with metal salt addition will remove the TP to a 2040 effluent concentration less than 0.5 mg/L.

Required Infrastructure. The upgrades to be installed to satisfy the 2040 planning criteria include the following:

- Tertiary MBBR
- Supplemental carbon feed and storage
- Metal salt addition storage and pumping
- Tertiary clarification and tertiary filtration
- Hydraulic upgrades, including new transfer pumps (installed in existing Effluent Pump Station), a new Effluent Pump Station and Reuse Pump Station. Effluent will only be pumped to West Boise WRF when Class A reuse water cannot be produced. A new conveyance pipeline that discharges the treated effluent to the canal for reuse is also needed.

Advantages and Disadvantages. The primary advantages and disadvantages of Alternative 4 are as follows:

- Advantages
  - Complete water self-reliance
  - Decreases the City of Boise O&M charges to nil unless water is discharged to West Boise WRF
- Disadvantages
  - Significant capital investment is required
  - Several unit processes are added, which significantly increases the O&M effort
  - Cost to construct new infrastructure
  - Treatment capacity that has already been purchased becomes a sunken investment, along with infrastructure to pump to West Boise WRF for treatment
  - Water reuse permit that requires sampling, monitoring, and annual reporting
  - There is a high risk associated with the issuance of the water reuse permit for the groundwater infiltration. Infiltration to groundwater is not currently done in the region. Therefore, a permit may not be issued, or a stringent permit is granted to show the reuse water will not adversely affect the quality of groundwater. Permit issuance will require significant engineering work, including infiltration and groundwater modeling, monitoring of nearby wells, and determining the fate and transport of wastewater constituents such as phosphorus and nitrate-nitrogen.

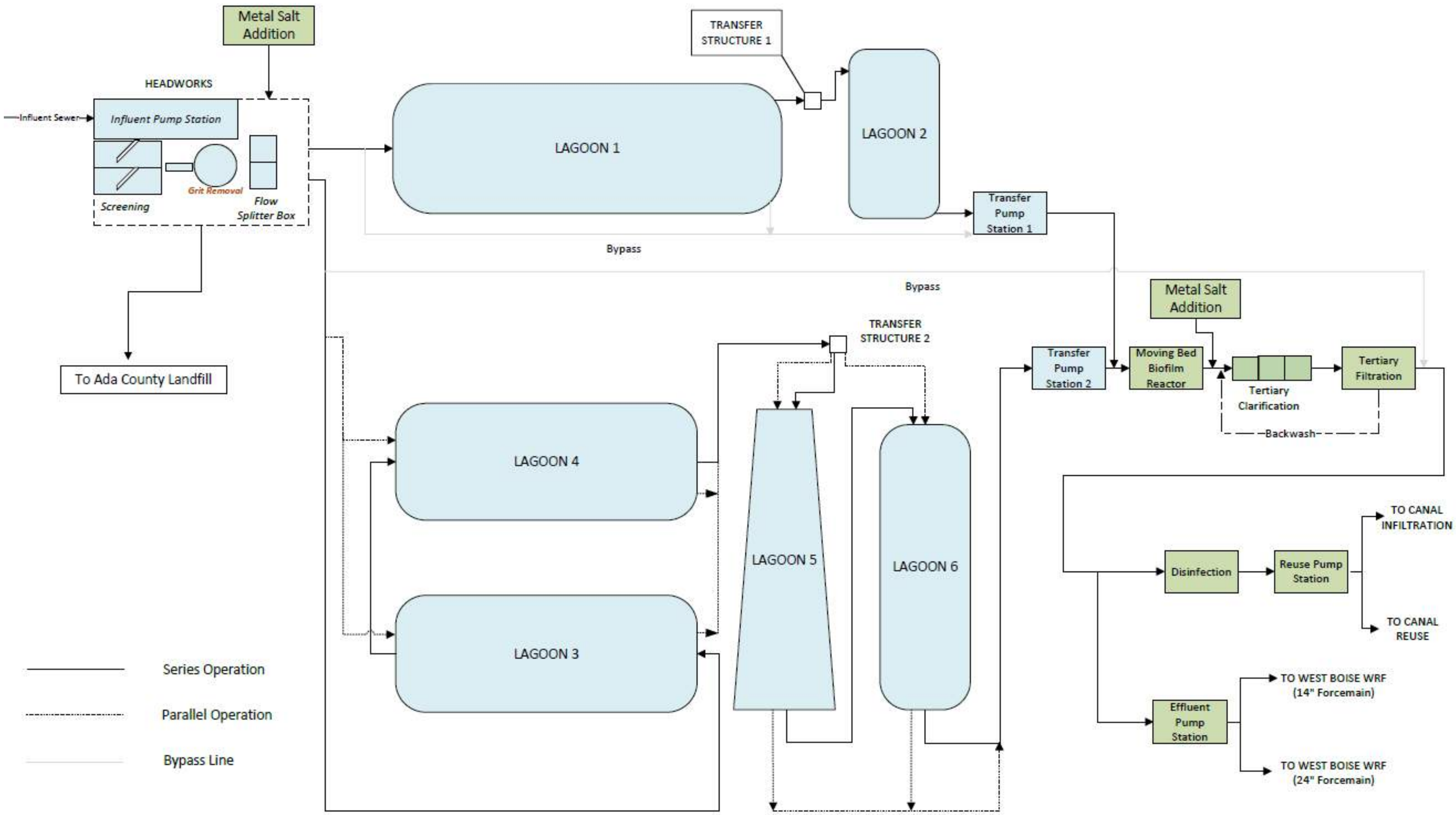

Figure 4-5. Alternative 4 – Summer Canal Reuse and Winter Canal Infiltration

Note:

Existing facilities are shown in blue and new facilities to be installed in this alternative are shown in green.

4.3.3.5 Alternative 5 – Membrane Bioreactor with Idaho Pollutant Discharge Elimination System Discharge and Solids Handling

In lieu of upgrading or expanding the lagoon treatment system, a new MBR facility will be constructed, which improves effluent water quality to a point where it can be discharged to the Boise River. This would take the place of the lagoon system altogether, and only one lagoon will be kept as an equalization lagoon. New unit processes include fine screening, metal salt addition, an MBR (suspended-growth bioreactor followed by the membrane tanks), UV disinfection system, and solids handling. The solids handling includes thickening, aerobic digester, and dewatering equipment. This system would reduce BOD_5, TSS, NH_3-N, and phosphorus to levels that would meet typical Boise River IPDES permit requirements. This alternative includes abandoning the existing effluent forcemains to the West Boise WRF and constructing a new system with an effluent diffuser for Boise River discharge. Securing an IPDES permit will be very challenging, if possible at all, for the District and would take several years. The District would initially need to secure a TMDL for each wastewater constituent in order to obtain a waste load allocation (WLA). The WLA for the key constituents of concern in the TMDL needs to be determined prior to any issuance of an IPDES permit. The existing TMDL for the Boise River has already determined the associated WLA for each discharger, so a new discharger would need to work with the existing entities within the framework of the TMDL to get this modified. This involves an extensive amount of work and coordination, which would take years to complete if it is even possible.

This alternative will be constructed all in one phase. Figure 4-6 shows Alternative 5 infrastructure.

BOD_5 Removal. BOD_5 would be reliably reduced with the MBR under this alternative. The system is designed to have a 2040 effluent BOD_5 concentration of 5 mg/L or less.

TSS Removal. This system also reliably reduces TSS to where the 2040 effluent concentration could be 2 mg/L or less.

Ammonia-nitrogen Removal. It is estimated that NH_3-N is reduced to a 2040 effluent concentration of less than 1 mg/L.

Phosphorus Removal. A biological phosphorus removal together with chemical addition is used to achieve the low-effluent TP required of an IPDES permit. Effluent phosphorus concentrations are estimated to be less than 0.1 mg/L.

Required Infrastructure. The following facilities will need to be constructed in this alternative:

- Existing lagoons are decommissioned except for an equalization lagoon
- A fine screening system will be installed after the equalization lagoon
- MBR
- UV disinfection
- Pipeline to convey the treated effluent to the Boise River
- Solids handling facilities such as storage tanks, thickening and dewatering facilities, and an aerobic digester

Advantages and Disadvantages. The primary advantages and disadvantages of Alternative 5 are as follows:

- Advantages
  - High effluent water quality accommodates direct discharge to the Boise River
  - The District will have no charges from the City of Boise after the MBR facility is operational
  - Permanent solids handling system replaces frequent solids removal from lagoons
  - Common treatment technology with multiple vendors
  - Small footprint
- Disadvantages
  - Difficulties obtaining an IPDES permit for discharge to the Boise River
  - Complicated mechanical operation and higher safety requirements to be addressed in design
  - High cost for both construction and O&M
  - Membranes typically require replacement every 7 to 10 years
  - Potential for odor from the solids handling processes, requiring additional odor control systems

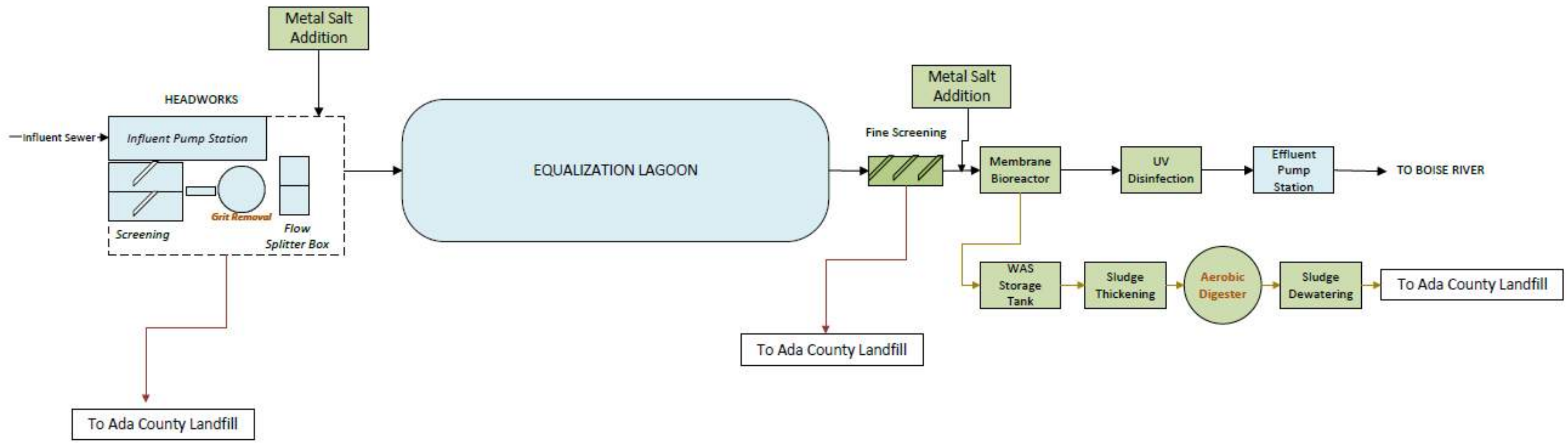

Figure 4-6. Alternative 5 – Membrane Bioreactor with Idaho Pollutant Discharge Elimination System Discharge and Solids Handling

Note:

Existing facilities are shown in blue and new facilities to be installed in this alternative are shown in green.

4.3.4 Comparison of Costs for the Wastewater Management Alternatives

Costs for each of the five alternatives were estimated based on the following categories:

- District capital costs
- District WLTF O&M costs
  - City of Boise wastewater treatment capacity charges
  - City of Boise monthly O&M charges
  - District WLTF O&M costs
  - Sludge removal costs
- Repair and replacement (R&R) costs

Capital costs are associated with building new facilities or expanding and renovating existing facilities. The economic evaluation considered 20-year net present value (NPV) comparisons using the following:

- The facility construction cost includes the cost for building a new unit process or treatment facility to satisfy a specific treatment objective. The quotes obtained from the vendors for the different alternatives can be found in Appendix D These costs are based on Jacobs' cost models (Replica Parametric Design) for high-level planning efforts, past project costs in the area, and engineering judgement.
- Inflation during the planning period was estimated to be 3.5 percent per year and the interest rate (discount rate) used was 5.25 percent per year.
- Land acquisition costs are assumed to be zero for the WLTF because the District owns sufficient land to accommodate all of the alternatives evaluated.
- Plant utility costs (electricity, water, and labor) were estimated based on the 2023 operating budget and escalated by the 3.5 percent inflation factor.
- Chemical and additional electrical costs due to the upgrades were based on Replica Parametric Design and considered the adjustment of inflation.
- The burdened labor cost to the District in 2023 was assumed as $100,000 per employee. The costs for additional operators included in alternatives is based on this number and then escalated for inflation.
- The frequency at which solids are removed from the lagoons was predicted by the Dynamita SUMO process model with validation against existing removal frequency. The historical cost of solids dewatering and disposal was adjusted for inflation for each predicted occurrence.
- Contractor markups, additional project costs, and non-construction costs are included for the alternative cost estimates and adjusted slightly among alternatives based on discussions with the District. Because there is no capital invested in Alternative 1, these markups are not shown.

Table 4-12 summarizes the various markups included in the capital cost for each alternative.

Table 4-12. Summary of Contractor Markups, Additional Project Costs, and Non-construction Costs Considered for the Alternatives

		Alternative 2	Alternative 3	Alternative 4	Alternative 5
Contractor Markups (Percent)	Overhead	12	12	12	12
	Profit	10	10	10	10
	Mob/bonds/insurance	5	5	5	5
	Contingency[a]	20	30	30	40
Additional Project Costs (Percent)	Overall sitework	6	6	8	12
	Plant computer system	6	6	8	12
	Yard electrical	4	6	8	8
	Yard piping	6	8	10	10
Non-construction Costs (Percent)	Permitting	2	2	5	5
	Engineering	15	15	15	15
	Services during construction	6	8	10	10
	Commissioning and startup	1	2	5	5

[a] Contingency percentages for each alternative are different depending on the complexity of the facilities constructed.

- City of Boise West Boise WRF capacity charges are assumed to increase each year by an average of 4 percent to reflect average annual increases between 2023 and 2040.

Table 4-13 presents the estimated 20-year NPV cost for each of the liquids treatment alternatives. Appendix E provides more details on the development of the 20-year NPV cost for the alternatives.

The Do Nothing/Status Quo alternative incurs the highest O&M charges from the City of Boise. In this scenario, the effluent quality would degrade as flows and load increase, causing additional discharge cost increases. It may also have the potential for excessive odors as treatment degrades. The lowest cost alternative is Alternative 2, which includes an upgrade of the existing lagoon system with improved quality while still discharging to West Boise WRF. The second lowest NPV cost alternative is Do Nothing/Status Quo (Alternative 1). Alternative 3, which is Summer Canal Reuse and Winter Discharge to West Boise WRF, has higher capital investment than Alternative 2 but much lower O&M costs.

Alternative 4 also has higher capital investment requirements than Alternatives 2 and 3. The District would no longer be paying City of Boise capacity or O&M charges, but the District will bear higher capital and O&M charges. There is high permit risk associated with Alternative 4 with the feasibility of winter infiltration within the canal system. This alternative requires high levels of treatment, and the system would need to be continuously monitored to ensure groundwater quality is not compromised.

The most expensive alternative is to construct a new MBR plant (Alternative 5) for an IPDES direct discharge to the Boise River. In this alternative, there would no longer be City of Boise capacity or O&M charges, but the high capital and O&M costs the District would bear, make this alternative unattractive. In addition, the District has purchased capacity in the West Boise WRF and this capacity would not be used with a direct river discharge. There is a significant scheduling implication with Alternative 5 in that it would take time to apply and secure an IPDES permit for discharge to the Boise River. Because the District currently does not have an allocation for discharge through the Lower Boise River TMDL that has been established, the process to secure an allocation (and follow-on IPDES permit) will be challenging and take several years to complete. The schedule to get an IPDES permit secured cannot be predicted, and this may or may not be possible given the steps required to get a new discharge into the Boise River.

4.3.4.1 Solids Treatment Alternatives

Table 4-14 presents the estimated 20-year NPV cost for each of the solids treatment alternatives. Appendix E provides more details on the development of the 20-year NPV cost for the alternatives.

Continuing solids dredging by a third-party contractor has the lowest NPV. Solids dredging if done by the District staff incurs capital costs to purchase the required equipment but has lower operating costs. Constructing a new digestion facility with aerobic digester with thickening and dewatering equipment has the highest capital investment.

Liquids Treatment Alternatives 1 through 4 include the costs for Solids Treatment Alternative A. Alternative C, Aerobic Digestion and Dewatering by the District, is evaluated only for solids generated in Liquids Treatment Alternatives 1 through 4. Digestion costs for Liquids Treatment Alternative 5 are included in the capital costs and not shown independently.

Table 4-13. Monetary Comparison of Eagle Sewer District Wastewater Lagoon Treatment Facility Liquids Treatment Alternatives

	Alternative 1: Do Nothing/ Status Quo	Alternative 2: Improved Water Quality to West Boise WRF	Alternative 3: Summer Canal Reuse and Winter Discharge to West Boise	Alternative 4: Summer Canal Reuse and Winter Canal Infiltration	Alternative 5: MBR with IPDES Discharge and Solids Handling
	Capital replacement with no capital investment	Upgrade existing system for improved water quality (remove BOD_5, TSS, NH_3-N, and phosphorus)	Produce Class A recycled water for reuse during irrigation season	Produce Class A recycled water for reuse and infiltration year-round	New MBR plant with IPDES permit for Boise River discharge
Capital NPV Cost	$0	$20,611,084	$38,114,632	$67,435,207	$120,326,823
O&M NPV Costs	$80,389,887	$50,821,311	$45,346,561	$56,118,624	$59,213,212
R&R NPV Costs	$3,047,951	$6,279,156	$6,417,777	$7,786,932	$5,725,159
Total NPV Cost (2023 Dollars)	**$83,437,838**	**$77,711,551**	**$89,878,970**	**$131,340,763**	**$185,265,194**

Table 4-14. Monetary Comparison of Eagle Sewer District Wastewater Lagoon Treatment Facility Solids Treatment Alternatives

	Alternative A: Solids Dredging by a Contractor	Alternative B: Solids Dredging and Dewatering by the District	Alternative C: Aerobic Digestion and Dewatering by the District
	Continue dredging operations by third-party contractor	Purchase dredging equipment and install permanent dewatering facilities; District staff to operate equipment	Construct new aerobic digester along with thickening and dewatering facilities
Capital NPV Cost	$—	$5,454,114	$17,330,694
O&M NPV Costs	$6,066,307	$2,377,603	$3,990,042
R&R NPV Costs	$—	$443,004	$1,139,279
Total NPV Cost (2023 Dollars)	**$6,066,307**	**$8,274,721**	**$22,460,015**

4.3.5 Cursory Environmental Screening of Alternatives Considered

The cursory environmental screening in Table 4-15 describes, in general, anticipated impacts associated with the various alternatives, as well as comparative costs of construction. More detail relative to anticipated impacts associated with the proposed action and alternatives will be developed during the design phase of the selected approach.

In general, all alternatives, including the Do Nothing/Status Quo alternative, would result in increased user rates. Upgrading the existing lagoons (Alternative 2) is the lowest cost alternative, with full mechanical treatment (Alternative 5) being the highest in cost. Non-monetary environmental criteria are established to provide an initial screening of alternatives developed for the WLTF. Table 4-15 shows the impacts to the respective criteria to various degrees.

Table 4-15. Wastewater Lagoon Treatment Facility Upgrade Cursory Environmental Screening

Criteria	Alternatives				
	Alternative 1: Do Nothing/ Status Quo	Alternative 2: Improved Water Quality to West Boise WRF	Alternative 3: Summer Canal Reuse and Winter Discharge to West Boise WRF	Alternative 4: Summer Canal Reuse and Winter Canal Infiltration	Alternative 5: MBR with IPDES Discharge and Solids Handling
Physical Aspects (topography, geology, and soils)	No impact	Requires excavation for treatment facilities and connecting infrastructure	Requires excavation for treatment facilities, connecting infrastructure, discharge to reuse canal; surface restoration of roads	Requires excavation for treatment facilities, connecting infrastructure, and discharge to reuse canal; surface restoration of roads	Requires excavation for new treatment facilities, connecting infrastructure, and discharge to river pipeline
Climate	No impact at District; increases in GHG emissions for power required to treat the water occur at West Boise WRF	Slight increase in GHG emissions from increased power requirements	Slight increase in GHG emissions from increased power requirements	Slight increase in GHG emissions from increased power requirements	Slight increase in GHG emissions from increased power requirements
Population, Commercial, and Industrial Growth	No impact	No impact	No impact	No impact	No impact
Economics and Social Profile	Increased user rates	Increased user rates	Increased user rates	Increased user rates	Increased user rates
Land Use	No impact	No impact	No impact	No impact	No impact
Floodplain Development	No impact	No impact	No impact	No impact	Temporary effect during construction

Criteria	Alternatives				
	Alternative 1: Do Nothing/ Status Quo	Alternative 2: Improved Water Quality to West Boise WRF	Alternative 3: Summer Canal Reuse and Winter Discharge to West Boise WRF	Alternative 4: Summer Canal Reuse and Winter Canal Infiltration	Alternative 5: MBR with IPDES Discharge and Solids Handling
Wetlands and Waters of the United States	No impact	No impact	No impact	No impact	Temporary effect during construction
Wild and Scenic Rivers	No Wild and Scenic Rivers within project vicinity	No Wild and Scenic Rivers within project vicinity	No Wild and Scenic Rivers within project vicinity	No Wild and Scenic Rivers within project vicinity	Boise River is located within project vicinity
Cultural Resources	No impact	No impact	No impact	No impact	Potential for cultural resources along the river
Environmental Justice	No impact	No impact	No impact	No impact	No impact
Flora	No impact	No impact	No impact	No impact	No impact
Fauna	No impact	Temporary disturbance during construction	Temporary disturbance during construction	Temporary disturbance during construction	Temporary disturbance during construction
Recreation and Open Space	No impact	No impact	No impact	No impact	No impact
Agricultural Lands	No impact	No impact	No impact	No impact	No impact
Air Quality	No impact Increase in permanent odors	Temporary construction dust Slight permanent increase in odors	Temporary construction dust Slight permanent increase in odors	Temporary construction dust Slight permanent increase in odors	Temporary construction dust Slight permanent increase in odors
Noise	No impact	Temporary construction noise Increased operating machinery noise	Temporary construction noise Increased operating machinery noise	Temporary construction noise Increased operating machinery noise	Temporary construction noise Increased operating machinery noise
Water Quality and Quantity	No impact	No impact	No impact	No impact	No impact
Public Health	No impact	No impact	No impact	No impact	No impact
Energy	No impact	Increased energy use	Increased energy use	Increased energy use	Increased energy use
Regionalization	No impact	No impact	No impact	End regionalization with City of Boise	End regionalization with City of Boise

GHG = greenhouse gas

4.3.6 Evaluation of Nonmonetary Benefits and Costs

The relative importance or ranking of the nonmonetary criteria was used to weight criteria when evaluating alternatives. Comparison and relative ranking were done using a pair-wise comparison (Table 4-16). The criteria listed in the left column are compared with each of the other criteria, which are again listed across the top of the table. If the criterion in the left column is significantly more important than the one listed at the top, the value 4 would be entered into the yellow cell. The criterion with highest score (summed across the row) is the most important. Based on this approach, the criteria were prioritized as listed in Table 4-16, with safety being ranked as most important and water self-reliance and public partnership comparatively lower.

Table 4-16. Nonmonetary Evaluation Criteria and Weights

	A	B	C	D	E			
Criteria	Safety	System Reliability	Affordability	Water Self-reliance	Public Partnership	Total Scores	Weighting Percentage	Relative Weights
Safety	A	4	4	4	4	16	32.0%	2.91
System Reliability	1	B	4	4	4	13	26.0%	2.36
Affordability	1	1	C	4	4	10	20.0%	1.82
Water Self-reliance	1	1	1	D	2.5	5.5	11.0%	1.00
Public Partnership	1	1	1	2.5	E	5.5	11.0%	1.00
						50	100.0%	9.09

The recommended approach for estimating and comparing the monetary costs of alternatives is to use an NPV analysis. For each set of project alternatives, Jacobs estimated capital and operating costs that were presented in Section 4.3.4.

The comparison of alternatives for overall facility, system, or subsystem improvements identified in the Facility Plan are on a benefit-to-cost basis. District staff assigned The benefits of an alternative using the five nonmonetary criteria previously identified, which align with the District's level of service goals identified at the beginning of this chapter. Each nonmonetary criterion for each alternative was rated using the following numerical score system:

- 1 = significantly less important
- 2 = less important
- 3 = equal in importance
- 4 = more important
- 5 = significantly more important

The total benefit for an alternative is the sum of individual criterion scores multiplied by their respective weightings to produce a weighted benefit score. The benefit-to-cost rating of an alternative were determined by dividing its total weighted benefit score by its normalized NPV cost. The normalized NPV cost for each alternative is the NPV cost of that alternative divided by the lowest NPV cost of the alternatives.

During the alternative evaluation workshop, District staff determined nonmonetary criteria scores for each of the proposed alternatives. Tables 4-17 and 4-18 present the results of the scoring, with Table 4-17 presenting the raw scores and Table 4-18 presenting the weighted scores based on the prioritization of each individual criterion listed in Table 4-16.

Table 4-17. Raw Nonmonetary Scores for Treatment Alternatives

Criteria	Liquids Treatment Alternatives				
	1: Do Nothing/ Status Quo	2: Improved Water Quality to West Boise WRF	3: Summer Canal Reuse and Winter Discharge to West Boise WRF	4: Summer Canal Reuse and Winter Canal Infiltration	5: MBR with IPDES Discharge and Solids Handling
Safety	5	4	3	2	2
System Reliability	1	3	4	4	5
Affordability	4	5	3	2	1
Water Self-reliance	1	1	4	5	3
Public Partnership	1	1	4	5	2
Raw Score	12	14	18	18	13
Number of Criteria	5	5	5	5	5
Relative Score	0.80	0.93	1.20	1.20	0.87

Note:

Scores greater than 1 indicate net positive; scores less than 1 indicate net negative compared to the District's level of service goals.

Table 4-18. Weighted Nonmonetary Scores for Treatment Alternatives

Criteria	Criteria Weighting	Liquids Treatment Alternatives				
		1: Do Nothing/ Status Quo	2: Improved Water Quality to West Boise WRF	3: Summer Canal Reuse and Winter Discharge to West Boise WRF	4: Summer Canal Reuse and Winter Canal Infiltration	5: MBR with IPDES Discharge and Solids Handling
Safety	32.0%	1.60	1.28	0.96	0.64	0.64
System Reliability	26.0%	0.26	0.78	1.04	1.04	1.30
Affordability	20.0%	0.80	1.00	0.60	0.40	0.20
Water Self-reliance	11.0%	0.11	0.11	0.44	0.55	0.33
Public Partnership	11.0%	0.11	0.11	0.44	0.55	0.22
	100%	—	—	—	—	—
	Weighted Score	2.88	3.28	3.48	3.18	2.69

Alternative 3 received the highest nonmonetary ranking because of its reliability and safety. Alternative 5 received the lowest score because of its lower public partnership, safety, water self-reliance, and affordability.

Table 4-19. Normalized Net Present Value Costs for Treatment Alternatives

	1: Do Nothing/ Status Quo	2: Improved Water Quality to West Boise WRF	3: Summer Canal Reuse and Winter Discharge to West Boise WRF	4: Summer Canal Reuse and Winter Canal Infiltration	5: MBR with IPDES Discharge and Solids Handling
Normalized NPV	1.07	1.00	1.16	1.69	2.38
Benefit-to-cost Ratio	2.7	3.3	3.0	1.9	1.1

Note:

The normalized NPV cost for each alternative is the NPV cost of that alternative divided by the lowest NPV cost of the alternatives. The benefit-to-cost ratio is the ratio of the weighted nonmonetary score divided by the normalized NPV cost score.

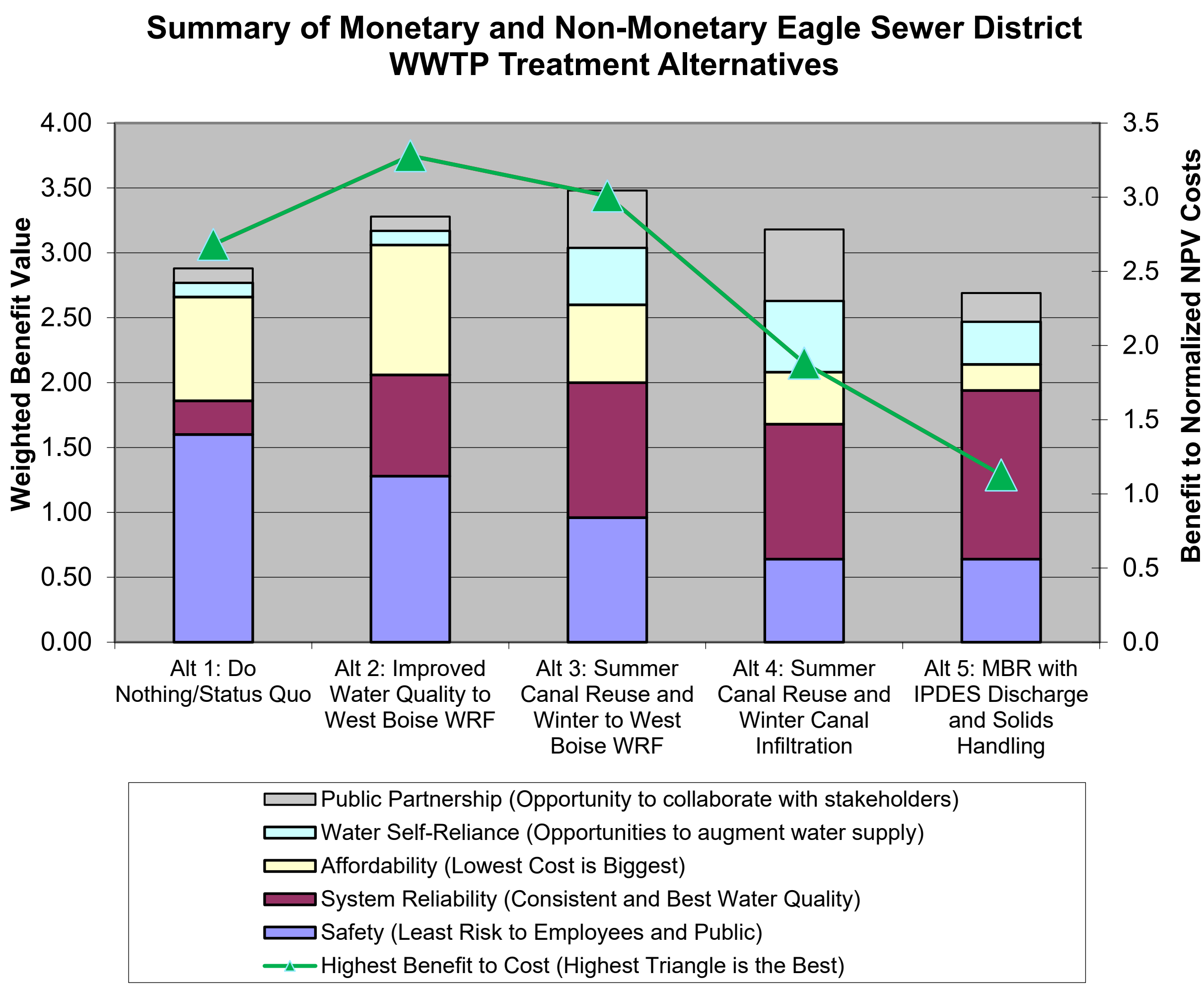

Figure 4-7. Weighted Nonmonetary Scores and Normalized Net Present Value Costs for Treatment Alternatives

Alternative 2: Improved Water Quality to West Boise WRF has the highest benefit to normalized NPV costs but has a slightly lower nonmonetary cost than Alternative 3. Therefore, Alternative 2 provides the most benefit at the lowest cost.

4.4 Sensitivity Analysis

After reviewing the evaluation results presented in Figure 4-7, a sensitivity analysis was carried out for the alternatives evaluation. Because every evaluation is performed based on assumptions and estimated costs, a sensitivity analysis is useful to help determine how sensitive the results are to changes in the underlying assumptions of the evaluation.

A single sensitivity analysis was performed, where it was assumed that the City of Boise capacity charge was further increased by 30 percent and the monthly O&M charges were increased by 25 percent. This analysis was done to reflect potential increased charges by the City of Boise due to either capacity limitations or more stringent IPDES permits. Table 4-20 presents the results from this analysis. Higher O&M NPV costs were observed for Alternatives 1 through 3 because in all these options, effluent flow will continue to be discharged to the West Boise WRF. The sensitivity of the City of Boise charges do not affect Alternatives 4 and 5 because these charges result in no changes to the capital NPV cost and R&R NPV costs.

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Alternative 2 has the lowest total NPV costs from the sensitivity analysis, followed by Alternatives 3 and 1. Alternative 3 is the preferred alternative for the District's patrons because it fulfills all the level of service goals and provides higher value (based on nonmonetary criteria).

4.5 Wastewater Management Alternative Evaluation Results

As presented, the alternatives evaluation workshop resulted in preferred alternatives for the District WLTF treatment process required to meet future flows and loads driven by growth in the District area of impact. A critical aspect of implementation of this facility plan will be how the various facilities are phased based on development and population growth and evolving discharge costs in the agreement with the City of Boise. The discharge agreement will evolve as the City of Boise sees changes in its IPDES discharge permit. Chapter 5 further describes phased implementation and development of a recommended capital improvement plan. The capital improvement plan will be based in part on the unit processes and system for Alternative 2 for the near-term improvements and expanding to Alternative 3 in the long term. Alternative 3 has the highest nonmonetary score with the second lowest monetary cost. Based on community values, meeting levels of service goals for the District's patrons, and the modest increase in expense, Alternative 3 is selected.

Table 4-20. Monetary Comparison of Eagle Sewer District Wastewater Lagoon Treatment Facility Liquid Treatment Alternatives – Sensitivity Analysis of increase City of Boise Capacity and Operations and Maintenance Charges

	Alternative 1: Do Nothing/ Status Quo	Alternative 2: Improved Water Quality to West Boise WRF	Alternative 3: Summer Canal Reuse and Winter Discharge to West Boise WRF	Alternative 4: Summer Canal Reuse and Winter Canal Infiltration	Alternative 5: MBR with IPDES Discharge and Solids Handling
	Capital replacement with no capital investment	Upgrade existing system for improved water quality (remove BOD_5, TSS, ammonia-nitrogen, and phosphorus)	Produce Class A recycled water for reuse during irrigation season	Produce Class A recycled water for reuse and infiltration year-round	New MBR plant with IPDES permit for Boise River discharge
Capital NPV Cost	$0	$20,611,084	$38,423,709	$67,435,207	$120,326,823
O&M NPV Costs	$96,890,910	$57,656,319	$49,792,241	$58,311,017	$62,222,334
R&R NPV Costs	$3,047,951	$6,279,156	$6,417,777	$7,786,932	$5,725,159
Total NPV Cost (2023 Dollars)	$99,938,861	$84,546,559	$94,633,727	$133,533,155	$188,274,316

5. Capital Improvement Plan

5.1 Introduction

This chapter of the Facility Plan summarizes the implementation strategy of recommended Alternative 3 with its capital cost outlay, implementation schedule, and funding strategies. A financial planning model, with a 9-year projection period, is also presented. Additionally, a Rate Impact Study, used to evaluate any required rate increases to wholly or partly fund Alternative 3, was developed by the District and is further described in this chapter.

5.2 Methodology

For any capital projects implementation plan, there are drivers and constraints that need to be considered prior to adoption. These drivers and constraints are unique to the organization and must be fully vetted prior to moving forward with any proposed project.

For the District, drivers to complete the projects in Alternative 3 include the following:

- **Cost increases:** The Boise rate increase schedule includes a fairly high uncertainty because it was prepared before the recent periods of high inflation. This inflation results in project cost inflation that puts upward pressure on rates to generate the money needed to fund the projects. The current structure of the agreement between the City of Boise and the District allows for treatment and capacity cost increases with as little as a year's notice. Additionally, inflation for construction costs continues to climb at unprecedented rates for all utilities. Capital revenue/funds cannot be used for Boise O&M fees. The District monthly service fee must cover the increased O&M costs from Boise.
- **Risk:** There is a certain amount of risk that goes with relying on a third party to clean the District's used water. With water cleaning self-reliance, the District is in more control of its unit processes and investments, and is able to better forecast capital and operating costs associated with it.
- **Public opinion:** Public outreach efforts have yielded results that indicate patrons prefer treated effluent for irrigation use rather than river discharge.

The District's constraints include the following:

- **Available funds:** In order to pay for capital projects, funds must be available through current user rates or borrowing repaid over a longer time period through user rates. Ideally, an agency can pay for capital projects with available funds or ongoing revenue.
- **Organizational capacity:** Projects require a lot of time and involvement from District staff. The District may not have needed staff to oversee projects from beginning to end. Using consultants is often the way that utilities offset this short-term workforce need.
- **Partnerships:** Additional partnerships are required. For example, partnering with a willing canal company that wants the irrigation reuse water.
- **IDEQ and regulatory review schedule:** IDEQ review time can be lengthy, which will need to be factored into a project's overall schedule.

Once these drivers and constraints are identified, an agency must determine that the drivers outweigh the drawbacks and make a plan to work within the constraints in order to proceed. In the case of the District, which relies on the City of Boise to treat its wastewater and is subject to any cost increase, the drivers for self-reliance to reuse the cleaned water for irrigation and lowering financial risk outweigh the constraints of available funds, partnerships, and organizational capacity.

Once the decision is made to proceed with the recommended capital projects, an implementation schedule is created that outlays the capital cost expenditure over the planning horizon. Not only does this assist with project planning, but it also enables a clear picture of total cost per fiscal year in order to analyze project funding sources and required revenue increases (e.g., service rate increase, connection fee increases), if needed, and when those increases should take effect.

Once an implementation plan is developed and finalized, the utility may proceed with evaluating how to best fund the projects. It should be noted that the implementation plan development and funding strategy can be an iterative process, meaning the available funds may dictate which capital projects get completed when. This can be a complex balancing act with lots of moving parts, and to oversimplify, involves balancing revenue with expenditures in either an aggressive or conservative manner, depending on the utility, urgency of project needs, stakeholders, and economy. One method to mitigate this is to approach the capital projects in phases, which the following section discusses in further detail.

Lastly, after a financial plan is finalized that is in sync with the implementation schedule, a final capital improvement plan (CIP) can be adopted and formalized as the official road map for capital projects. The District Board approves 1-year budgets, and the CIP provides a plan and schedule to know which projects should be included in the annual budget.

The following chapters elaborate on this methodology specific to the recommended Alternative 3.

5.2.1 Recommended Alternative and Phasing Approach

In the previous chapter, five alternatives were analyzed and ranked based on various nonmonetary and monetary attributes. Alternative 3 was recommended and selected for implementation. As it turns out, however, three other alternatives that were analyzed—Alternatives 1, 2, and 4—have quite a bit in common compared to the selected Alternative 3, and as such, can be phased into the ultimate goal of completing improvements for Alternative 3.

For example, Alterative 1, Do Nothing/Status Quo, is already being performed in the interim, as planning for future improvements takes place. The District has historically been intentional in investing in infrastructure used as building blocks for future water cleaning goals. This strategy avoids building infrastructure that is subsequently abandoned.

Alternative 2, which upgrades current unit processes in order to better treat used water prior to sending it to the City of Boise, includes unit process upgrades that are also included in recommended Alternative 3, and by implementing Alternative 2, a portion of Alternative 3 is also implemented. As an example, major unit process improvements included in Alternative 2 included lagoon intensification and tertiary filtration. These improvements are also included in Alternative 3 as a significant treatment upgrade to make Class A irrigation reuse water for canals. However, unlike Alternative 2, which continues 100 percent discharge to the City of Boise, Alternative 3 includes disinfection, a pump station, and a new pipeline to send the Class A irrigation water to a local canal. So, in essence, Alternative 3 can be completed in a phased approach, which starts with first implementing Alternative 2.

As a final example, once Alternative 3 has been implemented, the District may decide to move forward with Alternative 4, that is, 100 percent discharge to the local canal that also includes winter discharge for groundwater recharge. Alternative 4 is not the recommended alternative because of the uncertainty surrounding being able to get an IDEQ permit for winter canal groundwater recharge. Alternative 4 would take many improvements and years to complete, with Alternative 3 representing the building blocks to be able to accomplish Alternative 4. Other utilities are currently conducting the studies required to receive IDEQ permits for winter canal groundwater recharge. The District expects that these studies will be finished by the time Alternative 3 projects are completed, allowing the District to move forward, or not, based on better information.

A phased approach to reach the goal of Alternative 3 irrigation water production has two important benefits. First, it allows the District to install unit process improvements and assess the effectiveness, comparing against the projected treatment metrics, without first or even concurrently installing the costly disinfection and reuse pipeline. And second, it allows for better affordability for budgeting, spreading out the improvements over an approximate 9-year time frame. This allows the District, in an ever-changing and increasingly volatile economy, to verify benefits and weigh risks at the end of a phase, and then proceed. This systematic phased approach reduces the overall cost and rate risk to District patrons by avoiding large jumps in rates.

5.3 Implementation Schedule

Table 5-1 shows the capital cost outlay for Alternative 3 through fiscal year 2032. Projects labeled as Alternative 2 are included because these are a phase in reaching Alternative 3, as Chapter 5.2.1 discussed.

Table 5-1. 8-year Capital Improvement Plan (Inflated)

Description	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32
ALT 2 – Phosphorus Treatment	$725,000								
ALT 2 – Lagoon Intensification	$771,000	$2,394,000							
ALT 2 – Filtration	$329,000	$3,317,000	$1,764,000						
Expansion of ALT 2 Systems for Future Flows						$3,296,000	$1,896,000		
ALT 3 – Reuse Permit	$33,000	$136,000	$35,000		$725,000				
ALT 3 – UV Disinfection			$1,535,000	$1,588,000	$2,396,000				
ALT 3 – Pipeline to Canal			$855,000	$5,175,000	$5,989,000				
Expansion of ALT 3 Systems for Future Flows						$1,956,000	$5,546,000	$10,883,000	$107,315
Total CIP Cost	**$1,858,000**	**$5,847,000**	**$4,189,000**	**$6,763,000**	**$9,110,000**	**$5,252,000**	**$7,442,000**	**$10,883,000**	**$107,315**

Note: The costs presented above include specific vendor equipment quotes and should be considered budgetary. Actual manufacturers and technologies and prices will be determined through the engineering and procurement phases, respectively.

In Gantt chart format, Figure 5-1 shows the same implementation schedule with proposed start and end dates and costs assigned.

Figure 5-1. Implementation Schedule

As Figure 5-1 indicates, Alternative 2 improvements are complete in middle of fiscal year 2026, at which point the District will be able to assess performance prior to moving on to the next phase to complete Alternative 3, when UV disinfection and the reuse pump station and pipeline will be constructed.

5.4 Funding Strategies and Financing Scenarios

There are two typical funding strategies that the District considered for financing Alternative 3 improvements. These funding projects are through service rates, bonds, or both. Service rate revenue is simply the revenue generated from collecting patron service fees per month. Bonds are borrowing from a financial establishment at a predetermined interest rate. Both service rates and bonds, as funding sources, have their pros and cons. Table 5-2 elaborates on the identified pros and cons.

Table 5-2. Rates vs. Bonds

	Project Financing: Rates	Project Financing: Bonds
Pros	▪ Generates smaller amounts of liquid capital more quickly ▪ Public hearing only required for increase over 5% ▪ Limits indebtedness	▪ Often has a slower rate increase schedule ▪ Raise large amounts of capital at once
Cons	▪ Potential to miss opportunity for lower cost financing ▪ Typically takes years of savings to generate needed capital	▪ Bond origination fees can be around 10% of the bond amount ▪ Bond vote with significant public information campaign ▪ At least 1 year of lost time for bond voting ▪ Rate increase to pay for bond ▪ Indebting patrons for 20 to 30 years

With the high cost of bond origination fees coupled with the time it takes to prepare for a bond vote and the uncertainty of passing a bond, the District intends to fund as much of the CIP as possible through service rates. Even if bond funding is used, patron rates would increase to pay for the bond. Bonding remains a tool that will be analyzed as projects are completed to determine if and when it would be advantageous to fund projects through bonds. Jacobs recommends that the economic climate be closely monitored and projected revenue be analyzed annually so that the District can use the most appropriate funding strategy to implement the infrastructure investments in this CIP.

