Appendix F: Condition Assessment TM

Technical Memorandum

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Prepared for: Alexandria Lakes and Sanitary District (ALASD)

Project Title: ALASD Wastewater Treatment Plant Facility Plan

Project No.: 158466

Technical Memorandum

Subject: ALASD Wastewater Treatment Facility Condition Assessment

Date: November 4, 2022

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Section 1: Overview

1.1 Background

ALASD's wastewater treatment facility (WWTF) was constructed from 1976 to 1978. Future regulations require additional treatment to meet permit limits and prevent degradation of receiving waters. Recent industrial expansions have resulted in increased flow and load to ALASD causing the facility to operate near capacity at times. In addition, much of the facility is 45 years old and requires rehabilitation or replacement, and future growth projections include industrial growth as well as increased population in the ALASD service area.

1.2 Objective

The objective of this technical memorandum (TM) is to complete a condition assessment to establish a baseline for future equipment and facility decisions. Plant equipment and structures were evaluated to estimate the remaining useful life and whether it should be replaced, refurbished, or eliminated.

1.3 Plant Overview

The WWTF liquid processes consist of the following:

- Influent pump station
- Preliminary treatment with two perforated screens/screenings compactors and vortex grit removal
- Two primary clarifiers
- Three activated sludge aeration basins
- Three secondary clarifiers
- Three cloth disk filter systems
- Two chlorine contact tanks with gaseous chlorine disinfection and sodium bisulfite dechlorination
- Plant effluent outfall into Lake Winona

The WWTF solids processing includes the following:

- Dissolved air flotation thickener for waste active sludge (WAS)
- Four aerobic digesters
- Centrifuge
- Biosolids storage pad

Refer to Figure 1-1 for a map of the WWTF.

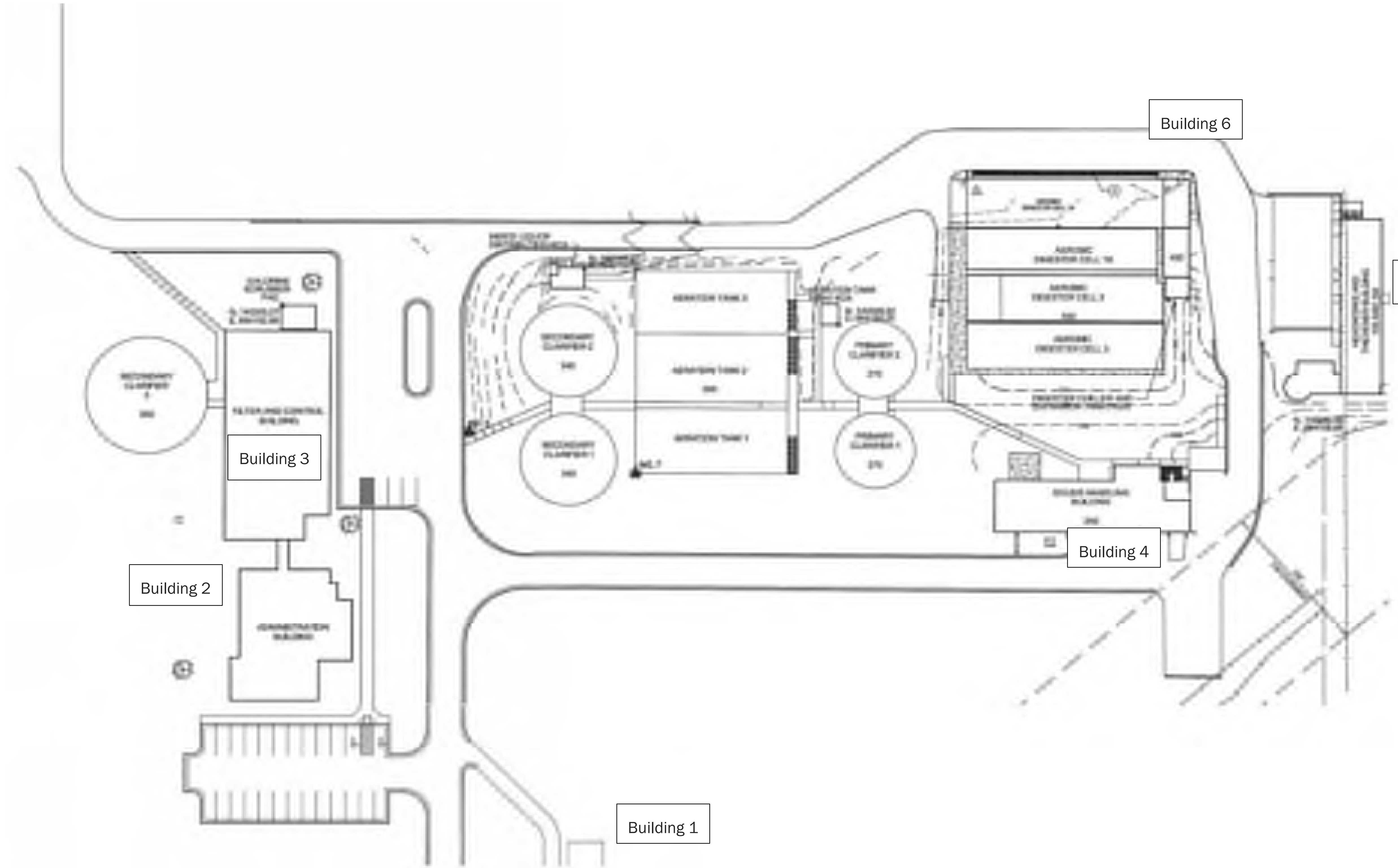

Figure 1-1. WWTF map

Section 2: Condition Assessment

2.1 Site Visit

A site visit was conducted on May 24, 2022. The primary activities consisted of a site walk and tour of each building, photo documentation, recording equipment nameplate data, and discussions with plant staff. The site visit was attended by:

- Scott Gilbertson, Troy Drewes, and Jason Dahl (ALASD)
- David Muenzner, Chuck Lewis, and Kellie Schaefer (Brown and Caldwell)

The plant was operating under normal conditions during the site visit, which meant that certain equipment and structures were in service and not visible or accessible for internal inspection. Primary Clarifier 2 and Aerobic Digester Cell 3 were emptied to allow visual inspections of the structures. Internal condition of aeration tanks, lift station wet well, and pumps could not be visually inspected. Conditions of these items were assumed based on age and discussions with facility staff.

2.2 Influent Pumping Station

The influent pumping station consists of three vertical, non-clog, centrifugal pumps. Each pump has a design capacity of 4,800 gallons per minute (gpm) at a total dynamic head (TDH) of 54 feet. Each pump has a 100 horsepower (hp) motor with a variable speed drive. The pumps are located in a dry well with an extended shaft to the pump motor located at grade level. The existing building layout does not have room for any additional pumps. Plant influent flow is pumped from the influent pumping station to the Headworks Building through a combination 18-inch/24-inch force main. Entrance to the wet well is through a 3 foot by 3 foot concrete shaft. Due to the confined space nature of entry and unknown condition of the ladder rungs, no attempt was made to enter the wet well. Refer to Table 2-1 for the influent pumping station equipment summary and Figure 2-1 for a picture of the influent pumps.

Two of the influent pumps were replaced in 2000 and the third pump was installed in 2008. The variable speed drives for influent pumps 1 and 2 were replaced within the last five years while the drive for the third pump was installed in 2008 with the pump. All of the pumps appear to be in good operating condition.

Table 2-1. Influent Pumping Station Equipment Summary		
Influent Pumps 1 and 2	Model	612
	Manufacturer	Aurora
	Capacity	4,800 gpm
	HP	100
	RPM	880
	Drive Type	VFD
	Year	2000
Influent Pump 3	Model	612
	Manufacturer	Aurora

Table 2-1. Influent Pumping Station Equipment Summary

	Capacity	4,800 gpm
	HP	100
	RPM	885
	Drive Type	VFD
	Year	2008
Influent Pumping Station Sump Pump	Quantity	1
	RPM	415
	HP	5

Figure 2-1: Influent pumps

The following are additional notes discussed with plant staff during the site visit:

- Plant staff mentioned it is difficult to exercise the valves on the discharge piping as it is always in service.
- The knife gate valve sealing gland cannot be replaced or repaired since the pump suction pipe cannot be isolated from the wet well.
- The influent pumps have had issues with rags clogging the pumps although this issue has become less frequent (refer to Figure 2-2).
- The air release valves on each pump may be undersized and tend to clog frequently.
- The entry shaft is on one end of the wet well, making access to clean out grit and accumulated debris difficult. Due to the depth of this entry shaft, visual observation of the wet well is very difficult.
- The pumping rate is limited to about 10.8 mgd by the length of 18” pipe and the 10” magnetic flow meter (described below) installed on the discharge piping between the pumps and the Headworks

Building. During the recent high flow event, the pumps could not keep up with the influent flow. To accommodate flows greater than 10.8 mgd, the 18” pipe would need to be upsized to 24”.

Figure 2-2: Influent pump ragging

2.2.1.1 Influent Flow Metering

Influent flow is measured with a 10-inch magnetic flow meter located in the grit pump room of the Headworks Building. The 10-inch flow meter was relocated during the 2008 expansion project to this location and was replaced in 2010.

Although the flow tube and transmitter are just over 10 years old and appear to be in good condition, the flow meter is undersized for current peak flows. During the recent high influent flow event in May 2022, the influent pump station was restricted to an output of about 10.8 mgd. A larger flow meter should be considered in future pump station improvements.

2.2.2 Preliminary Treatment

2.2.2.1 Screening

There are two stainless steel perforated plate mechanical screens, each located in a separate channel with inlet and outlet slide plates for isolation. The screens have 3/8”-diameter perforations and are each rated for 6.9 mgd. Each screen is equipped with a tip-up feature, allowing for access to and maintenance of the lower sprocket. Ultrasonic level transmitters are located upstream and downstream of each screen to monitor differential head across the screen. A manual bar screen with 1-inch openings is located in a separate bypass channel. The screenings influent and effluent channels were constructed with knock-out panels to allow for construction of a fourth channel to allow for the installation of a third mechanical plate screen. Refer to Table 2-2 for the screening equipment summary and Figure 2-3 for a picture of the perforated plate screen. The screening compactors are described in the section below.

Screen #1 was installed in 1999 and Screen #2 was installed in 2008. Screen #1 was completely disassembled and repaired in 2017 with new drive shafts and chains. The screens are still in relatively good condition and function well; however, Screen #2 may need refurbishment since it has been in use for almost 15 years.

ALASD has reported that odorous air from the adjacent dumpster room has been migrating into the electrical room. Smoke testing had been performed to determine where the air is leaking into the room.

Table 2-2. Screening Equipment Summary		
Screens	Quantity	2
	Manufacturer	Wastec Tech FSM Model FSM1100x75/10
	Type	3/8" diameter perforated plate
	Capacity	6.9 mgd
	Screen Drive, HP	1.5
	Deflector Drive, HP	0.5
	Brush Drive, HP	2
	Year Installed	1999, Refurbished 2017 (Screen#1) 2008 (Screen #2)
Screenings Compactors	Quantity	2
	Model	Wastec Tech Model SPW 200
	HP	2
	RPM	1800
	Year Installed	1999 (with Screen #1) 2008 (with Screen #2)

Figure 2-3: Perforated plate screen

Screenings collected on the mechanical screens discharge to screenings compactor units located immediately downstream of the screens. Each screen has a dedicated screenings compactor. The screenings compactors were installed with the screens and are therefore the same age as the respective screen. The compactor agitates, de-waters and compacts the screenings, thereby reducing disposal costs and making the screenings more acceptable to landfills for disposal. The screenings produced by the unit are conveyed by chute through an adjacent masonry wall into a dumpster.

The screenings compactors are in relatively good condition for their age, have worked well, and produce very dry and clean screenings. See Table 2-2 above for the screening compactor equipment summary. Pictures of the screening compactor are shown in Figures 2-4 and 2-5.

Figure 2-4: Screening compactor

Figure 2-5: Screening compactor discharge

2.2.2.2 Grit System

Downstream of the screening, wastewater flows through an EIMCO JETA vortex grit removal system consisting of a concrete tank, steel bridge, and stainless-steel mixing element. The mixing element helps to resuspend grit to wash off organic material. Heavier grit falls into a grit hopper under the mixing element. The screen effluent channel is constructed with a knock-out panel to allow for the installation of a second vortex grit tank adjacent to the existing tank. Flushing water is directed into the hopper using a solenoid valve prior to grit pump starting to break up compacted grit and generate a slurry. The vortex grit system works well and has generally been trouble-free since installation in 2008. The bridge coating system has failed but the bridge, motor, and drive all appear to be in good condition. The exterior hatch does not close tight and there is no insulation. The concrete above the water line was in good condition.

Collected grit is conveyed by two Wemco recessed impeller pumps to a hydrocyclone grit classifier and grit washer system. The suction piping is equipped with a solenoid valve actuated flushing water connection to flush the suction pipe of any compacted grit prior to the pump starting. The Wemco recessed impeller pumps have performed well with only routine maintenance since installation in 2008. One of the pumps was rebuilt with a new shaft seal and bearings within the past year. Figure 2-6 shows a picture of the grit pumps.

Figure 2-6: Grit pumps

Grit is pumped to a hydrocyclone-type grit classifier, which was originally installed in 1999 and then relocated to the Headworks Building in 2008. The overflow from the grit classifier is directed to the screen influent channel, and the underflow, consisting of concentrated grit, is discharged to the grit washer. The grit washer consists of a slow speed mixer and inclined conveyor, and discharges to a dumpster located in an adjacent room. The grit washer was installed in 1999 and relocated to the Headworks Building in 2008.

A new discharge nozzle was installed on the hydrocyclone classifier in the last year. The hydrocyclone is in good condition and has performed as expected. The grit washer manufacturer was acquired by Parkson and the installed model was discontinued, so parts may become difficult to acquire in the future. The grit is generally clean but not very dry when discharged to the dumpster. Figures 2-7 and 2-8 show pictures of the grit classifier and grit washer, respectively. It was noted by ALASD that the ductile iron grit piping also needs to be replaced.

Figure 2-7: Grit classifier

Figure 2-8: Grit washer

A summary of the grit removal system equipment is shown in Table 2-3.