The following chapters look at two different financing scenarios. Three projections for sewer permit sales for new connections were developed because the District does not control how fast development happens. Historic sewer permit sales have ranged from about 150 permits per year during economic recessions to as many as 1,000 permits per year in booming economic times. The average yearly sewer permit sales total is 500 per year. There is typically a 1-year lag between when the permit is sold and when the new patron starts monthly sewer billing. These sewer permit fees and monthly rate revenue were analyzed for use to fund capital upgrades. With the number of lots currently being developed and the strong commercial development on the horizon, the District expects revenues to be somewhere above the 500 permit per year level but below the 1,000 permit per year level on average during the time that Alternative 3 is being implemented.

5.4.1 Financing Scenario 1

Under this financing scenario, rates are kept at their current total of $39 per month and no money is borrowed through bonds. Taking into account the District's available capital funds account of $9,000,000 and the capital outlay of projects previously discussed, funds are anticipated to be depleted at different times under different permit and rate scenarios, as shown in Table 5-3 when the numbers are highlighted and red.

Table 5-3. Financing Scenario 1 Depletion Outlay

Fiscal Year	CIP Outlay	Ending Capital Funds Balance		
		Optimistic Rates/Fees (887 permits/year)	Realistic Rates/Fees (500 permits/year)	Pessimistic Rates/Fees (300 permits/year)
2024	$1,858,542	$7,410,613	$7,390,613	$7,390,613
2025	$5,847,102	$7,275,471	$4,489,439	$3,189,439
2026	$4,189,644	$8,918,827	$3,138,379	$538,379
2027	$6,763,137	$6,622,437	$157,773	$(2,442,227)
2028	$9,109,953	$3,420,939	$(6,447,173)	$(10,347,173)
2029	$5,252,593	$2,510,026	$(9,322,518)	$(14,522,518)
2030	$7,442,625	$(955,017)	$(14,751,993)	$(21,251,993)
2031	$10,883,403	$(8,243,140)	$(24,004,548)	$(31,804,548)
2032	$107,315	$(5,156,593)	$(22,882,433)	$(31,982,433)

Notes:

The starting balance of available capital funds is $17 million, $8 million of which is dedicated to reserves.
District reserve policy requires a minimum of $8 million in reserves at all times.
Monthly rates remain at $39 per month. There are no future rate increases.
There is no change in the $5,500 connection fee.
Depreciation funding is held constant. Budget balances are based on using depreciation funds.

The capital fund balances in each of the permit and rate scenarios go negative between 2027 and 2030. Fund balances going negative is not allowed, so a different funding strategy is required. Keeping current rates at $39 per month does not generate the revenue needed to fund the capital plan. These negative balances could be avoided by either raising rates or bonding.

5.4.2 Financing Scenario 2

Under Financing Scenario 2, rates are increased after facility plan adoption in early 2024, to an initial increase of at least $45 per month. Taking into account the District's available capital funds account of $9,000,000 and the capital outlay of projects previously discussed, funds are anticipated to be depleted as shown below in Table 5-4.

Table 5-4. Financing Scenario 2 Depletion Outlay

Fiscal Year	CIP Outlay	Ending Capital Funds Balance		
		Optimistic Rates/Fees (887 permits/year)	Realistic Rates/Fees (500 permits/year)	Pessimistic Rates/Fees (300 permits/year)
2024	$1,858,542	$7,410,613	$7,390,613	$7,390,613
2025	$5,847,102	$8,461,599	$5,576,639	$4,276,639
2026	$4,189,644	$11,355,019	$5,341,579	$2,741,579
2027	$6,763,137	$9,250,293	$2,447,373	$(152,627)
2028	$9,109,953	$7,426,587	$(2,976,773)	$(6,876,773)
2029	$5,252,593	$7,916,002	$(4,635,318)	$(9,835,318)
2030	$7,442,625	$5,851,287	$(8,847,993)	$(15,347,993)
2031	$10,883,403	$(36,508)	$(16,883,748)	$(24,683,748)
2032	$107,315	$4,450,367	$(14,544,833)	$(23,644,833)

Notes:

The starting balance of available capital funds is $17 million, $8 million of which is dedicated to reserves.
District reserve policy requires a minimum of $8 million in reserves at all times.
The service rate increases to $45 per month before fiscal year 2025. There are no future rate increases.
There is no change in the $5,500 connection fee.
Depreciation funding is held constant. Budget balances are based on using depreciation funds.

The fund balances in the optimistic permit and rate scenario nearly stay positive with all the capital investments shown. The realistic permit and rate scenario goes negative in 2028, but to a lesser extent with the increased rate revenue. The pessimistic permit and rate scenario goes negative in 2027. With the number of residential lots being developed and the commercial development on the horizon, the District expects revenues through 2028 to be somewhere between the optimistic and realistic projections. This would fund most of the Alternative 3 projects before requiring either additional rate revenue or bonding.

The total connection fee (currently $5,500) is assumed to remain at this level and was not included in the analysis for financing scenarios. However, this is another source of revenue that can be further evaluated as new infrastructure is added to the system. Reviewing the connection fee is recommended to verify that new patrons are adequately buying into the existing system when they begin sending used water to the District for cleaning.

5.4.3 Projected Monthly Rates

Predictable monthly user rates are important for District patrons. The funds required for Alternative 1, continuing the current operation without adding cleaning processes, and Alternative 3, cleaning the water to an irrigation water level during the summer for canal use and in the winter sending the water to Boise for the river, result in the monthly user rates per ERU presented in Figure 5-2. Alternative 1 is higher than Alternative 3 each year. After 2031, the rates diverge such that the 2040 rates for Alternative 1 are projected to be nearly $70/month and Alternative 3 rates remain around $58/month. These rates may change if the City of Boise rates increase above their published schedule, if other environmental regulations require additional treatment, or if inflation above 3.5% per year occurs. The District will regularly review these rates to verify that the monthly user rates are adequate to support District goals, including being as low as possible while providing a high level of service.

Figure 5-2 includes the rates through 2031 because they coincide with the capital improvement plan in Figure 5-1.

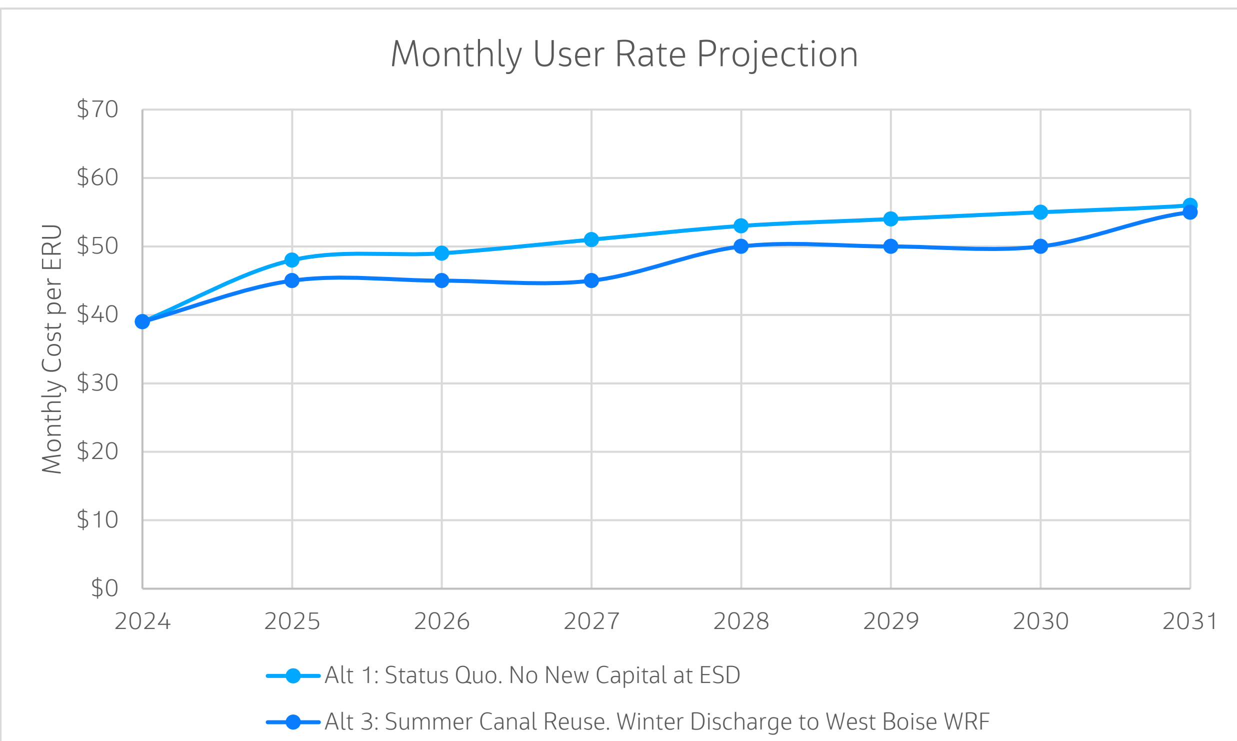

Figure 5-2. Projected Monthly User Rates

5.4.4 Preferred Financing Scenario

The recommended approach is to increase monthly service rates to $45 per month after this plan is adopted in early 2024. This increased revenue coupled with the current capital funds are expected to be able to fund capital projects through 2028. Jacobs recommends that the revenue and capital investment be reviewed every year as revenue projections are clearer and as each capital project is contracted and completed. This allows the District to update the implementation schedule to fit the available funding and project capital commitments. The schedule could be accelerated if revenues exceed projections, or capital projects could be delayed if funding falls short of expectations. In addition, the District should consider bonding for projects or additional rate increases as needed to achieve the benefits of reduced monthly charges from Boise and increased water self-reliance by producing irrigation water for District patron use.

The District has not had a rate increase since 2019, when rates were increased from $36 per month to the current rate of $39 per month. It is typical for utilities to raise their sewer rates every year or two in response to rising costs of labor, supplies, and construction. In comparison with its neighboring communities, the District's monthly rates are on the low end. Figure 5-3 presents neighboring utility rates. This comparison is not to justify a rate increase, but simply provide context to the proposed rate increase included in Financing Scenario 2. The District has been providing the same service as these neighboring utilities but at a lower cost. Over time the previous rate increase buying power eroded due to inflation and a rate increase is needed to sustain the current level of service provided to District patrons.

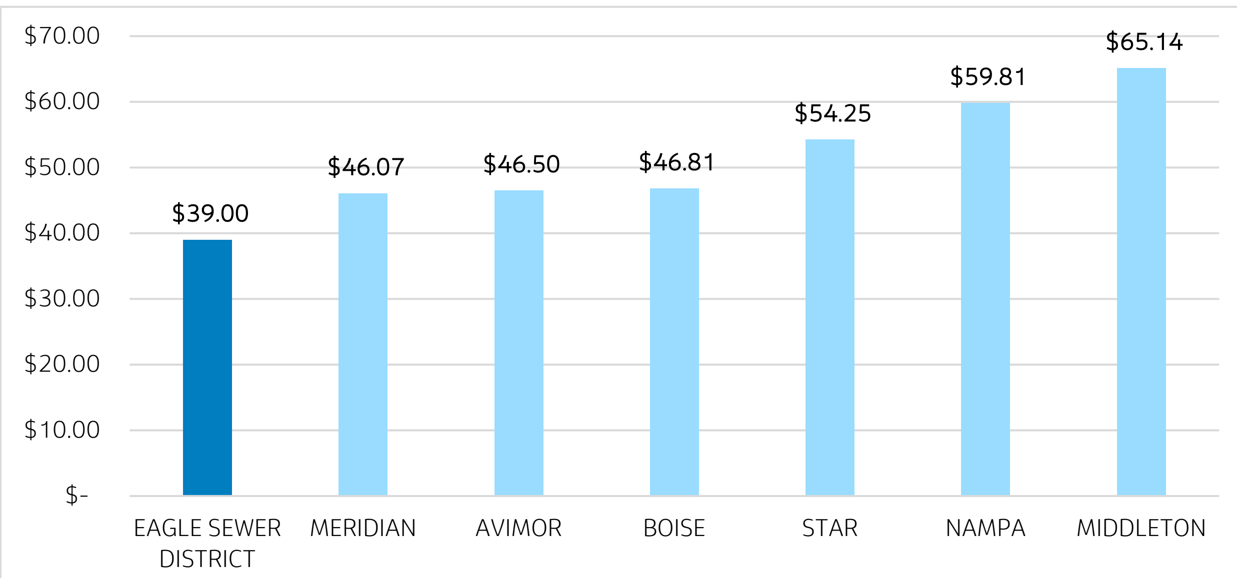

Figure 5-3. Neighboring Utility Fiscal Year 2024 Monthly Rates

Additionally, the District maintains a conservative approach to spending. The District operates with a financial reservice minimum of $8,000,000, which includes an emergency response fund and depreciation fund for asset replacement. The District has approximately $9,000,000 in unrestricted funds available for capital project funding, having anticipated future infrastructure investments being needed.

With the District's current and forecast operating and capital funds under Financing Scenario 2, the District is able to draw down the reserves starting in 2024 through 2028 to pay cash for the recommended capital improvements for those years. In anticipation of needing additional funding in 2028, Jacobs recommends that the District re-evaluate the operational needs and if required, bond the capital improvements recommended in 2028 through 2032. This creates a clean, phased financial model that allows cash flow for projects included in Alternative 3.

5.5 Conclusions

Jacobs and the District developed a financial model to determine the effects of Alternative 3 improvements on the future District cash flow. The analysis included a review of the implementation schedule, phasing, and funding strategies. Additionally, it included a forecast of the impacts on cash reserves and depreciation funding given increased operating expenses and planned capital costs over a 10-year planning period under 2 scenarios. Under current projections and Funding Scenario 2, the District will be able to fund capital projects with this strategy with its cash reserves and increased rate revenue until 2028, when the District will re-evaluate the funding sources, likely increasing rate revenue or bonding to complete the remainder of the Alternative 3 improvements.

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6. References

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Appendix A
Model Calibration and Validation

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ESD Sumo Model Calibration and Validation

Date: November 8, 2023

Project name: ESD Wastewater Treatment Facilities Plan

Author: Yash Chaudhary/Jacobs

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Suite 1200
Boise, ID 83702
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T +1.208.383.6208

www.jacobs.com

1. Introduction

Eagle Sewer District (District) is carrying out an update to their facility plan and is considering upgrades to their existing lagoon treatments systems to handle increased flows and loads as well as improve the effluent quality. This technical memorandum (TM) is to document the process model development, calibration, and validation for the Eagle Sewer District WLTF.

2. Historical Data

To calibrate plant-wide process model, historical influent and effluent water quality and flow data from the previous two years (2021-2022) were analyzed for trends in influent load. Different periods were selected for calibrating and validating a steady state model. Typically, periods of different seasonal conditions are selected in order to ensure the model predictability extends beyond a particular scenario.

Influent flow, five-day Biological Oxygen Demand (BOD_5), Total Suspended Solids (TSS), Ammonia Nitrogen (NH_3), and Total Phosphorus (TP) are recorded. Influent flow is collected daily, while the various wastewater constituents are measured once a month. Since June 2021, Chemical Oxygen Demand (COD) has also been measured once a month. Figure 1 shows the influent BOD5, COD and TSS, while Figure 2 shows the nutrient loadings to the WLTF.

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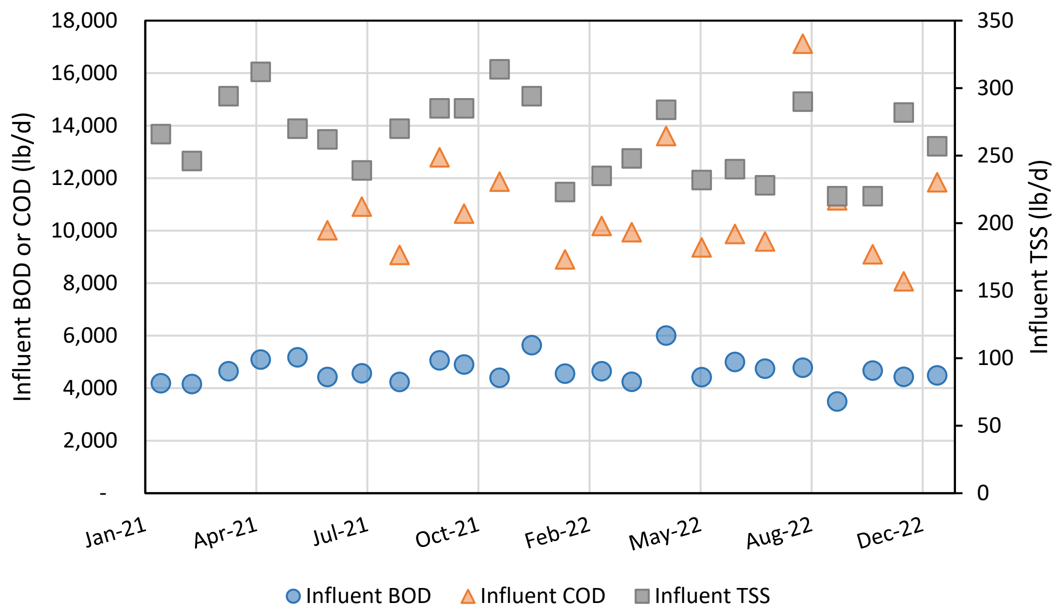

Figure 1. Monthly Average Influent Biochemical Oxygen Demand Load, Chemical Oxygen Demand Load, and Total Suspended Solid Load from January 2021 through December 2022

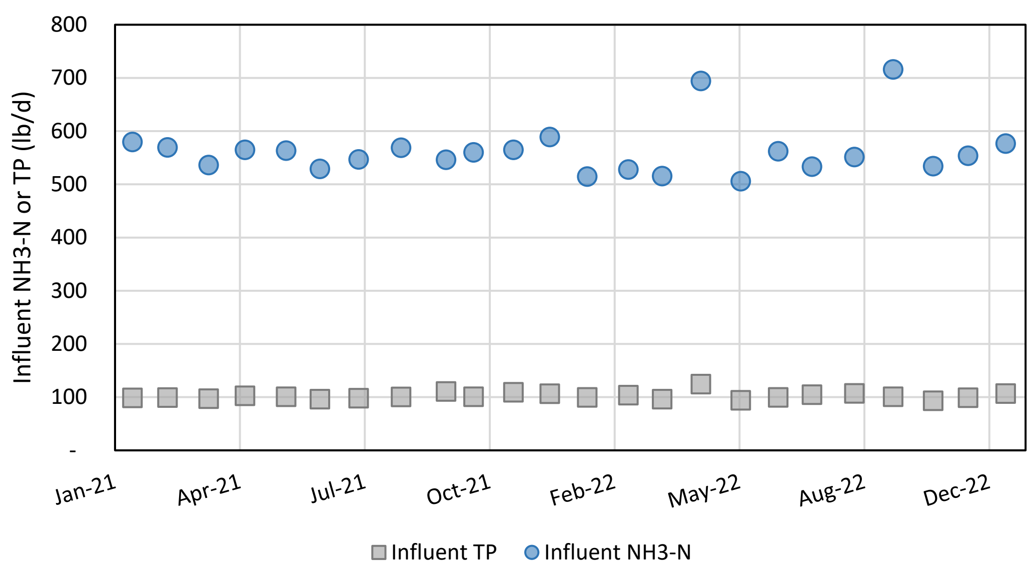

Figure 2. Monthly Average Influent Ammonia-Nitrogen Load and Total Phosphorous Load from January 2021 through December 2022

3. Plant Model Setup

Model development followed the five key steps of the Good Modeling Practice Unified Protocol outlined in *Guidelines for Using Activated Sludge Models* (Rieger,2012). The following provides a brief summary of the process model development. The process model of the Eagle Sewer District Wastewater Lagoon Treatment Facility (WLTF) was developed in the Sumo process modeling platform by Dynamita using the latest release (Sumo 22) and the Sumo1 model base. Figure 3 provides the process flow diagram of the model.

The historical data was used to develop the influent parameters. However, due to lack of influent fractionation data, assumptions were made for the kinetic and stoichiometric parameters based on the previous model. For model calibration, data from March 2022 was selected. Since the District only tests the influent once a month, daily flow and loads were assumed to be steady, with the same values of average monthly data. Table 1 provides a summary of influent parameters used. Table 2 and Table 3 show the influent fractions and kinetic parameters used in the model.

Table 1. Sumo Model Influent Parameters

Parameters	Value	Comments
Flow – mgd	2.2	March 2022 Data
COD – mg/L	565	March 2022 Data
BOD_5 – mg/L	241	March 2022 Data
TSS – mg/L	248	March 2022 Data
TKN – mg N/L	48	Assumed NH_3-N/TKN of 70 percent
Total Phosphorus – mg/L	5.7	March 2022 Data
Alkalinity – mg $CaCO_3$/L	250	Assumed
pH	7.2	Assumed
VFA – mg COD/L	23	Assumed VFA fraction of filtered COD to be 10 percent
Ammonia – mg N/L	29	March 2022 Data
Calcium – mg/L	150	Assumed
Magnesium – mg/L	15	Assumed
Other strong anions (Cl) – mg/L	300	Assumed
Other strong cations (Na) – mg/L	110	Assumed
Potassium – mg/L	16	Assumed
Temperature – °C	10	Obtained from the District

Notes:

°C = degree(s) Celsius
$CaCO_3$ = calcium carbonate
Cl = chlorine
mg/L = milligram(s) per liter
N = nitrogen
Na = sodium

Table 2. Sumo Model Influent Fractionation

Parameters	Model Input Value
Fraction of VSS/TSS	85
Fraction of filtered COD (SCCOD, 1.5 µm, incl. colloids) in total COD (TCOD)	40.5
Fraction of flocculated filtered (SCOD, wo colloids) COD in total COD (TCOD)	20.2
Fraction of VFA in filtered COD (SCCOD, 1.5 µm, incl. colloids)	11.8
Fraction of soluble unbiodegradable organics (SU) in filtered COD (SCCOD, 1.5 µm, including colloids)	13.3
Fraction of particulate unbiodegradable organics (XU) in total COD (TCOD)	14.0
Fraction of heterotrophs (OHO) in total COD (TCOD)	5.0
Fraction of endogenous products (XE) of OHOs	20.0
Fraction of colloidal unbiodegradable organics (CU) in colloidal COD (SCCOD-SCOD)	20.0
Fraction of NHx in TKN	70.0
Fraction of PO4 in TP	58.1
Fraction of N in readily biodegradable substrate (SB)	4.0
Fraction of N in particulate unbiodegradable substrate (XU)	1.0
Fraction of P in readily biodegradable substrate (SB)	1.0
Fraction of P in particulate unbiodegradable substrate (XU)	0.1

Note: Influent fractionation data was not available and therefore Sumo's default fractionation values were used.

Table 3. Sumo Model Kinetic and Stoichiometric Fractions

Parameters	Sumo Default Value	Model Input Value	Comments
COD of biodegradable substrate in volatile solids, g COD/g VSS	1.80	1.80	Acceptable
COD of particulate unbiodegradable organics in volatile solids, g COD/g VSS	1.30	1.42	
COD of biomass in volatile solids, g COD/g VSS	1.42	1.42	Sumo default values used due to lack of historical data.
COD of endogenous products in volatile solids, g COD/g VSS	1.42	1.42	Sumo default values used due to lack of historical data.
Yield on ultimate BOD, g O_2/g DCO	0.95	0.95	Sumo default values used due to lack of historical data.
Fraction of BOD_5 to ultimate BOD in soluble biodegradable substrates	0.90	0.90	Sumo default values used due to lack of historical data.
Fraction of BOD_5 to ultimate BOD in colloidal biodegradable substrates	0.60	0.60	Sumo default values used due to lack of historical data.

Parameters	Sumo Default Value	Model Input Value	Comments
Fraction of BOD_5 to ultimate BOD in particulate biodegradable substrates	0.50	0.50	Sumo default values used due to lack of historical data.
Maximum specific growth rate of OHOs (d^{-1})	4.00	0.95	Growth rate lowered to reasonably match lagoon effluent performance. Slow growth rates likely due to the lower substrate and biomass concentrations than a typical activated sludge process
Maximum specific growth rate of Aerobic Nitrifying organisms (d^{-1})	0.90	0.5	Daily flow and loads were assumed to be steady, with the same values of average monthly data.
Maximum specific growth rate of Algae (d^{-1})	2.0	1.0	Value adjusted to match the effluent performance. Higher value would result in greater release of nutrients from algal decay

Notes:

d = day(s)
g = gram(s)
O_2 = oxygen
OHO = ordinary heterotrophic organisms

The WLTF consists of two treatments trains – One aerated and settling cell in Treatment Train No. 1 and two aerated and two settling cells in Treatment Train No. 2 as shown in Figure 3. Model setup was consistent with the current operational conditions, where one third of the influent flow goes through Cells 1 and 2 and two thirds of the flow goes through Cells 3, 4, 5 and 6. Influent water temperature is set as 20 ^oC for summer and 10 ^oC for winter, obtained from the District. Dissolved oxygen was assumed to be 2 mg/L for the aerated Lagoon Cells 1 and 3, and 1 mg/L for Lagoon Cell 4.

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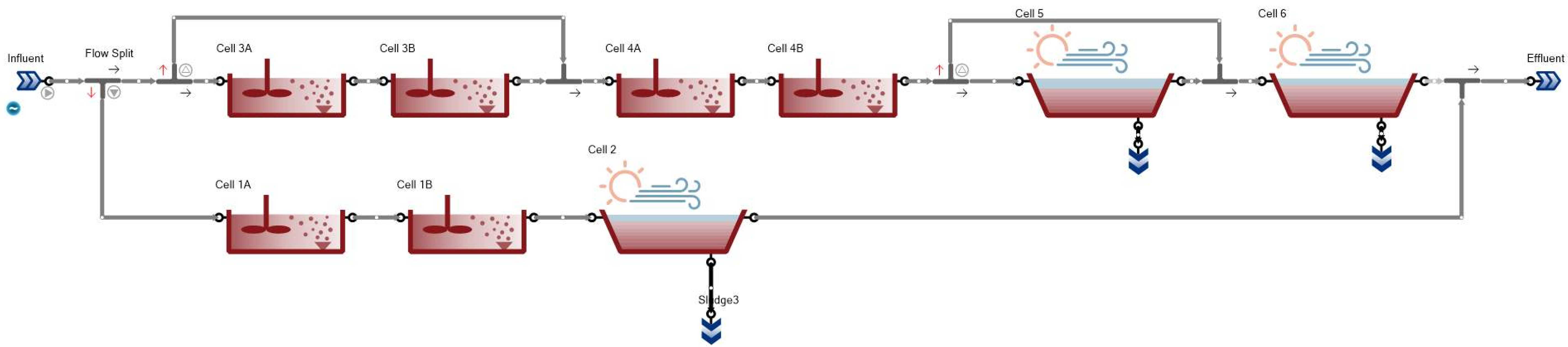

Figure 3. Sumo Model Configuration

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4. Calibration Results

Table 4 presents the results of the process simulation against the actual WLTF effluent data, along with the associated comparison of the two values (calibration error). The calibration range for these parameters should ideally be within 10 to 20 percent. A number of key parameters in Table 4 fall within the range, but there are a number of outliers as well.

Table 4. Calibration Results

Parameter	Model Output	Observed Value	Relative Calibration Error	Acceptable (Yes/No)	Comments
COD, mg/L	105	NA	NA	Yes	
TSS, mg/L	28	34	18%	Yes	
VSS, mg/L	22	NA	NA	Yes	
BOD_5, mg/L	45	48	6%	Yes	
pH	7.0	NA	NA	Yes	
Alkalinity	260	NA	NA	Yes	
TN, mg N/L	37	42	12%	Yes	Indicates little to nitrification occurring which is similar to what the WLTF observes in the winter
TKN, mg N/L	37	40	9%	Yes	
NH_3N, mg N/L	34	33	4%	Yes	
NO_XN, mg N/L	1.0	1.9	49%	Yes, even though the error is high	
TP mg P/L	4.6	5.1	9%	Yes	
OP mg P/L	3.7	3.9	6%	Yes	

5. Validation

The calibrated model was applied to a different period to further validate the predictability of the model, using data from January 2023. Modifications made in the validation model are limited to changes in influent conditions (e.g., influent flow and loads, temperature). No other parameters including characteristics or model parameters shown in Tables 1-3 were adjusted. The results from the validation model are provided in Table 5.

Table 5. Validation Results

Parameter	Model Output	Observed Value	Relative Calibration Error	Acceptable (Yes/No)	Comments
COD, mg/L	103	NA	NA	Yes	
TSS, mg/L	28	30	5%	Yes	
VSS, mg/L	22	NA	NA	Yes	
BOD_5, mg/L	45	56	20%	Yes, even though the error is high	
pH	7.0	NA	NA	Yes	
Alkalinity	251	NA	NA	Yes	
TN, mg N/L	33	40	19%	Yes, even though the error is high	
TKN, mg N/L	32	39	17%	Yes	
NH_3N, mg N/L	30	28.3	-5%	Yes	
NO_XN, mg N/L	0.2	0.47	52%	Yes, even though the error is high	
TP mg P/L	4.3	4.88	12%	Yes	
OP mg P/L	3.8	3.58	-7%	Yes	

6. Conclusions

Overall, the SUMO model simulated the historical performance well, with less than 20 percent error for nearly all the parameters. The calibrated and validated model is representative of the WLTF processes and will be used for the development of treatment upgrade options for the facility plan.

7. Reference

Rieger, Leiv, S. Gillot, G. Langergraber, T. Ohtsuki, A. Shaw, I. Takács, and S. Winkler. 2013. *Guidelines for Using Activated Sludge models*. London: IWA Publishing.

Appendix B
Sample Bills from City of Boise

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CITY OF BOISE

Water Renewal System
P.O. Box 500
Boise, ID 83701-0500
(208) 608-7151 Fax (208) 433-5650

INVOICE

EAGLE SEWER DISTRICT
44 NORTH PALMETTO AVE
EAGLE ID 83616

Date: 09/30/2023
Customer No. 493
Invoice No. IU3730
Due Date: 10/30/2023
Page: 1 of 1

PO Reference No.	Dept. Contact	Payment Terms		
	City of Boise	Net 30		
Description/Item		**Quantity**	**Unit Price**	**Amount Due**
10283 **ESD O&M, 9/23**		**1**	**114,816.77**	**114,816.77**
			Total Due:	**$114,816.77**

Please remit balance prior to the due date. Past due accounts may be referred to Collections.

Invoice No. IU3730

Account Number **493**

Due Date	**Amount Due**
10/30/2023	**$114,816.77**

Amount Enclosed $ ___________

Bill To:
EAGLE SEWER DISTRICT
44 NORTH PALMETTO AVE
EAGLE ID 83616

WATER RENEWAL FUND

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PUBLIC WORKS DEPARTMENT

CITYOFBOISE.ORG

EAGLE SEWER DISTRICT	O&M BILLING	PREPARED ON:	9/30/2023

SEPTEMBER 2023

PRIMARY MONITORING STATION	DAILY AVERAGE			MONTHLY UNIT RATE				BILLING
FLOW [1]	2,308,011.77	GALLONS	x	$	32.92	per 1,000 GAL	=	$ 75,972.05
BOD [2]	221.04	LBS	x		31.75	per LB	=	7,018.13
TSS [2]	272.21	LBS	x		25.00	per LB	=	6,805.18
NH3N [2]	230.89	LBS	x		18.33	per LB	=	4,232.92
TP [2]	86.34	LBS	x		108.33	per LB	=	9,353.41
PRIMARY CHARGES								$ 103,381.70

LAKEMOOR MONITORING STATION	DAILY AVERAGE			MONTHLY UNIT RATE				BILLING
FLOW [1]	60,400.00	GALLONS	x	$	32.92	per 1,000 GAL	=	$ 1,988.17
BOD [2]	165.05	LBS	x		31.75	per LB	=	5,240.25
TSS [2]	139.94	LBS	x		25.00	per LB	=	3,498.57
NH3N [2]	18.75	LBS	x		18.33	per LB	=	343.79
TP [2]	3.28	LBS	x		108.33	per LB	=	354.98
LAKMOOR CHARGES								$ 11,425.75

TOTAL CHARGES	
PRIMARY	$ 103,381.70
LAKEMOOR	11,425.75
FIXED RATE	9.32
	$ 114,816.77

[1] Average Daily Flow - The total flow in gallons divided by the number of days over which the total applies, and expressed as thousand gallons per day

[2] Average Daily Lbs - The total constituant in pounds for the sampling period divided by the number of days in the sampling period, multiplied by the ratio calculated by dividing the monthly Average Daily Flows by the sampling period Average Daily Flows.

RATE CONVERSION TABLE						
	Annual Unit Rates			Monthly Unit Rate [3]		
FLOW	$ 395.00	/	12	$	32.92	per 1,000 gallons
BOD	381.00	/	12		31.75	per Lb
TSS	300.00	/	12		25.00	per Lb
NH3N	220.00	/	12		18.33	per LB
TP	1,300.00	/	12		108.33	per LB
CCF: Hundred Cubic Feet; 1 CCF = 748.052 gallons						

[3] Monthly Unit Rate assumes 30.4167 days per month

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EAGLE SEWER DISTRICT

SEPTEMBER 2023

LOADING REPORT

Mean Daily Flow (MGD)	
Mean Daily Flow [A]	2.3267902
Mean Sampling Period Flows (MGD)	
TSS [B]	2.3328042
BODC [C]	2.3443440
NH3N [D]	2.3328042
Total P [E]	2.3328042
Mean Sample Period (lbs/day)	
TSS [F]	272.9106
BODC [G]	159.0794
NH3N [H]	231.4834
Total P [I]	86.5623
Mean Daily Loading (lbs/day)	
TSS (A/B*F)	272.2070
BOD (A/C*G) * 1.4	221.0436
NH3N (A/D*H)	230.8867
Total P (A/E*I)	86.3392
Total Monthly Loading (lbs/month)	
TSS (A/B*F*DAYS/MO)	8166
BOD (A/C*G*DAYS/MO)	6631
NH3N (A/D*H*DAYS/MO)	6927
Total P (A/E*I*DAYS/MO)	2590

Prepared by:

10/19/23

Validated by: Date:

10/19/23

Date	Parameter	Remarks

DRAFT

Eagle Sewer District | September 2023 Loading.

Date	Flow (MGD)	LIMS	TSS (mg/L)	BOD (mg/L)	NH3 as N (mg/L)	Total P. (mg/L)	COD (mg/L)	TSS (lbs)	BOD (lbs)	NH3 as N (lbs)	Total P. (lbs)
9/1/2023	2.387654										
9/2/2023	2.306559										
9/3/2023	2.302694										
9/4/2023	2.302333										
9/5/2023	2.310355										
9/6/2023	2.354033	BB03196-01	15.0		9.39	5.01	56.0	294.4895		184.3504	98.3595
9/7/2023	2.464394	BB03203-01	14.0	7.68	9.80	4.62	56.0	287.7426	157.8474	201.4199	94.9551
9/8/2023	2.521175										
9/9/2023	2.39931										
9/10/2023	2.383523										
9/11/2023	2.304368										
9/12/2023	2.297452										
9/13/2023	2.304286	BB03236-01	13.9		12.7	4.68	54.0	267.1267		244.0654	89.939
9/14/2023	2.309121	BB03241-01	15.5		11.7	4.19	51.0	298.5001		225.3194	80.6913
9/15/2023	2.304738										
9/16/2023	2.299747										
9/17/2023	2.29881										
9/18/2023	2.300274										
9/19/2023	2.304626										
9/20/2023	2.307639	BB03252-01	14.7	7.08	12.2	4.47	48.0	282.9119	136.2596	234.7977	86.0283
9/21/2023	2.317618	BB03255-01	13.0		11.4	4.42	54.0	251.2761		220.3498	85.4339
9/22/2023	2.31123										
9/23/2023	2.302385										
9/24/2023	2.300721										
9/25/2023	2.299385										
9/26/2023	2.300405										
9/27/2023	2.300192	BB03264-01	12.9	9.14	14.0	4.08	69.0	247.4685	175.3381	268.5704	78.2691
9/28/2023	2.305151	BB03265-01	13.2	8.68	14.2	4.10	62.0	253.7695	166.8726	272.9944	78.8223
9/29/2023	2.306358										
9/30/2023	2.29717										
Total Flow	69.803706	**Sampling Period**	8	4	8	8	8	8	4	8	8
Days	30	**Avg. Per Period**	14.0	8.15	11.9	4.45	56.3	272.91061	159.07943	231.48343	86.56231
Avg. Flow	2.3267902	**Period Total Flow**	18.66243	9.37738	18.66243	18.66243	18.66243	18.66243	9.37738	18.66243	18.66243
Flow Shift	No	**Avg. Flow/Period**	2.33280	2.34434	2.33280	2.33280	2.33280	2.33280	2.34434	2.33280	2.33280

DRAFT

LAKE MOOR (EAGLE SEWER DISTRCT)

SEPTEMBER 2023

LOADING REPORT

Mean Daily Flow (MGD)	
Mean Daily Flow [A]	0.0604000
Meon Sompling Period Flows (MGD)	
TSS [B]	0.0590000
BOD [C]	0.0590000
NH3N [D]	0.0590000
Total P [E]	0.0590000
Mean Sample Period (lbs/day)	
TSS [F]	136.6989
BOD [G]	161.2216
NH3N [H]	18.3177
Total P [I]	3.2008
Meon Doily Loading (lbs/day)	
TSS (A/B*F)	139.9426
BOD (A/C*G)	165.0472
NH3N (A/D*H)	18.7523
Total P (A/E*I)	3.2767
Totol Monthly Loading (lbs/month)	
TSS (A/B*F*DAYS/MO)	4198
BOD (A/C*G*DAYS/MO)	4951
NH3N (A/D*H*DAYS/MO)	563
Total P (A/E*I*DAYS/MO)	98

Prepared by:

10/19/23

Validated by: Date:

10/19/23

Date	Parameter	Remarks

DRAFT

Lake Moor (Eagle Sewer Distrct) | September 2023 Loading.

Date	Flow (MGD)	LIMS	TSS (mg/L)	BOD (mg/L)	NH3 as N (mg/L)	Total P. (mg/L)	COD (mg/L)	TSS (lbs)	BOD (lbs)	NH3 as N (lbs)	Total P. (lbs)
9/1/2023	0.067										
9/2/2023	0.064										
9/3/2023	0.061										
9/4/2023	0.065										
9/5/2023	0.067										
9/6/2023	0.064	BB03196-02	286	312	34.2	6.69	668	152.6554	166.5331	18.2546	3.5709
9/7/2023	0.059	BB03203-02	250	304	36.7	6.21	646	123.015	149.5862	18.0586	3.0557
9/8/2023	0.062										
9/9/2023	0.061										
9/10/2023	0.059										
9/11/2023	0.062										
9/12/2023	0.06										
9/13/2023	0.059	BB03236-02	289	366	36.7	6.66	899	142.2053	180.094	18.0586	3.2771
9/14/2023	0.057	BB03241-02	284	317	36.4	6.47	677	135.0079	150.6955	17.3038	3.0757
9/15/2023	0.059										
9/16/2023	0.059										
9/17/2023	0.062										
9/18/2023	0.061										
9/19/2023	0.059										
9/20/2023	0.059	BB03252-02	319	366	38.5	6.58	760	156.9671	180.094	18.9443	3.2378
9/21/2023	0.058	BB03255-02	269	321	39.0	6.98	692	130.1207	155.2741	18.8651	3.3764
9/22/2023	0.06										
9/23/2023	0.058										
9/24/2023	0.058										
9/25/2023	0.059										
9/26/2023	0.059										
9/27/2023	0.059	BB03264-02	271	309	38.5	6.51	690	133.3483	152.0465	18.9443	3.2033
9/28/2023	0.057	BB03265-02	253	327	38.1	5.91	657	120.2711	155.4493	18.112	2.8095
9/29/2023	0.059										
9/30/2023	0.059										
Total Flow	1.812	**Sampling Period**	8	8	8	8	8	8	8	8	8
Days	30	**Avg. Per Period**	278	328	37.3	6.50	711	136.69885	161.22159	18.31766	3.20080
Avg. Flow	0.0604000	**Period Total Flow**	0.47200	0.47200	0.47200	0.47200	0.47200	0.47200	0.47200	0.47200	0.47200
Flow Shift	No	**Avg. Flow/Period**	0.05900	0.05900	0.05900	0.05900	0.05900	0.05900	0.05900	0.05900	0.05900

DRAFT

2023 September Effluent Daily Pumping Totals to West Boise WRF

Eagle Sewer District
Daily Gallons Pumped

September	GALLONS
1	2,279,000
2	2,279,000
3	2,279,000
4	2,280,000
5	2,285,000
6	2,356,000
7	2,364,000
8	2,357,000
9	2,350,000
10	2,283,000
11	2,278,000
12	2,278,000
13	2,278,000
14	2,278,000
15	2,279,000
16	2,278,000
17	2,278,000
18	2,278,000
19	2,278,000
20	2,279,000
21	2,278,000
22	2,278,000
23	2,279,000
24	2,278,000
25	2,279,000
26	2,278,000
27	2,278,000
28	2,278,000
29	2,279,000
30	2,278,000
TOTAL	**68,677,000**

Appendix C
Expression of Interest Letters from Irrigation Companies

DRAFT

DRAFT

Boise Office
1101 W. River St.
Suite 110
Boise, Idaho 83702
Tel. (208) 629-7447

Challis Office
1301 E. Main Ave.
P.O. Box 36
Challis, Idaho 83226
Tel. (208) 879-4488

Twin Falls Office
213 Canyon Crest Drive
Suite 200
Twin Falls, Idaho 83301
Tel. (208) 969-9585

Fax (all offices)
(208) 629-7559

SAWTOOTH LAW
OFFICES, PLLC

David P. Claiborne
S. Bryce Farris
Evan T. Roth
Daniel V. Steenson
Andrew J. Waldera
Kelsea E. Donahue
Brian A. Faria
Thomas M. Larsen
Patxi Larrocea-Phillips
John A. Richards
Katie L. Vandenberg-Van Vliet
James R. Bennetts *(retired)*

Tuesday, June 20, 2023

Neil Jenkins, General Manager
Eagle Sewer District
44 N. Palmetto Avenue
Eagle, ID 83616-5149

RE: Class A Recycled Wastewater—Irrigation Reuse Opportunity

Dear Neil:

I write you on behalf of my client Farmers Union Ditch Company, Ltd. ("Company"). In response to your request, I spoke with the Company Board and it is excited by the potential irrigation reuse opportunity that Eagle Sewer District may make available as part of its long-term capital planning (potentially moving away from discharge to the City of Boise in favor of Class A recycling for irrigation reuse through a willing irrigation delivery entity).

As you know from our prior conversations, the Company is a proponent of these types of irrigation reuse opportunities having previously been under contractual arrangement with the City of Boise concerning wastewater discharge for irrigation reuse from its Lander Street facility to the Farmers Union Canal ("Canal"). Unfortunately, that proposal fell through for reasons largely unknown to the Company.

In addition to conceptual buy-in for the irrigation reuse proposal, the Company is also willing to explore potential opportunities for year-round discharge to the Canal. While year-round discharge to the Canal presents non-irrigation season maintenance challenges, there may be ways that maintenance can adequately be performed despite the presence of water, or there may be other mechanisms by which discharge can be routed or bypassed differently temporarily. At bottom, the Company is not a hard "no" against year-round discharge—it is willing to discuss the possibility further.

I trust that this letter serves the District's current needs for purposes of considering discharge to the Canal as at least one alternative to investigate during its long-range capital (and operational) planning process. If you need anything more, please feel free to contact me at 208-629-7447.

Regards,

Andrew J. Waldera

DRAFT

Boise Office
1101 W. River St.
Suite 110
Boise, Idaho 83702
Tel. (208) 629-7447

Challis Office
1301 E. Main Ave.
P.O. Box 36
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Tuesday, June 20, 2023

Neil Jenkins, General Manager
Eagle Sewer District
44 N. Palmetto Avenue
Eagle, ID 83616-5149

RE: Class A Recycled Wastewater—Irrigation Reuse Opportunity

Dear Neil:

I write you on behalf of my client Pioneer Irrigation District ("Pioneer"). In response to your request, I spoke with the Pioneer Board and it is excited by the potential irrigation reuse opportunity that Eagle Sewer District may make available as part of its long-term capital planning (potentially moving away from discharge to the City of Boise in favor of Class A recycling for irrigation reuse through a willing irrigation delivery entity).

As you know from our prior conversations, Pioneer is a proponent of these types of irrigation reuse opportunities as evidenced by its current contractual arrangement with the City of Nampa concerning wastewater discharge for irrigation reuse within Pioneer's Phyllis Canal system. Pioneer anticipates accepting discharge of Class A recycled wastewater from the city beginning in the 2025 irrigation season, if not sooner.

Unfortunately, year-round discharge to the Phyllis Canal is likely not achievable given existing maintenance difficulties at the head end of the Canal near Eagle Island. But, I am confident that the Board would at least revisit and discuss the issue with Eagle Sewer District if desired.