Table 2-3.Grit System Equipment Summary		
Grit Removal System	Quantity	1
	Model	JETA JGT-900
	Manufacturer	Eimco
	Diameter	16 feet
	Drive HP	0.5
	Year Installed	2008
Grit Pumps	Quantity	2
	Manufacturer	Wemco
	Model	3 x 3 Model C
	Type	Recessed impeller centrifugal
	HP	7.5
	Capacity	240 GPM at 24 feet TDH
	RPM	875
	Drive Type	Constant speed, belt drive
	Year Installed	2008
Grit Classifier	Quantity	1
	Model	D10LB
	Manufacturer	Krebs Engineering
	Capacity	300 gpm
	Year Installed	1999, relocated 2008
Grit Washers	Quantity	1
	Manufacturer	Hycor
	Model	TGR-400
	RPM	1440
	HP	0.75
	Year Installed	1999, relocated 2008

2.2.3 Primary Treatment

2.2.3.1 Primary Clarifiers

Primary treatment is provided by two circular primary clarifiers that were installed in 1976. Each clarifier is 45-feet in diameter with a side water depth of 11 feet. The clarifiers use a scraper-type sludge collector mechanism with a central sludge draw-off. The clarifier bridges and sludge collectors are still the original equipment, but the collector motor and drive mechanisms were replaced in 2000.

Scum is removed once per month on a manual basis by pumps located in the vault between the clarifier tanks.

During the site visit, Primary Clarifier 2 was taken down and emptied (as shown in Figure 2-9). The collector mechanisms appeared to be in good condition with only portions of the coating system damaged or missing. The typical life of a clarifier collector is approximately 20 to 30 years. The bridge coating system had failed, revealing rust in several areas. The tank concrete was in good condition. The tank is coated below the waterline, and above the waterline, the tank is uncoated, and no corrosion was apparent. It was noted that the scum baffles on both clarifiers were coming apart and failing in several areas, and that the v-notch effluent weirs were corroded in areas.

It was also noted that the concrete step to the bridge for Primary Clarifier 1 was damaged.

Figure 2-9: Primary clarifier 2

2.2.3.2 Primary Sludge Pumps

The primary sludge pumps, located in the basement of the Solids Handling Building, transfer sludge from the primary tanks to the aerobic digester. The original primary sludge pumps were replaced in 2002 with progressing cavity positive displacement pumps. Each clarifier has a dedicated sludge pump, with a standby pump which can be used for either clarifier. Each pump is rated for 150 gpm.

The primary sludge pumps appear to be in good condition and are functioning well. Plant staff reported that the discharge flow measured in the magnetic flow meter dropped significantly just prior to our site visit (up to 50%). It was determined following the site visit that the flow tubes were fouled, causing faulty readings. Once cleaned, the pumps appear to be producing the rated discharge.

Several minor deficiencies were observed during the site inspection including the following:

- The discharge and suction piping do not have independent support. The weight of the piping can affect the pump alignment and reduce bearing life. Additional supports could be configured to allow for the removal of the discharge elbow for stator replacement.
- The new piping that was installed in 2002 is not painted or labeled.
- Progressing cavity pumps can be installed with sensors and interlocks to prevent the pump from running dry and damaging the stator elastomer material. No run dry instrumentation appears to have been installed.

2.2.3.3 Primary Sludge Grinders

In 2002, primary sludge grinders were installed to protect the new progressive cavity pumps. These grinders are in the below grade vault between the primary clarifiers. The vault has been subject to flooding in the past and the heater has been replaced. The grinders and associated piping appear to be in good condition.

A summary of the primary treatment equipment is shown in Table 2-4.

Table 2-4.Primary Treatment Equipment Summary

Primary Clarifier	Quantity	2
	Diameter	45 feet
	Side Water Depth	11 feet
	Drive HP	0.75
	Year Installed	1976 (tanks and collectors) 2000 (drives/motors)
Primary Sludge Pumps	Quantity	3
	Type	Progressing cavity
	Manufacturer	Moyno
	Model	2L065G1 CDR 3AAE
	Capacity	150 gpm
	TDH	48 feet
	HP	7.5
	Drive Type	VFD
	Year Installed	2002
Primary Sludge Grinders	Quantity	2
	Type	Twin-shaft
	Manufacturer/Model	JWCE Muffin Monster
	Capacity	400 gpm
	HP	5
	Year Installed	2002

2.2.4 Secondary Treatment

2.2.4.1 Aeration Tanks

There are a total of three aeration tanks, with each tank having two passes. Each tank is approximately 91 feet long and 40 feet wide and has an operating depth of 15 feet, resulting in an effective volume of 0.38 million gallons. Two of the aeration tanks were constructed in 1976 with the third tank constructed in 2008. Each tank is equipped with a floor-mounted, ceramic disc-type, fine pore diffused aeration system with four independent grids. Dissolved oxygen (DO) probes were installed in each tank in 2008 near the midpoint of pass 2. The aeration manifold has four drop legs with manual butterfly valves that allow for fine adjustment of air to each grid. The ceramic disc diffusers for aeration tanks 1 and 2 were replaced in 1999 and the diffusers in tank 3 were installed in 2008. The diffusers in aeration tanks 1 and 2 may require replacement in the near future due to age.

The aeration tanks appear to be in good physical condition. The aeration grids were not observed directly but the aeration pattern indicated good air distribution with no leaks or breaks. Plant staff has reported difficulties in maintaining DO at the front of the tanks during high loading periods; however, bringing a second blower online seems to have resolved this DO issue. The surface concrete is generally in good condition. The north wall of one tank has numerous cracks probably due to poor concrete placement when constructed (Figure 2-10).

Figure 2-10: Concrete cracks in aeration tank

2.2.4.2 Aeration Blowers

Two single-stage centrifugal aeration blowers were installed in 1999. Each blower is rated for 3300 scfm at 7.9 psig discharge pressure. A blow-off valve is provided on the air main to maintain a constant discharge pressure. The digester blowers are available for stand-by purposes, if needed. The blowers are capable of capacity modulation using inlet and outlet dampers to minimize blower energy use. The blowers will modulate to maintain the DO setpoint.

The blowers are in good condition and are operating well. Plant staff report that the buried ductile iron aeration air main is in poor condition with multiple leaks between the Solids Handling Building and aeration tanks.

2.2.4.3 Secondary Clarifiers

There are three circular secondary clarifiers: two 55-foot diameter clarifiers (Clarifiers 1 and 2) and one 75-foot diameter clarifier (Clarifier 3), all of which were constructed in 1976. Clarifiers 1 and 2 operate with a side water depth of 12 feet, while Clarifier 3 has an operating depth of 15 feet. Mixed liquor from the aeration tanks flows through a splitter box to proportion flow to each clarifier.

The scum beaches were replaced in each clarifier in 2008 and the weir plates were replaced in Clarifier 3 in 2014. Clarifier 3 is equipped with an aluminum geodesic dome type cover. Clarifiers 1 and 2 are open to the atmosphere.

Clarifier structures appear to be in good physical condition. A picture of a secondary clarifier is shown in Figure 2-11.

Figure 2-11: Secondary clarifier 2

The secondary clarifier mechanisms, including walkway bridge, drive, turntable bearings, and center tubes, were replaced in 2008. Each clarifier is equipped with a Tow-Bro type suction scraper for sludge draw-off.

The collector mechanisms are in good physical condition and are operating well. The collector motor and drive mechanisms for the clarifiers appear to be in good condition. The coating system on the bridges of Clarifiers 1 and 2 have failed on the bottom side of the walkway beams but otherwise look to be in good condition. A picture of the secondary clarifier bridge and drive mechanism is shown in Figure 2-12.

Figure 2-12: Secondary clarifier bridge and drive

2.2.4.4 Return Activated Sludge (RAS) Pumps

Each clarifier is equipped with two variable speed centrifugal RAS pumps, configured in a lead and lag arrangement, located in the Filter and Control Building. One pump operates during average flow conditions and both pumps operate during peak conditions. All RAS pumps were installed in 2008 and appear to be in good condition.

2.2.4.5 Waste Activated Sludge (WAS) Pumps

Two variable speed positive displacement progressing cavity type pumps are located in the filter and Control Building for conveying WAS to thickening. One pump is duty and one is standby. The WAS pumps pull off sludge from the main RAS header that returns sludge to the aeration tanks. Both WAS pumps were installed in 2008 and appear to be in good condition.

A summary of the secondary treatment equipment is shown in Table 2-5.

Table 2-5. Secondary Treatment Equipment Summary		
Aeration Tanks	Quantity	3
	Size (LxWxH)	92 feet x 40 feet x 15 feet
	Capacity	0.38 MG
	Year Installed	1976 (Tanks 1 and 2) 2008 (Tank 3)
Aeration Blowers	Quantity	2
	Type	Single-stage centrifugal
	Manufacturer	Turblex
	HP	150
	Capacity	3,300 scfm
	Pressure	7.9 psig
	Year Installed	1999
Secondary Clarifiers	Quantity	3

Table 2-5. Secondary Treatment Equipment Summary		
	Diameter	55 feet (Clarifiers 1 and 2) 75 feet (Clarifier 3)
	Side Water Depth	12 feet (Clarifiers 1 and 2) 15 feet (Clarifier 3)
	Year Installed	1976
Secondary Clarifiers 1 & 2 RAS Pumps	Quantity	4
	Type	End suction centrifugal
	Manufacturer	Yeomans
	Model	6000
	Capacity	450 gpm
	TDH	24 feet
	HP	7.5
	Drive	VFD
	Year Installed	2008
Secondary Clarifier 3 RAS Pumps	Quantity	2
	Type	End suction centrifugal
	Manufacturer	Yeomans
	Model	6000
	Capacity	760 gpm
	TDH	22 feet
	HP	7.5
	Drive	VFD
	Year Installed	2008
WAS Pumps	Quantity	2
	Type	Progressing cavity
	Manufacturer	Moyno
	Model	2G065G1 CDQ3SAX
	Capacity	100 gpm
	TDH	50 psig
	HP	20
	Drive	VFD
	Year Installed	2008

2.2.5 Filtration

Three Aqua Aerobics cloth disk filter systems were installed in 2008 to replace the undersized dual media filters and meet a phosphorus limit of 0.3 mg/l. The filters are used to capture particulate matter to reduce total phosphorus in the plant effluent. However, this technology is not capable of meeting today's target phosphorus limits of less than 0.01 mg/l. Each cloth disk filter unit consists of a stainless steel tank, twelve cloth cover disks, two backwash pumps, and an integral control panel. Each unit is rated for an average flow of 6.2 mgd.

ALASD has had issues with chemical and/or biological fouling of the filter cloth. The filter cloth can be chemically cleaned to restore flux but must be replaced periodically, which is a time intensive process. All three cloth disk filter systems were in continuous backwash mode at the time of the site visit, indicating fouled cloth media. The backwash tank discharges by gravity to the influent pump station. During high influent flow events, influent can back up into the backwash tank. The level sensor located in the backwash tank inhibits filter backwash when a high level is triggered. A summary of the filtration equipment is in Table 2-6.

Table 2-6. Filtration Equipment Summary

Filters	Quantity	3
	Capacity	6.2 mgd
	Manufacturer	Aqua Aerobics
	Year Installed	2008

2.2.6 Disinfection

2.2.6.1 Chlorine Contact Tanks

There are two chlorine contact tanks located under the basement slab of the Filter and Control Building. The tanks were expanded as part of the 2008 expansion project. The combined tanks provide a detention time of 15 minutes for chlorine to mix and disinfect the final effluent at a peak flow of 11.9 mgd.

The chlorine contact tanks could not be visually inspected during the site visit. However, the concrete was in good condition when inspected during the 2008 project after more than 30 years of service.

2.2.6.2 Chlorinators

ALASD has 3 vacuum-type, solution fed chlorinators. Each chlorinator has a rated capacity of 500 ppd of chlorine. Based on a design chlorine dose of 6.0 mg/L (50 lb/mgd), one chlorinator has capacity to treat a peak effluent flow of 10.0 mgd. ALASD also uses chlorine to treat RAS for filamentous growth. Demand for RAS chlorination is roughly 65 to 100 ppd.

The chlorinators were replaced in 2000. Plant staff reported issues with the current chlorinator units. Chlorine gas is very corrosive, and it is likely that these units have reached the end of their useful life.

2.2.6.3 Dechlorination

Final effluent is dechlorinated before discharge with the addition of sodium bisulfite. A single 750-gallon bulk storage tank and two metering pumps are used for dechlorination. The tank can be filled from a tanker truck through a nozzle located at grade outside the building. The components were installed in 2000 and appear to be in relatively good condition.

2.2.6.4 Chlorine Fume Scrubber

A dry scrubber system was installed in 2008 to mitigate the potential for a chlorine gas leak. The system is designed to neutralize up to 2,350 pounds of chlorine, equivalent to an entire 1-ton gas cylinder. The packaged scrubber includes a fan to convey the chlorine cylinder room contents through the scrubber tank. The dry scrubber has never been used and appears to be in good condition.

A summary of the disinfection equipment is shown in Table 2-7.

Table 2-7. Disinfection Equipment Summary		
Chlorine Contact Tanks	Quantity	2
	Contact Time	15 minutes
	Size	125,230 gallons
	Year Installed	1976, Expanded 2008
Chlorinators	Quantity	3
	Capacity	500 ppd
	Manufacturer	Wallace & Tiernan
	Year Installed	2000
Sodium Bisulfite Tank	Quantity	1
	Capacity	750 gallons
	Material	XLPE
	Year Installed	2000
Sodium Bisulfite Pumps	Quantity	2
	Type	Diaphragm metering
	Manufacturer	LMI
	Year Installed	2000
Fume Scrubber	Quantity	1
	Capacity	2,350 lbs of chlorine
	Fan, HP	25
	Manufacturer	Purafil
	Year Installed	2008

2.2.7 Ferric Sulfate System

Ferric sulfate is fed to the mixed liquor splitter box for phosphorus sequestration. A single fiberglass reinforced plastic (FRP) storage tank is installed in a concrete containment structure in the basement of the Filter and Control Building. The tank is designed to hold up to 7,600 gallons of ferric sulfate at a concentration of 10 to 12%. A load-in nozzle is provided at grade to allow for the offload of chemical from tanker trucks. The FRP storage tank and concrete containment area was installed in 2008 and is in good condition.