I trust that this letter serves the Eagle Sewer District's current needs for purposes of considering discharge to the Phyllis Canal as at least one alternative to investigate during its long-range capital (and operational) planning process. If you need anything more, please feel free to contact me at 208-629-7447.

Regards,

Andrew J. Waldera

Appendix D
Vendor Quotes

DRAFT

Lagoon Intensification

- WavTex
- Webitat

DRAFT

Technologies
Engineering Clean Water Solutions

August 16, 2023

To: Neil Jenkins
Eagle Sewer District

Sub: WavTex™ SFF System for Eagle, ID WWTP: Entex Project #7425 R1

Dear Neil,

On behalf of Entex Technologies, thank you for the opportunity to present a design concept for your treatment application. Enclosed, please find Entex's WavTex SFF design and budgetary price for the referenced application.

Technology Selection
Entex's WavTex system second generation moving media c/w high-strength, lock-knit EnTextile™ and integral aeration.

Treatment Objective
- Polish NH_3-N at current flow (2.23 MGD)
- Add additional capacity per the following options:
  - Option I – Up to 0.5 MGD additional
  - Option II – Up to 2.5 MGD additional
  - Option III – Up to 4.0 MGD additional
- Effluent BOD_5 (soluble) ≤ 5 mg/L
- Effluent NH_3-N ≤ 1 mg/L

Treatment Concept
Cells 2, 4, and 5 will be outfitted with a floating WavTex system to create a self-sustained, biological process, thereby increasing the amount of stabilized biomass required for ammonia and BOD removal at various flow ranges.

Budgetary Pricing: See Section 5 below.

Freight: Included

Sincerely,

Lauren A. Takitch
Lauren Takitch, Project Manager

1340 Environ Way, Chapel Hill, NC 27517
919.913.4798 phone | www.entexinc.com

1. About Entex

Entex Technologies offers an unequaled selection of advanced wastewater treatment solutions for municipal and industrial applications alike, including turnkey installation services. Our solutions effectively address space constraints and budget concerns, as well as ever increasing demands for higher quality effluent and increased plant capacity. Technologies provided by Entex have been selected with confidence to treat more than 70 million gallons per day of design capacity.

Entex provides biological systems for carbon and nutrient removal, including phosphorus and nitrogen control. As a provider of both fixed and moving media processes, Entex offers an unbiased design assessment. The Entex team has been involved in over 750 installations with over a combined 100 years of experience. Additionally, Entex offers a flexible suite of tertiary filtration systems that have been Title 22 approved by the State of California for reuse quality effluent. Entex's filtration systems are designed to further polish final effluent and reduce turbidity for reuse purposes.

Entex provides the ability to upgrade treatment facilities to meet the needs of increased capacity and improved effluent discharge requirements, often without the need for additional treatment basins. These systems provide powerful solutions to the challenges facing wastewater treatment systems, offering extraordinary levels of performance typically at a substantially lower cost than conventional solutions.

2. About WavTex^{TM}

WavTex is a second generation moving media system using Entex's patent pending EnTextile™ media for use in Integrated Fixed-film Activated Sludge (IFAS) and Submerged Fixed-Film (SFF) systems. Independently moving EnTextile media sheets continually wave in the aeration basin in a random motion, ensuring excellent oxygen and substrate transfer.

WavTex is a cost-effective solution for existing activated sludge plants that need more advanced treatment. Because little or no additional tankage is required, WavTex is ideal for plants with limited room for expansion. It is also an excellent choice for space efficient, high performance new plant designs.

WavTex moving flex media provides extensive surface area for biomass growth. The attached biomass population can more than double the effective MLSS concentration. The vigorous motion of the EnTextile media in the aeration basin provides a high shear on the surface of the EnTextile media, maintaining a thin biological film. The thin film provides for high rate biological kinetics.

WavTex Modules in Aeration Tank

EnTextile Media close up

3. Basis and Design Description

3.1 Design Basis

The Eagle, ID lagoon upgrade was based on the following influent flow and characterization. The design basis below must be verified as accurate design basis information is critical for a properly performing system.

Current Lagoon Performance		
	Influent	Effluent
MGD	2.23	2.23
gpd	2,230,000	2,230,000
ppd	18,598,200	18,598,200
BOD (ppm)	214	46
BOD (ppd)	3,980	856
NH_3-N (ppm)	43	21
NH_3-N (ppd)	800	391

Additional Lagoon Upgrades				
	Polishing Only	Option I	Option II	Option III
MGD, additional	-	0.50	2.50	4.00
ppd, additional	-	4,170,000	20,850,000	33,360,000
BOD (ppm)	46	214	214	214
BOD (ppd)	-	892	4,462	7,139
NH_3-N (ppm)	21	43	43	43
NH_3-N (ppd)	-	179	897	1,434
MGD, total	2.23	2.73	4.73	6.23
ppd, total	18,598,200	22,768,200	39,448,200	51,958,200
BOD (ppm)	46.0	76.8	135	154
BOD (ppd)	856	1,748	5,317	7,995
NH_3-N (ppm)	21.0	25.0	32.6	35.1
NH_3-N (ppd)	391	570	1,287	1,825

The design effluent quality for all cases is below. These values were based on the Class A Reuse standards.

- Effluent BOD_5 (mg/L, soluble) ≤ 5
- Effluent NH_3-N (mg/L) ≤ 1

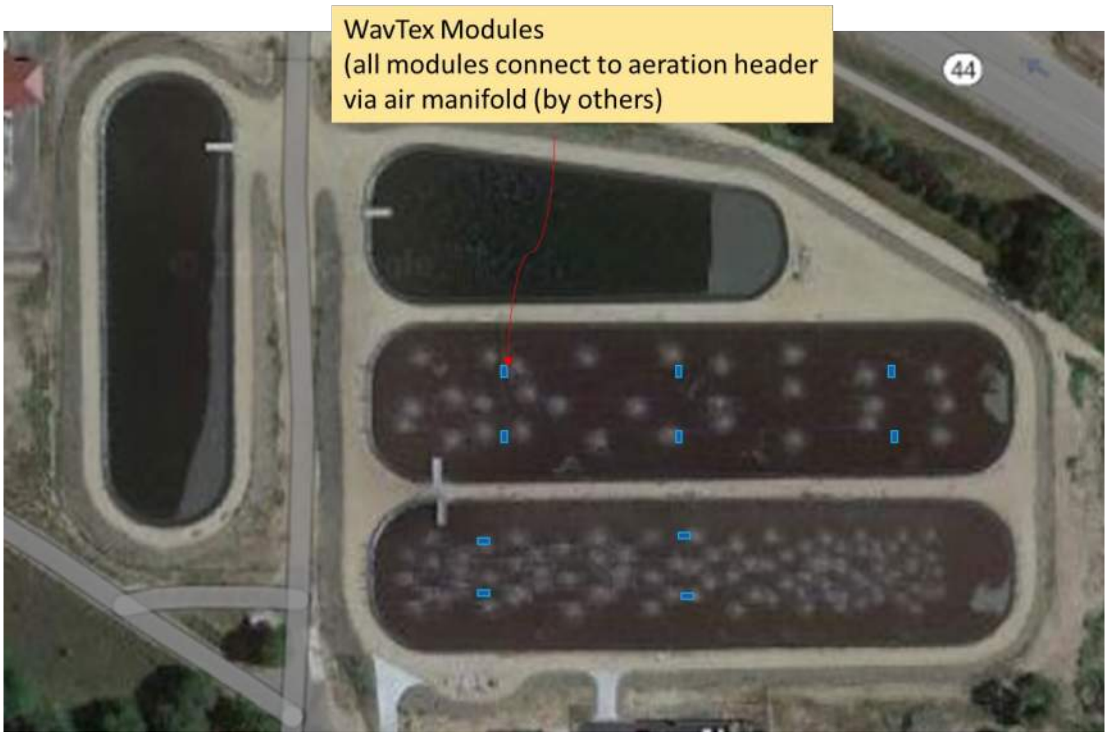
Note that both ground water recharge and non-recharge uses require full nitrification.

A minimum side water depth of 10 feet was used for this design.

3.2 Process Flow and Description

A schematic of the proposed process flow is shown below (Not to scale and arrangement to be optimized)

Polishing Only

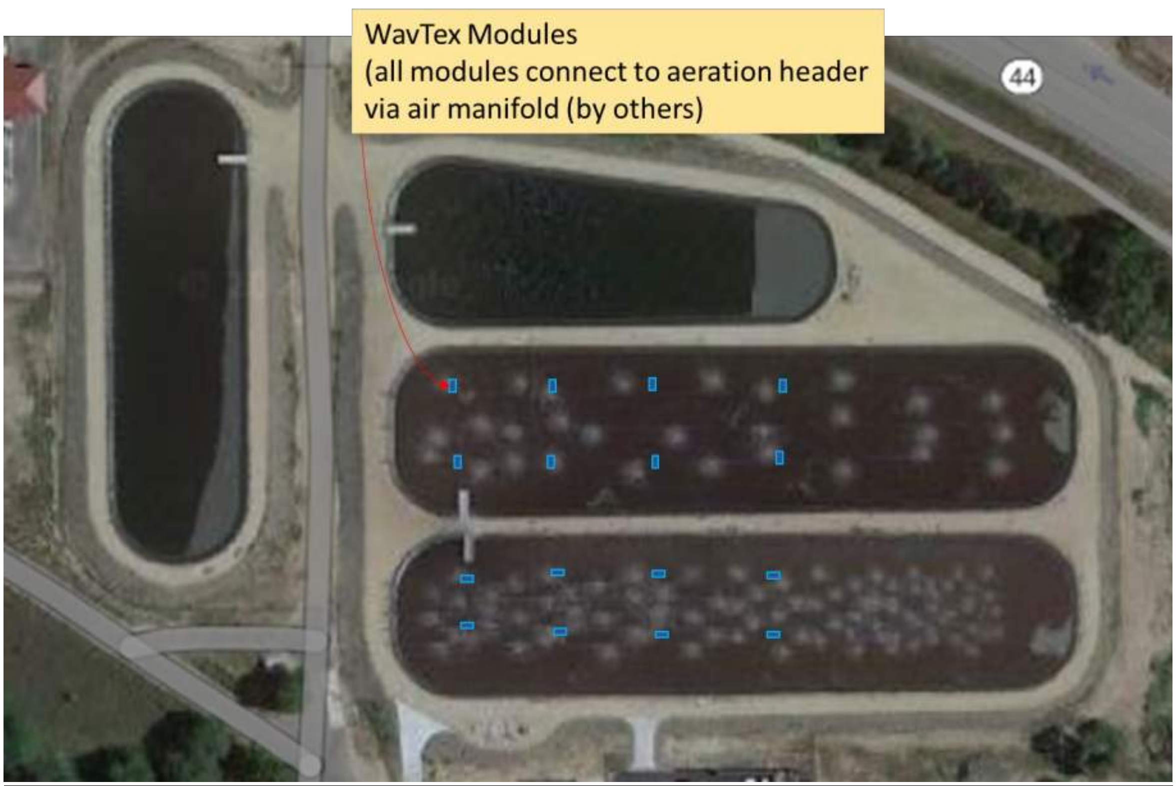


In the polishing option, sixteen (16) WavTex units will be installed in order to polish ammonia at the current flow of 2.23 MGD. The WavTex modules will be dispersed between the various trains and cells per the schematic above. Each WavTex module will be 12.5’ long by 6’ wide by 9.5’ tall with media sheets extending to an elevation of 8.5’. Each module will host 6,163 ft^2 of EnTextile media on which the microbes necessary for BOD and ammonia removal will grow and proliferate.

Each module has an integrated coarse bubble aeration grid that will provide 100 scfm of coarse bubble aeration for a total of 1,600 scfm. This airflow will scour the EnTextile media, ensuring that a healthy biofilm thickness is maintained. The scour will also contribute to the airflow required for mixing and treatment, however a supplemental airflow supplied by the floor mounted diffusers will also be required for treatment. The aeration requirements for each Option are summarized in Section 3.3 below.

Air will be conveyed from the blowers (by others) to the WavTex modules via a floating manifold of hoses and fittings (by others).

<u>Upgrade Option I – 2.23 to 2.73 MGD</u>

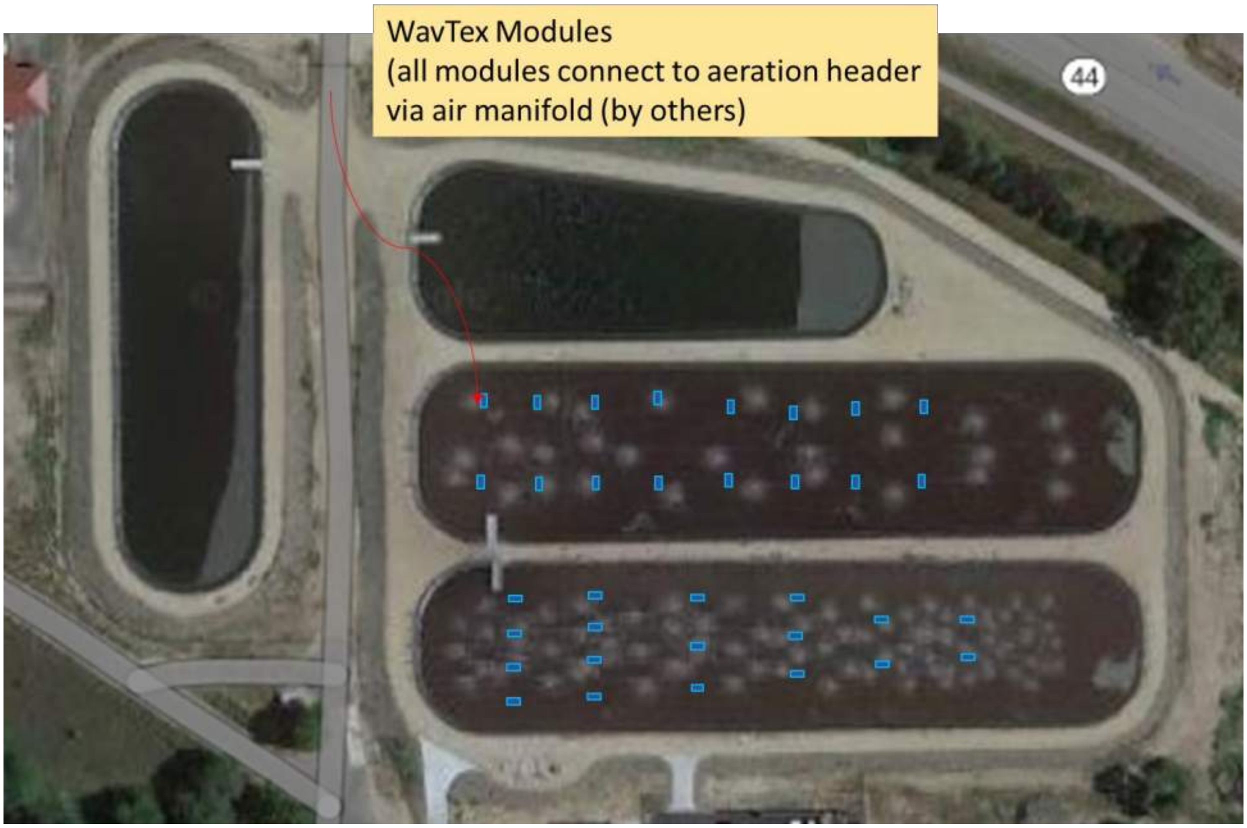


In Option I, twenty-four (24) WavTex units will be installed in order to polish ammonia at the current flow of 2.23 MGD as well as treat BOD and ammonia up to an additional 0.5 MGD. The total flowrate will be 2.23 - 2.73 MGD. The WavTex modules will be dispersed between the various trains and cells per the schematic above. Each WavTex module will be 12.5’ long by 6’ wide by 9.5’ tall with media sheets extending to an elevation of 8.5’. Each module will host 6,163 ft^2 of EnTextile media on which the microbes necessary for BOD and ammonia removal will grow and proliferate.

Each module has an integrated coarse bubble aeration grid that will provide 100 scfm of coarse bubble aeration for a total of 2,400 scfm. This airflow will scour the EnTextile media, ensuring that a healthy biofilm thickness is maintained. The scour will also contribute to the airflow required for mixing and treatment, however a supplemental airflow supplied by the floor mounted diffusers will also be required for treatment. The aeration requirements for each Option are summarized in Section 3.3 below.

Air will be conveyed from the blowers (by others) to the WavTex modules via a floating manifold of hoses and fittings (by others).

Upgrade Option II – 2.73 to 4.73 MGD



In Option II, fifty-two (52) WavTex units (28 additional) will be installed in order to polish ammonia at the current flow of 2.23 MGD as well as treat BOD and ammonia up to an additional 2.5 MGD. The total flowrate will be 2.73 - 4.73 MGD. The WavTex modules will be dispersed between the various trains and cells per the schematic above. Each WavTex module will be 12.5’ long by 6’ wide by 9.5’ tall with media sheets extending to an elevation of 8.5’. Each module will host 6,163 ft^2 of EnTextile media on which the microbes necessary for BOD and ammonia removal will grow and proliferate.

Each module has an integrated coarse bubble aeration grid that will provide 100 scfm of coarse bubble aeration for a total of 5,200 scfm. This airflow will scour the EnTextile media, ensuring that a healthy biofilm thickness is maintained. The scour will also contribute to the airflow required for mixing and treatment, however a supplemental airflow supplied by the floor mounted diffusers will also be required for treatment. The aeration requirements for each Option are summarized in Section 3.3 below.

Air will be conveyed from the blowers (by others) to the WavTex modules via a floating manifold of hoses and fittings (by others).

<u>Upgrade Option III – 4.73 to 6.23 MGD</u>

In Option III, seventy-two (72) WavTex units (20 additional) will be installed in order to polish ammonia at the current flow of 2.23 MGD as well as treat BOD and ammonia up to an additional 4.0 MGD. The total flowrate will be 4.73 – 6.23 MGD. The WavTex modules will be dispersed between the various trains and cells per the schematic above. Each WavTex module will be 12.5' long by 6' wide by 9.5' tall with media sheets extending to an elevation of 8.5'. Each module will host 6,163 ft^2 of EnTextile media on which the microbes necessary for BOD and ammonia removal will grow and proliferate.

Each module has an integrated coarse bubble aeration grid that will provide 100 scfm of coarse bubble aeration for a total of 7,200 scfm. This airflow will scour the EnTextile media, ensuring that a healthy biofilm thickness is maintained. The scour will also contribute to the airflow required for mixing and treatment, however a supplemental airflow supplied by the floor mounted diffusers will also be required for treatment. The aeration requirements for each Option are summarized in Section 3.3 below.

Air will be conveyed from the blowers (by others) to the WavTex modules via a floating manifold of hoses and fittings (by others).

3.3 Aeration Summary

The air requirements per option are detailed in the table below:

Additional Lagoon Upgrades				
	Polishing Only	Option I	Option II	Option III
# WavTex Modules	16	24	52	72
CB scfm	2,753	4,491	11,520	16,627
Coarse bubble scour/module, scfm	100	100	100	100
Coarse bubble scour/system, scfm	1,600	2,400	5,200	7,200
Supplemental coarse bubble, scfm	1,153	2,091	6,320	9,427
Supplemental fine bubble, scfm	692	1,255	3,792	5,656
Scour + supplemental FB, scfm	2,292	3,655	8,992	12,856
HP	100	200	400	600
psig at 10' SWD (9' diffuser depth)	6.3	6.3	6.3	6.3

Further analysis will determine if the existing blowers and aerators are capable of supplying the supplemental airflow required per option (blowers and aerators, if require, by others).

In all Options, air will be conveyed from the air header to the WavTex modules via a floating manifold of hoses and fittings (by others).

4. Installation

The WavTex modules will be placed into the lagoon with a crane. A 3-inch diameter drop pipe is connected to each aeration grid, terminating approximately 6 inches above the water line with a 3” threaded, male NPT fitting. Connections between the blowers (by others) and the WavTex aeration grids are made with floating hose, PVC fittings, and clamps (hoses, fittings, and clamps by others).

5. Pricing

The pricing for each option will be as follows:

Additional Lagoon Upgrades				
	Polishing Only	Option I	Option II	Option III
Total # WavTex Modules	16	24	52	72
Pricing	$895,367.00	$1,337,438.00	$2,878,723.00	$3,972,243.00

Freight included.

6. Scope of Supply

A detailed scope of supply will be provided along with a firm quotation. The equipment list utilized to develop this proposal is shown below.

WavTex Modules *	WavTex modules will be provided with EnTextile Media and welded 304L SS frames with lifting lugs. Each WavTex unit will be approximately 12.5 ft long x 6 ft wide x 9.5 ft high. Each module will have 65 sheets, or 6,163 ft^2 of EnTextile Media. Integrated PVC WavTex aeration included for all units c/w 3-inch diameter drop pipe.
Documentation	Technical submittals and IO&M Manuals
Site Services	One site visit of up to four days to supervise installation and startup and to provide operator training.

*WavTex module quantities varies per option – see Section 5.

Additional items included:

- Process Engineering for all equipment, equipment sizing and selection
- Review and approval of P&I Diagram for the ENTEX scope of supply
- Preliminary General Arrangement Drawings, review and approval of final General Arrangement Drawings for the ENTEX supplied equipment
- Review of biological process reactor drawings, excluding structural design
- Manufacturers' service for installation inspection
- Startup supervision and trainings not to exceed 5-days

Items excluded (not all inclusive):

- Unloading and storage of materials on-site
- Concrete tankage, foundation or secondary containment/spill retention.
- Interconnecting piping, hoses, valves and fittings.
- Electrical, including motor controllers and all electrical interconnections.
- Start-up and operation, including any analytical work.
- Anchor bolts and/or hold down beams, moorings posts and mooring cables.
- Turbidimeter, chemical addition, nutrient addition and chemical analysis.
- Influent and effluent pumping other than liquid transfer between lagoon and filter.
- Process blowers and aerators supplemental to the WavTex integral air grids.
- Covers, hoists or walkways including hoist for disc installation and maintenance.
- Installation, other than factory pre-assembled components.
- Customs, duties, insurance, taxes etc.

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7. Contact Information

Should you have any questions regarding the material found in this proposal, please do not hesitate to contact Lauren Takitch of Entex Technologies Inc.

Sincerely,

Lauren Takitch

Lauren Takitch
Entex Technologies Inc.
1340 Environ Way
Chapel Hill, NC 27517
(724) 953-2425
lauren.takitch@entexinc.com

DRAFT

August 16, 2023

To: Neil Jenkins
Eagle Sewer District

Sub: Webitat™ SFF System for Eagle, ID WWTP: Entex Project #7425a R1

Dear Neil,

On behalf of Entex Technologies, thank you for the opportunity to present a design concept for your treatment application. Enclosed, please find Entex's Webitat SFF design and budgetary price for the referenced application.

Technology Selection
Entex's Webitat system attached growth media c/w high-strength, lock-knit EnTextile™ and integral aeration.

Treatment Objective
- Polish NH_3-N at current flow (2.23 MGD)
- Add additional capacity per the following options:
  - Option I – Up to 0.5 MGD additional
  - Option II – Up to 2.5 MGD additional
  - Option III – Up to 4.0 MGD additional
- Effluent BOD_5 (soluble) ≤ 5 mg/L
- Effluent NH_3-N ≤ 1 mg/L

Treatment Concept
Cells 2, 4, and 5 will be outfitted with a floating Webitat system to create a self-sustained, biological process, thereby increasing the amount of stabilized biomass required for ammonia and BOD removal at various flow ranges.

Budgetary Pricing: See Section 5 below.

Freight: Included

Sincerely,

Lauren A. Takitch
Lauren Takitch, Project Manager

1340 Environ Way, Chapel Hill, NC 27517
919.913.4798 phone | www.entexinc.com

1. About Entex

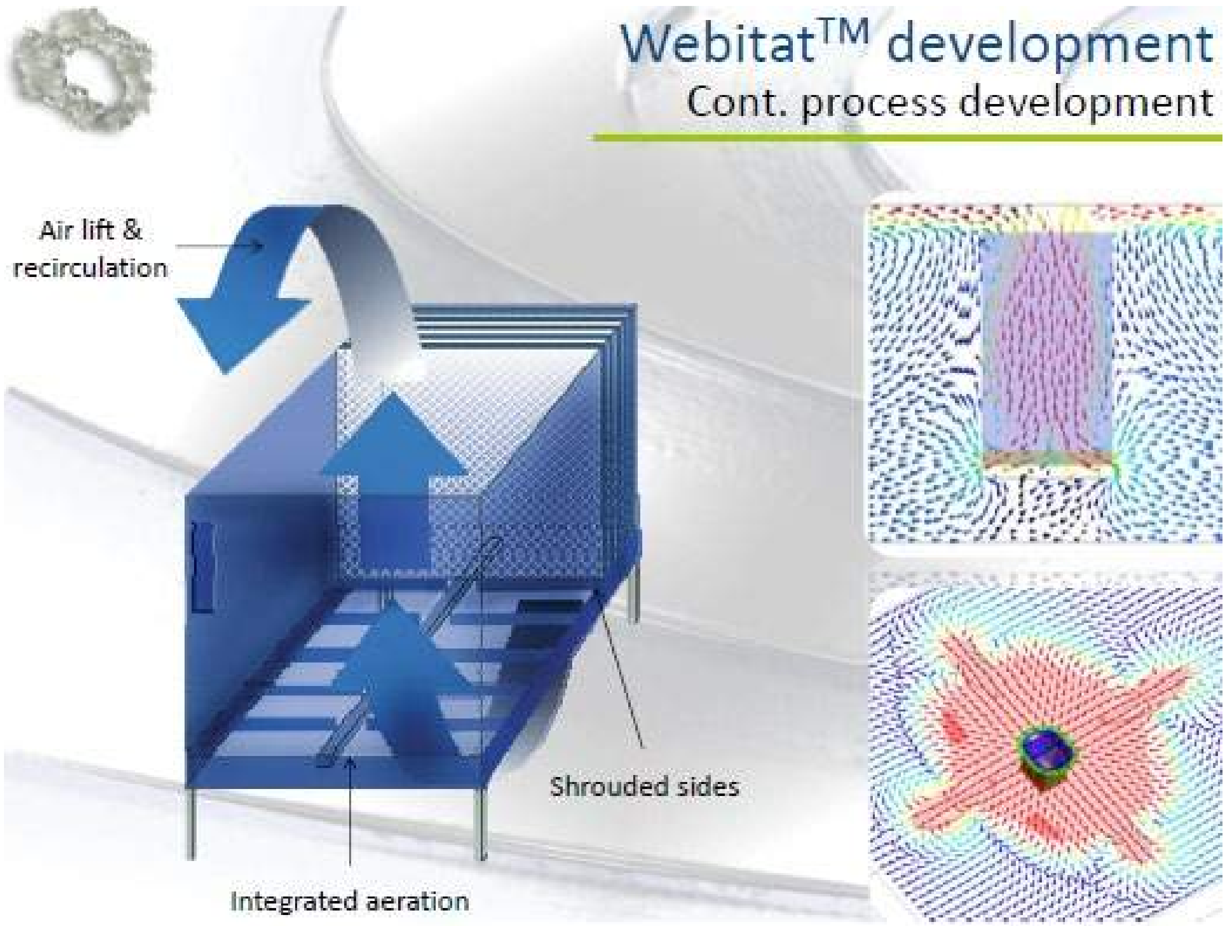
Entex Technologies offers an unequaled selection of advanced wastewater treatment solutions for municipal and industrial applications alike, including turnkey installation services. Our solutions effectively address space constraints and budget concerns, as well as ever increasing demands for higher quality effluent and increased plant capacity. Technologies provided by Entex have been selected with confidence to treat more than 70 million gallons per day of design capacity.

Entex provides biological systems for carbon and nutrient removal, including phosphorus and nitrogen control. As a provider of both fixed and moving media processes, Entex offers an unbiased design assessment. The Entex team has been involved in over 750 installations with over a combined 100 years of experience. Additionally, Entex offers a flexible suite of tertiary filtration systems that have been Title 22 approved by the State of California for reuse quality effluent. Entex's filtration systems are designed to further polish final effluent and reduce turbidity for reuse purposes.

Entex provides the ability to upgrade treatment facilities to meet the needs of increased capacity and improved effluent discharge requirements, often without the need for additional treatment basins. These systems provide powerful solutions to the challenges facing wastewater treatment systems, offering extraordinary levels of performance typically at a substantially lower cost than conventional solutions.

2. About Webitat™

Entex's patented, award winning Webitat process utilizes EnTextile media and allows a proactive control of the attached biofilm thickness by incorporating an integrated aeration mechanism below each Webitat frame. This dedicated aeration ensures a high rate of shear and serves to create an air lift effect, enabling a localized continuous recirculation of substrate. As a result, substrate transfer and diffusion rates can be optimized. Each Webitat is shrouded to confine and direct the integrated aeration into the EnTextile media, increasing scour and recirculation efficiency. The integral aeration flux rate can be controlled via dedicated Webitat process valving to provide proactive operation and process control. The enclosed Webitat module operates as its own high-rate biological reactor, enhancing mixing and biomass inventory. Once installed, the modules do not require access. The construction and configuration allow for maintenance free operation.



Webitat Integral Aeration

3. Basis and Design Description

3.1 Design Basis

The Eagle, ID lagoon upgrade was based on the following influent flow and characterization. The design basis below must be verified as accurate design basis information is critical for a properly performing system.

Current Lagoon Performance		
	Influent	Effluent
MGD	2.23	2.23
gpd	2,230,000	2,230,000
ppd	18,598,200	18,598,200
BOD (ppm)	214	46
BOD (ppd)	3,980	856
NH_3-N (ppm)	43	21
NH_3-N (ppd)	800	391

Additional Lagoon Upgrades				
	Polishing Only	Option I	Option II	Option III
MGD, additional	-	0.50	2.50	4.00
ppd, additional	-	4,170,000	20,850,000	33,360,000
BOD (ppm)	46	214	214	214
BOD (ppd)	-	892	4,462	7,139
NH_3-N (ppm)	21	43	43	43
NH_3-N (ppd)	-	179	897	1,434
MGD, total	2.23	2.73	4.73	6.23
ppd, total	18,598,200	22,768,200	39,448,200	51,958,200
BOD (ppm)	46.0	76.8	135	154
BOD (ppd)	856	1,748	5,317	7,995
NH_3-N (ppm)	21.0	25.0	32.6	35.1
NH_3-N (ppd)	391	570	1,287	1,825

The design effluent quality for all cases is below. These values were based on the Class A Reuse standards.

- Effluent BOD_5 (mg/L, soluble) ≤ 5
- Effluent NH_3-N (mg/L) ≤ 1

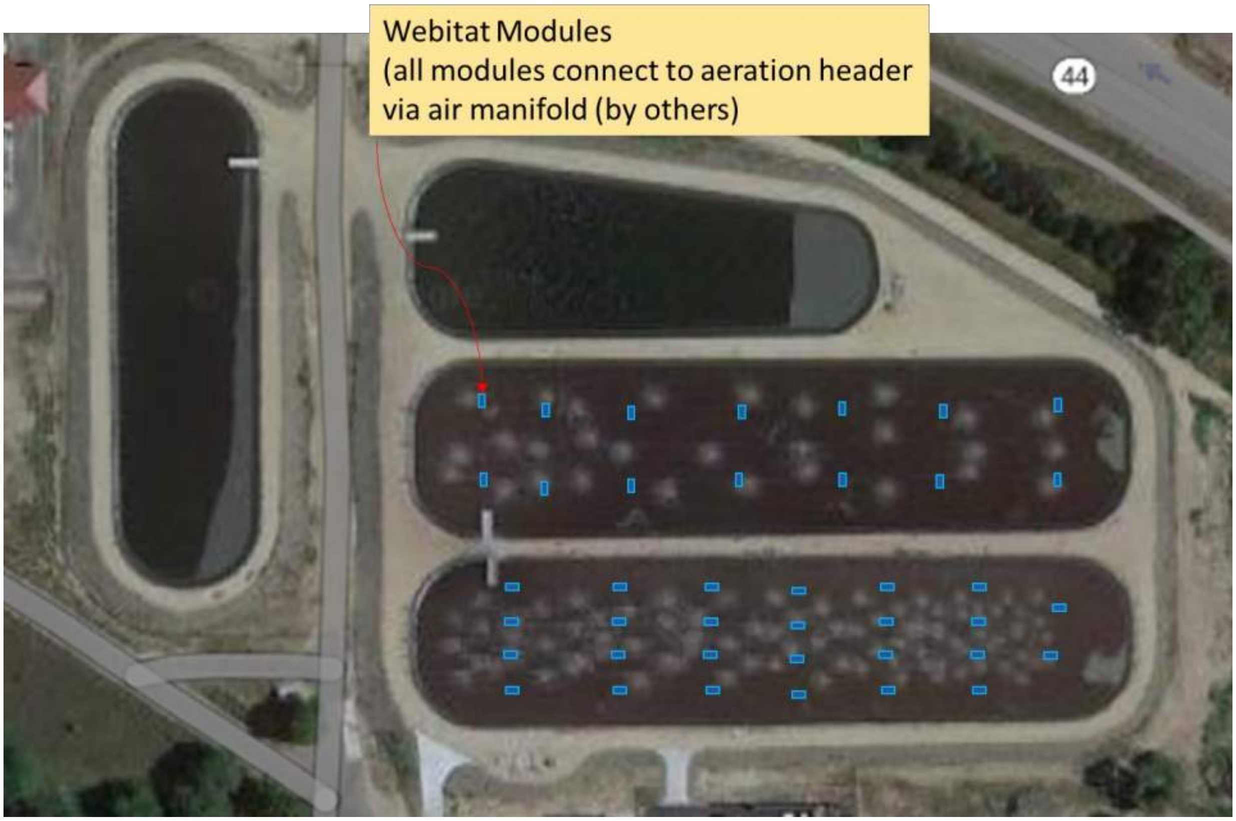
Note that both ground water recharge and non-recharge uses require full nitrification.

A minimum side water depth of 10 feet was used for this design.

3.2 Process Flow and Description

A schematic of the proposed process flow is shown below (Not to scale and arrangement to be optimized)

Polishing Only



In the polishing option, forty-eight (48) Webitat units will be installed in order to polish ammonia at the current flow of 2.23 MGD. The Webitat modules will be dispersed between the various trains and cells per the schematic above. Each Webitat module will be 10 ft. long by 6 ft. wide by 9.5 ft. tall with media sheets extending to an elevation of 8.5 ft.

Each module has an integrated coarse bubble aeration grid that will provide 60 scfm of coarse bubble aeration for a total of 2,880 scfm. This airflow will scour the EnTextile media, ensuring that a healthy biofilm thickness is maintained. The scour will also contribute to the airflow required for mixing and treatment. Note however supplemental airflow supplied by the floor mounted diffusers will not be required for treatment. The aeration requirements for each Option are summarized in Section 3.3 below.

Air will be conveyed from the blowers (by others) to the Webitat modules via a floating manifold of hoses and fittings (by others).

Upgrade Option I – 2.23 to 2.73 MGD

In Option I, seventy (70) Webitat units will be installed in order to polish ammonia at the current flow of 2.23 MGD as well as treat BOD and ammonia up to an additional 0.5 MGD. The total flowrate will be 2.23 - 2.73 MGD. The Webitat modules will be dispersed between the various trains and cells per the schematic above. Each Webitat module will be 10 ft. long by 6 ft. wide by 9.5 ft. tall with media sheets extending to an elevation of 8.5 ft.

Each module has an integrated coarse bubble aeration grid that will provide 650 scfm of coarse bubble aeration for a total of 4,550 scfm. This airflow will scour the EnTextile media, ensuring that a healthy biofilm thickness is maintained. The scour will also contribute to the airflow required for mixing and treatment Note however no supplemental airflow supplied by the floor mounted diffusers will also be required for treatment. The aeration requirements for each Option are summarized in Section 3.3 below.

Air will be conveyed from the blowers (by others) to the Webitat modules via a floating manifold of hoses and fittings (by others).

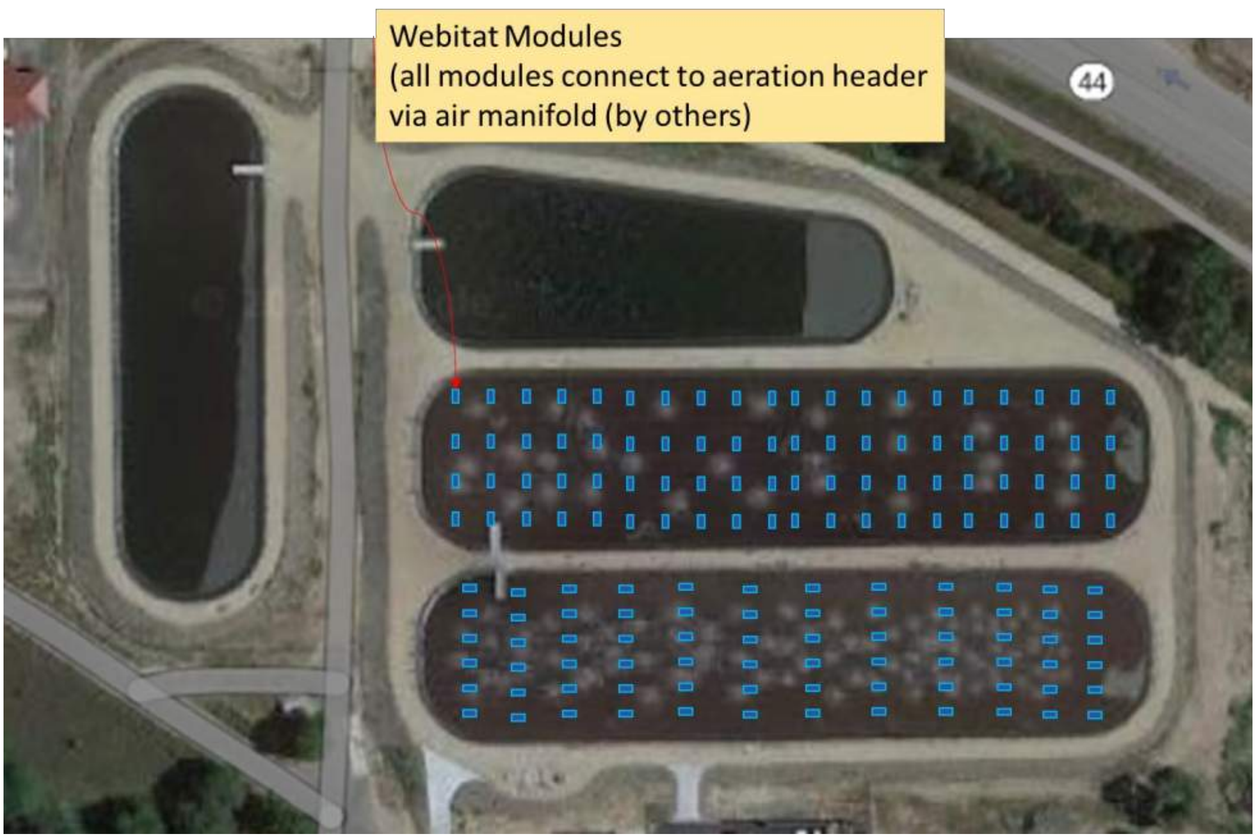
Upgrade Option II – 2.73 to 4.73 MGD

In Option II, one hundred fifty-six (156) Webitat units (86 additional) will be installed in order to polish ammonia at the current flow of 2.23 MGD as well as treat BOD and ammonia up to an additional 2.5 MGD. The total flowrate will be 2.73 - 4.73 MGD. The Webitat modules will be dispersed between the various trains and cells per the schematic above. Each Webitat module will be 10 ft. long by 6 ft. wide by 9.5 ft. tall with media sheets extending to an elevation of 8.5 ft.

Each module has an integrated coarse bubble aeration grid that will provide 75 scfm of coarse bubble aeration for a total of 11,700 scfm. This airflow will scour the EnTextile media, ensuring that a healthy biofilm thickness is maintained. The scour will also contribute to the airflow required for mixing and treatment. Note however no supplemental airflow supplied by the floor mounted diffusers will also be required for treatment. The aeration requirements for each Option are summarized in Section 3.3 below.

Air will be conveyed from the blowers (by others) to the Webitat modules via a floating manifold of hoses and fittings (by others).

<u>Upgrade Option III – 4.73 to 6.23 MGD</u>



In Option III, two hundred twenty-two (222) Webitat units (66 additional) will be installed in order to polish ammonia at the current flow of 2.23 MGD as well as treat BOD and ammonia up to an additional 4.0 MGD. The total flowrate will be 4.73 – 6.23 MGD. The Webitat modules will be dispersed between the various trains and cells per the schematic above. Each Webitat module will be 10 ft. long by 6 ft. wide by 9.5 ft. tall with media sheets extending to an elevation of 8.5 ft.

Each module has an integrated coarse bubble aeration grid that will provide 75 scfm of coarse bubble aeration for a total of 16,650 scfm. This airflow will scour the EnTextile media, ensuring that a healthy biofilm thickness is maintained. The scour will also contribute to the airflow required for mixing and treatment. Note however no supplemental airflow supplied by the floor mounted diffusers will also be required for treatment. The aeration requirements for each Option are summarized in Section 3.3 below.

Air will be conveyed from the blowers (by others) to the Webitat modules via a floating manifold of hoses and fittings (by others).

3.3 Aeration Summary

The air requirements per option are detailed in the table below:

Additional Lagoon Upgrades				
	Polishing Only	Option I	Option II	Option III
# Webitat Modules	48	70	156	222
CB scfm	2,753	4,491	11,520	16,627
Coarse bubble scour/module, scfm	60	65	75	75
Coarse bubble scour/system, scfm	2,880	4,550	11,700	16,650
HP	150	250	550	750
psig at 10' SWD (9' diffuser depth)	200.0	6.3	6.3	6.3

Further analysis will determine if the existing blowers and aerators are capable of supplying the supplemental airflow required per option (blowers and aerators, if require, by others).

In all Options, air will be conveyed from the air header to the Webitat modules via a floating manifold of hoses and fittings (by others).

4. **Installation**

The Webitat modules will be placed into the lagoon with a crane. A 3-inch diameter drop pipe is connected to each aeration grid, terminating approximately 6 inches above the water line with a 3” threaded, male NPT fitting. Connections between the blowers (by others) and the Webitat aeration grids are made with floating hose, PVC fittings, and clamps (hoses, fittings, and clamps by others).

5. **Pricing**

The pricing for each option will be as follows:

Additional Lagoon Upgrades				
	Polishing Only	Option I	Option II	Option III
Total # Webitat Modules	48	70	156	222
Pricing	$2,395,216	$3,486,842	$7,681,658	$10,648,644

Freight included.

6. Scope of Supply

A detailed scope of supply will be provided along with a firm quotation. The equipment list utilized to develop this proposal is shown below.

Webitat Modules *	Webitat modules will be provided with EnTextile Media and welded 304L SS frames with lifting lugs. Each Webitat unit will be approximately 10 ft long x 6 ft wide x 9.5 ft high. Integrated PVC Webitat aeration included for all units c/w 3-inch diameter drop pipe.
Documentation	Technical submittals and IO&M Manuals
Site Services	One site visit of up to four days to supervise installation and startup and to provide operator training.

*Webitat module quantities varies per option – see Section 5.

<u>Additional items included:</u>

- Process Engineering for all equipment, equipment sizing and selection
- Review and approval of P&I Diagram for the ENTEX scope of supply
- Preliminary General Arrangement Drawings, review and approval of final General Arrangement Drawings for the ENTEX supplied equipment
- Review of biological process reactor drawings, excluding structural design
- Manufacturers' service for installation inspection
- Startup supervision and trainings not to exceed 5-days

<u>Items excluded (not all inclusive):</u>

- Unloading and storage of materials on-site
- Concrete tankage, foundation or secondary containment/spill retention.
- Interconnecting piping, hoses, valves and fittings.
- Electrical, including motor controllers and all electrical interconnections.
- Start-up and operation, including any analytical work.
- Anchor bolts and/or hold down beams, moorings posts and mooring cables.
- Turbidimeter, chemical addition, nutrient addition and chemical analysis.
- Influent and effluent pumping other than liquid transfer between lagoon and filter.
- Process blowers and aerators supplemental to the Webitat integral air grids.
- Covers, hoists or walkways including hoist for disc installation and maintenance.
- Installation, other than factory pre-assembled components.
- Customs, duties, insurance, taxes etc.