Two sets of ferric sulfate metering pumps are installed in the basement of the Filter and Control Building. One set of smaller diaphragm metering pumps were installed in 2002 and primarily serve to deliver chemical to the three cloth disk effluent filters. Each pump is equipped with a variable speed 0.5 HP direct current drive. A second set of diaphragm metering pumps was installed in 2008 to deliver chemical to the mixed liquor distribution box. Each pump is equipped with a variable speed 1 HP direct current drive and design to pump 77 gph at 130 psig. Both sets of pumps are cross connected to serve as back-up for one another. All ferric sulfate diaphragm metering pumps appear to be in good condition.

ALASD reported that the ferric sulfate piping needs to be replaced and the injector needs to be inspected due to a large amount of scaling in the piping.

A summary of the ferric sulfate equipment is shown in Table 2-8.

Table 2-8. Ferric Sulfate Equipment Summary		
Ferric Sulfate Storage Tank	Quantity	1
	Material	FRP
	Capacity	7,500 gallons
	Year Installed	2008
Ferric Sulfate Metering Pumps (small)	Number	2
	Primary Feed Location	Cloth disk filters
	Type	Diaphragm metering
	Manufacturer	Wallace & Tiernan
	Model	Encore 700
	HP	0.5
	Drive	VFD
	Year Installed	2002
Ferric Sulfate Metering Pumps (large)	Number	2
	Primary Feed Location	Mixed liquor distribution box
	Type	Diaphragm metering
	Manufacturer	Wallace & Tiernan
	Model	Encore 700
	Capacity	77 gph
	Pressure	130 psig
	HP	1
	Drive	VFD
	Year Installed	2008

2.2.8 Thickening

A dissolved air flotation (DAF) thickener system was installed in 2008 to thicken WAS prior to feeding the digester tanks. The system consists of a DAF tank, air compressor, air saturation tank, pressurization pumps, thickened WAS storage tank, and thickened WAS transfer pumps.

2.2.8.1 DAF Tank

The DAF tank is a 16-foot diameter steel tank with a side water depth of 8 feet. The unit was designed for a loading rate of up to 6,400 lbs/day of solids under peak flow conditions. The expected thickened sludge concentration under normal operations was 2% total solids. The coating system on the tank internals failed in 2021, likely from galvanic induced corrosion from stainless steel baffles in contact with steel brackets. The tank was taken out of service, the interior was sand blasted to remove coating and corrosion, and several areas of the tank skin were patched where they had been corroded through. The tank was recoated, the internals reinstalled, and the system placed back into service. A photo of the DAF tank is shown in Figure 2-13.

Figure 2-13: DAF tank

2.2.8.2 Pressurization Pumps

There are two pressurization pumps, in a duty/standby arrangement, installed to convey clarified water from the DAF tank to the saturation tank, where it contacts compressed air. The saturation pumps are ANSI end suction centrifugal pumps rated for 150 gpm at up to 75 psig discharge pressure. The pumps appear to be in good condition with no reported operating issues.

2.2.8.3 Saturation Tank

The saturation tank mixes compressed air with clarified subnatant from the DAF tank under pressure to dissolve the air into solution. The tank consists of a steel pressure vessel, impingement plate, level control device, and air flow control panel to control the air addition to the tank. ALASD experienced issues with solids fouling the level control device after a few years of operation. The level switches were replaced and the level control device reconfigured, which resulted in improved function.

2.2.8.4 Air Compressor

A reciprocating piston type air compressor, rated for 17 acfm at 150 psig, was installed with a 120-gallon receiver to provide air to the saturation system. The receiver is equipped with a filter/separator, oil filter, and automatic drain valve. No issues have been reported with the air compressor unit and it appears to be in good condition.

2.2.8.5 Thickened WAS Storage Tank

A single 750-gallon FRP storage tank was installed to collect thickened WAS from the DAF tank upstream of the thickened WAS pumps. The tank was installed to act as an equalization tank such that the thickened WAS pump rate could be decoupled from the DAF tank operation. Volume in the tank is variable depending on WAS production and digester loading conditions. The tank appears to be in good condition.

2.2.8.6 Thickened WAS Pumps

Two positive displacement type rotary lobe pumps were originally installed to convey thickened WAS from the thickened WAS storage tank to the digesters. ALASD reported issues with maintaining pump output with these pumps. A vent was installed in the pumped line to minimize air binding but pumping issues remained. The rotary lobe pumps were replaced with progressing cavity pumps in 2015, which resolved the pumping issues.

ALASD has experienced more underflow solids than would be expected from WAS thickening and required more operator attention than expected. The sludge thickness has been difficult to control, which can lead to instability in the digesters. It is recommended to evaluate whether the system can be re-utilized as a surface air flotation (SAF) thickening system or replaced by another technology. A summary of the digestion equipment is shown in Table 2-9.

Table 2-9. DAF Equipment Summary

DAF	Quantity (cells)	4
	Diameter	16 feet
	Side Water Depth	8 feet
	Loading Rate	6,400 lbs/day
	Year Installed	2008 (refurbished 2021)
Pressurization Pumps	Quantity	2
	Type	Centrifugal
	Capacity	150 gpm
	Year Installed	2008
Saturation Tank	Quantity	1
	Type	ASME Section VIII Pressure Vessel
	Year Installed	2008
Air Compressor	Quantity	1
	Type	Reciprocating Piston Type
	Capacity	17 acfm
	Pressure	150 psig
	Year Installed	2008
Thickened WAS Storage Tank	Quantity	1
	Material	FRP
	Capacity	750 gallons
	Year Installed	2008
Thickened WAS Pumps	Quantity	2
	Type	Progressing Cavity
	Manufacturer	Moyno
	Capacity	50 gpm
	Year Installed	2015

2.2.9 Digestion

The digester system consists of four aerobic digester cells, a 100-ton chiller unit, two chopper-type, self-priming recirculation pumps, two sludge-to-glycol heat exchangers, and two digester blowers.

2.2.9.1 Digesters

Digester cells 2 and 3 were constructed in 1976, digester cell 1B was constructed in 1999, and digester cell 1A was constructed in 2014. Each tank is equipped with fine bubble aeration systems. The membrane diffuser elements were replaced in 2014 and the PVC piping headers and laterals were installed in 2008.

Digester cell 3 was dewatered during the site visit and observed from surface (as shown in Figure 2-14). The concrete was in good condition below the waterline, and there was surface aggregate visible above the waterline. The aluminum covers were weathered but in good condition. Some open cracks were observed in the top slab near the expansion joint. Additionally, some previous patches of slab at grade have failed (Figure 2-15).

Membrane diffusers in this service are expected to have a service life of 7-10 years while the PVC air distribution pipe is expected to have a service life of 15-20 years. The diffused air system is likely at the end of its useful life.

Figure 2-14: Digester cell 3

Figure 2-15: Failed concrete at south end of digesters

2.2.9.2 Chiller

The digester chiller was installed in 2008 to maintain a digesting sludge temperature at or below 30 degrees C for process stability and to prevent excessive foaming in the tanks. The vast majority of heat is generated in the parallel-operating digester cells 1A and 1B. Sludge is recirculated from cells 1A and 1B with chopper-type self-priming centrifugal pumps through two tube-in-tube, sludge-to-glycol heat exchangers. The chiller runs at or near full capacity during the summer months. Plant staff reports cottonwood seeds, dirt, and dust clogging the fins of the condenser coils, which reduces cooling capacity and requires staff intervention. The chiller is approximately 15 years old and requires extensive care to maintain. Also, the chiller runs on R14 refrigerant, which is no longer manufactured and expensive to obtain, if even available. The chiller has reached the end of its useful life. A picture of the chiller is shown in Figure 2-16.

Figure 2-16: Chiller

2.2.9.3 Recirculation Pumps

Two constant speed chopper-type self-priming recirculation pumps were installed in 2008 and 2014 and have generally performed well. Wear on these pumps tends to be more aggressive due to the high flow rates and some gritty material in the sludge. Plant staff reports yearly refurbishment which includes replacement of the flapper valve on the casing inlet. Additionally, one of the recirculation pumps was replaced in-kind within the last couple of years. A picture of the recirculation pumps is shown in Figure 2-17.

Figure 2-17: Recirculation pumps

2.2.9.4 Heat Exchangers

The two tube-in-tube, sludge-to-glycol heat exchangers were installed in 2014 to maximize the chiller capacity. Each heat exchanger is rated for up to 750,000 BTU/hr of heat transfer with 35% glycol solution and a sludge flow rate of 350 gpm. Plant staff reports that the sludge tubes were replaced in the last year due to excessive wear. ALASD changed operations to reduce flow through each heat exchanger by alternating recirculation in cells 1A and 1B instead of running simultaneously. This served to reduce the wear on the unit internals. A picture of the heat exchangers is shown in Figure 2-18.

Figure 2-18: Heat exchangers

2.2.9.5 Digester Blowers

Two single-stage centrifugal digester blowers were installed in 1999. Each blower is rated for 4,500 scfm at 8.6 psig discharge pressure. Air to the digesters is shut-off periodically to recover alkalinity (denitrify). This also aids in controlling digester foaming. Additionally, the air to digester cell 3 is shut off prior to dewatering to allow for decanting. Overall, the blowers are in good condition and operate well.

A summary of the digestion equipment is shown in Table 2-10.

Table 2-10. Digestion Equipment Summary

Digester	Quantity (cells)	4
	Size (LxWxH)	122 feet x 30 feet x 15 feet
	Capacity, total	1.64 MG
	Year Installed	1976 (cells 2 and 3) 1999 (cell 1B) 2014 (cell 1A)
Blowers	Quantity	2
	Type	Single-stage centrifugal
	Model	KA5SV-GK200
	Manufacturer	Turblex
	HP	250
	Capacity	4500 scfm
	Pressure	8.6 psig
	Year Installed	1999
Chiller	Quantity	1
	Manufacturer	Motivair
	Model	MLC FC-340
	Capacity	100 ton
	Year Installed	2008
Recirculation Pumps	Quantity	2
	Type	Self-priming chopper type centrifugal
	Manufacturer	Vaughan
	Model	SP4CB
	Capacity	200 gpm
	TDH	38 feet
	HP	7.5
	Drive	Constant speed, V-belt
	Year Installed	2008 and 2014

Table 2-10. Digestion Equipment Summary		
Heat Exchangers	Quantity	2
	Type	Concentric tube-in-tube
	Manufacturer	Walker Process
	Model	Type E HeatX
	Capacity	1,000,000 BTU/hr
	Sludge Flow	350 gpm
	Year Installed	2014

2.2.10 Dewatering

2.2.10.1 Centrifuge

A single Alfa-Laval ALDEC G2-100 dewatering centrifuge was installed in 2008 in the Solids Handling Building to process the aerobically digested sludge. The centrifuge is equipped with a 150 HP main drive and 30 HP back drive. The unit was designed for a hydraulic loading capacity of 255 gpm and solids loading of 2,000 lbs/hr at 1.5% TS digested sludge. The centrifuge typically produces a cake with 20% total solids with a polymer dose of about 15 lbs active per dry ton of solids.

Cake is dropped through the solids chute down to the loadout bay in the Solids Handling Building into the back of a dump truck. Solids can be taken to the biosolids storage pad located on-site, or directly to the land application fields. Centrate was designed to discharge into the primary clarifier influent. However, plant staff has had issues with residual polymer causing solids agglomeration in the primary clarifier influent wells. Therefore, ALASD has recently installed a new centrate line to take centrate to the primary clarifier effluent launder, which has resulted in better clarifier performance.

The centrifuge is in good condition and provides a good quality cake. The centrifuge is run five days per week, approximately 7-10 hours per day (2-3 loads per day), as needed to process waste solids. A new gear box was installed within the past couple of years. No back-up solids dewatering is currently available. Routine maintenance is conducted by the plant staff but major rebuilds such as scroll refurbishment must be done by the manufacturer off-site and is needed in the near future. A picture of the centrifuge is shown in Figure 2-19.

The biosolids storage pad, located to the east of the Maintenance Building, is used to store dewatered cake when solids cannot be land applied. The asphalt pad is over 20 years old has reached the end of its useful life. The bituminous pad can be reclaimed and resurfaced if it is to remain at its present location.

Figure 2-19: Centrifuge

2.2.10.2 Centrifuge Feed Pumps and Grinder

Two variable speed progressing cavity sludge pumps are located in the Solids Handling Building basement to feed digested sludge to the dewatering centrifuge. Both pumps were installed in 1999. High pressure switches were installed on the discharge of each pump in 2008 to protect against overpressure. A sludge grinder was installed on the common suction pipe to the centrifuge feed pumps in 2008. The pumps and grinder appear to be in good condition. A picture of the centrifuge feed pumps is shown in Figure 2-20.

Figure 2-20: Centrifuge feed pumps

2.2.10.3 Polymer Blending System

A polymer blending system was installed in 2008 in the Solids Handling Building to feed diluted polymer to the centrifuge. The polymer blending system consists of a neat polymer pump, dilution water booster pump, high speed polymer mixing chamber, and control panel. The unit is designed to produce up to 3,000 gallons per hour of polymer solution at 0.1% active polymer strength. Plant effluent water is provided for dilution water. A second connection with an inline static mixer is provided for secondary dilution, if needed. An in-floor weigh scale was installed in 2008 to hold IBC totes of neat polymer.

Plant staff have reported a number of failing components on the polymer blending unit but have been able to keep the unit operational. The unit appears to be at the end of its useful life. The scale appears to be in good condition. A picture of the polymer blending system is shown in Figure 2-21.

Figure 2-21: Polymer blending system

A summary of the dewatering equipment is shown in Table 2-11.

Table 2-11. Dewatering Equipment Summary

Centrifuge	Quantity	1
	Manufacturer	Alfa-Laval
	Model	ALDEC G2-100
	Main Drive, HP	150
	Back Drive, HP	30
	Hydraulic capacity	255 gpm
	Solids Loading	2000 lbs/hr
	Year Installed	2008
Centrifuge Feed Pumps	Quantity	2
	Type	Progressing Cavity
	Manufacturer	Moyno
	Model	1G115GI CDQ AAA
	Capacity	300 gpm

Table 2-11. Dewatering Equipment Summary		
	HP	20
	Drive	VFD
	Year Installed	1999
Centrifuge Feed Grinder	Quantity	1
	Manufacturer	JWC Environmental
	Type	In-line Twin Shaft
	Capacity	600 gpm
	HP	5
	Year Installed	2008
Polymer Blending Unit	Quantity	1
	Type	Mechanical
	Manufacturer	Siemens
	Model	Polyblend Model 600
	Capacity	3,000 gph
	Year Installed	2008

2.2.11 Plant Water System

2.2.11.1 Plant Water Pumps

Two variable speed, vertical turbine pumps were installed in the last pass of the chlorine contact tank to convey plant effluent to the plant water distribution system, which supplies water for multiple in-plant uses, including washdown and seal water. The pumps are installed in a lead/lag arrangement, each designed to deliver 360 gpm, and the speed is controlled to maintain a pressure set point in the distribution system.

The plant water pump internal components have suffered from severe corrosion due to the high dissolved chloride content of the plant effluent. Plant staff reconstructed one of the plant water pumps with new internal components. A summary of the plant water equipment is shown in Table 2-12.

2.2.11.2 Plant Water Piping

A buried ductile iron plant water distribution loop is installed to bring plant water to the various process buildings, yard hydrants, and the lawn irrigation system. Due to the chloride content, portions of the buried pipe loop have corroded and the valves on the pump discharge and in the distribution system are in poor condition.

Table 2-12. Plant Water Equipment Summary		
Plant Water Pumps	Quantity	2
	Type	Vertical Turbine
	Manufacturer	Peerless
	Model	L256VP
	Capacity	360 gpm

Table 2-12. Plant Water Equipment Summary		
	HP	20
	Drive	VFD
	Year Installed	2008

2.2.12 Buildings and Structural Assessment

The following structural observations were noted on the site visit:

Building 1: Influent Pump Station Building

- The roofing had no apparent leaks, and the flashing was in good condition.
- Grade level was in good condition, with worn floor paint.
- The pump level was in good condition. The bottom of the concrete stairs needs repairs as shown in Figure 2-22.
- Exterior door was in poor condition as scheduled to be replaced by ALASD.
- Access shaft to the wet well shows corrosion with visible surface aggregate.

Figure 2-22: Damage to concrete stairs in influent pump station building

Building 2: Office Building

- The structure is in good condition with the exception of a leaky roof in the corridor.

Building 3: Filter and Control Building

- All components were in good condition.
- A hatch between the ground level and lower level has damaged concrete and corroded rebar that needs repair (Figure 2-23).
- Floor paint has failed in the generator room (Figure 2-24).

Figure 2-23: Damaged concrete around hatch

Figure 2-24: Worn painted floor in generator room

Building 4: Solids Handling Building

Most of the components are in good condition except for the following:

- There were numerous cracks noted in the blower room floor (Figure 2-25).

- In the workshop, a large gap/crack was noted where the floor slab meets the approach apron of the overhead door (Figure 2-26).
- In the polymer room, the roof leaks over the sink area.
- In the centrifuge room, the windows appear to leak and the floor paint is worn (Figure 2-27).
- The exterior dock approach is sloped downhill from the dock making material unloading difficult (Figure 2-28).
- The green paint on the loadout area floor requires refurbishment (Figure 2-29).
- The concrete column with embedded steel angles to protect the corners are damaged and corroded in the loadout area (Figure 2-30).

Figure 2-25: Cracks in blower room floor

Figure 2-26: Large crack at overhead door

Figure 2-27: Leaking windows in centrifuge room

Figure 2-28: Exterior loading dock

Figure 2-29: Painted floor near stairs in the loadout area

Figure 2-30: Loadout area column base

Building 5: Headworks and DAFT Building

- Floors, walls, roof, and ceiling in good condition.
- Fiberglass doors were replaced 2 years ago and are in good condition.
- A handrail may be required along the south side of the lower roof adjacent to the air handling unit due to the proximity to the edge (Figure 2-31).
- The embedded floor plates in the screening loadout area do not match the dumpster width.
- Generator base and housing is corroded due to the irrigation system (Figure 2-32).
- Precast wall panels are cracked at the southeast and southwest corners (Figure 2-33).

Figure 2-31: South roof edge by AHU

Figure 2-32: Corroded generator base

Figure 2-33: Precast wall panel cracks

2.2.12.1 Building 5: Digester Control Building

- All components were in good condition.

Section 3: Recommendations

3.1 Recommended Improvements

The following equipment listed in Table 3-1 is recommended for repair/replacement dependent on the selected alternatives for each process area recommended during Facility Planning.

Table 3-1. Recommendations for Replacement/Repair

Equipment	Recommendation
Influent Flow Metering	Upsize flow meter pipe from 10" to 14" if equalization is not provided
Influent Pipe	Upsize to 24" pipe from the Influent Pumping Station to the Solids Handling Building if equalization is not provided
Screen 2	May require refurbishment due to age
Headworks Electrical Room	Seal openings and/or investigate HVAC improvements to prevent odorous air entering from dumpster room
Vortex Grit System	Bridge coating system has failed and requires refurbishment Repair or replace hatch adjacent to Grit Tank to close tightly. Add insulation to the underside of the hatch.
Grit Washer	Model has been discontinued, replacement parts may become difficult to acquire, requires replacement
Grit Piping	Replace grit piping due to wear and age
Primary Clarifiers	Replace baffles and v-notch weirs due to corrosion. Repair concrete step to the bridge on Primary Clarifier 1. Refurbish coating system on the bridges and collector mechanisms.
Aeration Blower Air Header	Poor condition and leaks, requires replacement
Aeration Tank Air Distribution System	Replace aeration distribution systems in tanks 1 and 2 at due to age
Secondary Clarifiers	Refurbish coating system on bridges
Filters	Existing equipment will not meet current regulations. Replace with a new filtration system technology.
Chlorination System	Current chlorinator units are near the end of their useful life, requires replacement
Ferric Sulfate System	Replace piping and inspect injector (replace if needed)
DAF	Evaluate whether the system can be re-utilized as a surface air flotation (SAF) thickening system or replaced by another technology, system has been problematic and difficult to control
Digester Cell Membrane Diffusers and PVC Distribution Pipe	Diffuser systems are near the end of their useful life and distribution piping is 15+ years old, requires replacement in all cells
Chiller	Multiple maintenance issues and at the end of its useful life, requires replacement
Plant Water Pumps	Replace plant water pumps and piping due to high corrosion or consider incorporating a city water line to replace the plant water
Centrifuge	Evaluate a backup solids de-watering system
Polymer Blending Unit	Multiple maintenance issues and at the end of its useful life, requires replacement
Biosolids Pad	Replace pad in-kind or evaluate biosolids storage options

Table 3-1. Recommendations for Replacement/Repair	
Building 1: Influent Pump Station and Wet Well	Refurbish floor paint. Repair concrete at the bottom of the stairs. Access shaft to wet well shows corrosion and requires refurbishment.
Building 2: Office	Repair roof leakage in corridor to Filter and Control Building
Building 3: Filter and Control	Refurbish floor paint. Repair concrete around hatch.
Building 4: Solids Handling	Recoat embedded steel angles and repair the concrete columns in loadout area Refurbish floor paint Replace windows that leak in centrifuge room Repair roof leak in polymer room Repair the g in the floor slab below overhead door Repair cracks in blower room floor Re-slope exterior dock
Building 5: Headworks and DAFT	South side of lower roof requires handrail to be installed Repair or replace hatch adjacent to Grit Tank to close tightly. Add insulation to the underside of the hatch Corroded generator base to be repaired and repainted Cracks in exterior wall panels to be repaired

Appendix G: Headworks TM

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Technical Memorandum

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Prepared for: Alexandria Lake Area Sanitary District (ALASD)

Project Title: ALASD Wastewater Treatment Facility Plan

Project No.: 158466

Technical Memorandum

Subject: Headworks Alternative Evaluation

Date: December 5, 2022

To: Scott Gilbertson and Troy Drewes

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List of Abbreviations

AAF	annual average flow
ALASD	Alexandria Lake and Sanitary District
BCE	Business Case Evaluation
EQ	flow equalization
ft	foot/feet
ft^3/day	cubic feet per day
gpm	gallons per minute
hp	horsepower
in	inch(es)
LS1	lift station
MG	million gallons
mgd	million gallons per day
NFPA	National Fire Protection Association
NPV	net present value
O&M	operations and maintenance
sec	seconds
TM	technical memorandum
WWTP	wastewater treatment plant

Executive Summary

This Technical Memorandum (TM) evaluates flow equalization, Main Pump Station, screening, and grit processing alternatives for the Alexandria Lake and Sanitary District (ALASD) wastewater treatment plant (WWTP) in Alexandria, MN. A business case evaluation (BCE) comparing the life-cycle costs of each alternative was completed for this TM.

Alternatives considered assumed an annual average flow (AAF) of 4.3 million gallons per day (mgd) and a peak instantaneous wet weather flow (PIWWF) of 16.6 mgd for 2045 projected design conditions.

The alternatives that were evaluated include:

- Flow Equalization (EQ)
  - Prestressed Concrete Tank (Alternative 1A)
  - Existing Basin with Lining (Alternative 1B)
- EQ Pumping
  - Dedicated EQ Pump Station (Alternative 2A)
  - Route Flow from Lift Station 1 (LS1) to EQ (Alternative 2B)
- Main Pump Station
  - New Main Pump Station (Alternative 3A)
  - Improvements to the Existing Wet Well (Alternative 3B)
- Screening
  - Replace/Refurbish One Screen (Alternative 4A)
  - Replace Two Screens (Alternative 4B)
- Grit Processing
  - Relocate Screen and Replace Grit Processing Equipment (Alternative 5A)
  - Expand Headworks Building for New Grit Processing Equipment (Alternative 5B)

The following alternatives are recommended:

- EQ
  - Alternative 1B – Existing Basin with Lining is recommended due to a lower Net Present Value (NPV), utilization of the existing basin, and ease of maintenance. Additionally, this alternative will have less visibility to the public due to its lower profile.
- EQ Pumping
  - Alternative 2B – Route EQ from LS1 is recommended due to the high cost of constructing a new EQ pump station. Improvements associated with this alternative, including a new valve vault and flow monitoring, would need to be coordinated with on-going work.
- Main Pump Station
  - Alternative 3B – Wetwell Improvements is recommended to provide better access to the wetwell. Based on cost, a new pump station is not recommended at this time.
- Screening
  - Alternative 4B – Replace Both Screens is recommended due to the age of the existing screens and to provide space for new grit processing equipment. It is recommended to install perforated plate screens to match the existing screens due to plant staff familiarity.

- Grit Processing
    - Alternative 5A – Relocate Screen channel is recommended to utilize existing building space. The specific grit processing technology can be chosen during detailed design.

A summary of the capital costs for each recommended alternative is in Table ES-1.

Table ES-1. Summary of Capital Costs

Recommended Alternative	Capital Costs
Alternative 1B - Existing Basin with Lining	$2.86M
Alternative 2B - Route flow from LS1 to EQ	TBD
Alternative 3B - Wetwell Improvements	$0.41M
Alternative 4B - Replace Two Screens	$1.60M
Alternative 5A – Relocate Screen and Replace Grit Processing Equipment	$0.93M
TOTAL	**$5.80M**

Section 1: Introduction

1.1 Background

The existing Main Pump Station consists of an influent wetwell that feeds three pumps with a nominal capacity of 4,800 gallons per minute (gpm) each. The wetwell has restricted access from a single access hatch and it is difficult for ALASD staff to visually inspect the wetwell due to safety risks. The influent pumps have also experienced rag accumulation which clogs the pumps. A 10-inch magnetic flow meter is used to measure flow rates from the influent pumps to the Headworks Building. The Headworks Building contains two - 6 mm perforated plate screens, a vortex grit removal system, two grit pumps, a hydrocyclone grit classifier, and a grit washer. The first screen was re-built in 2017, and the second screen was noted during the recent condition assessment to require replacement or refurbishment. The grit chamber and grit pumps are in good condition, but the grit piping, washer and classifier require replacement. Screenings and grit are conveyed to a dumpster in a separate room.

Section 2: Alternative Evaluation

Alternatives were evaluated for flow equalization (EQ), influent pumping, screening, and grit processing. Each alternative assumes an annual average flow (AAF) of 4.3 million gallons per day (mgd) and a peak instantaneous wet weather flow (PIWWF) of 16.6 mgd. Flow equalization for PIWWF events assumes a plant flow of 9.5 mgd with a diverted flow of 7.1 mgd to EQ.

2.1 Flow Equalization

To meet the proposed liquids treatment alternatives design plant flow of 9.5 mgd, flow equalization will be required for peak wet weather events. Excess flow over 9.5 mgd will be diverted to an EQ retention basin to prevent peak wet weather events from flooding system processes. PIWWF is based on a 5-year storm event and it is assumed that EQ will be used an average of 4 days per year. Based on these design criteria, 1.5 million gallons (MG) is required for EQ.

2.1.1 Flow Equalization Alternatives

Two alternatives were evaluated for flow equalization: (1) a 1.5 MG prestressed concrete tank, and (2) lining the existing basin located on the northwestern portion of the ALASD site. The maximum hydraulic grade line (HGL) in the wetwell (1377 feet) is lower than the invert elevation of the existing basin (1385 feet) or proposed concrete tank; therefore, pumping will be required to divert flows for both alternatives. The equalization tank/basin will drain by gravity back to the Main Pump Station wetwell after an event.

For both alternatives, it is assumed that the tank or basin would be uncovered. A 24-inch diameter, 300-foot long forcemain would be required to route flows to equalization, and an 18-inch diameter, 300-foot long gravity pipe would be needed to return flows to wetwell.

2.1.1.1 Alternative 1A: Prestressed Concrete Tank

Alternative 1A assumes an aboveground 1.5 MG prestressed concrete tank for flow equalization. The circular tank would be 20-feet in diameter and 20-feet high. The tank would be installed on a concrete pad at grade and would be located to the north of the Main Pump Station or placed in the existing basin to avoid proximity to Nevada Street. Manufacturers of prestressed concrete tanks include CROM and DN Tanks and have additional options to include automated or manual tank cleaning systems and floor drains for washdown requirements. Figure 2-1 below shows a typical prestressed concrete flow equalization tank in Roselle, IL.