DRAFT

7. Contact Information

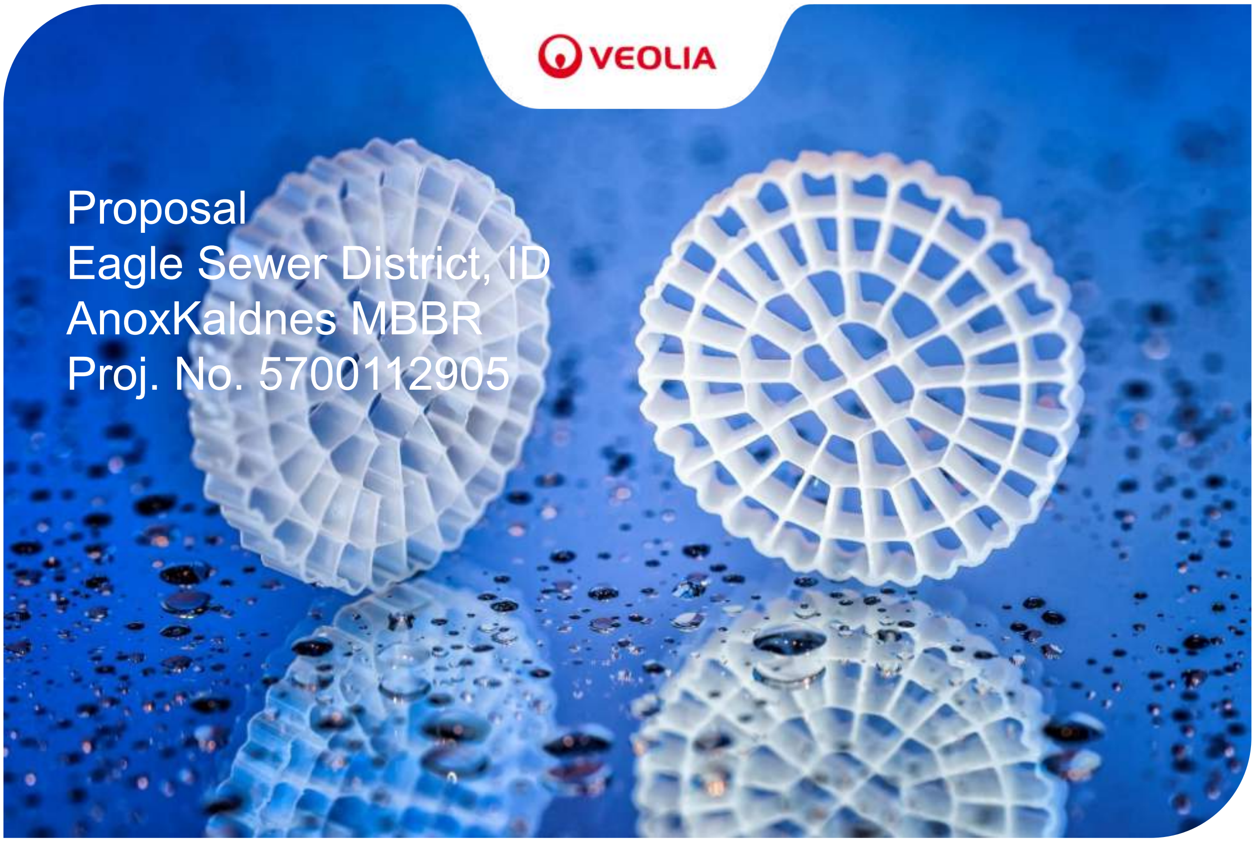
Should you have any questions regarding the material found in this proposal, please do not hesitate to contact Lauren Takitch of Entex Technologies Inc.

Sincerely,

Lauren Takitch

Lauren Takitch
Entex Technologies Inc.
1340 Environ Way
Chapel Hill, NC 27517
(724) 953-2425
lauren.takitch@entexinc.com

Moving Bed Biofilm Reactor (MBBR)



Proposal
Eagle Sewer District, ID
AnoxKaldnes MBBR
Proj. No. 5700112905

Submitted to: Marshall Pierce, P.E
Jacobs

Submitted by: Sarah Spivey
Application Engineer

Date: July 27, 2023

This document is confidential and may contain proprietary information
It is not to be disclosed to a third party without the written consent of Veolia Water Technologies.

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Water Technologies

Dear Marshall:

Veolia Water Technologies, Inc (dba Kruger) appreciates the project opportunity and is pleased to present this revised proposal for our AnoxKaldnes MBBR System for Eagle, ID.

The AnoxKaldnes MBBR technology has increasingly been employed by WWTPs or lagoon plants for either capacity increase, complete nitrification or biological nutrient removal due to its unique benefits. **The 0.82 MGD LagoonGuard MBBR system at Marbleton WY is a similar system to the current project.** The system was installed about 10 years ago. It helps the plant achieve a low ammonia limit at a design temperature of around 5 degree C. The AnoxKaldnes MBBR systems have unique benefits compared to other technologies. These benefits include but are not limited to the following:

1. Our MBBR system is simple and proven through years of practice and hundreds of installations.
2. It is designed to require little to no maintenance on the major equipment (i.e. media, air diffusers and media retention screens) throughout the lifetime of the system.
3. Our system can have a much smaller footprint than other MBBR systems due to higher media specific surface area.
4. Our media is specially designed to maximize mass and oxygen transfer while preventing macro fauna problems.
5. AnoxKaldnes/Veolia has the most experienced design team and best resources to serve a wide range of projects, from small (i.e. 0-1 mgd) to large (i.e. over 100 mgd), and from municipal to industrial.

In addition to the above information, we hope that you find the following detailed information helpful and convincing in understanding the advantages and benefits of our team, design and system. We also hope that our superior product quality, technical and financial capabilities and excellent customer services offer your team and the owner an extra measure of assurance in delivering a trouble-free project.

Unparalleled MBBR Experience

- Veolia/AnoxKaldnes is the inventor and worldwide leader in designing, manufacturing and implementing the MBBR technology. We have been designing and offering MBBR/IFAS systems in the past 30 years and have the most extensive reference base with more than 1,200 worldwide installations.
- Veolia has more than 30 MBBR installations with a design flow over 10 MGD, 10 MBBR plants with a design flow more than 20 MGD. Our largest MBBR plant has a design flow of 137 MGD.
- Veolia has more than 60 denitrification MBBR systems ranging from 0.01 to 137MGD. The largest MBBR denitrification installation in the US has a design flow rate of 78 MGD.
- Veolia/Kruger has the most experienced and comprehensive engineering design staff for the technology. Our process experts are well published on the technology and have a collective design experience of over 250 years, making us the strongest process design team in the world.

- Veolia has long-term design and application experience in almost any variations and combinations with the MBBR technology, whether it is pure MBBR, IFAS, MBBR in lagoon applications, MBBR combined with activated sludge system, or SBR MBBR etc. The technology has been applied for BOD removal, ammonia removal, and TN removal at extremely low levels.

Maintenance-Free, Simple and Robust MBBR System Design

The system utilizes the latest and field proven AnoxKaldnes AnoxK™5 media with a protected specific surface area (SSA) of 800 m2/m3 (243 ft2/ft3) that is greater than the SSA of most other media carries, providing much larger biomass inventory and enabling a much smaller reactor design (both MBBR) than other media carriers. This will help the plant save on footprint

- To ensure best media quality, the media used for this project will be virgin media manufactured in the US. It has been used in hundreds of plants in the past 10 years and has a proven track record. The media has a long life expectancy of more than 20 years.

- The system consists of stainless steel air diffusers that are robust, non-clogging and maintenance free throughout the lifetime of the biological wastewater treatment system.
- The system employs stainless steel maintenance-free cylindrical perforated plate screens at the reactor effluent wall to retain media, while allowing treated water to pass through. The current perforated plate screen design is a significant improvement over the previous wedge-wire screen design in terms of screen clogging. The wedge wire screen design is prone to clogging by stringy materials that easily get caught on the wire and are hard to remove.

Excellent Engineering Support and Customer Service

- Veolia prides itself for being a customer-focused organization that listens to our customers and provides solutions to challenges faced by our customers. We put our customers' interests and needs first.
- We work with our customers closely at every stage of a project. We assist our customers with design, construction, start-up, plant operation and troubleshooting with the best knowledge in the technology.
- Our relationship with our customers does not stop when the equipment warranty ends. We routinely follow up with our customers and provide assistance and advice years after the warranty expires.
- Our Veolia office has a staff of over 100 people, including Project Management, Process Engineering, I&C Engineering, Mechanical Engineering and Field Service are all located within the area of Cary, NC headquarters, providing a coordinated effort and single point of contact to Veolia's technical expertise for your team. Having one dedicated contact for the MBBR biological treatment system provides a simplified approach during design, construction, startup and throughout the lifetime of the project.
- This project has been assigned to a dedicated Process Manager and a team whose main function is to ensure proper process design, modeling and support for the MBBR system. As what's been done in the past, our process team will continue to work closely with your team and the owner to build and optimize the process design models to provide the best design.

- This project will have a dedicated Project Manager whose main function is to ensure best communication, on-time equipment delivery, proper installation and startup of the MBBR biological treatment system. Field service is a major component of project execution. Our field service personnel are thoroughly trained and have enormous experience in commissioning MBBR plants. It is crucial to tap into the team's experience and fully inspect the system components before, during and after the installation.

Financial Backing and Process Guarantee

- By collaborating with Veolia, your team and the owner will have access to Veolia, the world's #1 ranked water company. Veolia is a $26 billion USD company with strong financial security. Veolia Water Technologies Inc, dba Kruger, is a subsidiary of Veolia, a world leader in engineering and technical solutions in water treatment.
- We are not only technologically but also financially capable of supporting this and any other project through design, construction, and completion. You can be rest assured that we will stand behind our system through the warranty period and beyond.
- Bid and performance bonds and/or process guarantee bonds are recommended to protect your teams' interests and can be readily provided when specified.
- We can guarantee the performance of this system as we do for all of our other installations.

Thank you

The Veolia team provides the best value: originating from the inventor and leading innovator of the MBBR technology, being engineered as a complete system, and being the beneficiary of decades of wisdom earned from the largest install base, Veolia's AnoxKaldnes MBBR technology is a proven market leader. We are confident that Veolia's 30 plus years of process expertise and experience in MBBR (Veolia has more than 1,000 worldwide installations) design, excellent customer service, superior product quality and team competency will offer your firm and the owner an extra measure of assurance on this important project.

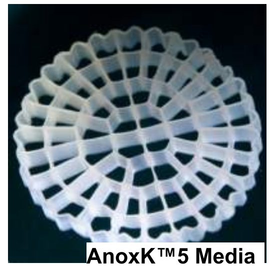
We appreciate the opportunity to provide this proposal to you and look forward to working with you to deliver a successful and hassle-free project. If you have any questions or need further information, please contact our local Representative, Scott Forsling, PE of Coombs Hopkins Company, or our Regional Sales Manager, Rodrigo Lara, at (503) 380-3995 (rodrigo.lara@veolia.com).

cc: Process, Sales, project file (Kruger)
Scott Forsling, PE (Coombs Hopkins Company)

Revision	Date	Process Eng.	Comments
0	07/27/2023	XL, MH	Initial, budgetary proposal.

Process Description

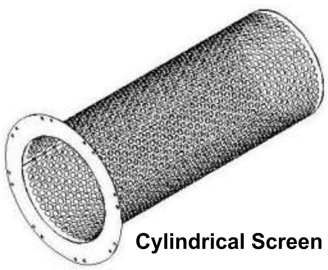
AnoxKaldnes MBBR and IFAS


AnoxK™5 Media

Kruger's AnoxKaldnes process design is based on more than 30 years of experience with Moving Bed Biological Reactors (MBBR) and Integrated Fixed Film Activated Sludge (IFAS) systems. Our knowledge is supported by lab and pilot scale studies and data from more than 1,200 AnoxKaldnes operating systems for BOD, nitrification, and TN removal.

The MBBR and IFAS (or Hybas™ – Hybrid Biofilm Activated Sludge) processes are continuous flow through, non-clogging bio-film reactors containing "carrier elements" or media with a high specific surface. The media does not require backwashing or cleaning.

The biomass that treats the wastewater is attached to the surfaces of the media. The media is designed to provide a large protected surface area for the biofilm and optimal conditions for biological activity when suspended in water. Media of different shapes and sizes provide flexibility to use the most suitable type depending on wastewater characteristics, discharge standards and available volumes. AnoxKaldnes media is made from polyethylene and has a density slightly less than water.


Cylindrical Screen

In the MBBR process, all of the biomass is attached to the media and retained in the reactor, with no returned sludge. In the Hybas process, the reactor contains both free-floating biomass (activated sludge) and biomass attached to the media. The free-floating biomass passes through the reactor, is settled and recycled back to the reactor. The media and attached biofilm remain in the reactor as in a MBBR.

The Hybas process is often considered for upgrading existing conventional activated sludge systems within the existing tankage for either maintaining nitrification at new higher flow rates or loads or upgrading a plant to meet new nitrification requirements. It is accomplished by adding the media directly into the activated sludge reactors to enhance the growth of the autotrophic bacteria. The Hybas system is capable of meeting these new effluent requirements at low solids retention times (SRTs) and short hydraulic retention times (HRTs).


AnoxKaldnes Airgrid

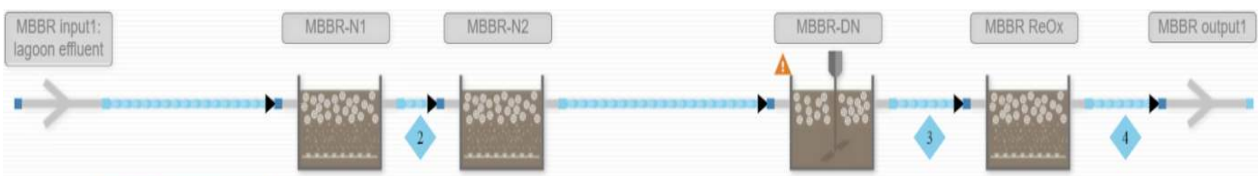
The mixing of the media within MBBR and Hybas reactors is provided by AnoxKaldnes' medium bubble aeration system in aerobic application, whereas specially designed submersible mixers are used in anoxic environments for denitrification.

Kruger's minimum scope of supply for MBBR and Hybas systems includes the AnoxKaldnes media, screen assemblies (to keep media in each reactor), medium bubble aeration grid assemblies and submersible mixers for the anoxic zones. In cases where they are needed, Kruger also provides the blowers, instrumentation and controls, SCADA, and field instruments (dissolved oxygen, nitrate, ammonia, etc.) for single source responsibility.

AnoxKaldnes MBBR System Configuration

The preliminary design summarized below consists of three (3) MBBR trains to treat 4 MGD of lagoon effluent. The current flow could be treated with just two (2) trains. Additional options treating screened influent at various flows may also be available and can be evaluated upon receipt of influent values.

Each train is equipped with four MBBR reactors, consisting of two nitrification stages (N1 and N2), followed by denitrification (DN) for effective TIN removal, and a final reaeration stage. All four stages of MBBR reactors will utilize AnoxK^{TM}5 media. The current proposed reactor design includes media fill of 30-40%, leaving 10-20% of the reactor volume to adjust media fill if necessary. To achieve the desired cBOD5, TSS, TN and turbidity levels for class A reuse, the MBBR system will be complemented by a solids separation system to remove particulates, such as Hydrotech Discfilters. Veolia's proposed solids separation system is provided as a separate proposal.



AnoxKaldnes MBBR Nitrification-Denitrification System configuration

Design Summary

The proposed design is based on the following influent wastewater characteristics and incorporating peak flow conditions for screen design purposes only. The design assumes that the raw influent wastewater is biodegradable, no toxic compounds are present, sufficient alkalinity is available to avoid pH depressions, that the COD/BOD ratio is between 1.7 and 2.3, and that none of the equipment provided would be used in a classified area (e.g. Class 1, Division 1 or Class 1, Division 2).

The headworks should be designed to prevent the passage of unscreened or poorly screened wastewater into the media reactors, including during maintenance or high-flow bypass events. The use of bar or step screens is discouraged, since they can allow passage of fibrous material that can blind the media retention screens.

To provide the best compatibility with the AnoxKTM5 media and sieves, the plant's headworks should include perforated mesh screens with a maximum of 6 mm (1/4 inch) diameter openings for removal of particulate matter (rags, debris, etc.) prior to entering the AnoxKaldnes MBBR/IFAS reactors.

Table 1: Influent Design Basis

Parameter	Units	Values
Flow, Annual Average, Current	MGD	2.23
Flow, Projected, Design	MGD	4.0
Flow, Projected Peak Hourly	MGD	7.04**
BOD_5, Design Flow	mg/L	26
TSS, Design Flow	mg/L	67
NH3-N, Design Flow	mg/L	33
TKN, Design Flow	mg/L	50*
TP, Design Flow	mg/L	4.2
Elevation	ft	2,570*
Min/Max Temperature	°C	5/24*

* Assumed values.
** Assumed projected peak hour flow based on the given peak factor 1.76

Table 2: Effluent Objectives - 30-Day Average

Parameter	Units	Values
soluble $cBOD_5$	mg/L	< 5.0
NH_3-N	mg/L	< 1.0
TIN	mg/L	< 8.0

**Provision for external carbon addition shall be provided in the post DN reactor by others.
**Biological non-degradable soluble nitrogen assumed to be less than 1.5 mg/L.
**Listed values represent anticipated performance; guaranteed values may be different.

Table 3: Process Design Summary

Parameter	Units	Values
Number of Process Trains	-	3
Number of MBBR-N Reactors per Train	-	2
Number of MBBR-Post DN Reactors per Train	-	1
Number of MBBR-Re-Aeration Reactors per Train	-	1
MBBR-N Reactor		
Dimensions (Each)	ft	36 L x 36 W x 20 SWD
Volume (Each)	ft^3	25,920
Total Volume (All Reactors, All Trains)	ft^3	155,520
Media Type:	-	AnoxK™5
Media Protected Surface Area	ft^2/ft^3	243.3
Fill of Biofilm Carriers	%	39 (N1) / 30 (N2)
Media Volume (All Reactors, All Trains)	ft^3	54,448
Total Effective Surface Area (All Reactors, All Trains)	ft^2	~13,280,000
Aeration System Type	-	Medium Bubble
Residual DO, Max. Month	mg/L	5 - 6
Total Process Air Requirement (All Reactors, All Trains)	SCFM	~ 6,200
Pressure From Top of Drop Pipe	psig	8.5
Post-Anoxic Reactor		
Dimensions (Each)	ft	30 L x 36 W x 20 SWD
Volume (Each)	ft^3	21,600
Total Volume (All Reactors, All Trains)	ft^3	64,800
Media Type:	-	AnoxK™5
Media Protected Surface Area	ft^2/ft^3	243.3
Fill of Biofilm Carriers	%	39
Media Volume (All Reactors, All Trains)	ft^3	25,317
Total Effective Surface Area (All Reactors, All Trains)	ft^2	~6,174,000
Number of Mixers Per Reactor	-	1
Total Number of Mixers (All Reactors, All Trains)	-	3
Re-Aeration Reactor		
Dimensions (Each)	ft	10 L x 20 W x 20 SWD
Volume (Each)	ft^3	4,000
Total Volume (All Reactors, All Trains)	ft^3	12,000
Media Type:	-	AnoxK™5
Media Protected Surface Area	ft^2/ft^3	243.3
Fill of Biofilm Carriers	%	18
Media Volume (All Reactors, All Trains)	ft^3	2,119
Total Effective Surface Area (All Reactors, All Trains)	ft^2	~516,700
Aeration System Type	-	Medium Bubble
Residual DO, Max. Month	mg/L	2 - 3
Total Mixing Air Requirement (All Reactors, All Trains)	SCFM	300
Pressure From Top of Drop Pipe	psig	8.5

Est. MBBR Effluent TSS, Design flow	mg/L	100 - 130
Recommended Freeboard	ft	2 - 3
Est. Sludge Production, Max. Month	lbs/day	~3,000
Est. Micro-C2000 Glycerin Dose, Max. Month	lbs/day	~6,200

Scope of Supply

Kruger is pleased to present our scope of supply which includes process engineering design, equipment procurement, and field services required for the proposed treatment system, as related to the equipment specified. The work will be performed to Kruger's high standards under the direction of a Project Manager. All matters related to the design, installation, or performance of the system shall be communicated through the Kruger representative giving the Engineer and Owner ready access to Kruger's extensive capabilities.

Process and Design Engineering

Kruger will provide process engineering and design support for the system as follows:

- Process Engineering consisting of aeration system sizing and configuration, sieve and outlet design.
- Review and approval of P&I Diagram for the AnoxKaldnes MBBR portion of the process. Preliminary General Arrangement Drawings and review and approval of final General Arrangement Drawings for the process. Review of reactor drawings with respect to penetrations and dimensions, excluding structural design.
- Equipment installation instructions for all equipment supplied by Kruger.

Field Services

Kruger will furnish a Service Engineer to perform the following tasks:

- Inspect installation of key pieces of equipment during construction.
- Inspect the completed system prior to startup.
- Assist the Contractor with initial startup of the system.
- Train the Owner's staff in the proper operation and maintenance of the AnoxKaldnes MBBR system.
- Test and start any Kruger-supplied control equipment, including PLC programming and SCADA systems.

Extended Services

The Supplier shall include an extended service plan, featuring a blend of remote and on-site services, to support the Owner in the proper operation, maintenance and optimization of the process and equipment. The active service plan period shall be one (1) year and will start upon completion of Supplier's commissioning activities for the process. The plan shall include the following:

A. One (1) trip to the project site consisting of two (2) days onsite for process and equipment (e.g. instruments/analyzers) inspections and follow-up training in process control and optimization

B. Remote quarterly review of operating data (Owner to provide data to Supplier) with issuance of summary report by a process engineer, noting key observations and recommendations

C. Twenty (20) hours of remote support conducted via phone and/or video conferencing for assistance in further optimization, troubleshooting, training or other needs of the Owner. The Supplier shall include the use of app-based augmented reality tools where such tools would be beneficial, such as FieldBit or equal, at no additional charge. Minimum of 1 hr charged per call.

AnoxKaldnes MBBR System Equipment – Limited to In-Basin Equipment Only

Process and Mechanical Equipment Items	Qty	Description
AnoxKaldnes AnoxK™5 Media (ft^3)	81,884	High density polyethylene carrier elements.
Cylindrical Screen Assemblies	48	Four (4) per reactor. 304L SS. 23" ø perforated plate pipes terminated in custom flanges for mounting directly to the tank wall.
V-port Ball Valves	3	One (1) 3" manual air regulating valve for each Re-Aeration Zone.
Medium Bubble Aeration System	3	One (1) aeration system per train. 304L SS including header, lateral piping, and hardware (excluding anchor bolts).
Top Entry Mixers	3	One (1) for each post-DN reactor. Top Entry Mixer approved for use with AnoxK5 media.
Modulating Airflow Control Valves	6	One (1) actuated BFV for each nitrification reactor.
Positive Displacement Blowers	3 + 1	Three (3) duty plus one (1) standby. Each per train. Each blower will be rated for 2,600 SCFM and 200 NPHP. VFD By Others
I&C Equipment Items	**Qty**	**Description**
PLC Control Panel	1	NEMA 12 Freestanding or Wall Mount Control Panel (For Indoor Use). ControlLogix PLC; Panelview HMI; 120V Feed.
High Level Float Switch	3	One (1) for each train.
DO Probe (LDO)	9	One (1) for each Aerobic zone. Aerobic Zone DO Monitoring with protective cage.
Thermal Mass Flowmeter	6	One (1) per nitrification reactor. 8 inch, MBBR zone air flow.
Ammonia/Nitrate Analyzer	6	Two (2) per train.

Notes Regarding System Design and Installation

- A note on concrete specifications: For any MBBR or IFAS systems, it is sound practice to require good, quality concrete work for the process reactors. The Consulting Engineer's standard concrete specification section is typically adequate to eliminate large holes, excessive form marks, large pockets, and excessively rough areas. It is particularly important to eliminate the potential for annular space around media retention screens.
- A note on construction sequencing: It is important, particularly for MBBR installations, to have level detection and level communication systems in place and operational prior to the filling of process tanks with water and media.

Scope of Supply BY INSTALLER/PURCHASER

The contractor's scope of supply for the AnoxKaldnes MBBR system should include, but is not limited to, the following items:

- All civil/site and electrical work.
- A concrete foundation for the tanks.
- Reactors to house the MBBR treatment equipment.
- All provisions for interconnecting piping.
- Unloading, storage and installation of equipment.
- Install and test all level floats, level transmitters, level alarms, and alarm communication devices prior to filling a process tank with media and water

Design Options

In addition to the proposed system as detailed herein, Kruger is able to further incorporate our process and controls expertise into wastewater treatment plants, allowing municipalities to meet stringent effluent requirements and future plant upgrades. Kruger is also able to offer our instrumentation and controls expertise to build upon the proposed system by providing a **customized plant-wide SCADA system** or designing a **Motor Control Center (MCC)**, providing clients a single source responsibility for plant controls. Please contact Kruger if the options above are of interest or to be included in the current proposed system or future upgrades. ***Please note that the design options listed above are not included in the pricing noted herein.*

Schedule

- Shop drawings will be submitted within 6-8 weeks of receipt of an executed contract by all parties.
- All equipment will be delivered within 18-30 weeks after receipt of written approval of the shop drawings.
- Installation manuals will be furnished upon delivery of equipment.
- Operation and Maintenance Manuals will be submitted within 90 days after receipt of approved shop drawings.

Pricing

The price for the AnoxKaldnes MBBR system, as defined herein, including process and design engineering, field services, and equipment supply is: **$5,184,400.**

Pricing is DDP to the job site. This pricing does not include any sales or use taxes. In addition, pricing is valid for thirty (30) days from the date of issue. The proposed goods may be affected by the ongoing market fluctuations impacting material and shipping costs. Kruger reserves the right to re-evaluate the Proposal price prior to order acceptance.

Please note that the above pricing is expressly contingent upon the items in this proposal and are subject to Kruger Standard Terms of Sale detailed herein.

Kruger Standard Terms of Payment

The terms of payment are as follows:

- 10% on receipt of fully executed contract
- 15% on submittal of shop drawings
- 75% on the delivery of equipment to the site

Payment shall not be contingent upon receipt of funds by the Contractor from the Owner. There shall be no retention in payments due to Kruger All other terms per our Standard Terms of Sale are attached.

All payment terms are net 30 days from the date of invoice. Final payment not to exceed 120 days from delivery of equipment.

Kruger Standard Terms of Sale

1. Applicable Terms. These terms govern the purchase and sale of the equipment and related services, if any (collectively, "Equipment"), referred to in Seller's purchase order, quotation, proposal or acknowledgment, as the case may be ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is conditioned on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.

2. Payment. Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation provides otherwise, freight, storage, insurance and all taxes, duties or other governmental charges relating to the Equipment shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. All payments are due within 30 days after receipt of invoice. Buyer shall be charged the lower of 1 ½% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval.

3. Delivery. Delivery of the Equipment shall be in material compliance with the schedule in Seller's Documentation. Unless Seller's Documentation provides otherwise, Delivery terms are DDP to jobsite.

4. Ownership of Materials. All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Buyer a non-exclusive, non-transferable license to use any such material solely for Buyer's use of the Equipment. Buyer shall not disclose any such material to third parties without Seller's prior written consent.

5. Changes. Seller shall not implement any changes in the scope of work described in Seller's Documentation unless Buyer and Seller agree in writing to the details of the change and any resulting price, schedule or other contractual modifications. This includes any changes necessitated by a change in applicable law occurring after the effective date of any contract including these terms.

6. Warranty. Subject to the following sentence, Seller warrants to Buyer that the Equipment shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship. The foregoing warranty shall not apply to any Equipment that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. If Buyer gives Seller prompt written notice of breach of this warranty within 18 months from delivery or 1 year from beneficial use, whichever occurs first (the "Warranty Period"), Seller shall, at its sole option and as Buyer's sole remedy, repair or replace the subject parts or refund the purchase price therefore. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Equipment in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller). THE WARRANTIES SET FORTH IN THIS SECTION ARE SELLER'S SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO SECTION 10 BELOW. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

7. Indemnity. Seller shall indemnify, defend and hold Buyer harmless from any claim, cause of action or liability incurred by Buyer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Buyer (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.

8. Force Majeure. Neither Seller nor Buyer shall have any liability for any breach (except for breach of payment obligations) caused by extreme weather or other act of God, strike or other labor shortage or disturbance, fire, accident, war or civil disturbance, delay of carriers, failure of normal sources of supply, act of government or any other cause beyond such party's reasonable control.

9. Cancellation. If Buyer cancels or suspends its order for any reason other than Seller's breach, Buyer shall promptly pay Seller for work performed prior to cancellation or suspension and any other direct costs incurred by Seller as a result of such cancellation or suspension.

10. LIMITATION OF LIABILITY. NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND SELLER'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE OF THE EQUIPMENT SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE EQUIPMENT. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.

11. Miscellaneous. If these terms are issued in connection with a government contract, they shall be deemed to include those federal acquisition regulations that are required by law to be included. These terms, together with any quotation, purchase order or acknowledgement issued or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Buyer's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Buyer. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. Buyer may not assign or permit any other transfer of the Agreement without Seller's prior written consent. The Agreement shall be governed by the laws of the State of North Carolina without regard to its conflict of laws provisions.

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AnoxKaldnes™

Moving Bed Biofilm Reactor (MBBR)

Integrated Fixed-Film Activated Sludge (IFAS)

and ANITA™ Mox Deammonification

WATER TECHNOLOGIES

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AnoxKaldnes™ MBBR and IFAS Processes

AnoxKaldnes™ MBBR

(Moving Bed Biofilm Reactor) is a biological wastewater treatment process that utilizes specialized polyethylene carriers (media) to create a large protected surface on which biofilm can attach. The media is mixed in the reactor, and the large surface area provides more treatment capacity in a smaller volume compared to activated sludge.

AnoxKaldnes™ IFAS

Hybrid Biofilm Activated Sludge technology is an application of the IFAS process in which moving media is mixed into an activated sludge environment. The result is both fixed-film and suspended growth biomass working together and lending the strengths of each to the hybrid process. The IFAS process is excellent for retrofitting existing activated sludge plants to improve ammonia and nitrogen removal.

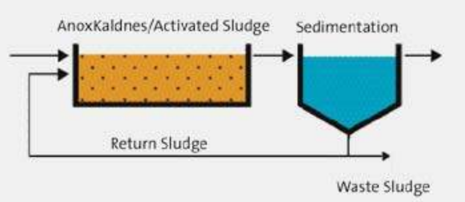
AnoxKaldnes™ IFAS for SBR

AnoxKaldnes IFAS systems can be retrofitted into a sequencing batch reactor (SBR) system. The AnoxKaldnes IFAS can increase the capacity of a SBR wastewater treatment process in the same footprint as a conventional SBR without the need for new tankage. The AnoxKaldnes IFAS for SBR uses engineered moving bed media to grow and foster nitrifying bacteria, even at low SRT's and low reactor temperatures. The process allows for greater BOD, NH_3-N, and TN removal.

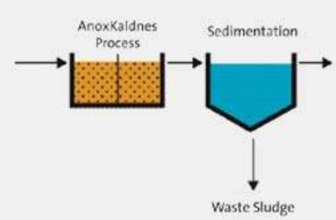
Advantages

- Simple and reliable operation
- Excellent for ammonia and total nitrogen limits (NH_3 -N < 1 mg/L, NO_3 -N < 1 mg/L)
- Smaller footprint than activated sludge
- Increase plant capacity for nitrification and/or denitrification
- Effective in cold water
- Accommodates a wide range of flow and load fluctuations
- Non-clogging media with a long lifespan
- Flexible design for almost any tank configuration

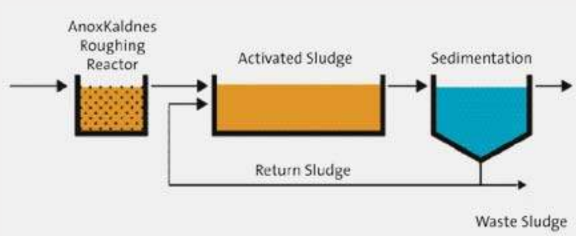
IFAS Technology



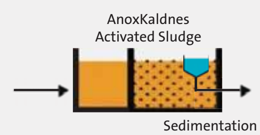
MBBR



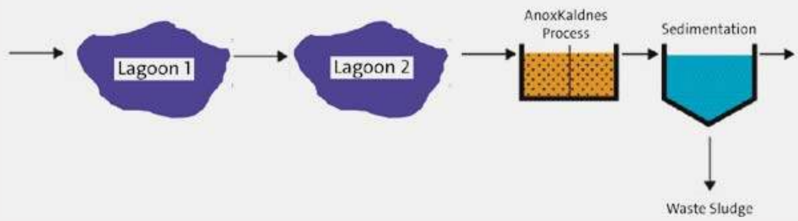
Biofilm Activated Sludge



IFAS for SBR



LagoonGuard® MBBR



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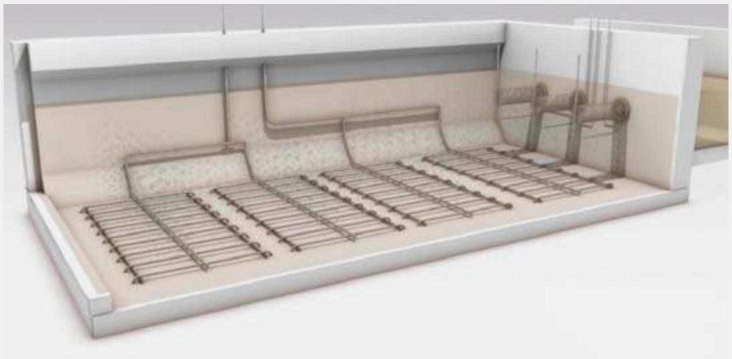
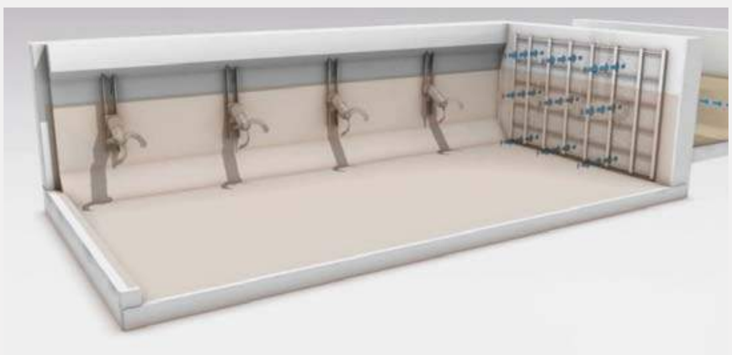
Air Grids and Media Retention Screens



Aerobic Applications

- AnoxKaldnes stainless steel air diffuser system is robust, non-clogging and maintenance free
- Diffusers provide oxygen for process needs and media mixing for optimal biological performance
- Cylindrical screens at reactor’s effluent wall retain media while allowing treated water and suspended solids to pass through

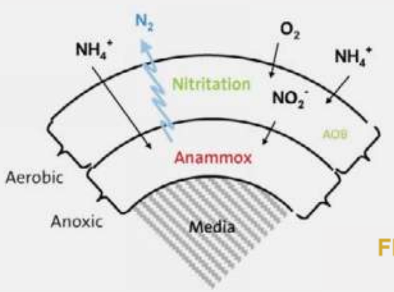
Mixers and Flat Screens



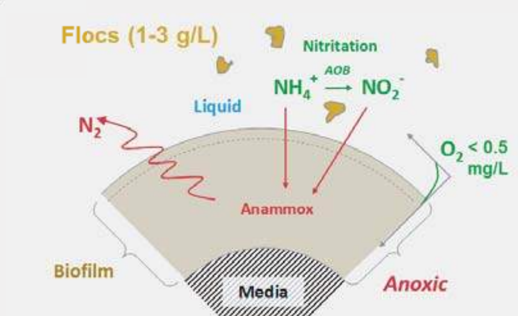
Anoxic Applications

- AnoxKaldnes stainless steel air diffuser system is robust, non-clogging and maintenance free
- Diffusers provide oxygen for process needs and media mixing for optimal biological performance
- Flat screens at reactor’s effluent wall retain media while allowing treated water and suspended solids to pass through

ANITA™ Mox Deammonification



MBBR



IFAS

System Supplier Scope of Supply

- *Complete process design with effluent guarantees*
- *Process equipment including media, screens, air grids, blowers, pumps, mixers and valves*
- *Field instruments and process control*
- *Customized SCADA for the highest level of operations monitoring and control*

The ANITA Mox process combines aerobic nitritation and anammox reactions simultaneously in a single reactor. With MBBR, the reactions take place in different layers of biofilm on the AnoxKaldnes media. With IFAS ANITA Mox, most of the nitritation reaction occurs in the suspended biomass, while the anammox reaction takes place on the carrier media. The MBBR and IFAS ANITA Mox platforms both provide a robust, stable process with simple operation, energy and chemical savings, and efficient ammonia removal.

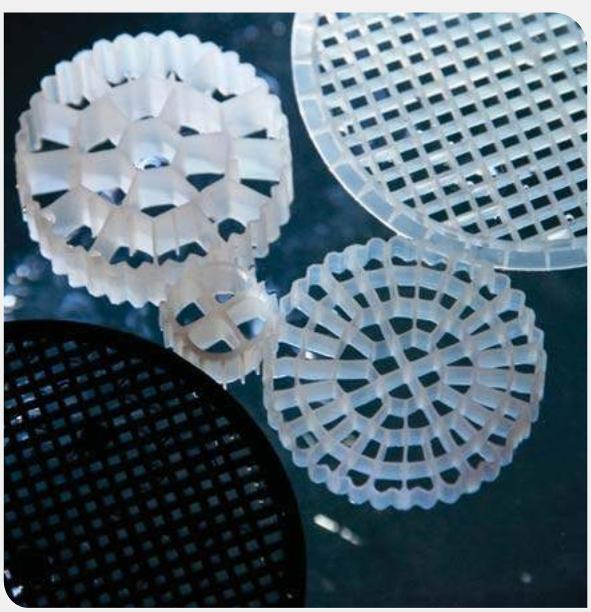
AnoxKaldnes Technology Can Benefit A Wide Range of Plant Sizes

Cheyenne, WY
AnoxKaldnes MBBR

- In 2005, MBBR replaced trickling filters and was chosen because it is a biofilm process that is compatible with the existing clarifiers.
- Consists of two trains of two pre-anoxic and four aerobic reactors in series to treat 6.5 MGD and achieve BOD <10 mg/L and ammonia <2 mg/L, NOx-N <9 mg/L.

Providence, RI
AnoxKaldnes IFAS

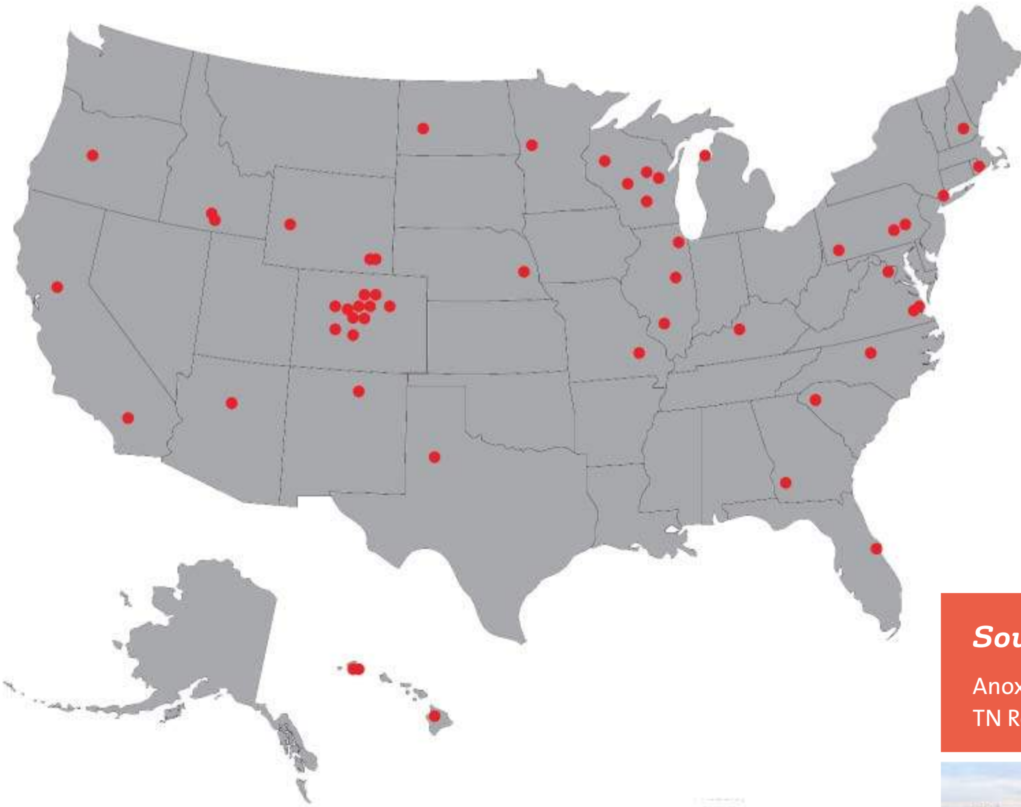
- Ten parallel process trains with a treatment capacity of 77 MGD
- Existing aeration basins converted to a 4 stage process with one IFAS zone per train
- Pre-anoxic stage for denitrification using the influent BOD as a carbon source
- Aerobic Nitrification stage for BOD and Nitrification – IFAS Zone. 52% fill using AnoxKaldnes K3 media type. Total media surface area of 36.3 million square feet
- Post-anoxic stage for additional denitrification using an external carbon source
- Clarification stage for solids separation and collection



Winning Combinations

- *High rate clarification with ACTIFLO®*
- *Primary clarification with MULTIFLO*
- *Filtration with Hydrotech Discfilter*

AnoxKaldnes Technologies Support Municipal Plants in Cities Across the Country



With more than 350 MGD of cumulative capacity at municipal plants based on design flows, there are more US AnoxKaldnes installations for more types of applications than any other MBBR/IFAS technology.

South Adams County, CO

AnoxKaldnes™ MBBR for
TN Removal 5.5 MGD

Cocoa Beach, FL

AnoxKaldnes™ IFAS for
TN Removal 6 MGD

Fairfax Co, VA

AnoxKaldnes™ MBBR for
Tertiary DN 78 MGD

Chicago, IL

ANITA™ Mox for
Deammonification 0.23 MGD

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Resourcing the world

Veolia Water Technologies
Kruger / 4001 Weston Parkway / Cary, NC 27513
Phone: 919.677.8310 • Fax: 919.677.0082
usmunicipal@veolia.com • www.veoliawatertech.com

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Hubgrade

ESSENTIAL

WATER TECHNOLOGIES

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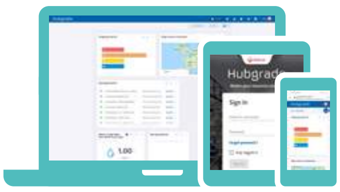
HUBGRADE ESSENTIAL

Hubgrade makes your resources smarter!

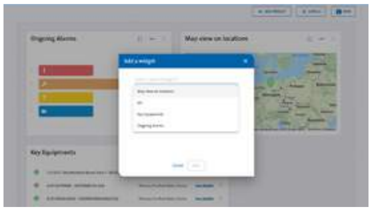
Hubgrade Essential enables you to be more informed to make faster and better decisions related to your water treatment facility and equipment for your business.

Hubgrade enhances Veolia and non-Veolia technology, a range of equipment, and existing or new industrial and municipal water treatment plants for all applications: drinking, waste and process water and all markets: municipal, pharma, lab water, etc.



- Connect to your plant anywhere, at anytime, using your mobile or desktop device

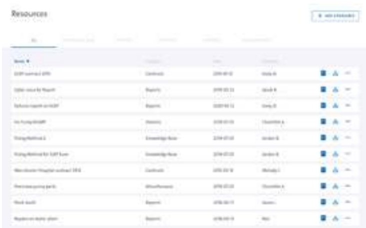
- Monitor all your process parameters as well as events such as alarms and warnings in real-time



- Customize your dashboard to your needs with quick links to your most important features using widgets
- User friendly dashboards

- Access all your locations from one single point of entry

- Receive notification by email or text to intervene early and avoid shutdown



- Find all resources linked to your plant in one single space

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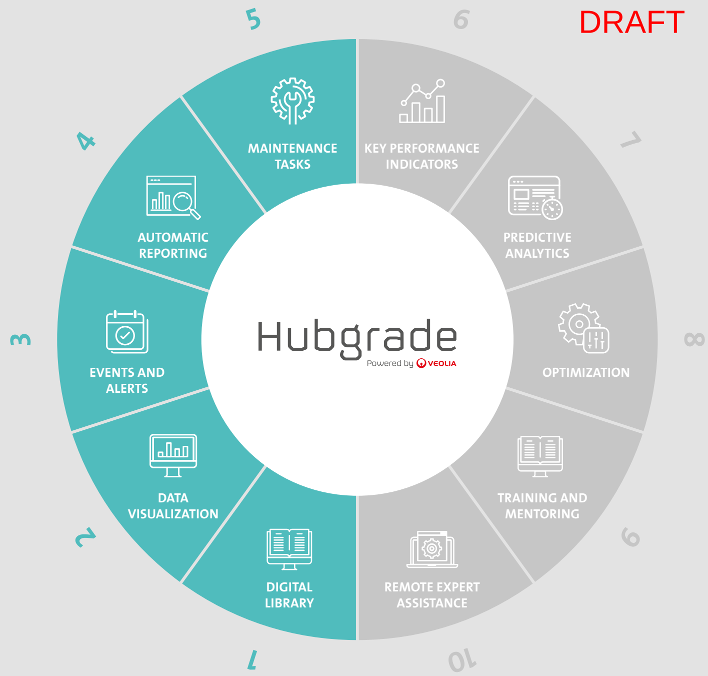
5 FEATURES

which enable access to all relevant process data and plant documentation as a foundation for informed decision making.