Figure 2-1. Uncovered prestressed concrete tank (courtesy DN Tanks)

2.1.2 Alternative 1B: Existing Basin with Lining

Alternative 1B includes lining a portion of the existing stormwater basin in order to serve as an influent flow equalization basin. The existing basin is approximately 520-feet long by 287-feet wide by 6-feet deep with a slope of 1.25 percent. For a capacity of 1.5 MG, the required lined basin dimensions are 175-feet long by 287-feet wide by 6-feet deep. A berm would be constructed to convert this portion of the pond to a lined EQ basin, while the remaining portion would continue to be used for stormwater retention. Grading and the placement of fine aggregate as bedding for the liner would also be required. Excess soil from the construction of the equalization basin could be used to construct the berm or to fill in low lying areas on the plant site. Figure 2-2 depicts the proposed layout of the EQ basin.

Figure 2-2. Alternative 1B lined EQ basin layout

2.1.3 Flow Equalization Alternative Comparison

Advantages and disadvantages for each flow equalization alternative are summarized in Table 2-1.

Table 2-1. Flow Equalization Alternative Comparison		
	Alt 1A Prestressed Concrete Tank	Alt 1B: Existing Basin with Lining
Advantages	• Smallest footprint • Automated cleaning options available • Structurally sound	• Utilize existing basin • Lower capital cost • Minimal visibility
Disadvantages	• Higher capital cost • Higher visibility • Taller tank results in increased static head on flow equalization pumps	• Larger surface area to clean • Lining could puncture and require replacement

2.2 Flow Equalization Pumping

Since flow equalization requires pumping, this section evaluates options for this pumping system including a submersible pumping station and routing from Lift Station 1 (LS1).

2.2.1 Alternative 2A: 7.1 mgd Submersible Pump Station to EQ

Alternative 2A includes the construction of a 7.1 mgd submersible pump station to route flow to EQ while utilizing the existing main pump station to continue to pump flows to the plant. The submersible pump station would be constructed within the vicinity of the existing Main Pump Station. Flow in excess of 9.5 mgd would flow over a weir wall constructed in the wetwell of the main lift station or could be diverted using a diversion structure constructed upstream of the existing station. The submersible pump station assumes a triplex layout at an approximate depth of 30-feet.

2.2.2 Alternative 2B: Route to EQ from LS1

Alternative 2B involves routing flows from LS1 to flow equalization and eliminates the need for a dedicated EQ pump station. The approximate distance from LS1 to the plant is approximately 5,000 feet. Currently, there are modifications being planned for LS1 and design details would have to be coordinated with that project, such as implementing a valve vault to split flow between flow equalization and the main pump station as well as flow monitoring. A peak flow of 8.4 mgd was estimated for this alternative, with two pumps running at LS1. Widseth will develop a system curve for the new forcemain as a part of the LS1 project in order to confirm the capacity of the station after the improvements are deigned. Valve automation also needs to be considered and could be either manual or the valves could modulate automatically to limit flow pumped from the main pump station. Figure 2-3 shows the assumed piping required from LS1 to the EQ basin/tank.

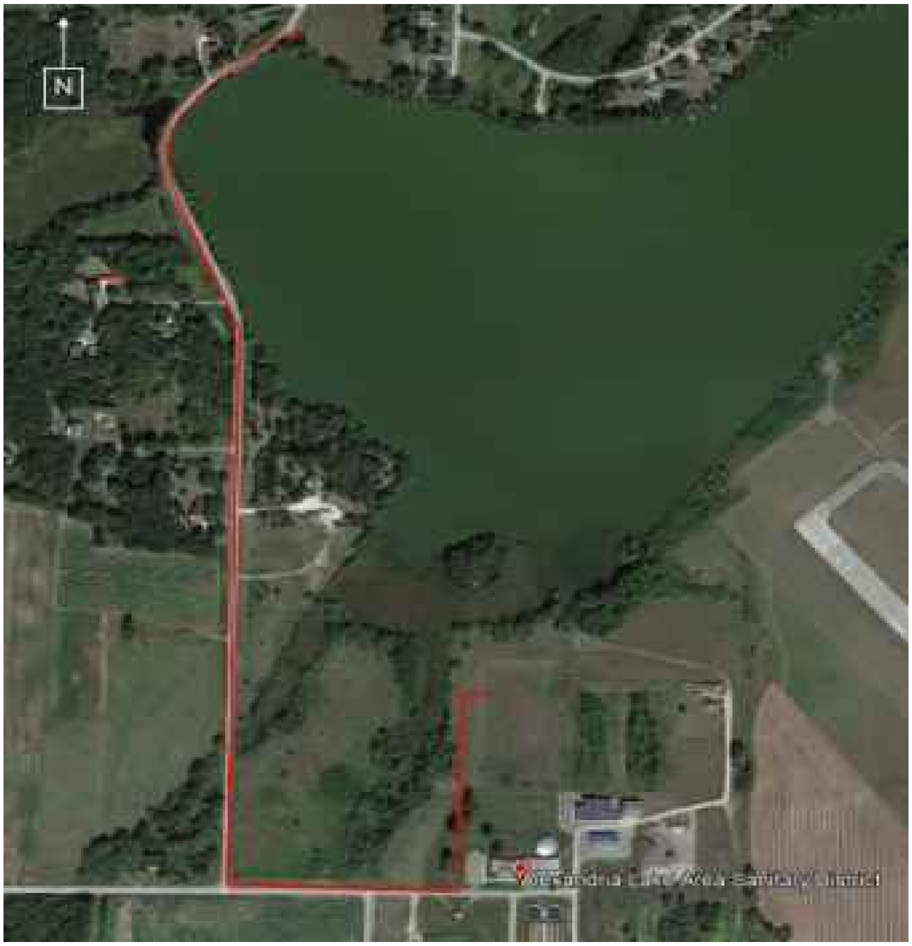

Figure 2-3. Forcemain route from LS1 to EQ

2.2.3 EQ Pumping Alternative Comparison

Advantages and disadvantages for each EQ pumping alternative are summarized in Table 2-2.

Table 2-2. EQ Pumping Alternative Comparison		
	Alt 2A: 7.1 mgd Submersible Pump Station	Alt 2B: Route from LS1 to EQ
Advantages	• Flows in excess of 9.5 mgd pumped to equalization	• No modifications to existing Main Pump Station are required • Construction of forcemain improvements already planned
Disadvantages	• Submersible pump station will be about 30 feet deep • High capital cost	• Range of flows from LS1 are unknown, may be less than 7.1 mgd during some events.

2.3 Main Pump Station

The existing Main Pump Station consists of a wetwell for receiving flow from the forcemain and a drywell with three influent pumps (two duty and one standby) with a nominal capacity of 4,800 gpm at 54 feet each. Two pumps running at full speed can deliver approximately 11 mgd. This exceeds the required influent pumping capacity of 9.5 mgd for the plant flow, and no additional influent pumping capacity is required. However, due to the poor access conditions for the existing wetwell, an alternative for wetwell improvements was evaluated as well as an alternative to replace the Main Pump Station. The remainder of the Main Pump Station appears to be in good condition.

2.3.1 Alternative 3A: New Main Pump Station

Alternative 3A consists of replacing of the existing Main Pump Station with a new pump station. If a new pump station were to be constructed, it would be designed to pump both influent and EQ flow for a total capacity of 16.6 mgd.

2.3.2 Alternative 3B: Main Pump Station Wetwell Improvements

The existing wetwell is difficult for plant staff to access due to the constricted entry, making it challenging to observe the wetwell and its condition. The proposed wetwell improvements consist of expanding the wetwell vault to the existing grade of 1393 feet and adding two access hatches. See proposed wetwell improvements in Figure 2-4.

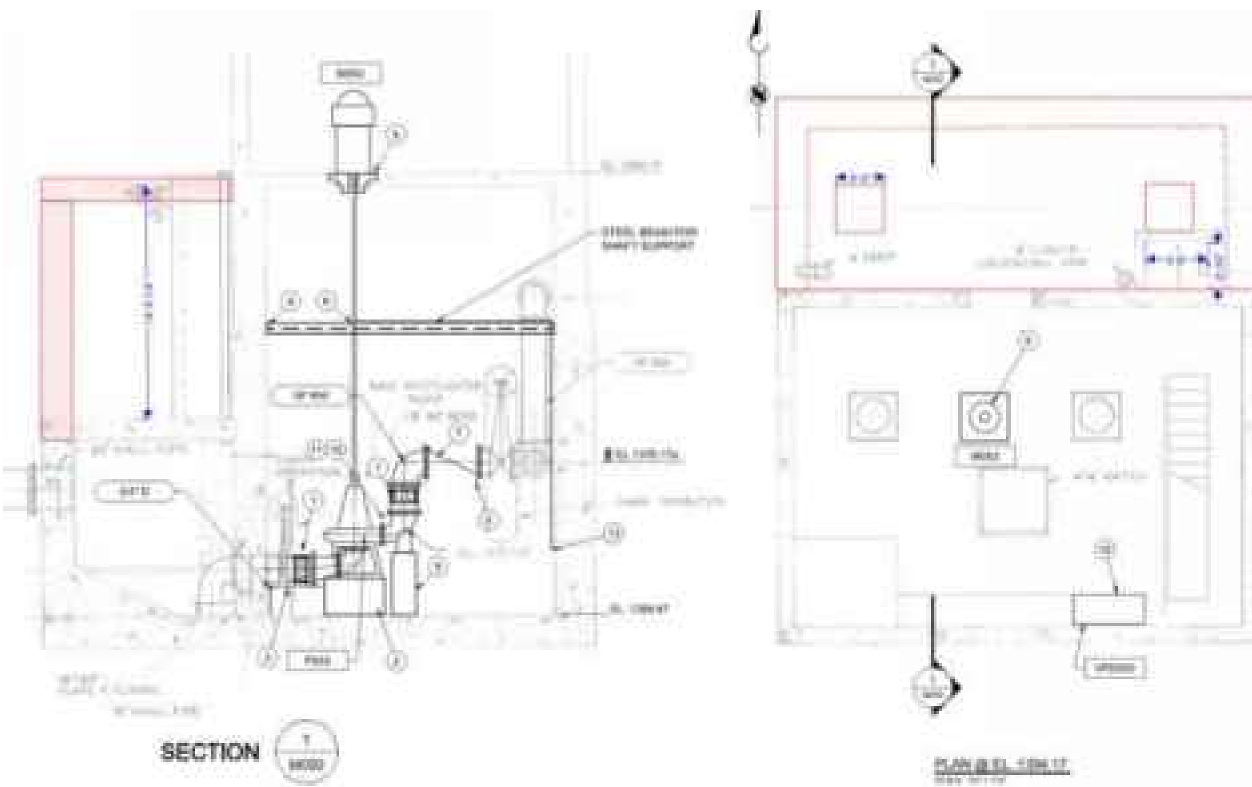

Figure 2-4. Wetwell Improvements

2.3.3 Main Pump Station Alternative Comparison

Advantages and disadvantages for each Main Pump Station alternative are summarized in Table 2-3.

Table 2-3. Main Pump Station Alternative Comparison

	Alt 3A: New Main Pump Station	Alt 3B: Existing Wetwell Improvements
Advantages	• Replaces aging pump station • Provides better wet well access and layout • A separate EQ pump station is not required	• Increased safety and improved access to wetwell • Lower capital cost
Disadvantages	• Highest capital cost	• Modifications only address wetwell

2.4 Screening Alternatives

Based on the recent condition assessment, Screen 2 requires replacement or refurbishment in the near future. This section evaluates the alternatives for replacement and/or refurbishment of this screen. The screening compactor is in good condition and does not require replacement at this time.

2.4.1 Design Criteria

The screening system would be designed in accordance with the following design criteria:

- Screen opening size of 6mm.
- An average of 4.3 cubic yards per day (yd3/day) is assumed based on operating data provided by ALASD. Due to the desired 6mm opening size and increase in flows, actual screenings are expected to be higher and will be confirmed during detailed design.
- The existing screen channel dimensions are 4.5-ft deep and 4.5-ft wide. The allowable flowrate for each screen channel is 8.3 mgd.

2.4.2 Screening Alternatives

Two screen alternatives were evaluated: perforated plate screens and multi-rake bar screens. Other types of screenings technology are available, but these represent the most common proven technologies that meet the desired design criteria. The existing screens are 3/8” diameter perforated plate-type.

Perforated plate screens are mechanically cleaned screens consisting of rotating perforated screening elements mounted on a conveying chain. At the upper turning point the perforated plates are continuously cleaned by a rotating brush. Two separate motors rotate the perforated plates and the brush. Perforated screening elements provide higher separation of solids compared to similar bar screen installations, at the expense of increased headloss. Manufacturers of perforated screens include Parkson, Huber, JWCE, and Headworks Inc. A typical layout of a perforated plate screen is shown in Figure 2-5.

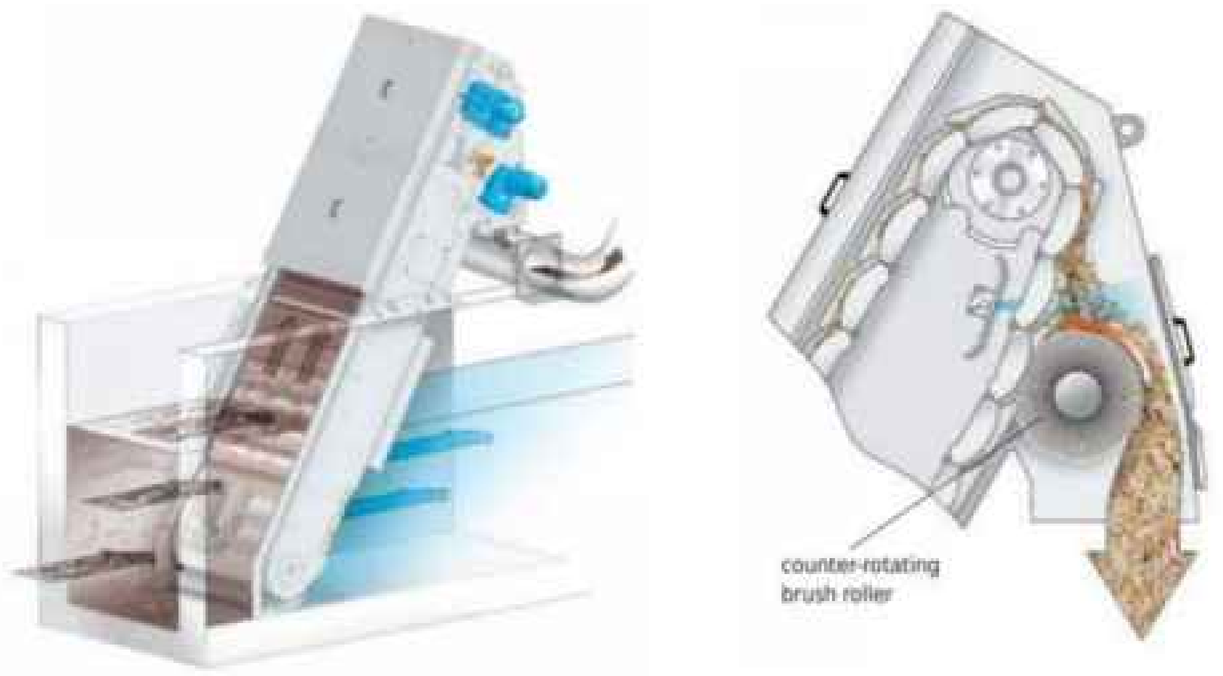

Figure 2-5. Perforated Plate Screen Layout

Multi-rake screens are mechanically cleaned screens consisting of a stationary bar rack with multiple rakes mounted on a conveying chain. A motor drives the chain and attached rakes, continuously engaging the bar screen and removing screenings. The screenings are conveyed out of the water up to a discharge point where the screenings are captured for disposal. The motor is located at the top of the unit, providing ease of maintenance. Guide hubs or sprockets located at both the top and bottom of the screen are used to fix the drive chain and rakes to the screen face. Multi-rake screens without lower sprockets are also available. Manufacturers of multi-rake screens include Vulcan, Parkson, Huber, Headworks,Inc., and JWCE. A typical sequence of operations for multi-rake screens is shown in Figure 2-6.