DIGITAL LIBRARY

Comfort of having all relevant documents and orders in one place, accessible from anywhere, at any time.

DATA VISUALIZATION

Access to the plant's process and equipment status data in real-time.

EVENTS AND ALERTS

Notifies the client by email or by SMS if a parameter exceeds a threshold. It provides the client the ability to enter comments or tasks for alarm resolutions.

AUTOMATIC REPORTING

Generates standardized and consistent pre-defined reports; specific to your equipment and/or locations with definition of the scope for certain parameters along with events information.

MAINTENANCE TASKS

Overview of maintenance tasks per equipment (open and completed), with the possibility to assign tasks to users, add information such as photos or comments.

MANUAL DATA UPLOAD AND AUTOMATIC DATA COLLECTION

"We are very happy with the results of the trial. So happy that we want to extend it to the distribution systems as well."

Client, Pharmaceutical, Manufacturing Manager, May 2020

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Resourcing the world

Veolia Water Technologies

L'Aquarène • 1 place Montgolfier • 94417 Saint-Maurice Cedex • France
tel. +(33) 0 1 45 11 55 55

www.veoliawatertechnologies.com/hubgrade

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Hubgrade

PERFORMANCE

WATER TECHNOLOGIES

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HUBGRADE PERFORMANCE

Hubgrade makes your resources smarter!

Hubgrade Performance aggregates real-time data and applies analytics and algorithms, developed and based on Veolia's experience in designing and operating water and wastewater treatment plants worldwide, to continuously benchmark and optimize your plant's performance.

The Plant module of Hubgrade Performance is an online digital twin of the wastewater treatment plant and/or sewer network. It creates a digital representation of the customers' assets which uses predictive analysis in real-time to provide optimized setpoints to the PLC control and deliver insight to the operators, process engineers and management.

The Plant module is an intelligent software, with a suite of powerful algorithms and holistic solutions offering state-of-the-art automated real-time performance optimization and capacity enhancement.

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Hubgrade

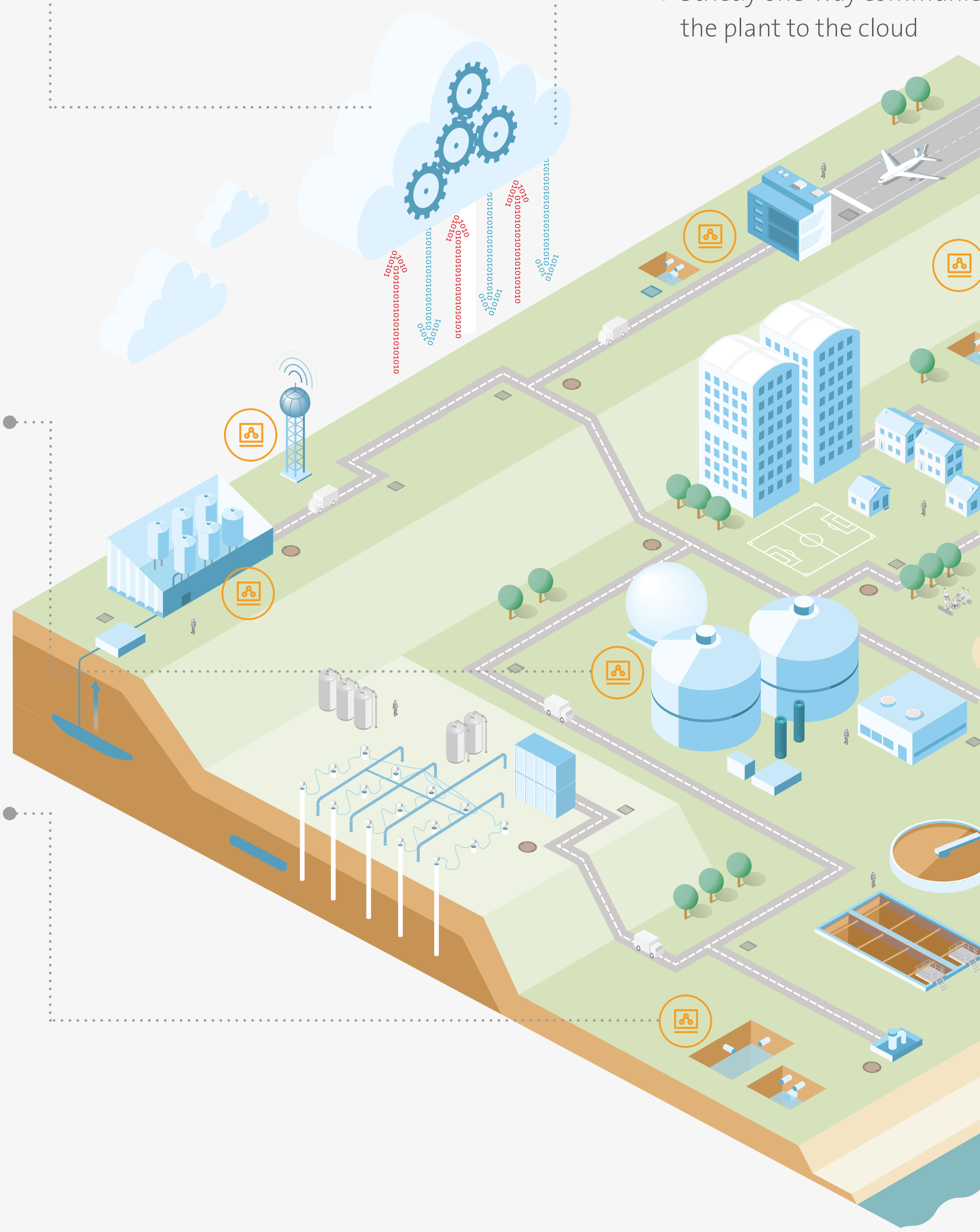
Powered by VEOLIA

Connect to Hubgrade's Plant module service in the cloud

- Forward to the cloud your choice of data for optimized setpoint calculation
- Pick from more than 60 standard features for real-time optimization, overview and forecasting
- Program your own optimizations and features in the add-on Lab function

Safe solution by cloud co

- Secure communication wit and certificates
- Role-based user access
- Strictly one-way communic the plant to the cloud



High priority on resources and biogas

- Enhance your biogas production
- Benefit the handling of industrial resources
- Stable and robust performance

Intelligence for sewer system operation

- Minimize number of CSOs (combined sewer overflows)
- Balance filling capacity of storage volumes
- Integrated optimization of sewage pumping and wastewater treatment plant capacity

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KEY PERFORMANCE INDICATORS

PREDICTIVE ANALYTICS

OPTIMIZATION

onnection

h encryption

ation from

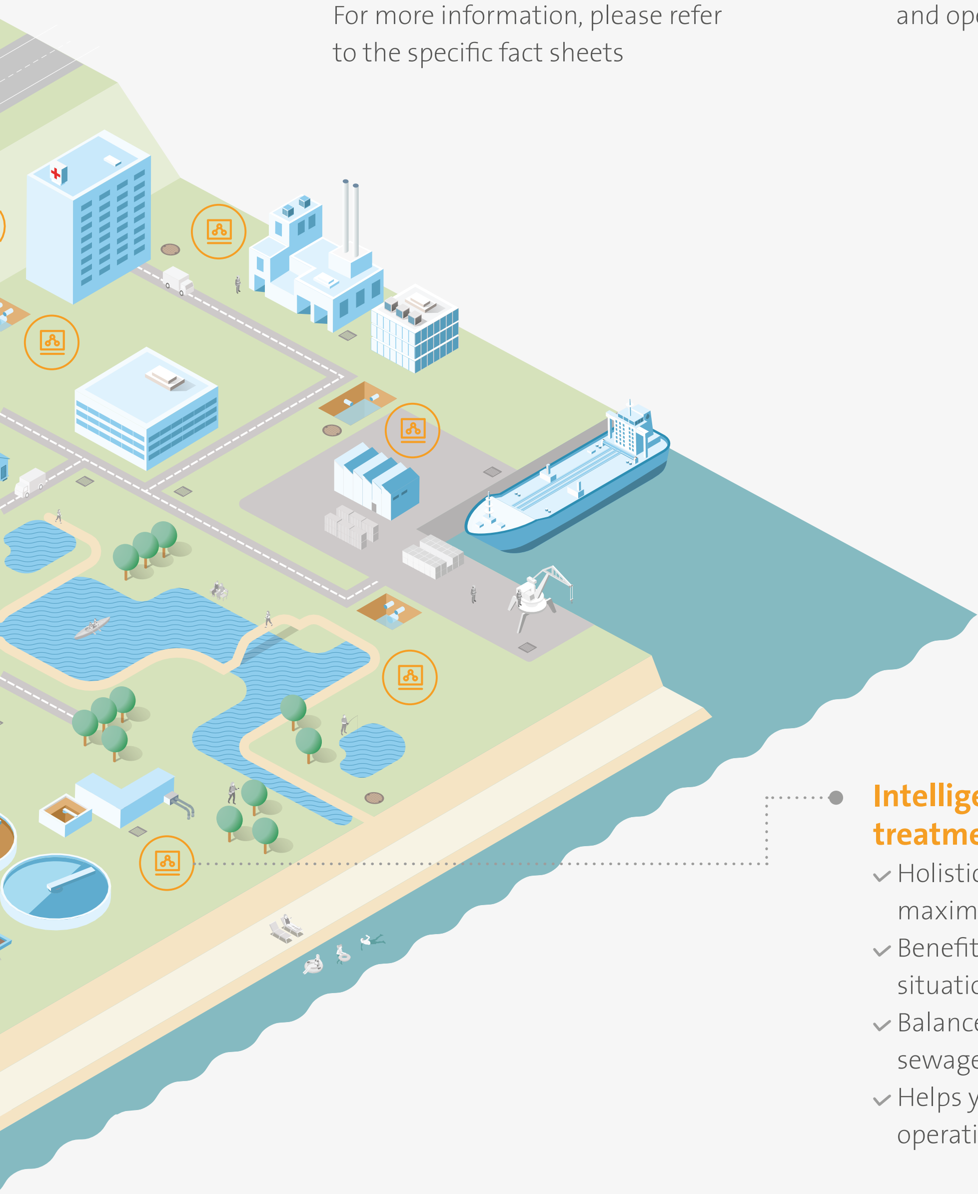
Focus on

- Operational savings
- Hydraulic capacity
- Biological capacity
- Compliance through stable operation

For more information, please refer to the specific fact sheets

User interface

- User interface supports different user demands
- Administration of login support roles and access
- Notifications from intelligent data handling – when all is normal, no disturbances
- View automatically calculated KPIs from process and operations.



Intelligence for wastewater treatment plants

- Holistic view across unit operations for maximized performance
- Benefit from adaptation to all weather situations
- Balance the plant capacity with maximized sewage handling
- Helps you achieve your environmental and operational targets

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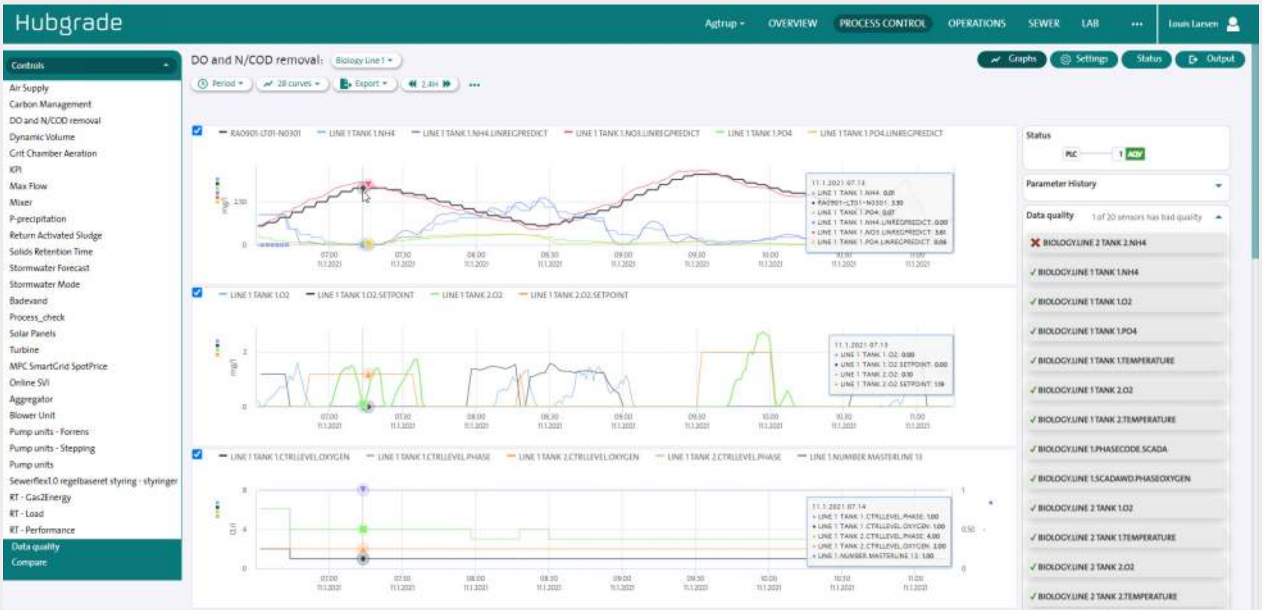

The Plant module is already installed at over 100 wastewater treatment plants and installations worldwide. The results experienced on those plants show up to:

- 40% higher biological capacity;
- 100% increase in hydraulic capacity;
- 25% energy reduction for aeration;
- 75% energy reduction for grit chamber aeration;
- 75% reduction in energy use for internal nitrate recirculation;
- 100% reduction in chemicals for denitrification and for phosphorus precipitation;
- 20-30% in overall OPEX savings.

“Hubgrade Performance boosts our performance by increasing the hydraulic capacity during wet weather. It is a smart solution with a high effect.”

Andrea Aliscioni, COO Milan Water Service

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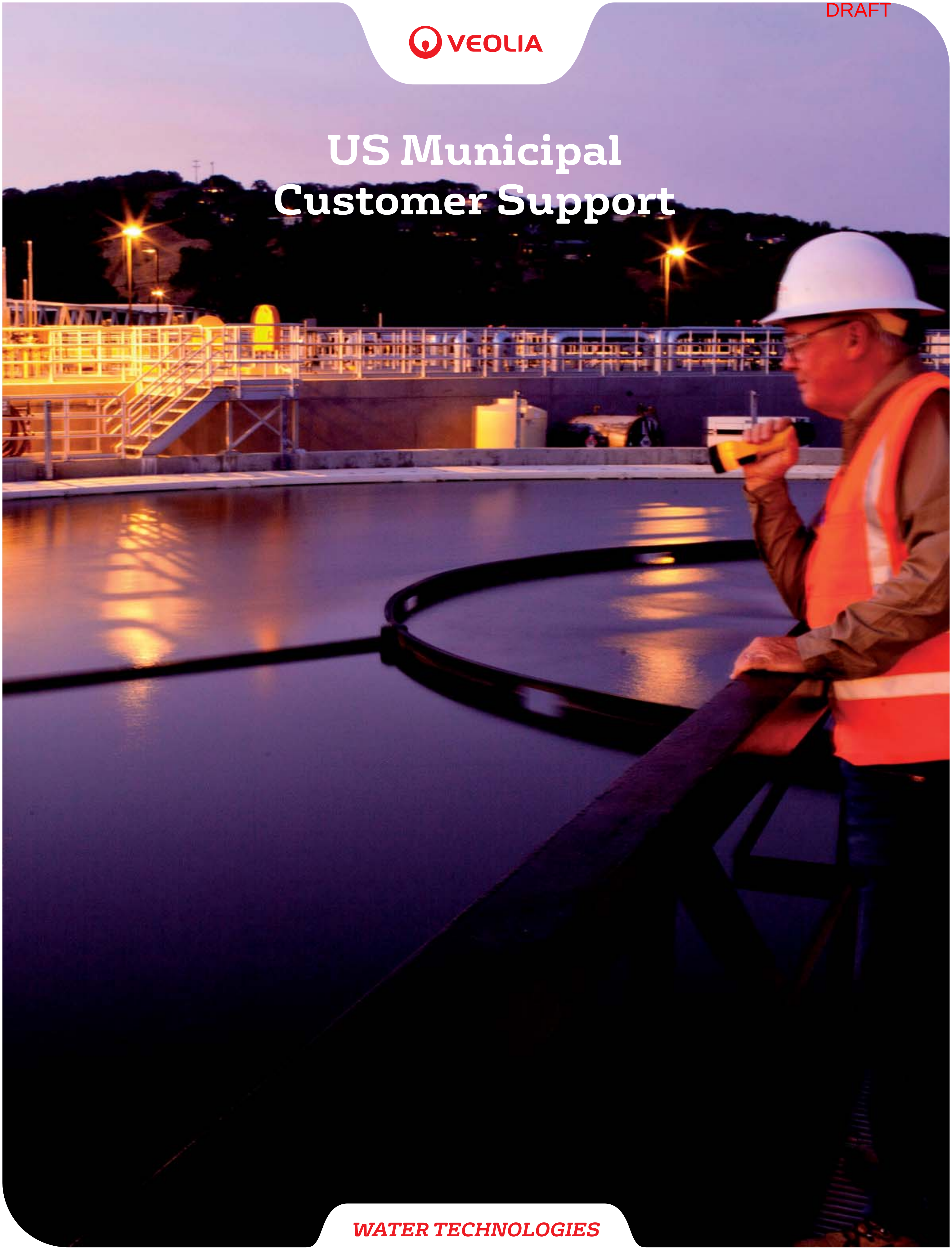
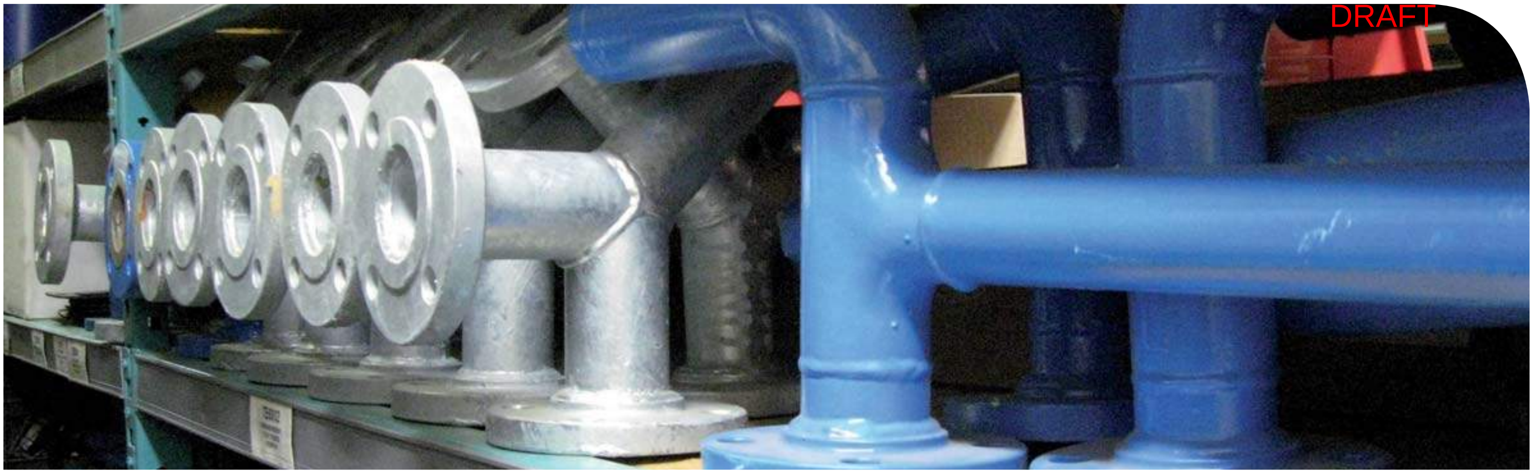
US Municipal Customer Support



WATER TECHNOLOGIES



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OEM Products & Replacement Parts

Kruger Customer Support is able to support all your repair and upgrade needs by providing Original Equipment Manufacturer Products and Replacement Parts. We maintain an extensive inventory and competitive pricing agreements with manufacturers for all parts needed to support:

Kruger Technologies

> ACTIFLO®
> Discfilter
> Drumfilter
> Oxidation Ditch
> BIOSTYR®
> MBBR/Hybas™
> NEOSEP®/MBR
> BioCon®
> OASES®
> Xtream™ and KCM Membranes
> OdoWatch®

Conventional Technologies

> Bar Screens
> Pump Stations
> Clarifiers
> Aeration Basins
> Digesters
> Wet Wells
> Thickeners

Services

Kruger Customer Support offers Service programs designed to reduce your overall operating cost, minimize downtime, increase the life expectancy of your equipment, and expand the operational knowledge of your staff. We have certified service experts throughout the US ready to provide:

> Mechanical Repairs (In-House & Local Repairs Available)
> Operator Training (Hand-On, Classroom, & Webinar Training Available)
> Process Optimization
> Discfilter Media Restoration
> Automation & Control Support
> Preventative Maintenance
> Performance Audits
> Lab Treatability Tests

DRAFT

Chemicals

Kruger Customer Support is able to supply certified chemicals intended to provide the best results for your treatment process. Our chemical formulations are developed specifically for our treatment technologies to optimize chemical consumption and improve performance. We have distribution centers throughout the US that are ready to supply:

> Polymers
> Coagulants
> Dewatering Polymers
> Microsand
> Media and Membrane Cleaners
> Micro C
> Odor Control Agents
> Acids
> Bases
> Oxidants
> Defoamers

Instrumentation, Automation, & Lab Supplies

Kruger Customer Support is able to offer instrumentation and lab supplies needed to monitor the quality of your water. We are a preferred supplier of HACH and Endress+Hauser. Our I&C experts are prepared to provide you discounted pricing on:

> Online Instrumentation
> Portable Laboratory Equipment
> Reagents
> Flow Meters
> Odor Monitoring
> Automated Microbiology
> AC & DC Drives
> Panel Boxes & Electrical Components
> HMIs
> PLCs
> Jar Testing Kits
> Gauges
> Transformers

Mobile Services

Kruger Customer Support offers Mobile Water Services to provide modular treatment plants for your short, mid, or long term water treatment needs. Our large fleet of mobile treatment units may be deployed as stand-alone units or combined to form complete water treatment systems. These mobile solutions are available for emergency rental, planned temporary hire, or long term contract to cover your needs:

> Equipment Breakdown
> Plant Commissioning
> Delayed delivery of new plant
> Plant downtime for maintenance purposes
> Process trial validation
> Peak demand
> Raw water changes

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Resourcing the world

Veolia Water Technologies

Kruger Inc. •1500 Garner Road, Suite C • Raleigh, NC 27610
tel. 888.578.4378 • fax 919.661.4568

usmunicipalsupport@veolia.com • www.krugerusa.com

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Cloth Media Filter

DRAFT

From: Paul Mora <paul_mora@dseslc.com>
Sent: Wednesday, July 12, 2023 10:56 AM
To: Pierce, Marshall
Cc: Neil Jenkins; Leaf, William
Subject: [EXTERNAL] RE: ESD - Facility Plan Update Treatment Options
Attachments: 2023-07-11 Preliminary Design 171778.pdf; 2023-07-11 Preliminary Design 171832.pdf; 2023-07-11 Preliminary Design 171833.pdf; 2023-07-11 Preliminary Design 172074.pdf

Importance: High

Marshall,

Per my discussion with the city, AASI has reevaluated their design and has come up with the following revised filter approach along with a membrane design. They have included a second phase filter for each phase of the project and recommend the following:

Phase 1 (Design #171778): Two (2) 10/4-Disk AquaDisk units fitted with 5 micron cloth. These will be followed by two (2) 8/4-Disk AquaDisk units fitted with 2 micron cloth. The preliminary budget price for the equipment in this design, including freight to the jobsite and our standard start-up supervision services is **$748,550 for the 10/4-Disk units and $660,810 for the 8/4-Disk units**.

Phase 2 (Design #171832): Expands the two (2) 10/4-Disk AquaDisk units fitted with 5 micron cloth to 10 disks each and adds an additional 10-Disk AquaDisk unit. These will be followed by the two (2) 8/4-Disk AquaDisk units fitted with 2 micron cloth that have been expanded to 8 disks each. The preliminary budget price for the equipment in this design, including freight to the jobsite and our standard start-up supervision services is **$589,020 for the 10 Disk unit and existing unit expansion and $120,200 for the existing 8 Disk units expansion.**

Phase 3 (Design #171833): No additional 10-Disk units with the 5 micron cloth will be added. A third 8-Disk unit fitted with 2 micron cloth is added for a total of three (3) units. The preliminary budget price for the equipment in this design, including freight to the jobsite and our standard start-up supervision services is **$400,930 for the third 8-Disk unit.**

Following the filters, we recommend our Aqua MultiBore P-Series Polymeric Membrane System in design **#172074** fitted with 136 membrane modules. The preliminary price for the equipment in this design, including freight to the jobsite and our standard start-up supervision services, is **$1,682,970.**

Please let us know if there are any questions or if any additional information is required.

Thanks!

VISIT OUR NEW WEBSITE AT WWW.DSESLC.COM!
Best Regards,

Paul R. Mora

DAVIDSON
SALES & ENGINEERING

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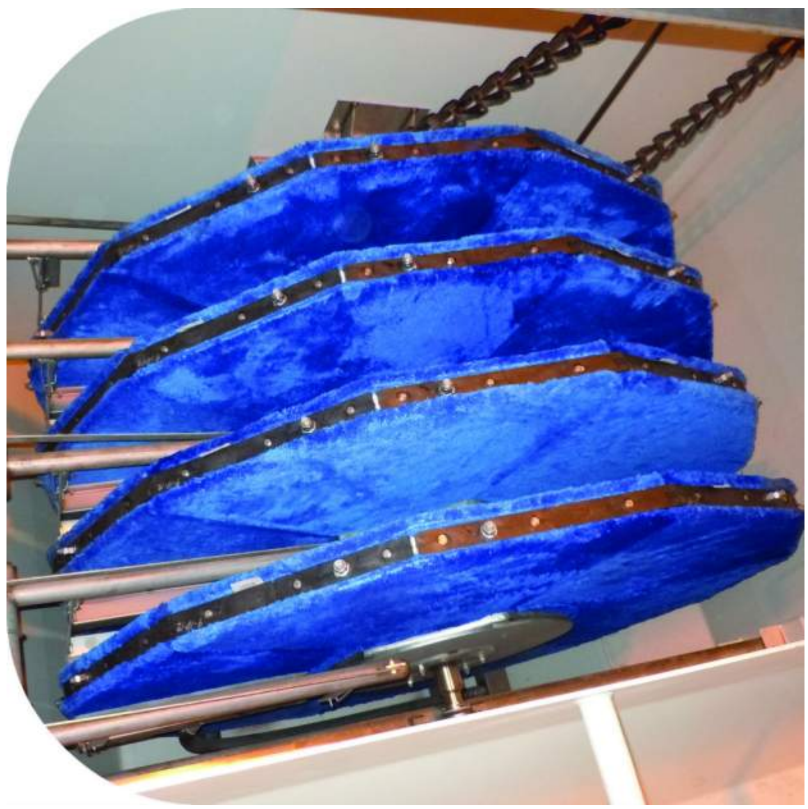
Process Design Report

EAGLE SEWER DISTRICT, ID

Design# 171778
Option: AquaDisk Design (Phase I)



AquaDisk®
Cloth Media Filter

July 11, 2023
Designed By: Bryce Hatfield

6306 N. Alpine Rd Loves Park, IL 61111
(815) 654-2501 www.aqua-aerobic.com

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Process/Site

- A treatability study is required to assure that the required effluent quality is achievable.

- The average and maximum design flow and loading conditions, shown within the report, are based on maximum month average conditions.

Filtration

- The cloth media filter recommendation and anticipated effluent quality are based upon influent water quality conditions as shown under "Design Parameters" of this Process Design Report.

- The filter influent should be free of algae and other solids that are not filterable through a nominal 5 micron pore size media. Provisions to treat algae and condition the solids to be filterable are the responsibility of others.

- A settling tank or inclined plate shall be utilized to remove the settleable portion of the TSS remaining from the lagoon effluent, or created during the coagulation step.

Equipment

- Scope of supply includes freight, installation supervision and start-up services.

- Equipment selection is based upon the use of Aqua-Aerobic Systems' standard materials of construction and electrical components, suitable for non-classified electrical environments.

- Aqua-Aerobic Systems, Inc. is familiar with various “Buy American” Acts (i.e. AIS, ARRA, Federal FAR 52.225, EXIM Bank, USAid, PA Steel Products Act, etc.). As the project develops Aqua-Aerobic Systems can work with you to ensure full compliance of our goods with various Buy American provisions if they are applicable/required for the project. When applicable, please provide us with the specifics of the project’s “Buy American” provisions.

- If the cloth media filter will be offline for extended periods of time, protection from sunlight is required.

AquaDisk® Tertiary Filtration - Design Summary

Design#: 171778 DRAFT

Project: **EAGLE SEWER DISTRICT, ID**

Option: **AquaDisk Design (Phase I)**

Designed by Bryce Hatfield on Tuesday, June 20, 2023

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DESIGN INFLUENT CONDITIONS

Pre-Filter Treatment:	Lagoon		
Avg. Design Flow	= 0.25 MGD	= 173.61 gpm	= 946.35 m³/day
Max Design Flow	= 0.50 MGD	= 347.22 gpm	= 1892.71 m³/day

DESIGN PARAMETERS			Effluent			
	Influent	**mg/l**	**Required**	**<= mg/l**	**Anticipated**	**<= mg/l**
Avg. Total Suspended Solids:	TSSa	67	TSSa	15	TSSa	15
Max. Total Suspended Solids:	TSSm	67	--	--	--	--
Phosphorus:	Total P	4.20	--	--	--	--
Bio/Chem Oxygen Demand:	BOD5	26	BOD5	15	BOD5	15

AquaDisk FILTER RECOMMENDATION

Qty Of Filter Units Recommended	= 2
Number Of Disks Per Unit	= 4
Total Number Of Disks Recommended	= 8
Total Filter Area Provided	= 430.4 ft² = (39.99 m²)
Filter Model Recommended	= AquaDisk Package: Model ADFSP-54 x 10/4E-PC
Filter Media Cloth Type	= OptiFiber PES-14®

AquaDisk FILTER CALCULATIONS

Filter Type:

Vertically Mounted Cloth Media Disks featuring automatically operated vacuum backwash . Tank shall include a rounded bottom and solids removal system.

Average Flow Conditions:

Average Hydraulic Loading = Avg. Design Flow (gpm) / Recommended Filter Area (ft²)
= 173.6 / 430.4 ft²
= 0.40 gpm/ft² (0.99 m/hr) at Avg. Flow

Maximum Flow Conditions:

Maximum Hydraulic Loading = Max. Design Flow (gpm) / Recommended Filter Area (ft²)
= 347.2 / 430.4 ft²
= 0.81 gpm/ft² (1.97 m/hr) at Max. Flow

Solids Loading:

Solids Loading Rate = (lbs TSS/day at max flow and max TSS loading) / Recommended Filter Area (ft²)
= 279.4 lbs/day / 430.4 ft²
= 0.65 lbs. TSS /day/ft² (3.16 kg. TSS/day/m²)

The above recommendation is based upon the provision to maintain a satisfactory hydraulic surface loading with (1) unit out of service. The resultant hydraulic loading rate at the Maximum Design Flow is: 1.6 gpm / ft² = (3.9 m/hr)

AquaDisk® Tertiary Filtration - Design Summary

Project: EAGLE SEWER DISTRICT, ID
Option: AquaDisk Design (Phase I) 2 Micron
Designed by Bryce Hatfield on Tuesday, July 11, 2023

DESIGN INFLUENT CONDITIONS

Pre-Filter Treatment:	Lagoon		
Avg. Design Flow	= 0.25 MGD	= 173.61 gpm	= 946.35 m³/day
Max Design Flow	= 0.50 MGD	= 347.22 gpm	= 1892.71 m³/day

DESIGN PARAMETERS

			Effluent			
	Influent	**mg/l**	**Required**	**<= mg/l**	**Anticipated**	**<= mg/l**
Avg. Total Suspended Solids:	TSSa	15	TSSa	5	TSSa	5
Max. Total Suspended Solids:	TSSm	20	--	--	--	--
Phosphorus:	Total P	4.20	--	--	--	--
***Turbidity:**	--	--	NTU	2	NTU	2
Bio/Chem Oxygen Demand:	BOD5	20	BOD5	5	BOD5	5

*Note: Tubidity represented in Nephelometric Turbidity Units (NTU's) in lieu of mg/l.

AquaDisk FILTER RECOMMENDATION

Qty Of Filter Units Recommended	= 2
Number Of Disks Per Unit	= 4
Total Number Of Disks Recommended	= 8
Total Filter Area Provided	= 430.4 ft² = (39.99 m²)
Filter Model Recommended	= AquaDisk Package: Model ADFSP-54 x 8/4E-PC
Filter Media Cloth Type	= OptiFiber UFS-9®

AquaDisk FILTER CALCULATIONS

Filter Type:

Vertically Mounted Cloth Media Disks featuring automatically operated vacuum backwash . Tank shall include a rounded bottom and solids removal system.

Average Flow Conditions:

Average Hydraulic Loading = Avg. Design Flow (gpm) / Recommended Filter Area (ft²)
= 173.6 / 430.4 ft²
= 0.40 gpm/ft² (0.99 m/hr) at Avg. Flow

Maximum Flow Conditions:

Maximum Hydraulic Loading = Max. Design Flow (gpm) / Recommended Filter Area (ft²)
= 347.2 / 430.4 ft²
= 0.81 gpm/ft² (1.97 m/hr) at Max. Flow

Solids Loading:

Solids Loading Rate = (lbs TSS/day at max flow and max TSS loading) / Recommended Filter Area (ft²)
= 83.4 lbs/day / 430.4 ft²
= 0.19 lbs. TSS /day/ft² (0.94 kg. TSS/day/m²)

The above recommendation is based upon the provision to maintain a satisfactory hydraulic surface loading with (1) unit out of service. The resultant hydraulic loading rate at the Maximum Design Flow is: 1.6 gpm / ft² = (3.9 m/hr)

Cloth Media Filters

AquaDisk Tanks/Basins

2 AquaDisk Model # ADFSP-54x10/4E-PC Package Filter Painted Steel Tank(s) consisting of:

- 10 Disk painted steel tank(s).
- 3" ball valve(s).

AquaDisk Centertube Assemblies

2 Centertube(s) consisting of:

- 304 stainless steel centertube weldment(s).
- Centertube driven sprocket(s).
- Dual wheel assembly(ies).
- Rider wheel bracket assembly(ies).
- Effluent seal plate weldment.
- Centertube bearing kit(s).
- Effluent centertube lip seal(s).
- Pile cloth media and non-corrosive support frame assemblies.
- Disk segment 304 stainless steel support rods.
- Media sealing gaskets.
- Centertube port covers.
- Centertube port gaskets.

2 Cloth set(s) will have the following feature:

- Cloth will be OptiFiber PES-14.

AquaDisk Drive Assemblies

2 Drive System(s) consisting of:

- Gearbox with motor.
- Drive sprocket(s).
- Drive chain(s) with pins.
- Stationary drive bracket weldment(s).
- Adjustable drive bracket weldment(s).
- Chain guard weldment(s).
- Warning label(s).

AquaDisk Backwash/Sludge Assemblies

2 Backwash System(s) consisting of:

- Backwash shoe assemblies.
- Backwash shoe support weldment(s).
- 1 1/2" flexible hose.
- Stainless steel backwash shoe springs.
- Hose clamps.
- Victaulic coupler(s).
- 2" 304 stainless steel cap(s).

2 Backwash/Solids Waste Pump(s) consisting of:

- Backwash/waste pump(s).
- Stainless steel anchors.
- 0 to 15 psi pressure gauge(s).
- 0 to 30 inches mercury vacuum gauge(s).

- Throttling gate valve(s).
- 3" ball valve(s).

AquaDisk Instrumentation

2 Pressure Transmitter(s) consisting of:

- Level transmitter(s).

2 Float Switch(es) consisting of:

- Float switch(es).

2 Vacuum Transmitter(s) consisting of:

- Vacuum transmitter(s).

AquaDisk Valves

2 Set(s) of Backwash Valves consisting of:

- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork).
- 2" flexible hose.
- Victaulic coupler(s).

2 Solids Waste Valve(s) consisting of:

- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork).
- 2" flexible hose.
- Victaulic coupler(s).

AquaDisk Controls w/Starters

2 Conduit Installation(s) consisting of:

- PVC conduit and fittings.

2 Control Panel(s) consisting of:

- NEMA 4X fiberglass enclosure(s).
- Circuit breaker with handle.
- Transformer(s).
- Fuses and fuse blocks.
- Line filter(s).
- GFI convenience outlet(s).
- Control relay(s).
- Selector switch(es).
- Indicating pilot light(s).
- Compactlogix Processor.
- Power supply(s).
- Input card(s)
- Output card(s).
- Analog input card(s).
- Ethernet switch(es).
- Power supply(ies).
- Operator interface(s).
- Motor starter(s).
- Terminal blocks.
- UL label(s).

Cloth Media Filters

AquaDisk Tanks/Basins

2 AquaDisk Model # ADFSP-54x8/4E-PC Package Filter Painted Steel Tank(s) consisting of:

- 8 Disk painted steel tank(s).
- 3" ball valve(s).

AquaDisk Centertube Assemblies

2 Centertube(s) consisting of:

- 304 stainless steel centertube weldment(s).
- Centertube driven sprocket(s).
- Dual wheel assembly(ies).
- Rider wheel bracket assembly(ies).
- Effluent seal plate weldment.
- Centertube bearing kit(s).
- Effluent centertube lip seal(s).
- Pile cloth media and non-corrosive support frame assemblies.
- Disk segment 304 stainless steel support rods.
- Media sealing gaskets.
- Centertube port covers.
- Centertube port gaskets.

2 Cloth set(s) will have the following feature:

- Cloth will be OptiFiber UFS-9.

AquaDisk Drive Assemblies

2 Drive System(s) consisting of:

- Gearbox with motor.
- Drive sprocket(s).
- Drive chain(s) with pins.
- Stationary drive bracket weldment(s).
- Adjustable drive bracket weldment(s).
- Chain guard weldment(s).
- Warning label(s).

AquaDisk Backwash/Sludge Assemblies

2 Backwash System(s) consisting of:

- Backwash shoe assemblies.
- Backwash shoe support weldment(s).
- 1 1/2" flexible hose.
- Stainless steel backwash shoe springs.
- Hose clamps.
- Victaulic coupler(s).
- 2" 304 stainless steel cap(s).

2 Backwash/Solids Waste Pump(s) consisting of:

- Backwash/waste pump(s).
- Stainless steel anchors.
- 0 to 15 psi pressure gauge(s).
- 0 to 30 inches mercury vacuum gauge(s).

- Throttling gate valve(s).
- 3" ball valve(s).

AquaDisk Instrumentation

2 Pressure Transmitter(s) consisting of:

- Level transmitter(s).

2 Float Switch(es) consisting of:

- Float switch(es).

2 Vacuum Transmitter(s) consisting of:

- Vacuum transmitter(s).

AquaDisk Valves

2 Set(s) of Backwash Valves consisting of:

- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork).
- 2" flexible hose.
- Victaulic coupler(s).

2 Solids Waste Valve(s) consisting of:

- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork).
- 2" flexible hose.
- Victaulic coupler(s).

AquaDisk Controls w/Starters

2 Conduit Installation(s) consisting of:

- PVC conduit and fittings.

2 Control Panel(s) consisting of:

- NEMA 4X fiberglass enclosure(s).
- Circuit breaker with handle.
- Transformer(s).
- Fuses and fuse blocks.
- Line filter(s).
- GFI convenience outlet(s).
- Control relay(s).
- Selector switch(es).
- Indicating pilot light(s).
- Compactlogix Processor.
- Power supply(s).
- Input card(s)
- Output card(s).
- Analog input card(s).
- Ethernet switch(es).
- Power supply(ies).
- Operator interface(s).
- Motor starter(s).
- Terminal blocks.
- UL label(s).

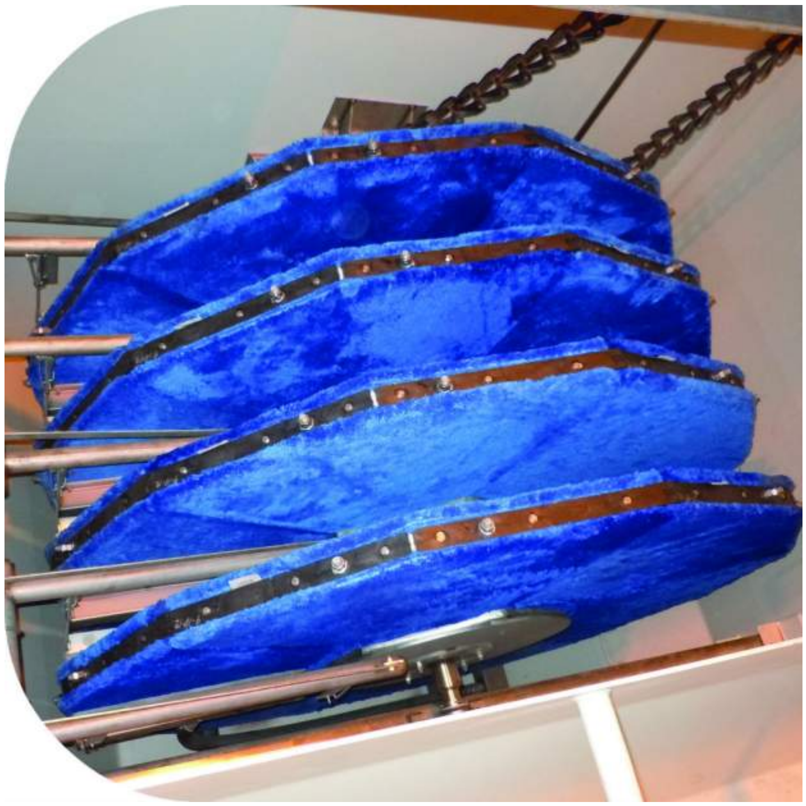
DRAFT

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Process Design Report

EAGLE SEWER DISTRICT, ID

Design# 171832
Option: AquaDisk Design (Phase 2)



AquaDisk®
Cloth Media Filter

July 11, 2023
Designed By: Bryce Hatfield

6306 N. Alpine Rd Loves Park, IL 61111
(815) 654-2501 www.aqua-aerobic.com

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Process/Site

- A treatability study is required to assure that the required effluent quality is achievable.

- The average and maximum design flow and loading conditions, shown within the report, are based on maximum month average conditions.

Filtration

- The cloth media filter recommendation and anticipated effluent quality are based upon influent water quality conditions as shown under "Design Parameters" of this Process Design Report.

- The filter influent should be free of algae and other solids that are not filterable through a nominal 5 micron pore size media. Provisions to treat algae and condition the solids to be filterable are the responsibility of others.

- A settling tank or inclined plate shall be utilized to remove the settleable portion of the TSS remaining from the lagoon effluent, or created during the coagulation step.

Equipment

- Scope of supply includes freight, installation supervision and start-up services.

- Equipment selection is based upon the use of Aqua-Aerobic Systems' standard materials of construction and electrical components, suitable for non-classified electrical environments.

- Aqua-Aerobic Systems, Inc. is familiar with various “Buy American” Acts (i.e. AIS, ARRA, Federal FAR 52.225, EXIM Bank, USAid, PA Steel Products Act, etc.). As the project develops Aqua-Aerobic Systems can work with you to ensure full compliance of our goods with various Buy American provisions if they are applicable/required for the project. When applicable, please provide us with the specifics of the project’s “Buy American” provisions.

- If the cloth media filter will be offline for extended periods of time, protection from sunlight is required.

AquaDisk® Tertiary Filtration - Design Summary

Project: EAGLE SEWER DISTRICT, ID

Option: AquaDisk Design (Phase 2)

Designed by Bryce Hatfield on Tuesday, June 20, 2023

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DESIGN INFLUENT CONDITIONS

Pre-Filter Treatment:	Lagoon		
Avg. Design Flow	= 0.50 MGD	= 347.22 gpm	= 1892.71 m^3/day
Max Design Flow	= 2.50 MGD	= 1736.11 gpm	= 9463.53 m^3/day

DESIGN PARAMETERS	Influent	mg/l	Effluent Required	<= mg/l	Effluent Anticipated	<= mg/l
Avg. Total Suspended Solids:	TSSa	67	TSSa	15	TSSa	15
Max. Total Suspended Solids:	TSSm	67	--	--	--	--
Phosphorus:	Total P	4.20	--	--	--	--
Bio/Chem Oxygen Demand:	BOD5	26	BOD5	15	BOD5	15

AquaDisk FILTER RECOMMENDATION

Qty Of Filter Units Recommended	= 3
Number Of Disks Per Unit	= 10
Total Number Of Disks Recommended	= 30
Total Filter Area Provided	= 1614.0 ft^2 = (149.95 m^2)
Filter Model Recommended	= AquaDisk Package: Model ADFSP-54 x 10E-PC
Filter Media Cloth Type	= OptiFiber PES-14®

AquaDisk FILTER CALCULATIONS

Filter Type:

Vertically Mounted Cloth Media Disks featuring automatically operated vacuum backwash . Tank shall include a rounded bottom and solids removal system.

Average Flow Conditions:

Average Hydraulic Loading
= Avg. Design Flow (gpm) / Recommended Filter Area (ft^2)
= 347.2 / 1614 ft^2
= 0.22 gpm/ft^2 (0.53 m/hr) at Avg. Flow

Maximum Flow Conditions:

Maximum Hydraulic Loading
= Max. Design Flow (gpm) / Recommended Filter Area (ft^2)
= 1736.1 / 1614 ft^2
= 1.08 gpm/ft^2 (2.63 m/hr) at Max. Flow

Solids Loading:

Solids Loading Rate
= (lbs TSS/day at max flow and max TSS loading) / Recommended Filter Area (ft^2)
= 1397 lbs/day / 1614 ft^2
= 0.87 lbs. TSS /day/ft^2 (4.22 kg. TSS/day/m^2)

The above recommendation is based upon the provision to maintain a satisfactory hydraulic surface loading with (1) unit out of service. The resultant hydraulic loading rate at the Maximum Design Flow is: 1.6 gpm / ft^2 = (3.9 m/hr)

AquaDisk® Tertiary Filtration - Design Summary

Project: **EAGLE SEWER DISTRICT, ID**

Option: **AquaDisk Design (Phase 2) 2 Micron**

Designed by Bryce Hatfield on Tuesday, June 20, 2023

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DESIGN INFLUENT CONDITIONS

Pre-Filter Treatment:	Lagoon		
Avg. Design Flow	= 0.50 MGD	= 347.22 gpm	= 1892.71 m³/day
Max Design Flow	= 2.50 MGD	= 1736.11 gpm	= 9463.53 m³/day

DESIGN PARAMETERS	Influent	mg/l	Effluent Required	<= mg/l	Effluent Anticipated	<= mg/l
Avg. Total Suspended Solids:	TSSa	15	TSSa	5	TSSa	5
Max. Total Suspended Solids:	TSSm	20	--	--	--	--
Phosphorus:	Total P	4.20	--	--	--	--
***Turbidity:**	--	--	NTU	2	NTU	2
Bio/Chem Oxygen Demand:	BOD5	15	BOD5	5	BOD5	5

*Note: Tubidity represented in Nephelometric Turbidity Units (NTU's) in lieu of mg/l.

AquaDisk FILTER RECOMMENDATION

Qty Of Filter Units Recommended	= 2
Number Of Disks Per Unit	= 8
Total Number Of Disks Recommended	= 16
Total Filter Area Provided	= 860.8 ft² = (79.97 m²)
Filter Model Recommended	= AquaDisk Package: Model ADFSP-54 x 8E-PC
Filter Media Cloth Type	= OptiFiber UFS-9®

AquaDisk FILTER CALCULATIONS

Filter Type:

Vertically Mounted Cloth Media Disks featuring automatically operated vacuum backwash . Tank shall include a rounded bottom and solids removal system.

Average Flow Conditions:

Average Hydraulic Loading
= Avg. Design Flow (gpm) / Recommended Filter Area (ft²)
= 347.2 / 860.8 ft²
= 0.40 gpm/ft² (0.99 m/hr) at Avg. Flow

Maximum Flow Conditions:

Maximum Hydraulic Loading
= Max. Design Flow (gpm) / Recommended Filter Area (ft²)
= 1736.1 / 860.8 ft²
= 2.02 gpm/ft² (4.93 m/hr) at Max. Flow

Solids Loading:

Solids Loading Rate
= (lbs TSS/day at max flow and max TSS loading) / Recommended Filter Area (ft²)
= 417 lbs/day / 860.8 ft²
= 0.48 lbs. TSS /day/ft² (2.36 kg. TSS/day/m²)

The above recommendation is based upon the provision to maintain a satisfactory hydraulic surface loading with (1) unit out of service. The resultant hydraulic loading rate at the Maximum Design Flow is: 4 gpm / ft² = (9.9 m/hr)

Cloth Media Filters

AquaDisk Tanks/Basins

1 AquaDisk Model # ADFSP-54x10E-PC Package Filter Painted Steel Tank(s) consisting of:

- 10 Disk painted steel tank(s).
- 3" ball valve(s).

AquaDisk Centertube Assemblies

1 Centertube(s) consisting of:

- 304 stainless steel centertube weldment(s).
- Centertube driven sprocket(s).
- Dual wheel assembly(ies).
- Rider wheel bracket assembly(ies).
- Effluent seal plate weldment.
- Centertube bearing kit(s).
- Effluent centertube lip seal(s).
- Pile cloth media and non-corrosive support frame assemblies.
- Disk segment 304 stainless steel support rods.
- Media sealing gaskets.

1 Cloth set(s) will have the following feature:

- Cloth will be OptiFiber PES-14.

AquaDisk Drive Assemblies

1 Drive System(s) consisting of:

- Gearbox with motor.
- Drive sprocket(s).
- Drive chain(s) with pins.
- Stationary drive bracket weldment(s).
- Adjustable drive bracket weldment(s).
- Chain guard weldment(s).
- Warning label(s).

AquaDisk Backwash/Sludge Assemblies

1 Backwash System(s) consisting of:

- Backwash shoe assemblies.
- Backwash shoe support weldment(s).
- 1 1/2" flexible hose.
- Stainless steel backwash shoe springs.
- Hose clamps.

1 Backwash/Solids Waste Pump(s) consisting of:

- Backwash/waste pump(s).
- Stainless steel anchors.
- 0 to 15 psi pressure gauge(s).
- 0 to 30 inches mercury vacuum gauge(s).
- Throttling gate valve(s).
- 3" ball valve(s).

AquaDisk Instrumentation

1 Pressure Transmitter(s) consisting of:

- Level transmitter(s).

1 Float Switch(es) consisting of:

- Float switch(es).

1 Vacuum Transmitter(s) consisting of:

- Vacuum transmitter(s).

AquaDisk Valves

1 Set(s) of Backwash Valves consisting of:

- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork).
- 2" flexible hose.
- Victaulic coupler(s).

1 Solids Waste Valve(s) consisting of:

- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork).
- 2" flexible hose.
- Victaulic coupler(s).

AquaDisk Misc/Spare Parts

1 AquaDisk Model # ADFSP-54x10/6E-PC Upgrade(s) consisting of:

- Pile cloth media and non-corrosive support frame assemblies.
- Disk segment 304 stainless steel support rods.
- Media sealing gaskets.
- Backwash shoe assemblies.
- Backwash shoe support weldment(s).
- 1 1/2" flexible hose.
- Hose clamps.
- Stainless steel backwash shoe springs.
- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork).
- 2" flexible hose.
- 316 stainless steel combination nipple(s).
- Victaulic coupler(s).
- Backwash/waste pump(s).
- Stainless steel anchors.
- 0 to 30 inches mercury vacuum gauge(s).
- 0 to 15 psi pressure gauge(s).

AquaDisk Controls w/Starters

1 Conduit Installation(s) consisting of:

- PVC conduit and fittings.

1 Control Panel(s) consisting of:

- NEMA 4X fiberglass enclosure(s).
- Circuit breaker with handle.
- Transformer(s).
- Fuses and fuse blocks.

- Line filter(s).
- GFI convenience outlet(s).
- Control relay(s).
- Selector switch(es).
- Indicating pilot light(s).
- Compactlogix Processor.
- Power supply(s).
- Input card(s)
- Output card(s).
- Analog input card(s).
- Ethernet switch(es).
- Operator interface(s).
- Power supply(ies).
- Motor starter(s).
- Terminal blocks.
- UL label(s).

Cloth Media Filters

AquaDisk Centertube Assemblies

2 Cloth set(s) will have the following feature:

- Cloth will be OptiFiber UFS-9.

AquaDisk Misc/Spare Parts

2 AquaDisk Model # ADFSP-54x8/4E-PC Upgrade(s) consisting of:

- Pile cloth media and non-corrosive support frame assemblies.
- Disk segment 304 stainless steel support rods.
- Media sealing gaskets.
- Backwash shoe assemblies.
- Backwash shoe support weldment(s).
- 1 1/2" flexible hose.
- Hose clamps.
- Stainless steel backwash shoe springs.
- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork).
- 2" flexible hose.
- 316 stainless steel combination nipple(s).

- Victaulic coupler(s).
- Backwash/waste pump(s).
- Stainless steel anchors.
- 0 to 30 inches mercury vacuum gauge(s).
- 0 to 15 psi pressure gauge(s).

DRAFT

Process Design Report

EAGLE SEWER DISTRICT, ID

Design# 171833
Option: AquaDisk Design (Phase 3)

AquaDisk®
Cloth Media Filter

July 11, 2023
Designed By: Bryce Hatfield

6306 N. Alpine Rd Loves Park, IL 61111
(815) 654-2501 www.aqua-aerobic.com

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Process/Site

- A treatability study is required to assure that the required effluent quality is achievable.

- The average and maximum design flow and loading conditions, shown within the report, are based on maximum month average conditions.

Filtration

- The cloth media filter recommendation and anticipated effluent quality are based upon influent water quality conditions as shown under "Design Parameters" of this Process Design Report.

- The filter influent should be free of algae and other solids that are not filterable through a nominal 5 micron pore size media. Provisions to treat algae and condition the solids to be filterable are the responsibility of others.

- A settling tank or inclined plate shall be utilized to remove the settleable portion of the TSS remaining from the lagoon effluent, or created during the coagulation step.

Equipment

- Scope of supply includes freight, installation supervision and start-up services.

- Equipment selection is based upon the use of Aqua-Aerobic Systems' standard materials of construction and electrical components, suitable for non-classified electrical environments.

- Aqua-Aerobic Systems, Inc. is familiar with various “Buy American” Acts (i.e. AIS, ARRA, Federal FAR 52.225, EXIM Bank, USAid, PA Steel Products Act, etc.). As the project develops Aqua-Aerobic Systems can work with you to ensure full compliance of our goods with various Buy American provisions if they are applicable/required for the project. When applicable, please provide us with the specifics of the project’s “Buy American” provisions.

- If the cloth media filter will be offline for extended periods of time, protection from sunlight is required.

AquaDisk® Tertiary Filtration - Design Summary

Design#: 171833 DRAFT

Project: **EAGLE SEWER DISTRICT, ID**

Option: **AquaDisk Design (Phase 3)**

Designed by Bryce Hatfield on Tuesday, July 11, 2023

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DESIGN INFLUENT CONDITIONS

Pre-Filter Treatment:	Lagoon		
Avg. Design Flow	= 2.50 MGD	= 1736.11 gpm	= 9463.53 m^3/day
Max Design Flow	= 4.00 MGD	= 2777.78 gpm	= 15141.65 m^3/day

DESIGN PARAMETERS

			Effluent			
	Influent	**mg/l**	**Required**	**<= mg/l**	**Anticipated**	**<= mg/l**
Avg. Total Suspended Solids:	TSSa	67	TSSa	15	TSSa	15
Max. Total Suspended Solids:	TSSm	67	--	--	--	--
Phosphorus:	Total P	4.20	--	--	--	--
Bio/Chem Oxygen Demand:	BOD5	26	BOD5	15	BOD5	15

AquaDisk FILTER RECOMMENDATION

Qty Of Filter Units Recommended	= 3
Number Of Disks Per Unit	= 10
Total Number Of Disks Recommended	= 30
Total Filter Area Provided	= 1614.0 ft^2 = (149.95 m^2)
Filter Model Recommended	= AquaDisk Package: Model ADFSP-54 x 10E-PC
Filter Media Cloth Type	= OptiFiber PES-14®

AquaDisk FILTER CALCULATIONS

Filter Type:

Vertically Mounted Cloth Media Disks featuring automatically operated vacuum backwash . Tank shall include a rounded bottom and solids removal system.

Average Flow Conditions:

Average Hydraulic Loading
= Avg. Design Flow (gpm) / Recommended Filter Area (ft^2)
= 1736.1 / 1614 ft^2
= 1.08 gpm/ft^2 (2.63 m/hr) at Avg. Flow

Maximum Flow Conditions:

Maximum Hydraulic Loading
= Max. Design Flow (gpm) / Recommended Filter Area (ft^2)
= 2777.8 / 1614 ft^2
= 1.72 gpm/ft^2 (4.21 m/hr) at Max. Flow

Solids Loading:

Solids Loading Rate
= (lbs TSS/day at max flow and max TSS loading) / Recommended Filter Area (ft^2)
= 2235.1 lbs/day / 1614 ft^2
= 1.38 lbs. TSS /day/ft^2 (6.75 kg. TSS/day/m^2)

The above recommendation is based upon the provision to maintain a satisfactory hydraulic surface loading with (1) unit out of service. The resultant hydraulic loading rate at the Maximum Design Flow is: 2.6 gpm / ft^2 = (6.3 m/hr)

Project: EAGLE SEWER DISTRICT, ID

Option: AquaDisk Design (Phase 3) 2 Micron

Designed by Bryce Hatfield on Tuesday, June 20, 2023

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DESIGN INFLUENT CONDITIONS

Pre-Filter Treatment:	Lagoon		
Avg. Design Flow	= 2.50 MGD	= 1736.11 gpm	= 9463.53 m³/day
Max Design Flow	= 4.00 MGD	= 2777.78 gpm	= 15141.65 m³/day

DESIGN PARAMETERS

			Effluent			
	Influent	**mg/l**	**Required**	**<= mg/l**	**Anticipated**	**<= mg/l**
Avg. Total Suspended Solids:	TSSa	15	TSSa	5	TSSa	5
Max. Total Suspended Solids:	TSSm	20	--	--	--	--
Phosphorus:	Total P	4.20	--	--	--	--
***Turbidity:**	--	--	NTU	2	NTU	2
Bio/Chem Oxygen Demand:	BOD5	15	BOD5	5	BOD5	5

*Note: Tubidity represented in Nephelometric Turbidity Units (NTU's) in lieu of mg/l.

AquaDisk FILTER RECOMMENDATION

Qty Of Filter Units Recommended	= 3
Number Of Disks Per Unit	= 8
Total Number Of Disks Recommended	= 24
Total Filter Area Provided	= 1291.2 ft² = (119.96 m²)
Filter Model Recommended	= AquaDisk Package: Model ADFSP-54 x 8E-PC
Filter Media Cloth Type	= OptiFiber UFS-9®

AquaDisk FILTER CALCULATIONS

Filter Type:

Vertically Mounted Cloth Media Disks featuring automatically operated vacuum backwash . Tank shall include a rounded bottom and solids removal system.

Average Flow Conditions:

Average Hydraulic Loading = Avg. Design Flow (gpm) / Recommended Filter Area (ft²)
= 1736.1 / 1291.2 ft²
= 1.34 gpm/ft² (3.29 m/hr) at Avg. Flow

Maximum Flow Conditions:

Maximum Hydraulic Loading = Max. Design Flow (gpm) / Recommended Filter Area (ft²)
= 2777.8 / 1291.2 ft²
= 2.15 gpm/ft² (5.26 m/hr) at Max. Flow

Solids Loading:

Solids Loading Rate = (lbs TSS/day at max flow and max TSS loading) / Recommended Filter Area (ft²)
= 667.2 lbs/day / 1291.2 ft²
= 0.52 lbs. TSS /day/ft² (2.52 kg. TSS/day/m²)

The above recommendation is based upon the provision to maintain a satisfactory hydraulic surface loading with (1) unit out of service. The resultant hydraulic loading rate at the Maximum Design Flow is: 3.2 gpm / ft² = (7.9 m/hr)

Cloth Media Filters

AquaDisk Tanks/Basins

1 AquaDisk Model # ADFSP-54x8E-PC Package Filter Painted Steel Tank(s) consisting of:

- 8 Disk painted steel tank(s).
- 3" ball valve(s).

AquaDisk Centertube Assemblies

1 Centertube(s) consisting of:

- 304 stainless steel centertube weldment(s).
- Centertube driven sprocket(s).
- Dual wheel assembly(ies).
- Rider wheel bracket assembly(ies).
- Effluent seal plate weldment.
- Centertube bearing kit(s).
- Effluent centertube lip seal(s).
- Pile cloth media and non-corrosive support frame assemblies.
- Disk segment 304 stainless steel support rods.
- Media sealing gaskets.

1 Cloth set(s) will have the following feature:

- Cloth will be OptiFiber UFS-9.

AquaDisk Drive Assemblies

1 Drive System(s) consisting of:

- Gearbox with motor.
- Drive sprocket(s).
- Drive chain(s) with pins.
- Stationary drive bracket weldment(s).
- Adjustable drive bracket weldment(s).
- Chain guard weldment(s).
- Warning label(s).

AquaDisk Backwash/Sludge Assemblies

1 Backwash System(s) consisting of:

- Backwash shoe assemblies.
- Backwash shoe support weldment(s).
- 1 1/2" flexible hose.
- Stainless steel backwash shoe springs.
- Hose clamps.

1 Backwash/Solids Waste Pump(s) consisting of:

- Backwash/waste pump(s).
- Stainless steel anchors.
- 0 to 15 psi pressure gauge(s).
- 0 to 30 inches mercury vacuum gauge(s).
- Throttling gate valve(s).
- 3" ball valve(s).

AquaDisk Instrumentation

1 Pressure Transmitter(s) consisting of:

- Level transmitter(s).

1 Float Switch(es) consisting of:

- Float switch(es).

1 Vacuum Transmitter(s) consisting of:

- Vacuum transmitter(s).

AquaDisk Valves

1 Set(s) of Backwash Valves consisting of:

- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork).
- 2" flexible hose.
- Victaulic coupler(s).

1 Solids Waste Valve(s) consisting of:

- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork).
- 2" flexible hose.
- Victaulic coupler(s).

AquaDisk Controls w/Starters

1 Conduit Installation(s) consisting of:

- PVC conduit and fittings.

1 Control Panel(s) consisting of:

- NEMA 4X fiberglass enclosure(s).
- Circuit breaker with handle.
- Transformer(s).
- Fuses and fuse blocks.
- Line filter(s).
- GFI convenience outlet(s).
- Control relay(s).
- Selector switch(es).
- Indicating pilot light(s).
- Compactlogix Processor.
- Power supply(s).
- Input card(s)
- Output card(s).
- Analog input card(s).
- Ethernet switch(es).
- Power supply(ies).
- Operator interface(s).
- Motor starter(s).
- Terminal blocks.
- UL label(s).

Ultraviolet (UV) Disinfection

- River Discharge Option

- Water Reuse Option

DRAFT

TROJANUVSIGNA™

PROPOSAL FOR EAGLE SEWER DISTRICT (RIVER DISCHARGE), IDAHO
QUOTE: 241523
08/11/2023

TrojanUVSigna™ incorporates revolutionary innovations, including TrojanUV Solo Lamp™ technology, to reduce the total cost of ownership and drastically simplify operation and maintenance. It is the ideal solution for facilities wanting to upgrade their disinfection system easily and cost-effectively.

We are pleased to provide the enclosed TrojanUVSigna proposal. Please do not hesitate to contact us if you have any questions regarding this proposal. We look forward to working with you.

With best regards,

Monica Harrington
3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400 ext. 3601
mharrington@trojantechnologies.com

Local Representative:

Kyle Bentley
Peterson and Matz, Inc.
248.345.6667
Kyle.Bentley@petersonandmatz.com

DESIGN CRITERIA

Phase 1 Peak Design Flow (Phase 2):	**3.6 MGD (Phase 2: 7.17 MGD)**
UV Transmittance:	**55%** (minimum)
Total Suspended Solids:	**30 mg/l (30 Day Average,** grab sample)
Disinfection Limit:	**126 E.coli per 100 ml**, 30 day Geomean, 406 Maximum of consecutive daily grab samples
Redundancy:	**1 Bank/Channel**

DESIGN SUMMARY

CHANNEL (Refer to Trojan layout drawing for complete details)	**PHASE 1**	**PHASE 2**
Number of Channels:	**1**	**2**
Minimum Channel Length Required:	**36 ft.**	
Channel Width at UV Banks:	**30.75 in.**	
Channel Depth Recommended:	**7ft. 8in.**	
UV BANKS		
Number of Banks per Channel:	**3**	
Number of Lamps per Bank:	**8**	
Total Number of UV Lamps:	**24**	**48**
Maximum Power Draw/Channel:	**26.5 kW**	
UV PANELS		
Power Distribution Center Quantity:	**1**	**2**
Hydraulic System Center Quantity:	**1**	**2**
System Control Center Quantity:	**1**	**1**
ANCILLARY EQUIPMENT		
Level Controller Quantity and Type:	**1 Fixed Weir**	**2 Fixed Weirs**
Integral Bank Walls:	**Included**	
ELECTRICAL REQUIREMENTS		

1. Each Power Distribution Center requires an electrical supply of one (1) 480/277V 60Hz, 27.4 kVA
2. Electrical supply for Hydraulic System Center will be (1) 480V 60Hz, 2.5 kVA
3. Electrical supply for System Control Center will be (1) 120V 60Hz, 1.8 kVA
4. The On-line UVT monitor requires (1) 120 Volts, 1 phase, 2 wire + ground, 1A
5. Electrical disconnects are not included in this proposal. Refer to local electrical codes

Confidential - Company Proprietary

COMMERCIAL INFORMATION

Total Capital Cost: $ 335,000 (USD)

This price excludes any taxes or duties that may be applicable.
Standard equipment warrantees and start up by Trojan-certified technicians are included.

Easy and Cost-Effective Maintenance

- The 1000 watt TrojanUV Solo Lamp combines the benefits of both low pressure and medium pressure lamps
- Fewer lamps, long lamp life and easy change-outs save time and money
- Lamp change-outs and cleaning solution replacement are done while the UV system is in the channel – minimizing downtime and simplifying maintenance
- Routine maintenance can be performed while banks are in the channel, but an Automatic Raising Mechanism (ARM) makes other tasks, such as winterization, simple, safe and easy
- Lamp plugs with LED status indicators and integral safety interlock prevent an operator from accidentally removing an energized lamp
- ActiClean WW™ chemical/mechanical cleaning system to keep sleeves clean during operation

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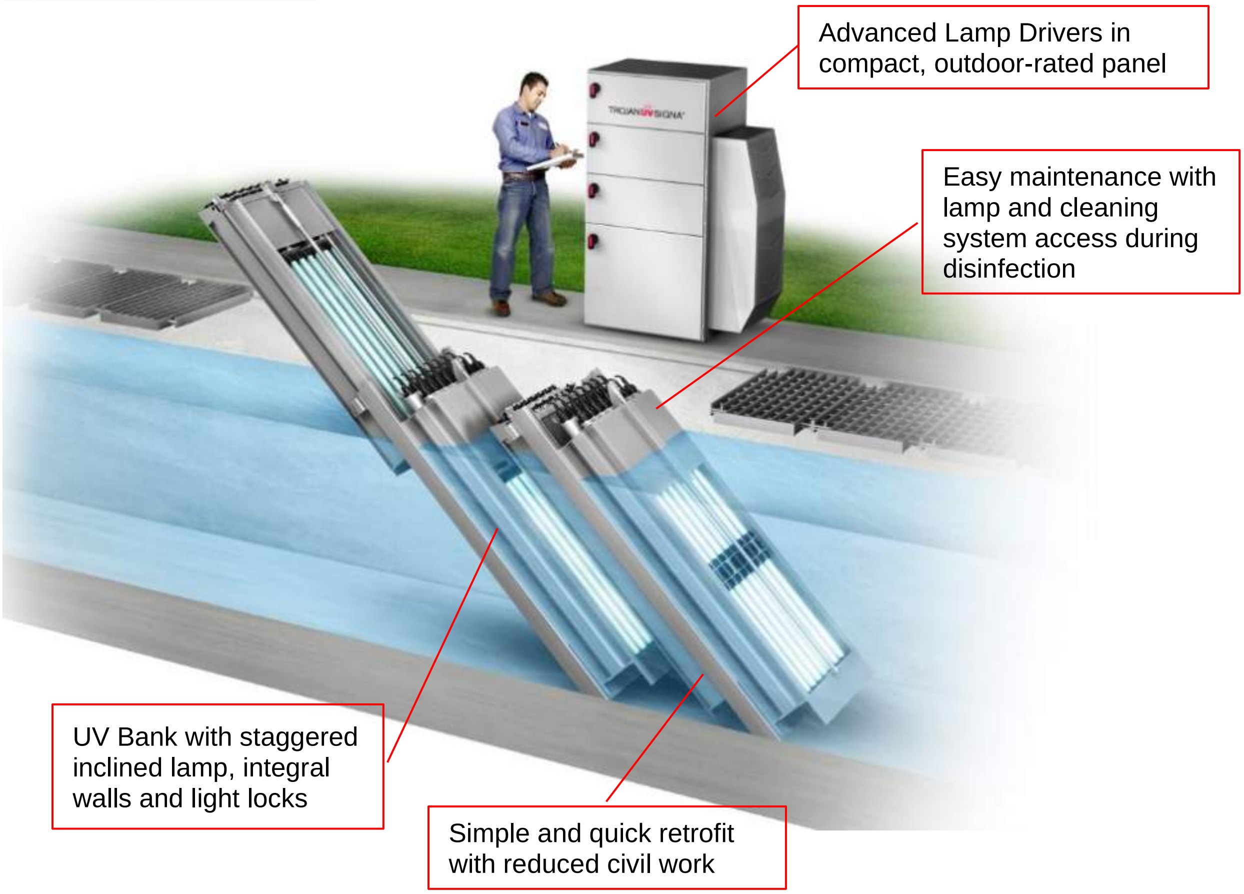
TROJANUVSIGNA™

SYSTEM OVERVIEW

SOLO LAMP TECHNOLOGY



Simple to Design and Install

- Light locks on the UV banks control water level within the channel, reducing dependence on downstream weirs and preventing short-circuiting above the lamp arc
- UV Banks include integral reactor walls to make installation easy and prevent short circuiting at the channel walls
- Stringent tolerances on concrete channel walls are not required – making retrofits simple and cost-effective

Supported by Trojan Technologies

- Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, whichever comes first.
- UV lamps are warranted for 15,000 hours of operation or 3 years from shipment, whichever comes first. Lamp warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
- Trojan offers an unparalleled Lifetime Performance Guarantee. The spirit of this guarantee is simple: the Trojan equipment, as sized for the project, will meet the disinfection requirements for the life of the system.

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PROPOSAL FOR EAGLE SEWER DISTRICT (REUSE), IDAHO
QUOTE: 241524
08/11/2023

TrojanUVSigna™ incorporates revolutionary innovations, including TrojanUV Solo Lamp™ technology, to reduce the total cost of ownership and drastically simplify operation and maintenance. It is the ideal solution for facilities wanting to upgrade their disinfection system easily and cost-effectively.

We are pleased to provide the enclosed TrojanUVSigna proposal. Please do not hesitate to contact us if you have any questions regarding this proposal. We look forward to working with you.

With best regards,

Monica Harrington
3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400 ext. 3601
mharrington@trojantechnologies.com

Local Representative:

Kyle Bentley
Peterson and Matz, Inc.
248.345.6667
Kyle.Bentley@petersonandmatz.com

DESIGN CRITERIA

Phase 1 Peak Design Flow (Phase 2):	**3.60 MGD (Phase 2: 7.17)**
UV Transmittance:	**55%** (minimum)
Total Suspended Solids:	**30 mg/l (30 Day Average,** grab sample)
Disinfection Limit:	**2.2 E.coli per 100 ml**, 7 day Median, consecutive daily grab samples
Redundancy:	**1 Bank/channel**

DESIGN SUMMARY

CHANNEL (Refer to Trojan layout drawing for complete details)	**PHASE 1**	**PHASE 2**
Number of Channels:	**1**	**2**
Minimum Channel Length Required:	**42.5 ft.**	
Channel Width at UV Banks:	**35.25 in.**	
Channel Depth Recommended:	**7ft. 8in.**	
UV BANKS		
Number of Banks per Channel:	**5**	
Number of Lamps per Bank:	**10**	
Total Number of UV Lamps:	**50**	**100**
Maximum Power Draw/Channel:	**56.2 kW**	
UV PANELS		
Power Distribution Center Quantity:	**1**	**2**
Hydraulic System Center Quantity:	**2**	**4**
System Control Center Quantity:	**1**	**1**
ANCILLARY EQUIPMENT		
Level Controller Quantity and Type:	**1 Fixed Weir**	**2 Fixed Weirs**
Integral Bank Walls:	**Included**	

ELECTRICAL REQUIREMENTS

1. Each Power Distribution Center requires an electrical supply of one (1) 480/277V 60Hz, 58.7 kVA
2. Electrical supply for Hydraulic System Center will be (1) 480V 60Hz, 2.5 kVA
3. Electrical supply for System Control Center will be (1) 120V 60Hz, 1.8 kVA
4. The On-line UVT monitor requires (1) 120 Volts, 1 phase, 2 wire + ground, 1A
5. Electrical disconnects are not included in this proposal. Refer to local electrical codes

Confidential - Company Proprietary

COMMERCIAL INFORMATION

Total Capital Cost: $ 520 000 (USD)

This price excludes any taxes or duties that may be applicable.
Standard equipment warrantees and start up by Trojan-certified technicians are included.

Easy and Cost-Effective Maintenance

- The 1000 watt TrojanUV Solo Lamp combines the benefits of both low pressure and medium pressure lamps
- Fewer lamps, long lamp life and easy change-outs save time and money
- Lamp change-outs and cleaning solution replacement are done while the UV system is in the channel – minimizing downtime and simplifying maintenance
- Routine maintenance can be performed while banks are in the channel, but an Automatic Raising Mechanism (ARM) makes other tasks, such as winterization, simple, safe and easy
- Lamp plugs with LED status indicators and integral safety interlock prevent an operator from accidentally removing an energized lamp
- ActiClean WW™ chemical/mechanical cleaning system to keep sleeves clean during operation

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SYSTEM OVERVIEW

Advanced Lamp Drivers in compact, outdoor-rated panel

Easy maintenance with lamp and cleaning system access during disinfection

UV Bank with staggered inclined lamp, integral walls and light locks

Simple and quick retrofit with reduced civil work

Simple to Design and Install

- Light locks on the UV banks control water level within the channel, reducing dependence on downstream weirs and preventing short-circuiting above the lamp arc
- UV Banks include integral reactor walls to make installation easy and prevent short circuiting at the channel walls
- Stringent tolerances on concrete channel walls are not required – making retrofits simple and cost-effective

Supported by Trojan Technologies

- Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, whichever comes first.
- UV lamps are warranted for 15,000 hours of operation or 3 years from shipment, whichever comes first. Lamp warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
- Trojan offers an unparalleled Lifetime Performance Guarantee. The spirit of this guarantee is simple: the Trojan equipment, as sized for the project, will meet the disinfection requirements for the life of the system.

Appendix E
Alternatives Evaluation

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Liquids Treatment Alternatives NPV Calculations

Alternative 1 - NPV

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ALTERNATIVE 1: Business as Usual (Do Nothing)

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
O&M Costs																		
Discharge to the City of Boise	$ 1,593,410	$ 1,970,577	$ 2,344,505	$ 2,681,289	$ 3,202,862	$ 3,759,592	$ 4,084,502	$ 4,435,851	$ 4,813,647	$ 5,221,911	$ 5,663,013	$ 6,142,000	$ 6,681,677	$ 7,215,504	$ 7,815,844	$ 8,490,776	$ 9,191,949	$ 9,948,559
Sludge Removal Costs	$ -	$ 725,794	$ -	$ 831,495	$ -	$ 921,689	$ -	$ 1,022,689	$ -	$ 1,132,894	$ -	$ 1,253,070	$ -	$ 1,384,041	$ -	$ 1,526,700	$ -	$ 1,682,005
ESD O&M Charges	$ 700,000	$ 724,500	$ 749,858	$ 776,103	$ 803,266	$ 831,380	$ 860,479	$ 890,595	$ 921,766	$ 954,028	$ 987,419	$ 1,021,979	$ 1,057,748	$ 1,094,769	$ 1,133,086	$ 1,172,744	$ 1,213,790	$ 1,256,273
City of Boise Capacity Charges	$ -	$ 317,175	$ 371,975	$ 571,547	$ 842,262	$ 1,265,365	$ 908,545	$ 988,278	$ 1,056,605	$ 1,139,053	$ 1,223,083	$ 1,373,813	$ 1,624,554	$ 1,707,479	$ 1,789,958	$ 1,900,198	$ 523,999	$ 534,938
Total O&M Costs	$ 2,293,410	$ 3,738,047	$ 3,466,337	$ 4,860,433	$ 4,848,390	$ 6,778,026	$ 5,853,525	$ 7,337,413	$ 6,792,019	$ 8,447,886	$ 7,873,515	$ 9,790,861	$ 9,363,979	$ 11,401,793	$ 10,738,888	$ 13,090,418	$ 10,929,738	$ 13,421,776
O&M NPV	$80,389,887																	
R&R Cost																		
R&R Costs	$ 326,949	$ 326,949	$ 326,949	$ 326,949	$ 326,949	$ 269,474	$ 269,474	$ 220,567	$ 220,567	$ 220,567	$ 220,567	$ 220,567	$ 220,567	$ 220,567	$ 216,796	$ 216,796	$ 214,546	$ 214,546
R&R NPV	$3,047,951																	

Project NPV (PTAC)	$83,437,837

potential total asset cost

Alternative 1 - Annual West Boise O&M Costs

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Water Usage Growth Rate (Annual) 2022 to 2028	1.060
Water Usage Growth Rate (Annual) 2029-2040	1.015

cBOD Escalation Factor	3.7

Year	MAX MONTH AVERAGE DAILY FLOW-GAL	$/ avg daily gal	FLOW BILLED per Year	Added Capacity Cost	$/ avg daily gal	Average Daily cBOD-mg/L	Average Daily cBOD-Lbs	$/avg day lb	cBOD Billed per Year	Added Capacity Cost	Total BOD Billed per Year	Average Daily TSS-mg/L	Average Daily TSS-Lbs	$/avg day lb	TSS Billed per Year	Added Capacity Cost	Total TSS Billed per Year
FY22	2,420,000.00	$ 0.50	$ 1,218,881	$ -	$ 1,218,881		0.0	$ 371.2	$ -				0.0	$ 173.30			
FY23	2,565,200.00	$ 0.40	$ 1,013,254	$ -	$ 1,013,254	20	427.9	$ 381.0	$ 163,021	$ -	$ 163,021	29	620.4	$ 300.00	$ 186,126	$ -	$ 186,126
FY24	2,719,112.00	$ 0.37	$ 1,006,071	$ 317,175	$ 1,323,247	24	537.5	$ 388.0	$ 208,532	$ -	$ 208,532	34	771.0	$ 300.00	$ 231,309	$ -	$ 231,309
FY25	2,882,258.72	$ 0.35	$ 1,000,144	$ 371,975	$ 1,372,118	27	658.6	$ 396.0	$ 260,822	$ -	$ 260,822	36	865.4	$ 300.00	$ 259,611	$ -	$ 259,611
FY26	3,055,194.24	$ 0.35	$ 1,069,318	$ 394,293	$ 1,463,611	31	792.4	$ 432.6	$ 342,832	$ -	$ 342,832	39	993.7	$ 300.00	$ 298,120	$ -	$ 298,120
FY27	3,238,505.90	$ 0.38	$ 1,238,340	$ 417,951	$ 1,656,290	35	939.9	$ 472.7	$ 444,252	$ -	$ 444,252	42	1134.4	$ 327.75	$ 371,794	$ -	$ 371,794
FY28	3,432,816.25	$ 0.41	$ 1,423,795	$ 443,028	$ 1,866,822	39	1102.2	$ 512.7	$ 565,087	$ -	$ 565,087	43	1231.1	$ 355.50	$ 437,648	$ -	$ 437,648
FY29	3,483,621.93	$ 0.44	$ 1,517,110	$ 115,837	$ 1,632,947	42	1226.1	$ 538.3	$ 659,989	$ -	$ 659,989	44	1278.3	$ 373.28	$ 477,176	$ -	$ 477,176
FY30	3,535,179.54	$ 0.46	$ 1,616,542	$ 117,551	$ 1,734,093	46	1353.3	$ 565.2	$ 764,904	$ -	$ 764,904	45	1326.8	$ 391.94	$ 520,006	$ -	$ 520,006
FY31	3,587,500.19	$ 0.48	$ 1,722,490	$ 119,291	$ 1,841,781	50	1484.0	$ 593.5	$ 880,735	$ -	$ 880,735	46	1376.3	$ 411.54	$ 566,400	$ -	$ 566,400
FY32	3,640,595.20	$ 0.50	$ 1,835,382	$ 121,057	$ 1,956,439	53	1618.3	$ 623.2	$ 1,008,465	$ -	$ 1,008,465	47	1427.0	$ 432.11	$ 616,642	$ -	$ 616,642
FY33	3,694,476.01	$ 0.53	$ 1,955,673	$ 122,848	$ 2,078,521	57	1756.3	$ 654.3	$ 1,149,154	$ -	$ 1,149,154	48	1479.0	$ 453.72	$ 671,037	$ -	$ 671,037
FY34	3,749,154.25	$ 0.56	$ 2,083,848	$ 124,666	$ 2,208,514	61	1898.0	$ 687.0	$ 1,303,952	$ 51,565	$ 1,355,518	49	1532.1	$ 476.40	$ 729,913	$ -	$ 729,913
FY35	3,804,641.73	$ 0.58	$ 2,220,423	$ 126,511	$ 2,346,935	64	2043.5	$ 721.4	$ 1,474,106	$ 202,963	$ 1,677,069	51	1618.3	$ 500.22	$ 809,496	$ -	$ 809,496
FY36	3,860,950.43	$ 0.61	$ 2,365,950	$ 128,384	$ 2,494,333	68	2192.8	$ 757.4	$ 1,660,962	$ 208,391	$ 1,869,353	51	1642.2	$ 525.24	$ 862,550	$ -	$ 862,550
FY37	3,918,092.50	$ 0.64	$ 2,521,014	$ 130,284	$ 2,651,298	72	2346.2	$ 795.3	$ 1,865,979	$ 213,935	$ 2,079,914	52	1699.2	$ 551.50	$ 937,103	$ -	$ 937,103
FY38	3,976,080.27	$ 0.68	$ 2,686,241	$ 132,212	$ 2,818,453	76	2503.6	$ 835.1	$ 2,090,735	$ 219,598	$ 2,310,333	54	1790.7	$ 579.07	$ 1,036,925	$ -	$ 1,036,925
FY39	4,034,926.25	$ 0.71	$ 2,862,297	$ 134,169	$ 2,996,466	79	2665.2	$ 876.8	$ 2,336,937	$ 225,381	$ 2,562,318	55	1850.8	$ 608.03	$ 1,125,346	$ -	$ 1,125,346
FY40	4,094,643.16	$ 0.74	$ 3,049,892	$ 136,155	$ 3,186,047	83	2831.0	$ 920.7	$ 2,606,430	$ 231,287	$ 2,837,717	56	1912.4	$ 638.43	$ 1,220,903	$ -	$ 1,220,903

Year	Average Daily NH3N-mg/L	Average Daily NH3N-Lbs	$/avg day lb	NH3N Billed per Year	Added Capacity Cost	Total NH3N Billed per Year	Average Daily TP-mg/L	Average Daily DAILY TP-Lbs	$/avg day lb	TP Billed per Year	Added Capacity Cost	Total TP Billed per Year	Yearly O&M Bill (Without Capacity Charges)	Capacity Charges	Total Bill
FY22		0	$ 99.72					0	$ -						
FY23	23.2	496.3354	$ 220.00	$ 109,194	$ -	$ 109,194	4.38	93.7	$ 1,300	$ 121,816	$ -	$ 121,816	$ 1,593,410	$ -	$ 1,593,410
FY24	24	544.2575	$ 340.00	$ 185,048	$ -	$ 185,048	5.76	130.6	$ 2,600	$ 339,617	$ -	$ 339,617	$ 1,970,577	$ 317,175	$ 2,287,753
FY25	25	600.9509	$ 460.00	$ 276,437	$ -	$ 276,437	5.84	140.4	$ 3,900	$ 547,490	$ -	$ 547,490	$ 2,344,505	$ 371,975	$ 2,716,479
FY26	25.3	644.6521	$ 502.55	$ 323,970	$ -	$ 323,970	5.96	151.9	$ 4,261	$ 647,049	$ 177,254	$ 824,303	$ 2,681,289	$ 571,547	$ 3,252,836
FY27	25.9	699.5367	$ 549.04	$ 384,074	$ -	$ 384,074	6.08	164.2	$ 4,655	$ 764,402	$ 424,311	$ 1,188,713	$ 3,202,862	$ 842,262	$ 4,045,124
FY28	26.3	752.9608	$ 595.53	$ 448,411	$ 178,064	$ 626,474	6.12	175.2	$ 5,049	$ 884,652	$ 644,274	$ 1,528,926	$ 3,759,592	$ 1,265,365	$ 5,024,957
FY29	26.5	769.9153	$ 625.31	$ 481,433	$ 73,328	$ 554,761	6.16	179.0	$ 5,301	$ 948,793	$ 719,380	$ 1,668,173	$ 4,084,502	$ 908,545	$ 4,993,047
FY30	26.7	787.2067	$ 656.57	$ 516,858	$ 74,785	$ 591,643	6.20	182.8	$ 5,567	$ 1,017,542	$ 795,941	$ 1,813,483	$ 4,435,851	$ 988,278	$ 5,424,129
FY31	26.8	801.8493	$ 689.40	$ 552,795	$ 63,329	$ 616,125	6.24	186.7	$ 5,845	$ 1,091,227	$ 873,985	$ 1,965,212	$ 4,813,647	$ 1,056,605	$ 5,870,253
FY32	26.9	816.753	$ 723.87	$ 591,223	$ 64,458	$ 655,682	6.28	190.7	$ 6,137	$ 1,170,199	$ 953,538	$ 2,123,737	$ 5,221,911	$ 1,139,053	$ 6,360,964
FY33	27	831.9221	$ 760.06	$ 632,314	$ 65,607	$ 697,921	6.32	194.7	$ 6,444	$ 1,254,836	$ 1,034,628	$ 2,289,464	$ 5,663,013	$ 1,223,083	$ 6,886,096
FY34	27.2	850.4881	$ 798.07	$ 678,747	$ 80,298	$ 759,045	6.36	198.9	$ 6,766	$ 1,345,541	$ 1,117,283	$ 2,462,823	$ 6,142,000	$ 1,373,813	$ 7,515,812
FY35	27.3	866.2484	$ 837.97	$ 725,891	$ 68,163	$ 794,054	6.44	204.3	$ 7,104	$ 1,451,762	$ 1,226,916	$ 2,678,677	$ 6,681,677	$ 1,624,554	$ 8,306,231
FY36	27.5	885.509	$ 879.87	$ 779,132	$ 83,302	$ 862,434	6.44	207.4	$ 7,460	$ 1,546,910	$ 1,287,402	$ 2,834,312	$ 7,215,504	$ 1,707,479	$ 8,922,983
FY37	27.6	901.8822	$ 923.86	$ 833,215	$ 70,814	$ 904,029	6.48	211.7	$ 7,833	$ 1,658,532	$ 1,374,925	$ 3,033,457	$ 7,815,844	$ 1,789,958	$ 9,605,802
FY38	27.6	915.2301	$ 970.06	$ 887,824	$ 57,729	$ 945,554	6.56	217.5	$ 8,224	$ 1,789,050	$ 1,490,659	$ 3,279,709	$ 8,490,776	$ 1,900,198	$ 10,390,974
FY39	27.7	932.1406	$ 1,018.56	$ 949,440	$ 73,138	$ 1,022,578	6.60	222.1	$ 8,635	$ 1,917,928	$ 91,311	$ 2,009,239	$ 9,191,949	$ 523,999	$ 9,715,947
FY40	27.8	949.3512	$ 1,069.49	$ 1,015,318	$ 74,436	$ 1,089,754	6.64	226.75	$ 9,067	$ 2,056,015	$ 93,061	$ 2,149,076	$ 9,948,559	$ 534,938	$ 10,483,498