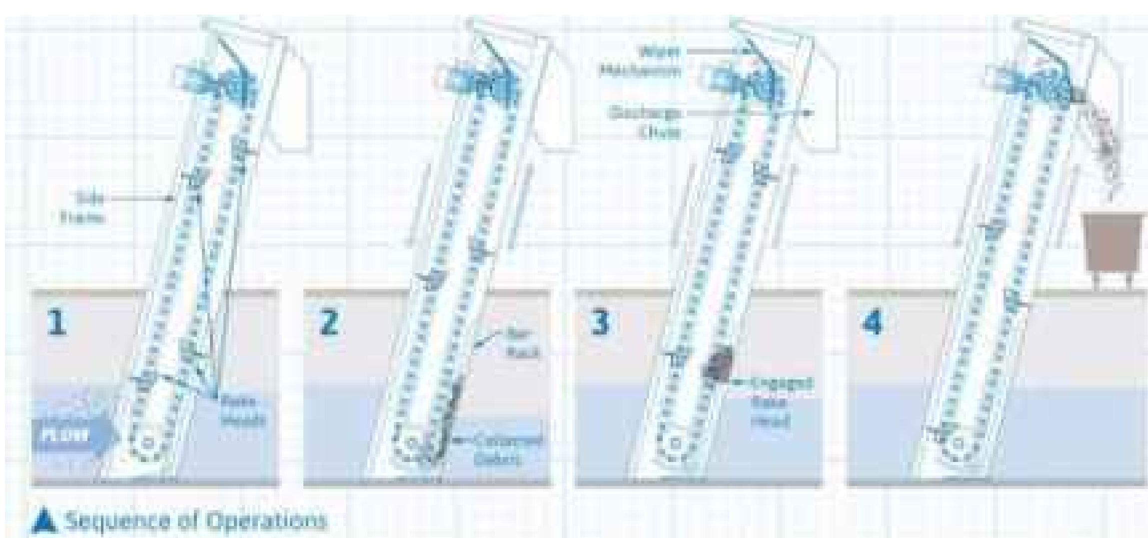

Figure 2-6. Multi-Rake Bar Screens Sequence of Operations

A comparison between perforated and multi-rake screens is outlined in Table 2-4.

Table 2-4. Screen Comparison			
Screen Model	Perforated Plate (Parkson)	Multi-Rake w/ Sprocket (Vulcan)	Multi-Rake without Sprocket (Vulcan)
Capacity	8.3 mgd	8.3 mgd	8.3 mgd
Opening	6mm	6mm	6mm
Discharge Height	9 feet	4 feet (minimum)	4 feet (minimum)
Headloss	8 inches	3.8 inches	6.4 inches
Motor Size	4 hp	2 hp	0.5 hp

2.4.2.1 Alternative 4A: Replace/ Refurbish One Screen

Alternative 4A consists of the refurbishment or replacement of the existing second screen. For cost estimating purposes, the replacement of the screen with a perforated plate screen was assumed. This alternative would be implemented along with Grit Processing Alternative 5B described below.

2.4.2.2 Alternative 4B: Replace Both Screens

Alternative 4B incorporates the replacement of both existing screens. Either the perforated plate or multi-rake screen could be installed; the cost estimate assumed a perforated plate type screen. This alternative would be implemented along with Grit Processing Alternative 5A described below.

2.5 Grit Processing

This Section describes grit processing design criteria and presents an evaluation of the alternatives. As previously mentioned, the grit chamber and grit pumps are in good condition, but the grit piping, washer and classifier require replacement.

2.5.1 Design Criteria

The grit processing system will be designed in accordance with the following design criteria:

- 95 percent capture of grit greater than 106 microns. Typical manufacturer assumptions for grit include a specific gravity of 2.65. Actual performance may be lower, as grit is rarely at a specific gravity of 2.65.
- Less than 5 percent volatile solids and less than 10 percent water content in washed grit.

2.5.2 Alternatives

Four grit processing technologies were evaluated for grit processing:

- Grit cyclone/classifier-type (WEMCO Hydrogritter)
- Fluidized bed-type (Hydro GritCleanse)
- Lamella plate-type (Smith and Loveless)
- Fluidized bed-type (Huber Coanda RoSF4)

Other grit processing technologies are available, but these represent the most common proven technologies that meet the desired design criteria.

The WEMCO Hydrogritter II Grit Removal System is a combination grit cyclone and classifier. Grit slurry enters the cyclone where grit is captured and processed. The grit concentrate from the cyclone underflow discharges to the spiral classifier where the grit is allowed to settle. The settled grit travels up the spiral conveyor where it is de-watered and then discharged as a low moisture product ready for disposal. A typical section cut of a WEMCO Hydrogritter II is shown in Figure 2-7.

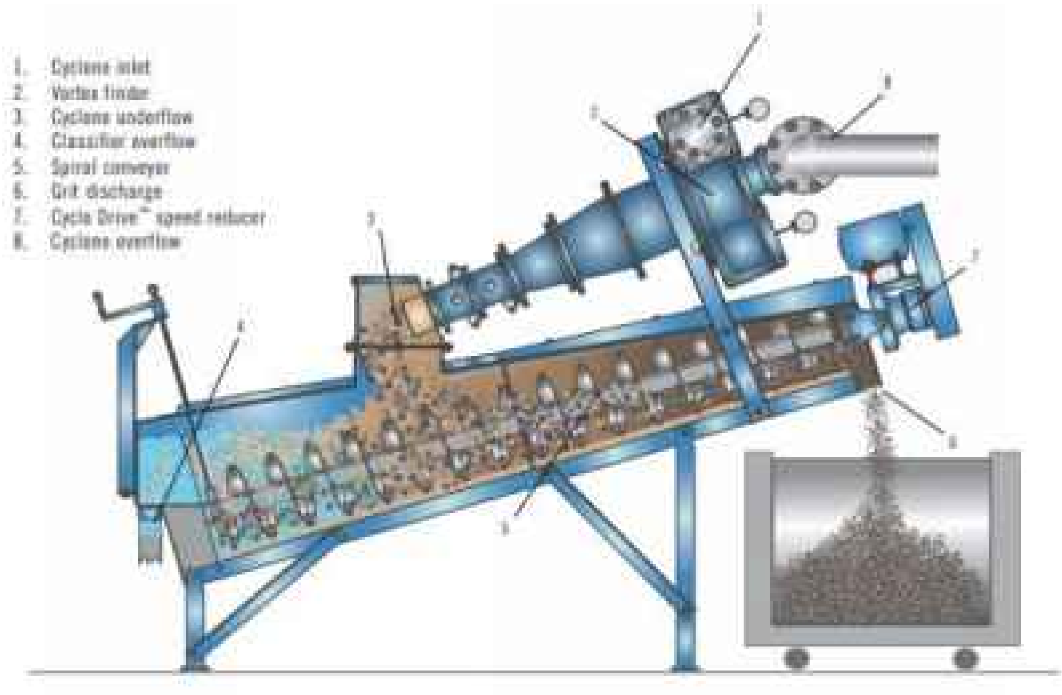

Figure 2-7. WEMCO Hydrogritter section view

The Hydro GritCleanse is a fluidized bed grit washing system. Flow is introduced tangentially into a conical clarifier that forces grit into the boundary layer located at the inside wall of the unit. Grit then settles to the bottom of the unit into a fluidized bed. Washing occurs in the fluidized bed as organic material attached to the grit particles is scrubbed away due to friction between particles, and higher density material descends to the bottom. The cleaned grit is then intermittently discharged and dewatered by means of a screw. A typical layout of a Hydro International GritCleanse unit is shown in Figure 2-8.

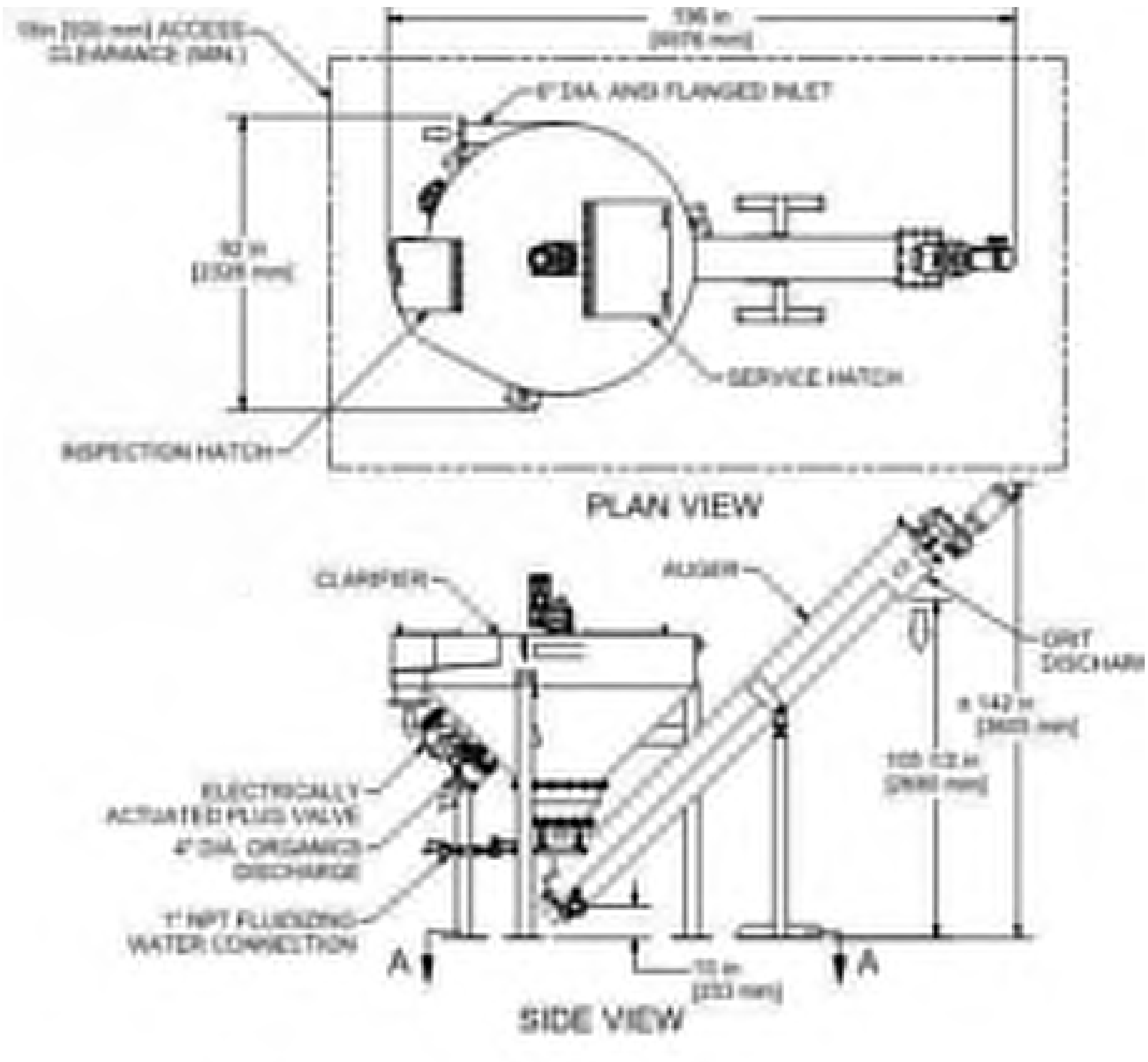

Figure 2-8. Hydro International GritCleanse preliminary layout

The Smith and Loveless grit washer provides dewatering and retention of fine grit. Flow enters into a lamella parallel plate section for high-rate settling. Grit then continues up an inclined screw conveyor for dewatering. The classifier screw transports the clean grit up an inclined plane before discharge into a container. A typical layout of a Smith and Loveless grit washer unit is shown in Figure 2-9.