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Alternative 1 - R&R Current Assets

Component	Number of units	Installation Date	Expected Useful Life	Year to Be Raplaced	Replacement Cost	Monthly cost	
Headworks						Until Replacement	After Repacement
Headworks Building	Number = 1	2010 Construction	50	2060	N/A		
Influent pumps	Number = 4	Three pumps were installed in 2010	20	2030	$ 201,000	$ 28,714.29	$ 10,050
		One shelf spare was purchased in 2021	20	2041	$ 67,000	$ 3,722	N/A
Screen	Number = 2	Screens replaced in 2023	20	2043	$ 475,000.00	$ 23,750.00	N/A
Grit chamber (Internal components)	Number = 1	2010 Construction	20	2030	$ 85,000	$ 12,142.86	$ 4,250
Grit pump	Number = 1	2010 Construction	20	2030	$ 42,000	$ 4,200	$ 2,100
Grit separator/classifier	Number = 1	2010 Construction	20	2030	$ 180,000	$ 18,000	$ 9,000
Secondary Treatment							
Lagoon Cell 1	Number = 1	Liner replaced in 2008; 60-mil HDPE liner	20	2028	$ 307,300.00	$ 61,460.00	$ 15,365.00
Submerged diffused aeration system	Number of Diffusers= 84	Installed in 2017	20	2037	$275,000	$19,643	$13,750
Lagoon Cell 2	Number = 1	Liner replaced in 2008; 60-mil HDPE liner	20	2028	$ 117,200	$ 23,440.00	$ 5,860.00
Lagoon Cell 3	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 203,300	$ 11,294	N/A
Submerged diffused aeration system	Number of Diffusers = 90	Installed in 2021	20	2041	$ 291,176	$16,176	N/A
Lagoon Cell 4	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 209,000	$ 11,611	N/A
Submerged diffused aeration system	Number of Diffusers = 30	Installed in 2021	20	2041	$98,214	$5,456	N/A
Lagoon Cell 5	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 137,300	$ 7,628	N/A
Lagoon Cell 6	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 123,200	$ 6,844	N/A
Effluent Pump Station	Number = 3	2 Pumps purchased in 2019	2019	2039	$ 180,000	$ 11,250	$ 9,000
		1 Pump purchased in 2023	20	2051	$ 186,000	$ 9,300	N/A
Blower Building							
Blower Building	Number = 1	2017 Construction	50	2067	N/A		
Train 1 Blowers	Number = 2	Installed in 2017	20	2037	$ 426,000	$ 30,428.57	$ 21,300
Train 2 Blowers	Number = 2	Installed in 2021	20	2021	$ 426,000	$ 22,421.05	N/A
Transfer Pump Station	Number = 2	Installed in 2021	20	2041	$ 102,000	$ 5,667	N/A

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Alternative 1 - District O&M Costs

Inflation Rate	3.5%

ESD O&M Charges

	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40
Utility Charges	$ 700,000	$ 724,500	$ 749,858	$ 776,103	$ 803,266	$ 831,380	$ 860,479	$ 890,595	$ 921,766	$ 954,028	$ 987,419	$ 1,021,979	$ 1,057,748	$ 1,094,769	$ 1,133,086	$ 1,172,744	$ 1,213,790	$ 1,256,273
Seepage Testing (Aerated Lagoons Only)					$ 29,692				$ 39,504						$ 41,884			

Alternative 2 - NPV

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ALTERNATIVE 2:

Alternative Description: Add Processes to Improve Water Quality to Boise, Year-Round Discharge to Boise

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Capital Costs																		
Total Capital Costs	$ -	$ -	$ 8,948,695	$ -	$ -	$ -	$ -	$ 19,246,474	$ 244,926	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Capital NPV	$ 20,611,084																	
O&M Costs																		
Discharge to the City of Boise	$ 1,593,410	$ 1,970,577	$ 2,344,505	$ 1,229,744	$ 1,426,580	$ 1,643,107	$ 1,753,930	$ 1,872,288	$ 1,980,904	$ 2,114,376	$ 2,256,912	$ 2,409,134	$ 2,571,707	$ 2,745,340	$ 2,930,796	$ 3,128,885	$ 3,340,480	$ 3,566,509
Sludge Removal Costs	$ -	$ 725,794	$ -	$ 831,495	$ -	$ 921,689	$ -	$ 1,022,689	$ -	$ 1,132,894	$ -	$ 1,253,070	$ -	$ 1,384,041	$ -	$ 1,526,700	$ -	$ 1,682,005
ESD O&M Charges	$ 700,000	$ 724,500	$ 749,858	$ 1,247,447	$ 1,319,795	$ 1,336,296	$ 1,383,067	$ 1,431,474	$ 1,521,080	$ 1,984,581		$ 2,125,933	$ 2,200,341	$ 2,277,353	$ 2,397,527	$ 2,439,557	$ 2,524,942	$ 2,613,315
City of Boise Capacity Charges	$ -	$ 317,175	$ 371,975	$ 394,293	$ 417,951	$ 443,028	$ 120,358	$ 122,231	$ 119,291	$ 125,598	$ 127,549	$ 129,532	$ 139,671	$ 142,005	$ 144,383	$ 146,806	$ 154,183	$ 156,771
Total O&M Costs	$ 2,293,410	$ 3,738,047	$ 3,466,337	$ 3,702,978	$ 3,164,326	$ 4,344,119	$ 3,257,354	$ 4,448,682	$ 3,621,275	$ 5,357,449	$ 2,384,461	$ 5,917,669	$ 4,911,718	$ 6,548,740	$ 5,472,706	$ 7,241,949	$ 6,019,604	$ 8,018,600
O&M NPV	$49,651,364																	
R&R Cost																		
R&R Costs	$ 326,949	$ 326,949	$ 326,949	$ 546,607	$ 546,607	$ 654,168	$ 654,168	$ 654,168	$ 623,691	$ 623,691	$ 623,691	$ 623,691	$ 623,691	$ 623,691	$ 619,920	$ 619,920	$ 617,670	$ 617,670
R&R NPV	$6,279,156																	

Project NPV (PTAC)	$76,541,604

potential total asset cost

Alternative 2 - Annual West Boise O&M Costs

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Water Usage Growth Rate (Annual) 2022 to 2028	1.060
Water Usage Growth Rate (Annual) 2029-2040	1.015

cBOD Escalation Factor	3.7

2%	Decrease in BOD and TSS performance

Year	MAX MONTH AVERAGE DAILY FLOW-GAL	$/ avg daily gal	FLOW BILLED per Year	Added Capacity Cost	$/ avg daily gal	Average Daily cBOD-mg/L	Average Daily cBOD-Lbs	$/avg day lb	cBOD Billed per Year	Added Capacity Cost	Total BOD Billed per Year	Average Daily TSS-mg/L	Average Daily TSS-Lbs	$/avg day lb	TSS Billed per Year	Added Capacity Cost	Total TSS Billed per Year
FY22	2,420,000.00	$ 0.50	$ 1,218,881	$ -	$ 1,218,881		0.0	$ 371.2	$ -				0.0	$ 173.30			
FY23	2,565,200.00	$ 0.40	$ 1,013,254	$ -	$ 1,013,254	20.0	427.9	$ 381.0	$ 163,021	$ -	$ 163,021	29.0	620.4	$ 300.00	$ 186,126	$ -	$ 186,126
FY24	2,719,112.00	$ 0.37	$ 1,006,071	$ 317,175	$ 1,323,247	23.7	537.5	$ 388.0	$ 208,532	$ -	$ 208,532	34.0	771.0	$ 300.00	$ 231,309	$ -	$ 231,309
FY25	2,882,258.72	$ 0.35	$ 1,000,144	$ 371,975	$ 1,372,118	27.4	658.6	$ 396.0	$ 260,822	$ -	$ 260,822	36.0	865.4	$ 300.00	$ 259,611	$ -	$ 259,611
FY26	3,055,194.24	$ 0.35	$ 1,069,318	$ 394,293	$ 1,463,611	5.0	127.4	$ 432.6	$ 55,118	$ -	$ 55,118	5.0	127.4	$ 300.00	$ 38,220	$ -	$ 38,220
FY27	3,238,505.90	$ 0.38	$ 1,238,340	$ 417,951	$ 1,656,290	5.1	137.7	$ 472.7	$ 65,106	$ -	$ 65,106	5.1	137.7	$ 327.75	$ 45,146	$ -	$ 45,146
FY28	3,432,816.25	$ 0.41	$ 1,423,795	$ 443,028	$ 1,866,822	5.2	148.9	$ 512.7	$ 76,353	$ -	$ 76,353	5.2	148.9	$ 355.50	$ 52,945	$ -	$ 52,945
FY29	3,483,621.93	$ 0.44	$ 1,517,110	$ 115,837	$ 1,632,947	5.3	154.2	$ 538.3	$ 82,984	$ -	$ 82,984	5.3	154.2	$ 373.28	$ 57,544	$ -	$ 57,544
FY30	3,535,179.54	$ 0.46	$ 1,616,542	$ 117,551	$ 1,734,093	5.4	159.6	$ 565.2	$ 90,191	$ -	$ 90,191	5.4	159.6	$ 391.94	$ 62,541	$ -	$ 62,541
FY31	3,587,500.19	$ 0.48	$ 1,722,490	$ 119,291	$ 1,841,781	5.0	149.6	$ 593.5	$ 88,784	$ -	$ 88,784	5.0	149.6	$ 411.54	$ 61,565	$ -	$ 61,565
FY32	3,640,595.20	$ 0.50	$ 1,835,382	$ 121,057	$ 1,956,439	5.1	154.8	$ 623.2	$ 96,495	$ -	$ 96,495	5.1	154.8	$ 432.11	$ 66,912	$ -	$ 66,912
FY33	3,694,476.01	$ 0.53	$ 1,955,673	$ 122,848	$ 2,078,521	5.2	160.3	$ 654.3	$ 104,875	$ -	$ 104,875	5.2	160.3	$ 453.72	$ 72,724	$ -	$ 72,724
FY34	3,749,154.25	$ 0.56	$ 2,083,848	$ 124,666	$ 2,208,514	5.3	165.9	$ 687.0	$ 113,984	$ -	$ 113,984	5.3	165.9	$ 476.40	$ 79,040	$ -	$ 79,040
FY35	3,804,641.73	$ 0.58	$ 2,220,423	$ 126,511	$ 2,346,935	5.4	171.7	$ 721.4	$ 123,884	$ 8,123	$ 132,006	5.4	171.7	$ 500.22	$ 85,904	$ -	$ 85,904
FY36	3,860,950.43	$ 0.61	$ 2,365,950	$ 128,384	$ 2,494,333	5.5	177.8	$ 757.4	$ 134,643	$ 8,408	$ 143,051	5.5	177.8	$ 525.24	$ 93,365	$ -	$ 93,365
FY37	3,918,092.50	$ 0.64	$ 2,521,014	$ 130,284	$ 2,651,298	5.6	184.0	$ 795.3	$ 146,337	$ 8,703	$ 155,040	5.6	184.0	$ 551.50	$ 101,474	$ -	$ 101,474
FY38	3,976,080.27	$ 0.68	$ 2,686,241	$ 132,212	$ 2,818,453	5.7	190.5	$ 835.1	$ 159,046	$ 9,008	$ 168,055	5.7	190.5	$ 579.07	$ 110,287	$ -	$ 110,287
FY39	4,034,926.25	$ 0.71	$ 2,862,297	$ 134,169	$ 2,996,466	5.9	197.1	$ 876.8	$ 172,859	$ 9,324	$ 182,184	5.9	197.1	$ 608.03	$ 119,866	$ -	$ 119,866
FY40	4,094,643.16	$ 0.74	$ 3,049,892	$ 136,155	$ 3,186,047	6.0	204.1	$ 920.7	$ 187,872	$ 9,652	$ 197,524	6.0	204.1	$ 638.43	$ 130,276	$ -	$ 130,276

Year	Average Daily NH_3N-mg/L	Average Daily NH3N-Lbs	$/avg day lb	NH3N Billed per Year	Added Capacity Cost	Total NH3N Billed per Year	Average Daily TP-mg/L	Average Daily DAILY TP-Lbs	$/avg day lb	TP Billed per Year	Added Capacity Cost	Total TP Billed per Year	Yearly O&M Bill (Without Capacity Charges)	Capacity Charges	Total Bill
FY22		0	$ 99.72					0	$ -						
FY23	23.2	496.3354176	$ 220.00	$ 109,194	$ -	$ 109,194	4.38	93.7	$ 1,300	$ 121,816	$ -	$ 121,816	$ 1,593,410	$ -	$ 1,593,410
FY24	24	544.2574579	$ 340.00	$ 185,048	$ -	$ 185,048	5.76	130.6	$ 2,600	$ 339,617	$ -	$ 339,617	$ 1,970,577	$ 317,175	$ 2,287,753
FY25	25.0	600.9509431	$ 460.00	$ 276,437	$ -	$ 276,437	5.84	140.4	$ 3,900	$ 547,490	$ -	$ 547,490	$ 2,344,505	$ 371,975	$ 2,716,479
FY26	1.0	25.48031999	$ 502.55	$ 12,805	$ -	$ 12,805	0.5	12.7	$ 4,261	$ 54,283	$ -	$ 54,283	$ 1,229,744	$ 394,293	$ 1,624,037
FY27	1.0	27.54932197	$ 549.04	$ 15,126	$ -	$ 15,126	0.5	13.5	$ 4,655	$ 62,862	$ -	$ 62,862	$ 1,426,580	$ 417,951	$ 1,844,531
FY28	1.0	29.78632692	$ 595.53	$ 17,739	$ -	$ 17,739	0.5	14.3	$ 5,049	$ 72,276	$ -	$ 72,276	$ 1,643,107	$ 443,028	$ 2,086,135
FY29	1.1	30.83170784	$ 625.31	$ 19,279	$ 4,521	$ 23,801	0.5	14.5	$ 5,301	$ 77,012	$ -	$ 77,012	$ 1,753,930	$ 120,358	$ 1,874,288
FY30	1.1	31.91377746	$ 656.57	$ 20,954	$ 4,680	$ 25,634	0.5	14.7	$ 5,567	$ 82,060	$ -	$ 82,060	$ 1,872,288	$ 122,231	$ 1,994,519
FY31	1.0	29.91975162	$ 689.40	$ 20,627	$ -	$ 20,627	0.5	15.0	$ 5,845	$ 87,438	$ -	$ 87,438	$ 1,980,904	$ 119,291	$ 2,100,195
FY32	1.0	30.96981522	$ 723.87	$ 22,418	$ 4,542	$ 26,960	0.5	15.2	$ 6,137	$ 93,169	$ -	$ 93,169	$ 2,114,376	$ 125,598	$ 2,239,974
FY33	1.0	32.05673186	$ 760.06	$ 24,365	$ 4,701	$ 29,066	0.5	15.4	$ 6,444	$ 99,275	$ -	$ 99,275	$ 2,256,912	$ 127,549	$ 2,384,461
FY34	1.1	33.18179492	$ 798.07	$ 26,481	$ 4,866	$ 31,347	0.5	15.6	$ 6,766	$ 105,781	$ -	$ 105,781	$ 2,409,134	$ 129,532	$ 2,538,666
FY35	1.1	34.34634319	$ 837.97	$ 28,781	$ 5,037	$ 33,818	0.5	15.9	$ 7,104	$ 112,714	$ -	$ 112,714	$ 2,571,707	$ 139,671	$ 2,711,377
FY36	1.1	35.55176245	$ 879.87	$ 31,281	$ 5,213	$ 36,494	0.5	16.1	$ 7,460	$ 120,102	$ -	$ 120,102	$ 2,745,340	$ 142,005	$ 2,887,345
FY37	1.1	36.79948711	$ 923.86	$ 33,998	$ 5,396	$ 39,394	0.5	16.3	$ 7,833	$ 127,973	$ -	$ 127,973	$ 2,930,796	$ 144,383	$ 3,075,179
FY38	1.1	38.09100191	$ 970.06	$ 36,950	$ 5,586	$ 42,536	0.5	16.6	$ 8,224	$ 136,361	$ -	$ 136,361	$ 3,128,885	$ 146,806	$ 3,275,692
FY39	1.2	39.42784371	$ 1,018.56	$ 40,160	$ 5,782	$ 45,941	0.5	16.8	$ 8,635	$ 145,298	$ 4,908	$ 150,205	$ 3,340,480	$ 154,183	$ 3,494,663
FY40	1.2	40.81160331	$ 1,069.49	$ 43,647	$ 5,985	$ 49,632	0.5	17.07	$ 9,067	$ 154,820	$ 4,980	$ 159,801	$ 3,566,509	$ 156,771	$ 3,723,280

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Alternative 2 - Capital Costs

Inflation Rate	3.5%

ESD Capital Costs

FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40
		$ 8,948,695	$ -	$ -	$ -	$ -	$ 19,246,474	$ 244,926	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Phase 1
- 26 Units of WavTex
- Metal Salt Addition
- 1 Filtration Train
- Transfer 2 Pumps
- Effluent Pump Station
- Standby Generator

Phase 2
- 26 Units of WavTex
- Blower 5 and additional Diffusers to meet air demand for WavTex
- 1 Filtration Train
- Tertiary Clarification

Installation of New effluent pumps

Non Construction Costs	23%

Capital Upgrades (2023 Dollars)		
WavTex (Lagoon Intensification)	$ 4,693,067	WavTex Option 2. Divided into 2 phases.
Metal Salt Addition Storage and Pumping	$ 491,326	
Blower 5 and Additional Diffusers	$ 938,150	Blower 5 and Additional Diffusers in Cells 1, 3 and 4
Tertiary Clarification (ActiFlo)	$ 6,507,860	1 Basin. No redudancy Needed to reduce TSS before filtration when TSS is beyond 35 mg/L
Tertiary Filtration (Cloth Disk)	$ 5,012,563	2 Filtration trains only. 5 Micron Units
Transfer Pump Station 2 Pumps	$ 72,000	To be installed in existing Effluent Pump Station. 30k per pump (Only Pumps)
Effluent Pump Station	$ 1,375,487	New Pump Station to West Boise WRF. Reuse existing pumps till 2031
New Effluent Pumps	$ 62,000	Cost per pump. Flygt 3202 (45 HP) 3 will be installed in the new effluent pump station
Lab Building	$ -	
Standby Generator	$ 588,100	Blower Building serviced by existing generator. Headworks and new facilities serviced by this generator
Total Construction Cost	**$ 19,740,553**	This does not include nonconstruction costs or inflation factors

Assumption

WavTex and Cloth Disk Filter will be installed in 2 phases
Blower 5 and Additional Diffusers will be installed with the Phase 2 of WaxTex Addition
Rest of the Facilities will be constructed in 2025
Capital Costs for each facility include Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added
Treatment design criteria: 5 mg/L BOD, 5 mg/L TSS, 1 mg/L Ammonia, 0.5 mg/L TP
All costs are based on 2023 dollar
Non-Construction costs: 1% permitting, 15% engineering, 6% SDC, and 1% startup and Cx
Inflation rate of 3.5%
Equipment prices provided by manufacturer (Entex and Aqua-Aerobic)

Evaporators (If needed)	$ 1,092,551	
Lab Building (If needed) 1000 sqft	$ 404,110	
Tertiary Filtration (Memrbane Filter If needed)		$ 29,120,885

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Alternative 2 - District O&M Costs

Inflation Rate	3.5%

Cost of Operator	$ 100,000.00	per year
Additional Operators	1	

ESD O&M Charges

	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31
Utility Charges (Existing Facility)	$ 700,000	$ 724,500	$ 749,858	$ 776,103	$ 803,266	$ 831,380	$ 860,479	$ 890,595	$ 921,766
Seepage Testing (Aerated Lagoons Only)					$ 28,688				$ 39,504
Additional O&M Charges	$ -			$ 360,472	$ 373,089	$ 386,147	$ 399,662	$ 413,650	$ 428,128
Additional Operators				$ 110,872	$ 114,752	$ 118,769	$ 122,926	$ 127,228	$ 131,681
Total O&M Charges	$ 700,000	$ 724,500	$ 749,858	$ 1,247,447	$ 1,319,795	$ 1,336,296	$ 1,383,067	$ 1,431,474	$ 1,521,080

	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40
Utility Charges (Existing Facility)	$ 954,028	$ 987,419	$ 1,021,979	$ 1,057,748	$ 1,094,769	$ 1,133,086	$ 1,172,744	$ 1,213,790	$ 1,256,273
Seepage Testing (Aerated Lagoons Only)						$ 40,467			
Additional O&M Charges	$ 894,263	$ 925,563	$ 957,957	$ 991,486	$ 1,026,188	$ 1,062,104	$ 1,099,278	$ 1,137,753	$ 1,177,574
Additional Operators	$ 136,290	$ 141,060	$ 145,997	$ 151,107	$ 156,396	$ 161,869	$ 167,535	$ 173,399	$ 179,468
Total O&M Charges	$ 1,984,581	$ 2,054,042	$ 2,125,933	$ 2,200,341	$ 2,277,353	$ 2,397,527	$ 2,439,557	$ 2,524,942	$ 2,613,315

Facility

WavTex (Lagoon Intensification)	$ 25,000	$ 25,000	Assumed 25k for maintenance
Metal Salt Addition Storage and Pumping	$ 164,587	$ 164,587	
Blower 5 and Additional Diffusers	$ 41,664	$ 41,664	
Tertiary Clarification (ActiFlo)	$ 243,395	$ 243,395	
Tertiary Filtration (Cloth Disk)	$ 160,397		
Tertiary Filtration (Memrbane Filter)		$ 2,870,767	
Transfer Pump Station 2 Pumps	$ 33,920	$ 33,920	
Effluent Pump Station	$ 33,920	$ 33,920	
Total	**$ 702,883**	**$ 3,413,253**	

Assumptions

O&M Costs for WavTex and Cloth Filter divided by 2 as construction is done in two phases

Alternative 2 - R&R Costs

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Component	Number of units	Installation Date	Expected Useful Life	Year to Be Raplaced	Replacement Cost	Monthly cost: Until Replacement	Monthly cost: After Repacement
Secondary Treatment							
Lagoon Cell 1	Number = 1	Liner replaced in 2008; 60-mil HDPE liner	20	2028	$ 307,300.00	$ 61,460.00	$ 15,365.00
Submerged diffused aeration system	Number of Diffusers= 84	Installed in 2017	20	2037	$275,000	$19,643	$13,750
Lagoon Cell 2	Number = 1	Liner replaced in 2008; 60-mil HDPE liner	20	2028	$ 117,200	$ 23,440.00	$ 5,860.00
Lagoon Cell 3	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 203,300	$ 11,294	N/A
Submerged diffused aeration system	Number of Diffusers = 90	Installed in 2021	20	2041	$ 291,176	$16,176	N/A
Lagoon Cell 4	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 209,000	$ 11,611	N/A
Submerged diffused aeration system	Number of Diffusers = 30	Installed in 2021	20	2041	$98,214	$5,456	N/A
Submerged diffused aeration system	Additional 42 Diffusers	2030	20	2050	$138,600	$6,930	NA
Lagoon Cell 5	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 137,300	$ 7,628	N/A
Lagoon Cell 6	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 123,200	$ 6,844	N/A
WavTex (Lagoon Intensification) Phase 1	Number = 52	New Construction	20	2044	$ 2,878,723	$ 143,936	NA
Effluent Pump Station (Pumps repurposed to new pump station)	Number = 3	2 Pumps purchased in 2019	2019	2039	$ 180,000	$ 11,250	$ 9,000
		1 Pump purchased in 2023, 2 pump will be purchased in 2031	20	2051	$ 186,000	$ 9,300	N/A

Component	Number of units	Installation Date	Expected Useful Life	Year to Be Raplaced	Replacement Cost	Monthly cost: Until Replacement	Monthly cost: After Repacement
Headworks							
Headworks Building	Number = 1	2010 Construction	50	2060	N/A		
Influent pumps	Number = 4	Three pumps were installed in 2010	20	2030	$ 201,000	$ 28,714.29	$ 10,050
		One shelf spare was purchased in 2021	20	2041	$ 67,000	$ 3,722	N/A
Screen	Number = 2	Screens replaced in 2023	20	2043	$ 475,000.00	$ 23,750.00	N/A
Grit chamber (Internal components)	Number = 1	2010 Construction	20	2030	$ 85,000	$ 12,142.86	$ 4,250
Grit pump	Number = 1	2010 Construction	20	2030	$ 42,000	$ 4,200	$ 2,100
Grit separator/classifier	Number = 1	2010 Construction	20	2030	$ 180,000	$ 18,000	$ 9,000
Tertiary Treatment							
Metal Salt Addition System	Number = 2	New Construction	20	2044	$ 30,000	$ 1,500.00	NA
Membrane Filtration	Number = 3	New Construction	10	2044	$ 2,737,141	$ 273,714.11	$ 273,714.11
Tertiary Clarification	Number = 3	New Construction	20	2044	$ 1,831,361	$ 91,568	NA
Tertiary Filtration	Number = 3	New Construction	20	2044	$ 2,519,510	$ 125,976	NA
Blower Building							
Blower Building	Number = 1	2017 Construction	50	2067	N/A	NA	
Train 1 Blowers	Number = 2	Installed in 2017	20	2037	$ 426,000	$ 30,428.57	$ 21,300
Train 2 Blowers	Number = 2	Installed in 2021	20	2021	$ 426,000	$ 22,421.05	N/A
Blower 5	Number = 1	New Construction 2030	20	2050	$ 230,000	$ 11,500.00	NA
Transfer Pump Station	Number = 2	Installed in 2021	20	2041	$ 102,000	$ 5,667	N/A
Transfer Pump Station 2 - Pumps	Number = 3	New Construction	20	2044	$ 60,000	$ 3,000	NA

Alternative 3 - NPV

ALTERNATIVE 3:

Alternative Description: Water Self-Reliance - Summer Canal Reuse and Winter to Boise

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Capital Costs																		
Total Capital Costs	$ -	$ -	$ 26,144,706	$ -	$ -	$ -	$ -	$ 23,394,424	$ 244,926	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Capital NPV	**$ 38,114,632**																	
O&M Costs																		
Discharge to the City of Boise	$ 1,593,410	$ 1,970,577	$ 2,344,505	$ 614,872	$ 719,035	$ 834,749	$ 891,306	$ 951,731	$ 990,452	$ 1,057,188	$ 1,128,456	$ 1,204,567	$ 1,285,853	$ 1,372,670	$ 1,465,398	$ 1,564,443	$ 1,670,240	$ 1,783,254
Sludge Removal Costs	$ -	$ 725,794	$ -	$ 831,495	$ -	$ 921,689	$ -	$ 1,022,689	$ -	$ 1,132,894	$ -	$ 1,253,070	$ -	$ 1,384,041	$ -	$ 1,526,700	$ -	$ 1,682,005
ESD O&M Charges	$ 700,000	$ 724,500	$ 749,858	$ 1,763,344	$ 1,853,749	$ 1,888,938	$ 1,955,051	$ 2,023,477	$ 2,133,803	$ 2,313,811		$ 2,478,612	$ 2,565,364	$ 2,655,151	$ 2,788,549	$ 2,844,264	$ 2,943,814	$ 3,046,847
City of Boise Capacity Charges	$ -	$ 317,175	$ 371,975	$ 394,293	$ 417,951	$ 443,028	$ 120,358	$ 122,231	$ 119,291	$ 125,598	$ 127,549	$ 129,532	$ 139,671	$ 142,005	$ 144,383	$ 146,806	$ 154,183	$ 156,771
Total O&M Costs	$ 2,293,410	$ 3,738,047	$ 3,466,337	$ 3,604,003	$ 2,990,734	$ 4,088,403	$ 2,966,715	$ 4,120,128	$ 3,243,546	$ 4,629,491	$ 1,256,005	$ 5,065,781	$ 3,990,888	$ 5,553,868	$ 4,398,330	$ 6,082,213	$ 4,768,237	$ 6,668,878
O&M NPV	**$44,017,057**																	
R&R Cost																		
R&R Costs	$ 326,949	$ 326,949	$ 326,949	$ 566,630	$ 566,630	$ 636,504	$ 636,504	$ 636,504	$ 652,089	$ 652,089	$ 652,089	$ 652,089	$ 652,089	$ 652,089	$ 648,318	$ 648,318	$ 646,068	$ 646,068
R&R NPV	**$6,417,777**																	

Project NPV (PTAC)	$88,549,466

potential total asset cost

Alternative 3 - Annual West Boise O&M Costs

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Water Usage Growth Rate (Annual) 2022 to 2028	1.060
Water Usage Growth Rate (Annual) 2029-2040	1.015

cBOD Escalation Factor	3.7

2%	Degradation in performance

Reuse/Infiltration Time Period 6 Months

Bill Time to West Boise 50%

Year	MAX MONTH AVERAGE DAILY FLOW-GAL	$/ avg daily gal	FLOW BILLED per Year	Added Capacity Cost	$/ avg daily gal	Average Daily cBOD-mg/L	Average Daily cBOD-Lbs	$/avg day lb	cBOD Billed per Year	Added Capacity Cost	Total BOD Billed per Year
FY22	2,420,000.00	$ 0.50	$ 1,218,881	$ -	$ 1,218,881		0.0	$ 371.2	$ -		
FY23	2,565,200.00	$ 0.40	$ 1,013,254	$ -	$ 1,013,254	20	427.9	$ 381.0	$ 163,021	$ -	$ 163,021
FY24	2,719,112.00	$ 0.37	$ 1,006,071	$ 317,175	$ 1,323,247	24	537.5	$ 388.0	$ 208,532	$ -	$ 208,532
FY25	2,882,258.72	$ 0.35	$ 1,000,144	$ 371,975	$ 1,372,118	27	658.6	$ 396.0	$ 260,822	$ -	$ 260,822
FY26	3,055,194.24	$ 0.35	$ 534,659	$ 394,293	$ 928,952	5.0	127.4	$ 432.6	$ 27,559	$ -	$ 27,559
FY27	3,238,505.90	$ 0.38	$ 619,170	$ 417,951	$ 1,037,121	5.1	137.7	$ 472.7	$ 32,553	$ -	$ 32,553
FY28	3,432,816.25	$ 0.41	$ 711,897	$ 443,028	$ 1,154,925	5.2	148.9	$ 512.7	$ 38,176	$ -	$ 38,176
FY29	3,483,621.93	$ 0.44	$ 758,555	$ 115,837	$ 874,392	5.3	154.2	$ 538.3	$ 41,492	$ -	$ 41,492
FY30	3,535,179.54	$ 0.46	$ 808,271	$ 117,551	$ 925,822	5.4	159.6	$ 565.2	$ 45,096	$ -	$ 45,096
FY31	3,587,500.19	$ 0.48	$ 861,245	$ 119,291	$ 980,536	5.0	149.6	$ 593.5	$ 44,392	$ -	$ 44,392
FY32	3,640,595.20	$ 0.50	$ 917,691	$ 121,057	$ 1,038,748	5.1	154.8	$ 623.2	$ 48,247	$ -	$ 48,247
FY33	3,694,476.01	$ 0.53	$ 977,836	$ 122,848	$ 1,100,685	5.2	160.3	$ 654.3	$ 52,438	$ -	$ 52,438
FY34	3,749,154.25	$ 0.56	$ 1,041,924	$ 124,666	$ 1,166,590	5.3	165.9	$ 687.0	$ 56,992	$ -	$ 56,992
FY35	3,804,641.73	$ 0.58	$ 1,110,212	$ 126,511	$ 1,236,723	5.4	171.7	$ 721.4	$ 61,942	$ 8,123	$ 70,064
FY36	3,860,950.43	$ 0.61	$ 1,182,975	$ 128,384	$ 1,311,359	5.5	177.8	$ 757.4	$ 67,321	$ 8,408	$ 75,729
FY37	3,918,092.50	$ 0.64	$ 1,260,507	$ 130,284	$ 1,390,791	5.6	184.0	$ 795.3	$ 73,168	$ 8,703	$ 81,871
FY38	3,976,080.27	$ 0.68	$ 1,343,121	$ 132,212	$ 1,475,333	5.7	190.5	$ 835.1	$ 79,523	$ 9,008	$ 88,531
FY39	4,034,926.25	$ 0.71	$ 1,431,149	$ 134,169	$ 1,565,318	5.9	197.1	$ 876.8	$ 86,430	$ 9,324	$ 95,754
FY40	4,094,643.16	$ 0.74	$ 1,524,946	$ 136,155	$ 1,661,101	6.0	204.1	$ 920.7	$ 93,936	$ 9,652	$ 103,588

Year	Average Daily TSS-mg/L	Average Daily TSS-Lbs	$/avg day lb	TSS Billed per Year	Added Capacity Cost	Total TSS Billed per Year
FY22		0.0	$ 173.30			
FY23	29	620.4	$ 300.00	$ 186,126	$ -	$ 186,126
FY24	34	771.0	$ 300.00	$ 231,309	$ -	$ 231,309
FY25	36.0	865.4	$ 300.00	$ 259,611	$ -	$ 259,611
FY26	5.0	127.4	$ 300.00	$ 19,110	$ -	$ 19,110
FY27	5.1	137.7	$ 327.75	$ 22,573	$ -	$ 22,573
FY28	5.2	148.9	$ 355.50	$ 26,473	$ -	$ 26,473
FY29	5.3	154.2	$ 373.28	$ 28,772	$ -	$ 28,772
FY30	5.4	159.6	$ 391.94	$ 31,271	$ -	$ 31,271
FY31	5.0	149.6	$ 411.54	$ 30,783	$ -	$ 30,783
FY32	5.1	154.8	$ 432.11	$ 33,456	$ -	$ 33,456
FY33	5.2	160.3	$ 453.72	$ 36,362	$ -	$ 36,362
FY34	5.3	165.9	$ 476.40	$ 39,520	$ -	$ 39,520
FY35	5.4	171.7	$ 500.22	$ 42,952	$ -	$ 42,952
FY36	5.5	177.8	$ 525.24	$ 46,683	$ -	$ 46,683
FY37	5.6	184.0	$ 551.50	$ 50,737	$ -	$ 50,737
FY38	5.7	190.5	$ 579.07	$ 55,144	$ -	$ 55,144
FY39	5.9	197.1	$ 608.03	$ 59,933	$ -	$ 59,933
FY40	6.0	204.1	$ 638.43	$ 65,138	$ -	$ 65,138

Year	Average Daily NH_3N-mg/L	Average Daily NH3N-Lbs	$/avg day lb	NH3N Billed per Year	Added Capacity Cost	Total NH3N Billed per Year	Average Daily TP-mg/L	Average Daily DAILY TP-Lbs	$/avg day lb	TP Billed per Year	Added Capacity Cost	Total TP Billed per Year	Yearly O&M Bill (Without Capacity Charges)	Capacity Charges	Total Bill
FY22		0	$ 99.72					0	$ -						
FY23	23.2	496.3354176	$ 220.00	$ 109,194	$ -	$ 109,194	4.38	93.7	$ 1,300	$ 121,816	$ -	$ 121,816	$ 1,593,410	$ -	$ 1,593,410
FY24	24	544.2574579	$ 340.00	$ 185,048	$ -	$ 185,048	5.76	130.6	$ 2,600	$ 339,617	$ -	$ 339,617	$ 1,970,577	$ 317,175	$ 2,287,753
FY25	25.0	600.9509431	$ 460.00	$ 276,437	$ -	$ 276,437	5.84	140.4	$ 3,900	$ 547,490	$ -	$ 547,490	$ 2,344,505	$ 371,975	$ 2,716,479
FY26	1.0	25.48031999	$ 502.55	$ 6,403	$ -	$ 6,403	0.5	12.7	$ 4,261	$ 27,141	$ -	$ 27,141	$ 614,872	$ 394,293	$ 1,009,165
FY27	1.0	27.54932197	$ 549.04	$ 7,563	$ -	$ 7,563	0.5	13.5	$ 4,655	$ 31,431	$ -	$ 31,431	$ 713,290	$ 417,951	$ 1,131,241
FY28	1.0	29.78632692	$ 595.53	$ 8,869	$ -	$ 8,869	0.5	14.3	$ 5,049	$ 36,138	$ -	$ 36,138	$ 821,554	$ 443,028	$ 1,264,581
FY29	1.1	30.83170784	$ 625.31	$ 9,640	$ 4,521	$ 14,161	0.5	14.5	$ 5,301	$ 38,506	$ -	$ 38,506	$ 876,965	$ 120,358	$ 997,323
FY30	1.1	31.91377746	$ 656.57	$ 10,477	$ 4,680	$ 15,157	0.5	14.7	$ 5,567	$ 41,030	$ -	$ 41,030	$ 936,144	$ 122,231	$ 1,058,375
FY31	1.0	29.91975162	$ 689.40	$ 10,313	$ -	$ 10,313	0.5	15.0	$ 5,845	$ 43,719	$ -	$ 43,719	$ 990,452	$ 119,291	$ 1,109,743
FY32	1.0	30.96981522	$ 723.87	$ 11,209	$ 4,542	$ 15,751	0.5	15.2	$ 6,137	$ 46,584	$ -	$ 46,584	$ 1,057,188	$ 125,598	$ 1,182,786
FY33	1.0	32.05673186	$ 760.06	$ 12,183	$ 4,701	$ 16,883	0.5	15.4	$ 6,444	$ 49,638	$ -	$ 49,638	$ 1,128,456	$ 127,549	$ 1,256,005
FY34	1.1	33.18179492	$ 798.07	$ 13,241	$ 4,866	$ 18,107	0.5	15.6	$ 6,766	$ 52,891	$ -	$ 52,891	$ 1,204,567	$ 129,532	$ 1,334,099
FY35	1.1	34.34634319	$ 837.97	$ 14,391	$ 5,037	$ 19,427	0.5	15.9	$ 7,104	$ 56,357	$ -	$ 56,357	$ 1,285,853	$ 139,671	$ 1,425,524
FY36	1.1	35.55176245	$ 879.87	$ 15,640	$ 5,213	$ 20,854	0.5	16.1	$ 7,460	$ 60,051	$ -	$ 60,051	$ 1,372,670	$ 142,005	$ 1,514,675
FY37	1.1	36.79948711	$ 923.86	$ 16,999	$ 5,396	$ 22,395	0.5	16.3	$ 7,833	$ 63,987	$ -	$ 63,987	$ 1,465,398	$ 144,383	$ 1,609,781
FY38	1.1	38.09100191	$ 970.06	$ 18,475	$ 5,586	$ 24,061	0.5	16.6	$ 8,224	$ 68,180	$ -	$ 68,180	$ 1,564,443	$ 146,806	$ 1,711,249
FY39	1.2	39.42784371	$ 1,018.56	$ 20,080	$ 5,782	$ 25,862	0.5	16.8	$ 8,635	$ 72,649	$ 4,908	$ 77,557	$ 1,670,240	$ 154,183	$ 1,824,423
FY40	1.2	40.81160331	$ 1,069.49	$ 21,824	$ 5,985	$ 27,808	0.5	17.07	$ 9,067	$ 77,410	$ 4,980	$ 82,391	$ 1,783,254	$ 156,771	$ 1,940,026

Alternative 3 - Capital Costs

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Inflation Rate	3.5%

ESD Capital Costs

FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40
		$ 26,144,706	$ -	$ -	$ -	$ -	$ 23,394,424	$ 244,926	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Phase 1	26 Units of WavTex Metal Salt Addition 1 Filtration Train (2 10/4 5 micron and 2 8/4 2 micron) Transfer 2 PS Effluent PS Lab Building UV Disinfection Reuse Pipeline Reuse Pump Station Standby Generator	Phase 2	26 Units of WavTex Blower 5 and Diffusers to meet air demand for WavTex 1 Filtration Train (Two 10/4 5 micron and Three 8/4 2 micron) UV Disinfection	Installation of New effluent pumps

Non Construction Costs	27%	
Capital Upgrades (2023 Dollars)		
WavTex (Lagoon Intensification)	$ 4,693,067	WavTex Option 2. Divided into 2 phases.
Metal Salt Addition Storage and Pumping	$ 551,670	
Blower 5 and Additional Diffusers	$ 938,150	
Tertiary Clarification (ActiFlo)	$ 6,507,860	Needed to reduce TSS before filtration. Includes an Redudant Unit
Tertiary Filtration (Cloth Disk)	$ 5,012,563	1 Treatment Train 5 micron Units only. Only one train installed in each phase. No redudancy provided
Transfer Pump Station 2 Pumps	$ 60,000	(Only Pumps) To be installed in existing Effluent Pump Station. 30k per pump
Effluent Pump Station	$ 1,375,487	New Pump Station to West Boise WRF. Reuse existing pumps
New Effluent Pumps	$ 62,000	Cost per pump. Flygt 3202 (45 HP) 3 will be installed in the new effluent pump station
Lab Building	$ 480,695	(1000 sqft building)
UV Disinfection	$ 4,359,525	
Standby Generator	$ 1,588,179	
Reuse Pipeline	$ 6,074,256	10,500 LF to Reuse Site
Reuse/Infiltration Pump Station	$ 2,054,744	This pump station will pump Class A water to reuse site. Includes pumps as well
Total Construction Cost	**$ 33,758,196**	This does not include nonconstruction costs or inflation factors

Assumption

WavTex, UV Disinfection and Cloth Disk Filter will be installed in 2 phases
Blower 5 and Additional Diffusers will be installed with the Phase 2 of WavTex Addition, in order to meet Wavtex requirements
Rest of the Facilities will be constructed in 2025
Capital Costs for each facility include Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added
Treatment design criteria: 5 mg/L BOD, 5 mg/L TSS, 1 mg/L Ammonia, 0.5 mg/L TP
All costs are based on 2023 dollar
Non-Construction costs: 2% permitting, 15% engineering, 8% SDC, and 2% startup and Cx
Inflation rate of 3.5%
Equipment prices provided by manufacturer (Entex, Aqua-Aerobic, and Trojan)

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Alternative 3 - District O&M Costs

Inflation Rate	3.5%

Cost of Operator	$ 100,000.00	per year
Additional Operators	2	

ESD O&M Charges

	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40
Utility Charges (Existing Facility)	$ 700,000	$ 724,500	$ 749,858	$ 776,103	$ 803,266	$ 831,380	$ 860,479	$ 890,595	$ 921,766	$ 954,028	$ 987,419	$ 1,021,979	$ 1,057,748	$ 1,094,769	$ 1,133,086	$ 1,172,744	$ 1,213,790	$ 1,256,273
Seepage Testing (Aerated Lagoons Only)					$ 28,688				$ 39,504						$ 40,467			
Additional O&M Charges	$ -			$ 765,498	$ 792,290	$ 820,020	$ 848,721	$ 878,426	$ 909,171	$ 1,087,203	$ 1,125,255	$ 1,164,639	$ 1,205,402	$ 1,247,591	$ 1,291,257	$ 1,336,451	$ 1,383,226	$ 1,431,639
Additional Operators				$ 221,744	$ 229,505	$ 237,537	$ 245,851	$ 254,456	$ 263,362	$ 272,579	$ 282,120	$ 291,994	$ 302,214	$ 312,791	$ 323,739	$ 335,070	$ 346,797	$ 358,935
Total O&M Charges	$ 700,000	$ 724,500	$ 749,858	$ 1,763,344	$ 1,853,749	$ 1,888,938	$ 1,955,051	$ 2,023,477	$ 2,133,803	$ 2,313,811	$ 2,394,794	$ 2,478,612	$ 2,565,364	$ 2,655,151	$ 2,788,549	$ 2,844,264	$ 2,943,814	$ 3,046,847

O&M Costs

WavTex (Lagoon Intensification)	$ 50,000	$ 50,000	Assumed 50k Reuse/Infiltra 6 Months
Metal Salt Addition Storage and Pumping	$ 164,587	$ 164,587	
Blower 5 and Additional Diffusers	$ 41,664	$ 41,664	
Tertiary Clarification (ActiFlo)	$ 243,395	$ 243,395	
Tertiary Filtration (Cloth Disk)	$ 160,397	$ 160,397	
Transfer Pump Station 2 Pumps	$ 33,920	$ 33,920	
Effluent Pump Station	$ 33,920	$ 33,920	
Lab Building	$ 4,016	$ 4,016	
UV Disinfection	$ 34,469	$ 34,469	Assuming 6 months of operation for the Disinfection Systems
Chlorine Contact Basin	$ -	$ 735	
Sodium Hypochlorite Storage and Pumping	$ -	$ 69,914	
Sodium Bisulfite Dechlorination Storage and Pumping	$ -	$ 35,811	
Reuse Pump Station	$ 88,164	$ 88,164	Assuming 6 months of Operation for Disinfection System
Total	**$ 854,532**	**$ 766,368**	