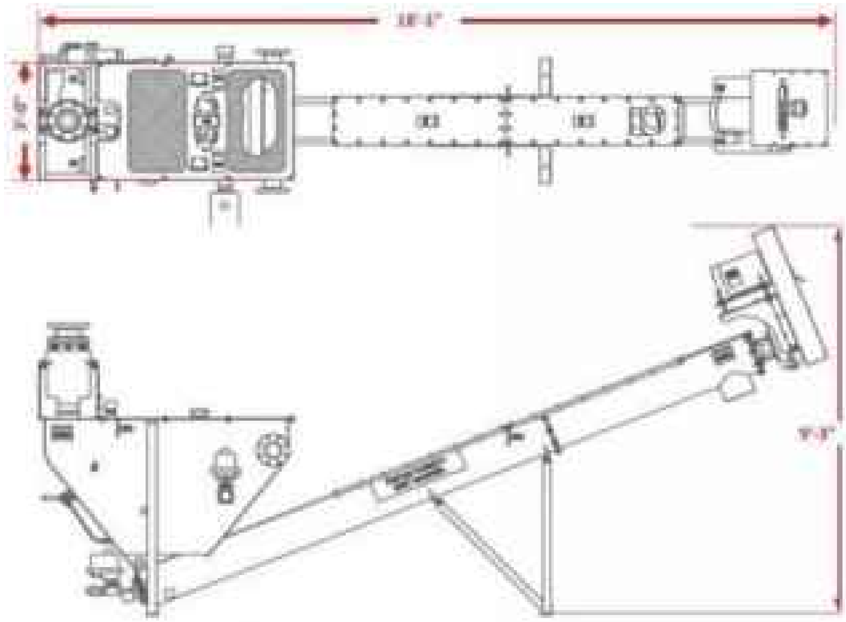

Figure 2-9. Smith and Loveless grit washer preliminary layout

The Huber Coanda RoSF4 utilizes fluidized bed technology similar to the Hydro International GritCleanse to remove organics from the grit surface and uses a central stirrer to keep grit particles in motion. The height of the fluidized bed is controlled with a pressure sensor and washed grit is removed through the bottom when the fluidized bed exceeds a specific height. The layout for the Huber RoSF4 model is shown in Figure 2-10.

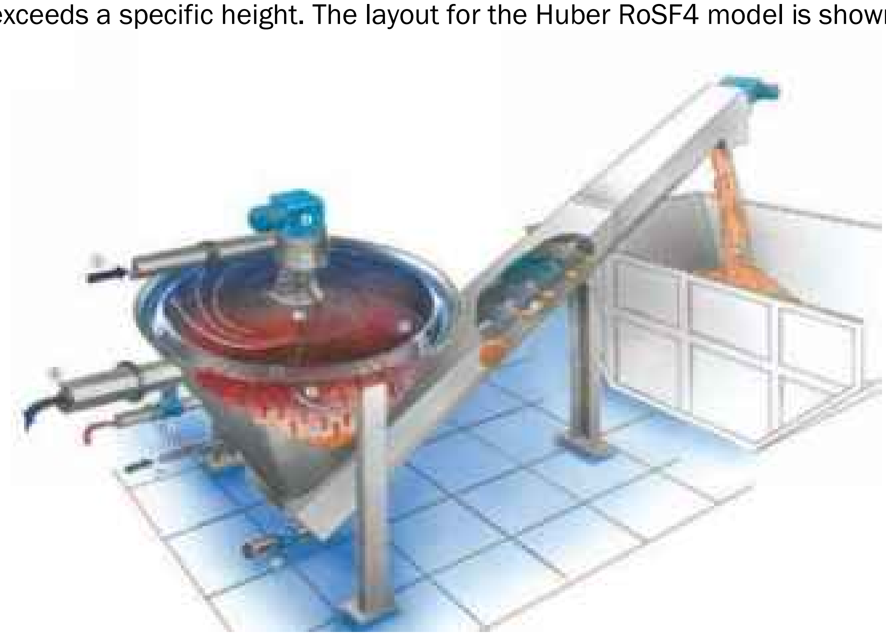

Figure 2-10. Huber Coanda grit washer layout

The sizing for each model is outlined in Table 2-5.

Table 2-5. Grit Processing Comparison

Grit Processing Model	Wemco Hydrogritter	Hydro Int GritCleanse	Smith and Loveless Grit Washer	Huber Coanda RoSF4
Capacity (gpm)	250	250	250	250
Length (inches)	120	196	217	184
Height (inches)	84	142	111	120
Diameter (inches)	42	92	32	94

The configuration of the Wemco Hydrogritter may not be compatible with the existing grit discharge configuration, but the other types of equipment should be able to convey grit to the existing roll-off container location. All of these units are much larger than the existing grit processing system, so modifications to the Headworks Building would be required to accommodate the equipment.

2.5.2.1 Alternative 5A: Relocate Screen Channel and Retrofit Grit Processing Equipment

This alternative consists of moving the existing second screen to the third screen channel to make room for the grit processing equipment since the new grit equipment would be too large to fit the existing grit system footprint. This alternative would be implemented with Screening Alternative 3B described above since new screens would be provided and could be relocated at that time. This alternative includes removing the fill and concrete cap from the third screen channel and installing the second screen there to make room for the grit processing equipment. See Figure 2-11 for the proposed screen channel relocation.

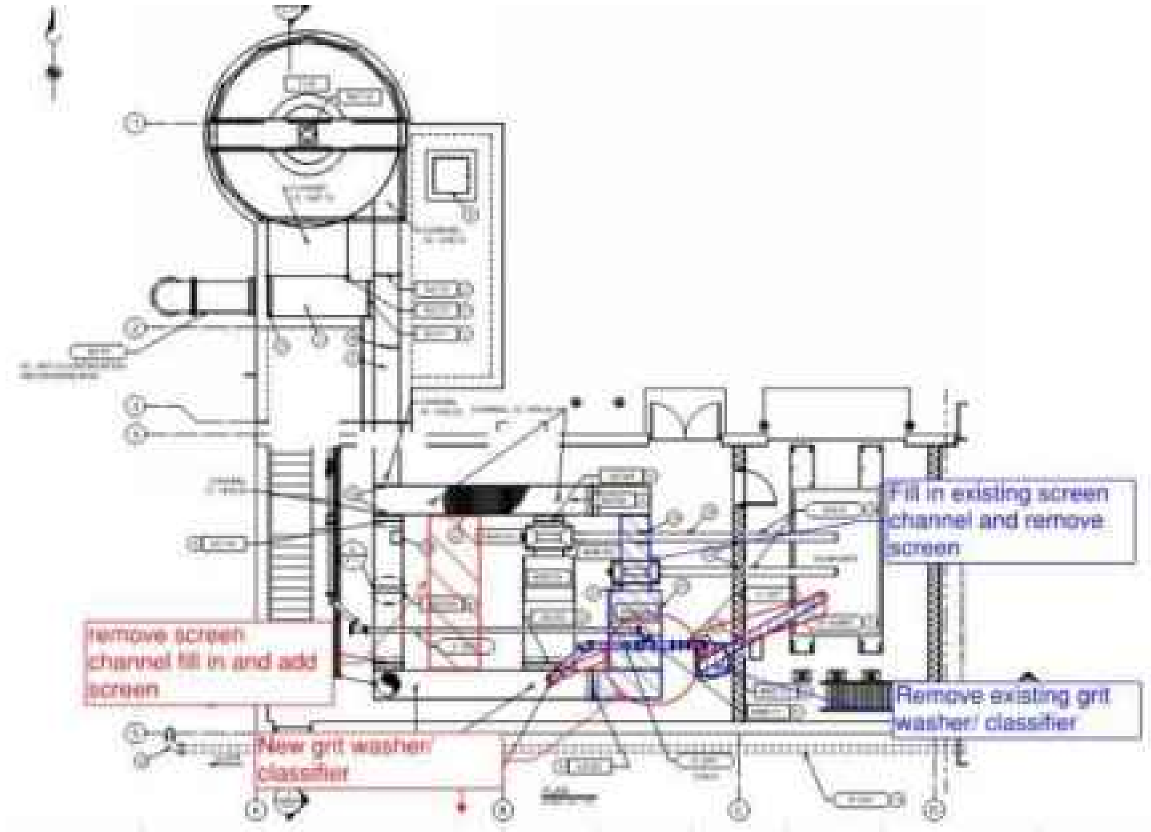

Figure 2-11 - Screen channel relocation for grit processing equipment

2.5.2.2 Alternative 5B: Expand Headworks Building for Grit Processing Equipment

This alternative consists of expanding the Headworks Building to create additional room for the grit processing equipment. This alternative would be implemented with Screening Alternative 4A since only one screen would be replaced/refurbished and relocation of the screens would not be justified. In this alternative, the screens would remain in the existing locations and the building would be expanded to the south to allow for the new grit processing equipment and a dedicated grit dumpster area. National Fire Protection Association (NFPA) 820 considerations, including ventilation and explosion proof equipment, would be required for this building expansion. Figure 2-12 shows the proposed layout for the grit processing and Headworks Building expansion.

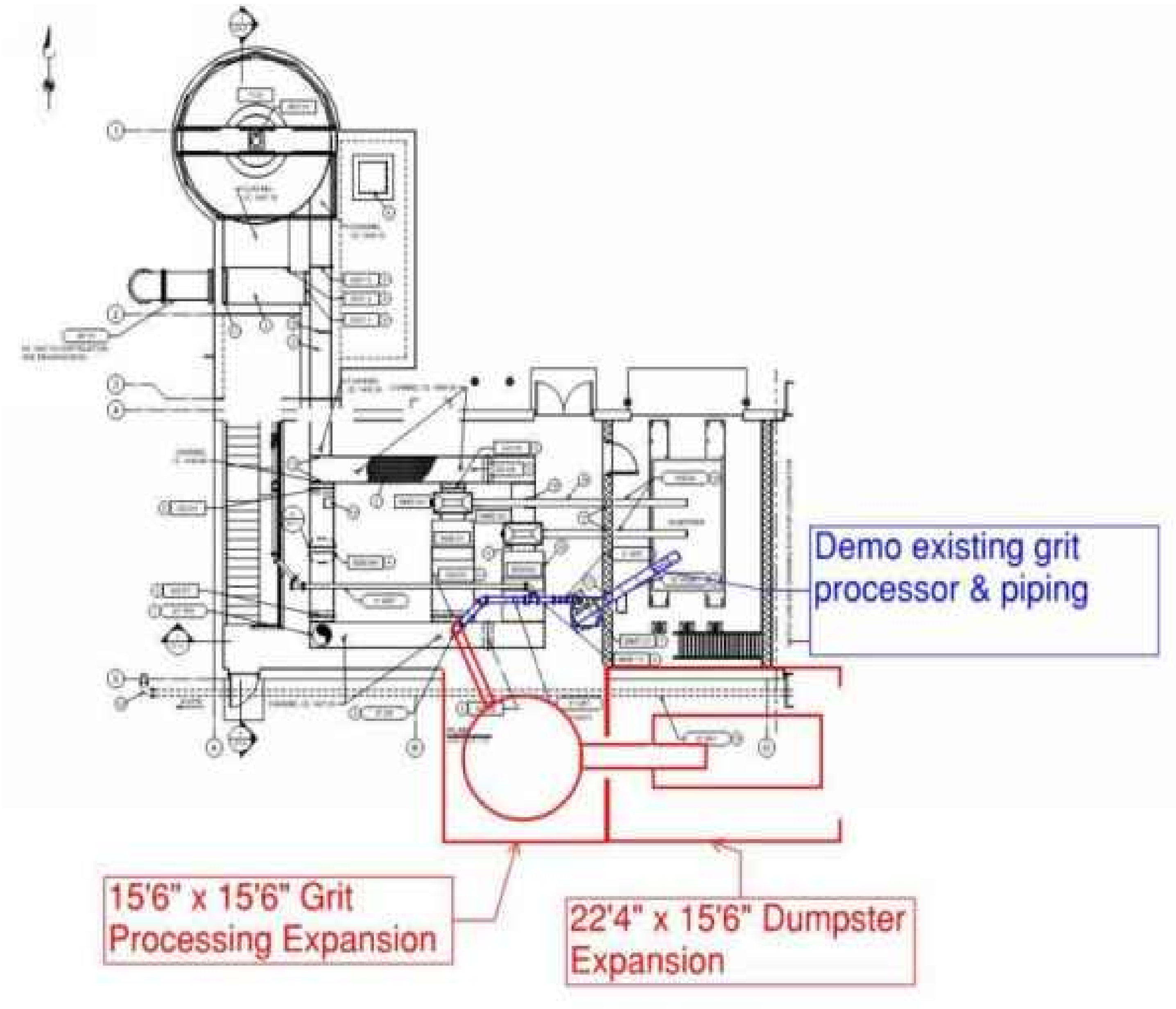

Figure 2-12. Grit processing and Headworks building expansion

2.5.3 Grit Processing Technology Comparison

Advantages and disadvantages for each grit processing technology are summarized in Table 2-6.

Table 2-6. Grit Processing Alternative Comparison				
	WEMCO Hydrogritter II	Hydro International GritCleanse	Smith and Loveless Grit Washer	Huber Coanda RoSF4
Advantages	• Manufacturer indicates capture of 95% of fine (150 mesh/106 micron) grit at a specific gravity of 2.65 • Rubber-lined cyclone provides maximum abrasion-resistance • Single motor for entire unit • Small footprint	• Manufacturer indicates capture of 95% of fine (75 micron) grit at a specific gravity of 2.65	• Manufacturer indicates capture of 95% of fine (140 mesh/105 micron) grit at a specific gravity of 2.65 • Single motor for entire unit • Small footprint	• Reduced organic content • Dryer grit
Disadvantages	• Cyclone back-pressure increases grit pump energy • No discharge chute to convey to dumpster	• Larger footprint • Two motors increase maintenance • Specifically designed to operate with Hydro International HeadCell	• Requires additional grit concentrator equipment, increasing maintenance	• 95% capture of fine 200 to 250-micron grit

Section 3: Summary of Recommendations

This section summarizes the viable alternatives and recommendations for floe equalization pumping, influent pumping, screenings, and grit removal.

3.1 Cost Assumptions and Summary

A business case evaluation (BCE) was developed to evaluate costs for each process area. The following assumptions, as summarized in Table 3-1, were used for all alternatives.

Table 3-1. BCE Assumptions	
Description	Value
Base year	2022
Planning period end	2045
Analysis horizon (number of years)	20
Undeveloped Design Details	30%
Annual inflation	3.0%
Construction Contingency	10%
Electricity Cost	$0.074/kW-hr
Building/Structures Useful Life	40 years
Process Piping Useful Life	30 years
Mechanical Equipment Useful Life	20 years

Table 3-1. BCE Assumptions	
Description	**Value**
Electrical Equipment Useful Life	20 years
Instrumentation and Control Equipment Useful Life	15 Years

Based on proposed design conditions for each alternative, the following costs for each option were calculated. Cost comparison inputs were based on equipment quotes from manufacturers, energy consumption assumptions, and construction cost estimates. A detailed BCE is located in Attachment A. The costs for each alternative are shown in Table 3-2 and include capital cost, O&M coss, and total net present value (NPV). The cost for routing the EQ flow from LS1 are not yet determined since this project is still in progress.