Assumption

Two full-time employees are considered starting at Year 2026

Disinfection operates 6 months per year (irrigation season)

Alternative 3 - R&R Costs

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Component	Number of units	Installation Date	Expected Useful Life	Year to Be Raplaced	Replacement Cost	Monthly cost	
						Until Replacement	After Repacement
Secondary Treatment							
Lagoon Cell 1	Number = 1	Liner replaced in 2008; 60-mil HDPE liner	20	2028	$ 307,300.00	$ 61,460.00	$ 15,365.00
Submerged diffused aeration system	Number of Diffusers= 84	Installed in 2017	20	2037	$275,000	$19,643	$13,750
Lagoon Cell 2	Number = 1	Liner replaced in 2008; 60-mil HDPE liner	20	2028	$ 117,200	$ 23,440.00	$ 5,860.00
Lagoon Cell 3	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 203,300	$ 11,294	N/A
Submerged diffused aeration system	Number of Diffusers = 90	Installed in 2021	20	2041	$ 291,176	$16,176	N/A
Lagoon Cell 4	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 209,000	$ 11,611	N/A
Submerged diffused aeration system	Number of Diffusers = 30	Installed in 2021	20	2041	$98,214	$5,456	N/A
Submerged diffused aeration system	Additional 42 Diffusers	2030	20	2050	$138,600	$6,930	NA
Lagoon Cell 5	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 137,300	$ 7,628	N/A
Lagoon Cell 6	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 123,200	$ 6,844	N/A
WavTex (Lagoon Intensification) Phase 1	Number = 52	New Construction	20	2044	$ 2,878,723	$ 143,936	NA
Effluent Pump Station (Pumps repurposed to new pump station)	Number = 3	2 Pumps purchased in 2019	2019	2039	$ 180,000	$ 11,250	$ 9,000
		1 Pump purchased in 2023, 2 pump will be purchased in 2031	20	2051	$ 186,000	$ 9,300	N/A

Component	Number of units	Installation Date	Expected Useful Life	Year to Be Raplaced	Replacement Cost	Monthly cost	
						Until Replacement	After Repacement
Headworks							
Headworks Building	Number = 1	2010 Construction	50	2060	N/A		
Influent pumps	Number = 4	Three pumps were installed in 2010	20	2030	$ 201,000	$ 28,714.29	$ 10,050
		One shelf spare was purchased in 2021	20	2041	$ 67,000	$ 3,722	N/A
Screen	Number = 2	Screens replaced in 2023	20	2043	$ 475,000.00	$ 23,750.00	N/A
Grit chamber (Internal components)	Number = 1	2010 Construction	20	2030	$ 85,000	$ 12,142.86	$ 4,250
Grit pump	Number = 1	2010 Construction	20	2030	$ 42,000	$ 4,200	$ 2,100
Grit separator/classifier	Number = 1	2010 Construction	20	2030	$ 180,000	$ 18,000	$ 9,000
Tertiary Treatment							
Metal Salt Addition System	Number = 2	New Construction	20	2044	$ 51,000	$ 2,550.00	NA
Membrane Filtration	Number = 3	New Construction	10	2044	$ 2,737,141	$ 273,714.11	$ 273,714.11
Tertiary Clarification	Number = 3	New Construction	20	2044	$ 1,831,361	$ 91,568	NA
Tertiary Filtration	Number = 3	New Construction	20	2044	$ 2,519,510	$ 125,976	NA
UV Disinfection	Number = 1	New Construction	20	2044	$ 335,000	$ 16,750	NA
Sodium Hypo Disinfection Pumps	Number = 2	New Construction	20	2044	$ 30,000	$ 1,500	NA
Sodium Bisfulite	Number = 2	New Construction	20	2044	$ 30,000	$ 1,500	NA
Blower Building							
Blower Building	Number = 1	2017 Construction	50	2067	N/A	NA	
Train 1 Blowers	Number = 2	Installed in 2017	20	2037	$ 426,000	$ 30,428.57	$ 21,300
Train 2 Blowers	Number = 2	Installed in 2021	20	2021	$ 426,000	$ 22,421.05	N/A
Blower 5	Number = 1	New Construction 2030	20	2050	$ 230,000	$ 11,500.00	NA
Transfer Pump Station	Number = 2	Installed in 2021	20	2041	$ 102,000	$ 5,667	N/A
Transfer Pump Station 2 - Pumps	Number = 3	New Construction	20	2044	$ 60,000	$ 3,000	NA
Lab Building	Number = 1	New Construction	50	2044	$ 204,884	NA	
Reuse Pump Statio	Number = 2	New Construction	20	2044	586252	29312.6	NA

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Alternative 4 - NPV

ALTERNATIVE 4:

Alternative Description: Water Self-Reliance - Summer Canal Reuse and Winter Canal Infiltration

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Capital Costs																		
Total Capital Costs	$ -	$ -	$ -	$ 73,400,935	$ -	$ -	$ -	$ -	$ 12,076,515	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Capital NPV	$ 67,435,207																	
O&M Costs																		
Discharge to the City of Boise	$ 1,593,410	$ 1,970,577	$ 2,344,505	$ 2,681,289	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sludge Removal Costs	$ -	$ 725,794	$ -	$ 831,495	$ -	$ 921,689	$ -	$ 1,022,689	$ -	$ 1,132,894	$ -	$ 1,253,070	$ -	$ 1,384,041	$ -	$ 1,526,700	$ -	$ 1,682,005
ESD O&M Charges	$ 700,000	$ 724,500	$ 749,858	$ 3,629,552	$ 3,785,275	$ 3,888,067	$ 4,024,150	$ 4,164,995	$ 4,350,274	$ 4,443,305	$ 4,598,821	$ 4,759,779	$ 4,926,372	$ 5,098,795	$ 5,317,720	$ 5,461,956	$ 5,653,125	$ 5,850,984
City of Boise Capacity Charges	$ -	$ 317,175	$ 371,975	$ 571,547	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total O&M Costs	$ 2,293,410	$ 3,738,047	$ 3,466,337	$ 7,713,883	$ 3,785,275	$ 4,809,756	$ 4,024,150	$ 5,187,684	$ 4,350,274	$ 5,576,199	$ 4,598,821	$ 6,012,849	$ 4,926,372	$ 6,482,836	$ 5,317,720	$ 6,988,656	$ 5,653,125	$ 7,532,989
O&M NPV	$56,118,624																	
R&R Cost																		
R&R Costs	$ 302,627	$ 302,627	$ 302,627	$ 841,120	$ 841,120	$ 796,292	$ 796,292	$ 796,292	$ 786,885	$ 786,885	$ 786,885	$ 786,885	$ 786,885	$ 786,885	$ 771,863	$ 771,863	$ 769,613	$ 769,613
R&R NPV	$7,786,932																	

Project NPV (PTAC)	$131,340,762

potential total asset cost

Alternative 4 - Annual West Boise O&M Costs

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Water Usage Growth Rate (Annual) 2022 to 2028	1.060
Water Usage Growth Rate (Annual) 2029-2040	1.015

cBOD Escalation Factor	3.7

Year	MAX MONTH AVERAGE DAILY FLOW-GAL	$/ avg daily gal	FLOW BILLED per Year	Added Capacity Cost	$/ avg daily gal	Average Daily cBOD-mg/L	Average Daily cBOD-Lbs	$/avg day lb	cBOD Billed per Year	Added Capacity Cost	Total BOD Billed per Year	Average Daily TSS-mg/L	Average Daily TSS-Lbs	$/avg day lb	TSS Billed per Year	Added Capacity Cost	Total TSS Billed per Year
FY22	2,420,000.00	$ 0.50	$ 1,218,881	$ -	$ 1,218,881		0.0	$ 371.2	$ -				0.0	$ 173.30			
FY23	2,565,200.00	$ 0.40	$ 1,013,254	$ -	$ 1,013,254	20	427.9	$ 381.0	$ 163,021	$ -	$ 163,021	29	620.4	$ 300.00	$ 186,126	$ -	$ 186,126
FY24	2,719,112.00	$ 0.37	$ 1,006,071	$ 317,175	$ 1,323,247	24	537.5	$ 388.0	$ 208,532	$ -	$ 208,532	34	771.0	$ 300.00	$ 231,309	$ -	$ 231,309
FY25	2,882,258.72	$ 0.35	$ 1,000,144	$ 371,975	$ 1,372,118	27	658.6	$ 396.0	$ 260,822	$ -	$ 260,822	36	865.4	$ 300.00	$ 259,611	$ -	$ 259,611
FY26	3,055,194.24	$ 0.35	$ 1,069,318	$ 394,293	$ 1,463,611	31	792.4	$ 432.6	$ 342,832	$ -	$ 342,832	39	993.7	$ 300.00	$ 298,120	$ -	$ 298,120
FY27		$ 0.38	$ -	$ -	$ -		0.0	$ 472.7	$ -	$ -	$ -		0.0	$ 327.75	$ -	$ -	$ -
FY28		$ 0.41	$ -	$ -	$ -		0.0	$ 512.7	$ -	$ -	$ -		0.0	$ 355.50	$ -	$ -	$ -
FY29		$ 0.44	$ -	$ -	$ -		0.0	$ 538.3	$ -	$ -	$ -		0.0	$ 373.28	$ -	$ -	$ -
FY30		$ 0.46	$ -	$ -	$ -		0.0	$ 565.2	$ -	$ -	$ -		0.0	$ 391.94	$ -	$ -	$ -
FY31		$ 0.48	$ -	$ -	$ -		0.0	$ 593.5	$ -	$ -	$ -		0.0	$ 411.54	$ -	$ -	$ -
FY32		$ 0.50	$ -	$ -	$ -		0.0	$ 623.2	$ -	$ -	$ -		0.0	$ 432.11	$ -	$ -	$ -
FY33		$ 0.53	$ -	$ -	$ -		0.0	$ 654.3	$ -	$ -	$ -		0.0	$ 453.72	$ -	$ -	$ -
FY34		$ 0.56	$ -	$ -	$ -		0.0	$ 687.0	$ -	$ -	$ -		0.0	$ 476.40	$ -	$ -	$ -
FY35		$ 0.58	$ -	$ -	$ -		0.0	$ 721.4	$ -	$ -	$ -		0.0	$ 500.22	$ -	$ -	$ -
FY36		$ 0.61	$ -	$ -	$ -		0.0	$ 757.4	$ -	$ -	$ -		0.0	$ 525.24	$ -	$ -	$ -
FY37		$ 0.64	$ -	$ -	$ -		0.0	$ 795.3	$ -	$ -	$ -		0.0	$ 551.50	$ -	$ -	$ -
FY38		$ 0.68	$ -	$ -	$ -		0.0	$ 835.1	$ -	$ -	$ -		0.0	$ 579.07	$ -	$ -	$ -
FY39		$ 0.71	$ -	$ -	$ -		0.0	$ 876.8	$ -	$ -	$ -		0.0	$ 608.03	$ -	$ -	$ -
FY40		$ 0.74	$ -	$ -	$ -		0.0	$ 920.7	$ -	$ -	$ -		0.0	$ 638.43	$ -	$ -	$ -

Year	Average Daily NH_3N-mg/L	Average Daily NH3N-Lbs	$/avg day lb	NH3N Billed per Year	Added Capacity Cost	Total NH3N Billed per Year	Average Daily TP-mg/L	Average Daily DAILY TP-Lbs	$/avg day lb	TP Billed per Year	Added Capacity Cost	Total TP Billed per Year	Yearly O&M Bill (Without Capacity Charges)	Capacity Charges	Total Bill
FY22		0	$ 99.72					0	$ -						
FY23	23.2	496.3354176	$ 220.00	$ 109,194	$ -	$ 109,194	4.38	93.7	$ 1,300	$ 121,816	$ -	$ 121,816	$ 1,593,410	$ -	$ 1,593,410
FY24	24	544.2574579	$ 340.00	$ 185,048	$ -	$ 185,048	5.76	130.6	$ 2,600	$ 339,617	$ -	$ 339,617	$ 1,970,577	$ 317,175	$ 2,287,753
FY25	25	600.9509431	$ 460.00	$ 276,437	$ -	$ 276,437	5.84	140.4	$ 3,900	$ 547,490	$ -	$ 547,490	$ 2,344,505	$ 371,975	$ 2,716,479
FY26	25.3	644.6520957	$ 502.55	$ 323,970	$ -	$ 323,970	5.96	151.9	$ 4,261	$ 647,049	$ 177,254	$ 824,303	$ 2,681,289	$ 571,547	$ 3,252,836
FY27		0	$ 549.04	$ -	$ -	$ -	0.5	0.0	$ 4,655	$ -	$ -	$ -	$ -	$ -	$ -
FY28		0	$ 595.53	$ -	$ -	$ -	0.5	0.0	$ 5,049	$ -	$ -	$ -	$ -	$ -	$ -
FY29		0	$ 625.31	$ -	$ -	$ -	0.5	0.0	$ 5,301	$ -	$ -	$ -	$ -	$ -	$ -
FY30		0	$ 656.57	$ -	$ -	$ -	0.5	0.0	$ 5,567	$ -	$ -	$ -	$ -	$ -	$ -
FY31		0	$ 689.40	$ -	$ -	$ -	0.5	0.0	$ 5,845	$ -	$ -	$ -	$ -	$ -	$ -
FY32		0	$ 723.87	$ -	$ -	$ -	0.5	0.0	$ 6,137	$ -	$ -	$ -	$ -	$ -	$ -
FY33		0	$ 760.06	$ -	$ -	$ -	0.5	0.0	$ 6,444	$ -	$ -	$ -	$ -	$ -	$ -
FY34		0	$ 798.07	$ -	$ -	$ -	0.5	0.0	$ 6,766	$ -	$ -	$ -	$ -	$ -	$ -
FY35		0	$ 837.97	$ -	$ -	$ -	0.5	0.0	$ 7,104	$ -	$ -	$ -	$ -	$ -	$ -
FY36		0	$ 879.87	$ -	$ -	$ -	0.5	0.0	$ 7,460	$ -	$ -	$ -	$ -	$ -	$ -
FY37		0	$ 923.86	$ -	$ -	$ -	0.5	0.0	$ 7,833	$ -	$ -	$ -	$ -	$ -	$ -
FY38		0	$ 970.06	$ -	$ -	$ -	0.5	0.0	$ 8,224	$ -	$ -	$ -	$ -	$ -	$ -
FY39		0	$ 1,018.56	$ -	$ -	$ -	0.5	0.0	$ 8,635	$ -	$ -	$ -	$ -	$ -	$ -
FY40		0	$ 1,069.49	$ -	$ -	$ -	0.5	0.00	$ 9,067	$ -	$ -	$ -	$ -	$ -	$ -

Alternative 4 - Capital Costs

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Inflation Rate	3.5%

ESD Capital Costs

FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40
			$ 73,400,935	$ -	$ -	$ -		$ 12,076,515	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Phase 1

Tertiary MBBR (80% Media Fill)
Supplemental Carbon
1 Filtration Train (2 10/4 5 micron and 2 8/4 2 micron)
Transfer 2 PS
Effluent PS
Lab Building
UV Disinfection
Metal Salt Addition
Reuse + Infiltration Pipeline
Reuse/Infiltration Pump Station
Tertiary Clarificatior (Needed in Phase 1 to capture suspended solids from MBBR.TSS is too high for filters)
Standby Generator

Phase 2

Tertiary MBBR (20% Media Fill)

1 Filtration Train (Two 10/4 5 micron and Three 8/4 2 micron)
UV Disinfection

Non Construction Costs	35%	
Capital Upgrades (2023 Dollars)		
Tertiary MBBR	$ 23,135,555	
Supplemental Carbon Storage and Pumping	$ 1,803,516	
Metal Salt Addition Storage and Pumping	$ 551,670	
Tertiary Clarification (ActiFlo)	$ 7,008,407	Needed to reduce TSS before filtration
Tertiary Filtration (Cloth Disk)	$ 5,309,452	5 Micron Units. Assumes both trains installed at the same time to provide redundacy
Transfer Pump Station 2 Pumps	$ 72,000	(Only Pumps) To be installed in existing Effluent Pump Station and converted to a transfer pump station 2. 30k per pump.20% installation factor
Effluent Pump Station	$ 1,375,487	New Pump Station to West Boise WRF. Reuse existing pumps till 2031
Lab Building	$ 480,695	1000 sqft building
UV Disinfection	$ 4,332,511	
Standby Generator	$ 1,976,314	
Reuse + Infiltration Pipeline	$ 6,074,256	Pipeline to Farmers Union Ditch Company.
Reuse/Infiltration Pump Station	$ 2,054,744	This pump station is bigger than Alt 3. Has two pumps for reuse. Two pumps for infiltration — Revise Pump Station Costs
Total Construction Cost	**$ 54,174,607**	This does not include nonconstruction costs or inflation factors

Assumption

UV Disinfection and Cloth Disk Filter will be installed in 2 phases
Rest of the Facilities will be constructed in 2026
Capital Costs for each facility include Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added
Treatment design criteria: 5 mg/L BOD, 5 mg/L TSS, 1 mg/L Ammonia, 0.5 mg/L TP
All costs are based on 2023 dollar
Non-Construction costs: 5% permitting, 15% engineering, 10% SDC, and 5% startup and Cx
Inflation rate of 3.5%
Equipment prices provided by manufacturer (Entex, Aqua-Aerobic, and Trojan)

Alternative 4 - District O&M Costs

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Inflation Rate	3.5%

Cost of Operator	$ 100,000.00	per year
Additional Operators	2	

ESD O&M Charges

	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40
Utility Charges (Existing Facility)	$ 700,000	$ 724,500	$ 749,858	$ 776,103	$ 803,266	$ 831,380	$ 860,479	$ 890,595	$ 921,766	$ 954,028	$ 987,419	$ 1,021,979	$ 1,057,748	$ 1,094,769	$ 1,133,086	$ 1,172,744	$ 1,213,790	$ 1,256,273
Seepage Testing (Aerated Lagoons Only)					$ 28,688				$ 39,504						$ 40,467			
Additional O&M Charges	$ -	$ -		$ 2,631,706	$ 2,723,816	$ 2,819,150	$ 2,917,820	$ 3,019,944	$ 3,125,642	$ 3,216,697	$ 3,329,282	$ 3,445,807	$ 3,566,410	$ 3,691,234	$ 3,820,427	$ 3,954,142	$ 4,092,537	$ 4,235,776
Additional Operators				$ 221,744	$ 229,505	$ 237,537	$ 245,851	$ 254,456	$ 263,362	$ 272,579	$ 282,120	$ 291,994	$ 302,214	$ 312,791	$ 323,739	$ 335,070	$ 346,797	$ 358,935
Total O&M Charges	$ 700,000	$ 724,500	$ 749,858	$ 3,629,552	$ 3,785,275	$ 3,888,067	$ 4,024,150	$ 4,164,995	$ 4,350,274	$ 4,443,305	$ 4,598,821	$ 4,759,779	$ 4,926,372	$ 5,098,795	$ 5,317,720	$ 5,461,956	$ 5,653,125	$ 5,850,984

O&M Costs

MBBR	$ 600,888	$ 600,888	
Metal Salt Addition Storage and Pumping	$ 164,587	$ 164,587	
Supplemental Carbon Storage and Pumping	$ 913,500	$ 913,500	A lot of carbon is needed to drive nitrification/denitrification
Tertiary Clarification (ActiFlo)	$ 243,395	$ 243,395	
Tertiary Filtration (Cloth Disk)	$ 160,397	$ 160,397	
Transfer Pump Station 2 Pumps	$ 33,920	$ 33,920	
Effluent Pump Station	$ -	$ -	Assumed 0 costs here
Lab Building	$ 4,016	$ 4,016	(1,000 sf)
UV Disinfection	$ 68,938		
Chlorine Contact Basin	$ -	$ 1,470	
Sodium Hypochlorite Storage and Pumping	$ -	$ 139,828	
Sodium Bisulfite Dechlorination Storage and Pumping	$ -	$ 71,622	
Reuse Pump Station	$ 338,654	$ 338,654	
Total	**$ 2,528,295**	**$ 2,672,277**	

Assumption

Costs include chemicals for carbon addition (Micro-C 2000) in MBBR following the suggestions from Veolia. A unit cost of $5/gallon was used.
Rest of the Facilities will be constructed in 2026
Two full-time employees are considered starting at Year 2026
Disinfection operates 12 months per year

Alternative 4 - R&R Costs

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Component	Number of units	Installation Date	Expected Useful Life	Year to Be Raplaced	Replacement Cost	Monthly cost Until Replacement	Monthly cost After Repacement
Headworks							
Headworks Building	Number = 1	2010 Construction	50	2060	N/A		
Influent pumps	Number = 4	Three pumps were installed in 2010	20	2030	$ 201,000	$ 28,714.29	$ 10,050
		One shelf spare was purchased in 2021	20	2041	$ 67,000	$ 3,722	N/A
Screen	Number = 2	Screens replaced in 2023	20	2043	$ 475,000.00	$ 23,750.00	N/A
Grit chamber (Internal components)	Number = 1	2010 Construction	20	2030	$ 85,000	$ 12,142.86	$ 4,250
Grit pump	Number = 1	2010 Construction	20	2030	$ 42,000	$ 4,200	$ 2,100
Grit separator/classifier	Number = 1	2010 Construction	20	2030	$ 180,000	$ 18,000	$ 9,000
Secondary Treatment							
Lagoon Cell 1	Number = 1	Liner replaced in 2008; 60-mil HDPE liner	20	2028	$ 307,300.00	$ 61,460.00	$ 15,365.00
Submerged diffused aeration system	Number of Diffusers= 84	Installed in 2017	20	2037	$275,000	$19,643	$13,750
Lagoon Cell 2	Number = 1	Liner replaced in 2008; 60-mil HDPE liner	20	2028	$ 117,200	$ 23,440.00	$ 5,860.00
Lagoon Cell 3	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 203,300	$ 11,294	N/A
Submerged diffused aeration system	Number of Diffusers = 90	Installed in 2021	20	2041	$ 291,176	$16,176	N/A
Lagoon Cell 4	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 209,000	$ 11,611	N/A
Submerged diffused aeration system	Number of Diffusers = 30	Installed in 2021	20	2041	$98,214	$5,456	N/A
Lagoon Cell 5	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 137,300	$ 7,628	N/A
Lagoon Cell 6	Number = 1	2021 Construction; 60-mil HDPE liner	20	2041	$ 123,200	$ 6,844	N/A
MBBR	Number = 1	New Construction	20	2044	$ 5,184,400	$ 259,220	NA
Effluent Pump Station (Pumps repurposed to new pump station)	Number = 3	2 Pumps purchased in 2019	2019	2039	$ 180,000	$ 11,250	$ 9,000
		1 Pump purchased in 2023, 2 pump will be purchased in 2031	20	2043	N/A	$ 4,500	N/A

Component	Number of units	Installation Date	Expected Useful Life	Year to Be Raplaced	Replacement Cost	Monthly cost Until Replacement	Monthly cost After Repacement
Tertiary Treatment							
Metal Salt Addition System	Number = 2	New Construction	20	2044	$ 30,000	$ 1,500.00	NA
Membrane Filtration	Number = 3	New Construction	10	2044	$ 2,737,141	$ 273,714.10	$ 273,714.10
Tertiary Clarification	Number = 3	New Construction	20	2044	$ 1,831,361	$ 91,568	NA
Tertiary Filtration	Number = 3	New Construction	20	2044	$ 2,519,510	$ 125,976	NA
UV Disinfection	Number = 1	New Construction	20	2044	$ 335,000	$ 16,750	NA
Sodium Hypo Disinfection Pumps	Number = 2	New Construction	20	2044	$ 30,000	$ 1,500	NA
Sodium Bisfulite	Number = 2	New Construction	20	2044	$ 30,000	$ 1,500	NA
Supplemental Carbon Addition	Number = 1	New Construction	20	2044	$ 30,000	$ 1,500	NA
Blower Building							
Blower Building	Number = 1	2017 Construction	50	2067	N/A	NA	
Train 1 Blowers	Number = 2	Installed in 2017	20	2037	$ 426,000	$ 30,428.57	$ 21,300
Train 2 Blowers	Number = 2	Installed in 2021	20	2021	$ 426,000	$ 22,421.05	N/A
Blower 5	Number = 1	New Construction 2030	20	2050	$ 230,000	$ 11,500.00	NA
Transfer Pump Station	Number = 2	Installed in 2021	20	2041	$ 102,000	$ 5,667	N/A
Transfer Pump Station 2 - Pumps	Number = 3	New Construction	20	2044	$ 60,000	$ 3,000	NA
Lab Building	Number = 1	New Construction	50	2044	$ 204,884	NA	
Reuse Pump Station	Number = 2	New Construction	20	2044	$ 977,087	$ 48,854.35	NA
Lab Building	Number = 1	New Construction	20	2044	$ 409,676	NA	NA

Alternative 5 - NPV

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ALTERNATIVE 5:

Alternative Description: Secure Boise River Discharge Permit and Add Process to Meet Permit

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Capital Costs																		
Total Capital Costs	$ -	$ -	$ -	$ -	$ -	$ 163,566,770	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Capital NPV	$ 120,326,823																	
O&M Costs																		
Discharge to the City of Boise	$ 1,593,410	$ 1,970,577	$ 2,344,505	$ 2,681,289	$ 3,202,862	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sludge Removal Costs	$ -	$ 725,794	$ -	$ 831,495	$ -	$ 921,689	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
ESD O&M Charges	$ 700,000	$ 724,500	$ 749,858	$ 776,103	$ 1,172,043	$ 831,380	$ 5,403,341	$ 5,592,458	$ 5,788,194	$ 5,990,781		$ 6,417,474	$ 6,642,086	$ 6,874,559	$ 7,115,168	$ 7,364,199	$ 7,621,946	$ 7,888,714
City of Boise Capacity Charges	$ -	$ 317,175	$ 371,975	$ 571,547	$ 842,262	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total O&M Costs	$ 2,293,410	$ 3,738,047	$ 3,466,337	$ 4,860,433	$ 5,217,167	$ 1,753,069	$ 5,403,341	$ 5,592,458	$ 5,788,194	$ 5,990,781	$ -	$ 6,417,474	$ 6,642,086	$ 6,874,559	$ 7,115,168	$ 7,364,199	$ 7,621,946	$ 7,888,714
O&M NPV	$55,681,538																	
R&R Cost																		
R&R Costs	$ 328,349	$ 328,349	$ 328,349	$ 328,349	$ 328,349	$ 328,349	$ 669,336	$ 631,679	$ 631,679	$ 631,679	$ 631,679	$ 631,679	$ 631,679	$ 631,679	$ 622,550	$ 622,550	$ 622,550	$ 622,550
R&R NPV	$5,725,159																	

Project NPV (PTAC)	$181,733,520

potential total asset cost

Alternative 5 - Annual West Boise O&M Costs

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Water Usage Growth Rate (Annual) 2022 to 2028	1.060
Water Usage Growth Rate (Annual) 2029-2040	1.015

cBOD Escalation Factor	3.7

Year	MAX MONTH AVERAGE DAILY FLOW-GAL	$/ avg daily gal	FLOW BILLED per Year	Added Capacity Cost	$/ avg daily gal	Average Daily cBOD-mg/L	Average Daily cBOD-Lbs	$/avg day lb	cBOD Billed per Year	Added Capacity Cost	Total BOD Billed per Year	Average Daily TSS-mg/L	Average Daily TSS-Lbs	$/avg day lb	TSS Billed per Year	Added Capacity Cost	Total TSS Billed per Year
FY22	2,420,000.00	$ 0.50	$ 1,218,881	$ -	$ 1,218,881		0.0	$ 371.2	$ -				0.0	$ 173.30			
FY23	2,565,200.00	$ 0.40	$ 1,013,254	$ -	$ 1,013,254	20	427.9	$ 381.0	$ 163,021	$ -	$ 163,021	29	620.4	$ 300.00	$ 186,126	$ -	$ 186,126
FY24	2,719,112.00	$ 0.37	$ 1,006,071	$ 317,175	$ 1,323,247	24	537.5	$ 388.0	$ 208,532	$ -	$ 208,532	34	771.0	$ 300.00	$ 231,309	$ -	$ 231,309
FY25	2,882,258.72	$ 0.35	$ 1,000,144	$ 371,975	$ 1,372,118	27	658.6	$ 396.0	$ 260,822	$ -	$ 260,822	36	865.4	$ 300.00	$ 259,611	$ -	$ 259,611
FY26	3,055,194.24	$ 0.35	$ 1,069,318	$ 394,293	$ 1,463,611	31	792.4	$ 432.6	$ 342,832	$ -	$ 342,832	39	993.7	$ 300.00	$ 298,120	$ -	$ 298,120
FY27	3,238,505.90	$ 0.38	$ 1,238,340	$ 417,951	$ 1,656,290	35	939.9	$ 472.7	$ 444,252	$ -	$ 444,252	42	1134.4	$ 327.75	$ 371,794	$ -	$ 371,794
FY28			$ -	$ -	$ -		0.0		$ -	$ -	$ -		0.0		$ -	$ -	$ -
FY29			$ -	$ -	$ -		0.0		$ -	$ -	$ -		0.0		$ -	$ -	$ -
FY30			$ -	$ -	$ -		0.0		$ -	$ -	$ -		0.0		$ -	$ -	$ -
FY31			$ -	$ -	$ -		0.0		$ -	$ -	$ -		0.0		$ -	$ -	$ -
FY32			$ -	$ -	$ -		0.0		$ -	$ -	$ -		0.0		$ -	$ -	$ -
FY33			$ -	$ -	$ -		0.0		$ -	$ -	$ -		0.0		$ -	$ -	$ -
FY34			$ -	$ -	$ -		0.0		$ -	$ -	$ -		0.0		$ -	$ -	$ -
FY35			$ -	$ -	$ -		0.0		$ -	$ -	$ -		0.0		$ -	$ -	$ -
FY36			$ -	$ -	$ -		0.0		$ -	$ -	$ -		0.0		$ -	$ -	$ -
FY37			$ -	$ -	$ -		0.0		$ -	$ -	$ -		0.0		$ -	$ -	$ -
FY38			$ -	$ -	$ -		0.0		$ -	$ -	$ -		0.0		$ -	$ -	$ -
FY39			$ -	$ -	$ -		0.0		$ -	$ -	$ -		0.0		$ -	$ -	$ -
FY40			$ -	$ -	$ -		0.0		$ -	$ -	$ -		0.0		$ -	$ -	$ -

Year	Average Daily NH_3N-mg/L	Average Daily NH3N-Lbs	$/avg day lb	NH3N Billed per Year	Added Capacity Cost	Total NH3N Billed per Year	Average Daily TP-mg/L	Average Daily DAILY TP-Lbs	$/avg day lb	TP Billed per Year	Added Capacity Cost	Total TP Billed per Year	Yearly O&M Bill (Without Capacity Charges)	Capacity Charges	Total Bill
FY22		0	$ 99.72					0	$ -						
FY23	23.2	496.3354176	$ 220.00	$ 109,194	$ -	$ 109,194	4.38	93.7	$ 1,300	$ 121,816	$ -	$ 121,816	$ 1,593,410	$ -	$ 1,593,410
FY24	24	544.2574579	$ 340.00	$ 185,048	$ -	$ 185,048	5.76	130.6	$ 2,600	$ 339,617	$ -	$ 339,617	$ 1,970,577	$ 317,175	$ 2,287,753
FY25	25	600.9509431	$ 460.00	$ 276,437	$ -	$ 276,437	5.84	140.4	$ 3,900	$ 547,490	$ -	$ 547,490	$ 2,344,505	$ 371,975	$ 2,716,479
FY26	25.3	644.6520957	$ 502.55	$ 323,970	$ -	$ 323,970	5.96	151.9	$ 4,261	$ 647,049	$ 177,254	$ 824,303	$ 2,681,289	$ 571,547	$ 3,252,836
FY27	25.9	699.536705	$ 549.04	$ 384,074	$ -	$ 384,074	6.08	164.2	$ 4,655	$ 764,402	$ 424,311	$ 1,188,713	$ 3,202,862	$ 842,262	$ 4,045,124
FY28		0	$ 595.53	$ -	$ -	$ -		0.0		$ -	$ -	$ -	$ -	$ -	$ -
FY29		0	$ 625.31	$ -	$ -	$ -		0.0		$ -	$ -	$ -	$ -	$ -	$ -
FY30		0	$ 656.57	$ -	$ -	$ -		0.0		$ -	$ -	$ -	$ -	$ -	$ -
FY31		0	$ 689.40	$ -	$ -	$ -		0.0		$ -	$ -	$ -	$ -	$ -	$ -
FY32		0	$ 723.87	$ -	$ -	$ -		0.0		$ -	$ -	$ -	$ -	$ -	$ -
FY33		0	$ 760.06	$ -	$ -	$ -		0.0		$ -	$ -	$ -	$ -	$ -	$ -
FY34		0	$ 798.07	$ -	$ -	$ -		0.0		$ -	$ -	$ -	$ -	$ -	$ -
FY35		0	$ 837.97	$ -	$ -	$ -		0.0		$ -	$ -	$ -	$ -	$ -	$ -
FY36		0	$ 879.87	$ -	$ -	$ -		0.0		$ -	$ -	$ -	$ -	$ -	$ -
FY37		0	$ 923.86	$ -	$ -	$ -		0.0		$ -	$ -	$ -	$ -	$ -	$ -
FY38		0	$ 970.06	$ -	$ -	$ -		0.0		$ -	$ -	$ -	$ -	$ -	$ -
FY39		0	$ 1,018.56	$ -	$ -	$ -		0.0		$ -	$ -	$ -	$ -	$ -	$ -
FY40		0	$ 1,069.49	$ -	$ -	$ -		0.00		$ -	$ -	$ -	$ -	$ -	$ -

Alternative 5 - Capital Costs

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Inflation Rate	3.5%

ESD Capital Costs

FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40
$ -	$ -	$ -	$ -	$ -	$ 163,566,770	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Everything Constructed in one phase

Non Construction Costs 40%

Capital Upgrades	Overall Project Cost (2023 Dollars)	
Fine Screening	$ 11,983,686	
MBR	$ 40,289,594	Sized for 4 mgd flows
Metal Salt Addition Storage and Pumping	$ 551,670	
UV Disinfection	$ 4,168,086	Sized for 4 mgd flows
River Discharge Piping and Outfall Diffusers	$ 2,018,332	
Cooling Tower	$ 133,500	Sized for 4 mgd flows
Standby Generator	$ 1,166,483	
Lab Building	$ 480,695	1000 sqft building
WAS Storage and Pumping	$ 2,806,678	
Aerobic Digester	$ 15,951,671	
Thickening and Dewatering	$ 18,820,199	
Total Construction Cost	**$ 98,370,594**	This does not include nonconstruction costs or inflation factors

Assumption

One of the lagoons will be repurposed into Equalization lagoon
Existing effluent pump station will be modified with new pumps to pump to the river
Capital Costs for each facility include Facility Cost with Standard Additional Project Costs, Contractor Markups, and Location Adjustment Factor Added
Treatment design criteria: 5 mg/L BOD, 5 mg/L TSS, 1 mg/L Ammonia, 0.5 mg/L TP
All costs are based on 2023 dollar
Non-Construction costs: 10% permitting, 15% engineering, 10% SDC, and 5% startup and Cx
Inflation rate of 3.5%

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Alternative 5 - District O&M Costs

Inflation Rate	3.5%

Cost of Operator	$ 100,000.00	per year
Additional Operators	3	

ESD O&M Charges

Do Nothing till the plant is built

	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40
ESD O&M Charges	$ 700,000	$ 724,500	$ 749,858	$ 776,103	$ 803,266	$ 831,380	$ 5,034,564	$ 5,210,774	$ 5,393,151	$ 5,581,911	$ 5,777,278	$ 5,979,483	$ 6,188,765	$ 6,405,372	$ 6,629,560	$ 6,861,594	$ 7,101,750	$ 7,350,311
Additional Operators							$ 368,776.60	$ 381,683.78	$ 395,042.71	$ 408,869.21	$ 423,179.63	$ 437,990.92	$ 453,320.60	$ 469,186.82	$ 485,608.36	$ 502,604.65	$ 520,195.81	$ 538,402.67
Total O&M Charge	$ 700,000	$ 724,500	$ 749,858	$ 776,103	$ 1,172,043	$ 831,380	$ 5,403,341	$ 5,592,458	$ 5,788,194	$ 5,990,781	$ 6,200,458	$ 6,417,474	$ 6,642,086	$ 6,874,559	$ 7,115,168	$ 7,364,199	$ 7,621,946	$ 7,888,714

Facility	**Annual O&M Co**	**Annual O&M Cost**
Fine Screening	$ 231,525	$ 231,525
MBR	$ 3,458,164	$ 3,458,164
Metal Salt Addition Storage and Pumping	$ 164,587	$ 164,587
UV Disinfection	$ 41,664	$ -
River Discharge Piping and Outfall Diffusers	$ 24,000	$ 24,000
Chlorine Contact Basin	$ -	$ 1,470
Sodium Hypochlorite Storage and Pumping	$ -	$ 139,828
Sodium Bisulfite Dechlorination Storage and	$ -	$ 71,622
Lab Building	$ 4,016	$ 4,016
WAS Storage and Pumping	$ 44,445	$ 44,445
Aerobic Digester	$ 72,616	$ 72,616
Thickening and Dewatering	$ 197,951	$ 197,951
Total	**$ 4,238,968**	**$ 4,410,224**

Assumption

Three full-time employees are considered starting at Year 2029

All facilities constructed in 2028

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Solids Alternatives Comparison

Alternative Description: Continue with solids removal from lagoons and disposing in the Ada County Landfill. The solids removal will be done by ESD.

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Capital Costs																		
Total Capital Costs	$ -	$ -	$ -	$ 6,692,874	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Capital NPV	**$ 5,454,114**																	
O&M Costs																		
Sludge Disposal Charges	$ -	$ 725,794	$ -	$ 32,226	$ -	$ 34,938	$ -	$ 37,957	$ -	$ 41,204	$ -	$ 44,699	$ -	$ 48,462	$ -	$ 52,517	$ -	$ 56,888
Facilities O&M	$ -	$ -	$ -	$ 260,326	$ -	$ 279,546	$ -	$ 300,261	$ -	$ 322,510	$ -	$ 346,404	$ -	$ 372,065	$ -	$ 399,621	$ -	$ 429,211
Total O&M Costs	$ -	**$ 725,794**	**$ -**	**$ 292,552**	**$ -**	**$ 314,485**	**$ -**	**$ 338,219**	**$ -**	**$ 363,714**		**$ 391,103**	**$ -**	**$ 420,527**	**$ -**	**$ 452,138**	**$ -**	**$ 486,100**
O&M NPV	$2,420,129																	
R&R Cost																		
R&R Costs	$ -	$ -	$ -	$ -	$ 55,800	$ 55,800	$ 55,800	$ 55,800	$ 55,800	$ 55,800	$ 55,800	$ 55,800	$ 55,800	$ 55,800	$ 55,800	$ 55,800	$ 55,800	$ 55,800
R&R NPV	**$443,004**																	
Project NPV (PTAC)	$8,317,247																	

potential total asset cost

Alternative Description: Continue with solids removal from lagoons and disposing in the Ada County Landfill. The solids removal will be done by a Contractor.

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Capital Costs																		
Total Capital Costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Capital NPV	$ -																	
O&M Costs																		
Sludge Removal Costs	$ -	$ 725,794	$ -	$ 831,495	$ -	$ 921,689	$ -	$ 1,022,689	$ -	$ 1,132,894	$ -	$ 1,253,070	$ -	$ 1,384,041	$ -	$ 1,526,700	$ -	$ 1,682,005
Total O&M Costs	$ -	$ 725,794	$ -	$ 831,495	$ -	$ 921,689	$ -	$ 1,022,689	$ -	$ 1,132,894	$ -	$ 1,253,070	$ -	$ 1,384,041	$ -	$ 1,526,700	$ -	$ 1,682,005
O&M NPV	$6,066,307																	
R&R Cost																		
R&R Costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
R&R NPV	$0																	
Project NPV (PTAC)	$6,066,307																	

potential total asset cost

Alternative Description: Include WAS Storage, Aerobic Digestion Process, Thickening and Dewatering unit processes for reduced solids disposal to Ada County Landfill

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Capital Costs																		
Total Capital Costs		$ 18,240,556	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Capital NPV	$ 17,330,694																	
O&M Costs																		
Sludge Removal Costs	$ -	$ 725,794	$ 85,359	$ 95,514	$ 101,108	$ 111,974	$ 120,190	$ 123,324	$ 132,207	$ 135,676	$ 145,280	$ 149,114	$ 159,495	$ 163,726	$ 174,945	$ 179,607	$ 191,731	$ 196,860
Solids Facility O&M	$ -	$ -	$ 168,724	$ 174,630	$ 180,742	$ 187,068	$ 193,615	$ 200,392	$ 207,405	$ 214,665	$ 222,178	$ 229,954	$ 238,002	$ 246,332	$ 254,954	$ 263,877	$ 273,113	$ 282,672
Total O&M Costs	$ -	$ 725,794	$ 254,083	$ 270,144	$ 281,849	$ 299,042	$ 313,805	$ 323,715	$ 339,612	$ 350,341		$ 379,068	$ 397,497	$ 410,058	$ 429,900	$ 443,485	$ 464,844	$ 479,532
O&M NPV	$3,853,754																	
R&R Cost																		
R&R Costs			$ 107,000	$ 107,000	$ 107,000	$ 107,000	$ 107,000	$ 107,000	$ 107,000	$ 107,000	$ 107,000	$ 107,000	$ 107,000	$ 107,000	$ 107,000	$ 107,000	$ 107,000	$ 107,000
R&R NPV	$1,139,279																	
Project NPV (PTAC)	$22,323,727																	

potential total asset cost

Solids Treatment Alternatives NPV Calculations

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Alternative 5 - R&R Costs

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Component	Number of units	Installation Date	Expected Useful Life	Year to Be Raplaced	Replacement Cost	Monthly cost	
						Until Replacement	After Repacement
Headworks							
Headworks Building	Number = 1	2010 Construction	50	2060	N/A		
Influent pumps	Number = 4	Three pumps were installed in 2010	20	2030	$ 201,000	$ 28,714.29	$ 10,050
		One shelf spare was purchased in 2021	20	2041	$ 67,000	$ 3,722	N/A
Screen	Number = 2	Screens replaced in 2023	20	2043	$ 475,000.00	$ 23,750.00	N/A
Grit chamber (Internal components)	Number = 1	2010 Construction	20	2030	$ 85,000	$ 12,142.86	$ 4,250
Grit pump	Number = 1	2010 Construction	20	2030	$ 42,000	$ 4,200	$ 2,100
Grit separator/classifier	Number = 1	2010 Construction	20	2030	$ 180,000	$ 18,000	$ 9,000
Fine Screening Equipmet	Number = 2	New Construction	20	2044	$ 1,445,030	$ 72,251.50	

Component	Number of units	Installation Date	Expected Useful Life	Year to Be Raplaced	Replacement Cost	Monthly cost	
						Until Replacement	After Repacement
Secondary Treatment							
Metal Salt Addition System	Number = 2	New Construction	20	2047	$ 30,000	$ 1,500.00	NA
MBR	Number = 4	New Construction	10	2037	$ 2,000,000	$ 200,000	$ 200,000
Aeration Basin					$ 604,640	$ 30,232	NA
Blower Building	Number = 1	2017 Construction	50	2067	N/A	NA	
Train 1 Blowers	Number = 2	Installed in 2017	20	2037	$ 426,000	$ 30,428.57	$ 21,300
Train 2 Blowers	Number = 2	Installed in 2021	20	2021	$ 426,000	$ 22,421.05	N/A
Transfer Pump Station	Number = 2	Installed in 2021	20	2041	$ 102,000	$ 5,667	N/A
Pipeline for River Discharge	Number = 1	New Construction	50	2057	NA	NA	NA
Lab Building	Number = 1	New Construction	50	2044	NA	NA	NA
UV Disinfection	Number = 1	New Construction	20	2047	$ 335,000	$ 16,750	NA
Sodium Hypo Disinfection Pumps	Number = 2	New Construction	20	2047	$ 30,000	$ 1,500	NA
Sodium Bisfulite	Number = 2	New Construction	20	2047	$ 30,000	$ 1,500	NA
Solids Handling							
Aerobic Digester Equipment	Number = 2	New Construction	20	2047	$ 888,712	$ 44,435.60	NA
WAS Storage Tank Equipment	Number = 4	New Construction	20	2047	$ 500,834	$ 25,041.70	NA
Thickening and Dewatering	Number = 4	New Construction	20	2047	$ 2,601,584	$ 130,079.20	NA

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