Table 3-2. BCE Summary			
Alternative	**Capital Costs**	**O & M Costs**	**Total NPV with Adjustment**
Flow Equalization (EQ)			
Alt 1A: Prestressed Concrete Tank	$3.32M	$118K	$3.44M
Alt 1B: Existing Basin with Lining	$2.86M	$118K	$2.98M
EQ Pumping			
Alt 2A: 7.1 mgd Submersible Pump Station	$2.11M	$244K	$2.34M
Alt 2B: Route to EQ from LS1	TBD	TBD	TBD
Main Pump Station			
Alt 3A: New Influent Pump Station	$18.5M	$860K	$19.3M
Alt 3B: Wetwell Improvements	$411K	$853K	$1.26M
Screens			
Alt 4A: Replace One Screen	$653K	$469K	$1.12M
Alt 4B: Replace Both Screens	$1.6M	$484K	$2.05M
Grit Processing			
Alt 5A: Relocate Screen Channel	$932K	$434K	$1.37M
Alt 5B: Expand Headworks Building	$1.79M	$434K	$2.23M

3.2 Recommendations

The following alternatives are recommended:

- EQ
    - Alternative 1B – Existing Basin with Lining is recommended due to a lower NPV, utilization of the existing basin, and ease of maintenance. Additionally, this alternative will have less visibility to the public due to its lower profile.
- EQ Pumping
    - Alternative 2B – Route EQ from LS1 is recommended due to the high cost of constructing a new EQ pump station. Improvements associated with this alternative, including a new valve vault and flow monitoring, would need to be coordinated with on-going work.
- Main Pump Station
    - Alternative 3B – Wetwell Improvements is recommended to provide better access to the wetwell. Based on cost, a new pump station is not recommended at this time.
- Screening
    - Alternative 4B – Replace Both Screens is recommended due to the age of the existing screens and to provide space for new grit processing equipment. It is recommended to install perforated plate screens to match the existing screens due to plant staff familiarity.
- Grit Processing
    - Alternative 5A – Relocate Screen Channel is recommended to utilize existing building space. The specific grit processing technology can be chosen during detailed design.

A summary of the capital costs for each alternative is provided in Table 3-3.

Table 3-3. Summary of Capital Costs

Recommended Alternative	Capital Costs
Alternative 1B - Existing Basin with Lining	$2.86M
Alternative 2B - Route flow from LS1 to EQ	TBD
Alternative 3B - Wetwell Improvements	$0.41M
Alternative 4B - Replace Two Screens	$1.60M
Alternative 5A – Relocate Screen and Replace Grit Processing Equipment	$0.93M
TOTAL	**$5.80M**

Attachment A: Business Case Evaluations

PROJECT NAME	ALASD Facility Plan			
	ASSUMPTIONS			
Engineering Economics Analysis Inputs		Value		Source/Comment
Base Year		2022		Common for all alternatives. Reference year for all cost data input. Year of NPV.
Planning Period End		2045		Common for all alternatives.
Analysis Horizon (number of years)		24		
Annual Inflation (per year)		3.0%		
Engineering and Administration		15%		Engineering Fee Estimates are for planning purposes only
Undeveloped Design Details		30%		Set to zero if cost is generated by cost group
Construction Contingency		10%		Set to zero if cost is generated by cost group
Useful Lives (years)		Useful Life (yr)		
Building/Structures		40		
Process Piping		30		
Mechanical Equipment		20		
Electrical Equipment		20		
Instrumentation and Control Equipment		15		
Operation and Mainteance Cost Inputs	Unit	Unit Cost		Source/Comment
Labor (Operations)	FTE	$ 93,359		1.4 x hourley wage of plant operator $32.06, 2,080 hrs per year
Natural Gas	MMBTU	$ 14.10		Rates vary, based off June 2022 rate of $1.41/ THM (10 THM per MMBTU)
Electricity	KWHr	$ 0.0740		Electricity bill provided by ALASD w/ demand charges
Polymer	Pound	$ 1.65		40% delivery concentration
Chlorine	Tons	$ 1,855.00		
Citric	Pound	$ 1.30		
Ferrous Sulfate	Gal	$ 2.28		12% delivery concentration
Sodium Bisulfite	Gal	$ 5.27		40% delivery concentration
Sodium Hypochlorite	Gal	$ 2.15		quoted cost from Hawkins in Fargo, ND, 12.5% concentration
Floc Aid	55 gal drum	$ 1,482.19		
Carbon (MicroC)	Gal	$ 3.24		
Land Application	Wet Tons	$ 40.00		
Disposal of Screenings & Grit	Tons	$ 127.50		Annual disposal cost for grit and screenings is $14,174 for 111.17 tons
Dewatering	Dry Tons	$ 85.00		
Labor	LS	1%		Percent of Equipment Cost
Materials	LS	1%		Percent of Equipment Cost

PROJECT NAME	ALASD Facility Plan			
Business Case Evaluation Summary				
Alternative #	**Descriptive Title**	**Total NPV**	**Capital Costs**	**O & M Costs**
1	EQ Tank (Alt 1)	$ 3,437,446	$ 3,318,633	$ 118,813
2	EQ Basin (Alt 2)	$ 2,975,083	$ 2,856,270	$ 118,813
3	Influent Pump Station - Wetwell Improvements	$ 1,264,280	$ 411,464	$ 852,816
4	7.1 mgd Submersible Pump Station	$ 2,357,430	$ 2,113,062	$ 244,368
5	New Influent Pump Station	$ 19,348,851	$ 18,489,293	$ 859,558

PROJECT NAME	ALASD Facility Plan
Alternative	EQ Tank (Alt 1)

New Project/Improvement Time Line

		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 444,113	Capital =	$ 3,318,633	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 2,874,520			
Annual Operating Labor	$ 59,407	O & M =	$ 118,813	
Annual Operating Electricity	$ -			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 59,407			
Annual Maintenance Non-Labor	$ -			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 3,437,446**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 3,141,065	$ 471,160	-	% Total Construction
Total Engineering Cost				**$ 471,160**	**$ 444,113**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	$ 2,133,096	$ 2,133,096	-	DIV 3-10, 12,13
Process Piping	LS	1	$ -	$ -	-	DIV 22
Mechanical Equipment	LS	1	$ 603,201	$ 603,201	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	$ -	$ -	-	DIV 26
Instrumentation and Control Equipment	LS	1	$ -	$ -	-	DIV 27
Site Work	LS	1	$ 119,217	$ 119,217	-	DIV 2
Subtotal Bare Construction				**$ 2,855,514**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	30%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$ 285,551	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$ 285,551**	-	
Total Construction Phase Cost				**$ 3,141,065**	**$ 2,874,520**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	5.00%	$ 4,668	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	-	$ -	-	
Polymer	Pound	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 4,668	$ 59,407	
Subtotal Non-Labor Operating Costs - Electricity				$ -	$ -	
Subtotal Non-Labor Operating Costs - Other				$ -	$ -	
Total Operating Costs				**$ 4,668**	**$ 59,407**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	5.00%	$ 4,668	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost ☐ Check to include		Total Equip Cost: $663,521	Applied %: 1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs						
Materials at 1% of Total Equip Cost ☐ Check to include		Total Equip Cost: $663,521	Applied %: 1.00%	$ -		Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-	$ -	-	
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 4,668	$ 59,407	
Subtotal Annual Non-Labor Maintenance Costs				$ -	$ -	
Total Annual Maintenance Costs				**$ 4,668**	**$ 59,407**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
	Cyclic Replacement Costs						
Building/Structures	N	40	1.00	$ 2,346,406	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ -	0	$ -	
Mechanical Equipment	N	20	1.00	$ 663,521	0	$ -	
Electrical Equipment	N	20	1.00	$ -	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ -	0	$ -	
Totals						$ -	Always default to NO unless major equipment replacement in known to occur within useful lifespan

EQ and Influent Pump Station BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
2	Division 2 - Site Work and Demolition							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
3	Division 3 - Concrete							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
4	Division 4 - Masonry							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
5	Division 5 - Metals							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
6	Division 6 - Wood, Plastic & Composite							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
7	Division 7 - Thermal and Moisture Protection							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
8	Division 8 - Openings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
9	Division 9 - Finishes							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
10	Division 10 - Specialties							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
11	Division 11 - Equipment							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
12	Division 12 - Furnishings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
13	Division 13 - Special Construction							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
14	Division 14 - Conveying Systems							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
21	Division 21 - Fire Suppression							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
22	Division 22 - Process Piping							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
23	Division 23- HVAC							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
26	Division 26 - Electrical Systems (35%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
27	Division 27- Instrumentation and Control Equipment (15%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
40	Division 40 - Process Integration							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -

EQ and Influent Pump Station BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
43	Division 43 - Process Gas and Liquid Handling							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
46	Division 46 - Water and Wastewater Equipment (140%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	Other							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	TOTAL							$ -

PROJECT NAME	ALASD Facility Plan
Alternative	EQ Basin (Alt 2)

New Project/Improvement Time Line

		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 382,238	Capital =	$ 2,856,270	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 2,474,032			
Annual Operating Labor	$ 59,407			
Annual Operating Electricity	$ -			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 59,407	O & M =	$ 118,813	
Annual Maintenance Non-Labor	$ -			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 2,975,083**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 2,703,441	$ 405,516	-	% Total Construction
Total Engineering Cost				**$ 405,516**	**$ 382,238**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	$ -	$ -	-	DIV 3-10, 12,13
Process Piping	LS	1	$ -	$ -	-	DIV 22
Mechanical Equipment	LS	1	$ 1,379,830	$ 1,379,830	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	$ -	$ -	-	DIV 26
Instrumentation and Control Equipment	LS	1	$ -	$ -	-	DIV 27
Site Work	LS	1	$ 1,077,844	$ 1,077,844	-	DIV 2
Subtotal Bare Construction				**$ 2,457,674**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	30%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$ 245,767	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$ 245,767**	-	
Total Construction Phase Cost				**$ 2,703,441**	**$ 2,474,032**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	5.00%	$ 4,668	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	-	$ -	-	
Polymer	Pound	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 4,668	$ 59,407	
Subtotal Non-Labor Operating Costs - Electricity				$ -	$ -	
Subtotal Non-Labor Operating Costs - Other				$ -	$ -	
Total Operating Costs				**$ 4,668**	**$ 59,407**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	5.00%	$ 4,668	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost ☐ Check to include		Total Equip Cost: $1,517,813	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost ☐ Check to include		$1,517,813	1.00%	$ -		Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-	$ -	-	Froth generating pump replacement every 1-3 years, assumed replacement every 2 years
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 4,668	$ 59,407	
Subtotal Annual Non-Labor Maintenance Costs				$ -	$ -	
Total Annual Maintenance Costs				**$ 4,668**	**$ 59,407**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
	Cyclic Replacement Costs						
Building/Structures	N	40	1.00	$ -	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ -	0	$ -	
Mechanical Equipment	N	20	1.00	$ 1,517,813	0	$ -	
Electrical Equipment	N	20	1.00	$ -	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ -	0	$ -	
Totals						$ -	Always default to NO unless major equipment replacement in known to occur within useful lifespan

EQ and Influent Pump Station BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
2	Division 2 - Site Work and Demolition							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
3	Division 3 - Concrete							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
4	Division 4 - Masonry							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
5	Division 5 - Metals							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
6	Division 6 - Wood, Plastic & Composite							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
7	Division 7 - Thermal and Moisture Protection							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
8	Division 8 - Openings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
9	Division 9 - Finishes							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
10	Division 10 - Specialties							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
11	Division 11 - Equipment							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
12	Division 12 - Furnishings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
13	Division 13 - Special Construction							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
14	Division 14 - Conveying Systems							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
21	Division 21 - Fire Suppression							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
22	Division 22 - Process Piping							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
23	Division 23- HVAC							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
26	Division 26 - Electrical Systems (35%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
27	Division 27- Instrumentation and Control Equipment (15%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
40	Division 40 - Process Integration							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -

EQ and Influent Pump Station BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
43	Division 43 - Process Gas and Liquid Handling							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
46	Division 46 - Water and Wastewater Equipment (140%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	Other							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	TOTAL							$ -

PROJECT NAME	ALASD Facility Plan
Alternative	Influent Pump Station - Wetwell Improvements

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 55,064	Capital =	$ 411,464	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 356,400			
Annual Operating Labor	$ 118,813	O & M =	$ 852,816	
Annual Operating Electricity	$ 615,190			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 118,813			
Annual Maintenance Non-Labor	$ -			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 1,264,280**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 389,448	$ 58,417	-	% Total Construction
Total Engineering Cost				**$ 58,417**	**$ 55,064**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	$ 253,320	$ 253,320	-	DIV 3-10, 12,13
Process Piping	LS	1	$ -	$ -	-	DIV 22
Mechanical Equipment	LS	1	$ -	$ -	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	$ -	$ -	-	DIV 26
Instrumentation and Control Equipment	LS	1	$ -	$ -	-	DIV 27
Site Work	LS	1	$ 100,724	$ 100,724	-	DIV 2
Subtotal Bare Construction				**$ 354,044**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	30%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$ 35,404	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$ 35,404**	-	
Total Construction Phase Cost				**$ 389,448**	**$ 356,400**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	10.00%	$ 9,336	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	653,233	$ 48,339	-	74.57 kW for 4,800 gpm influent pump, 1 pump for 3.8 mgd (3,169 gpm) pumping 24/7
Polymer	Pound	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 9,336	$ 118,813	
Subtotal Non-Labor Operating Costs - Electricity				$ 48,339	$ 615,190	
Subtotal Non-Labor Operating Costs - Other				$ -	$ -	
Total Operating Costs				**$ 57,675**	**$ 734,003**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	10.00%	$ 9,336	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
Check to include		$0	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$0	1.00%	$ -		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-	$ -	-	
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 9,336	$ 118,813	
Subtotal Annual Non-Labor Maintenance Costs				$ -	$ -	
Total Annual Maintenance Costs				**$ 9,336**	**$ 118,813**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
	Cyclic Replacement Costs						
Building/Structures	N	40	1.00	$ 278,652	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ -	0	$ -	
Mechanical Equipment	N	20	1.00	$ -	0	$ -	
Electrical Equipment	N	20	1.00	$ -	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ -	0	$ -	
Totals						$ -	Always default to NO unless major equipment replacement in known to occur within useful lifespan

EQ and Influent Pump Station BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
2	Division 2 - Site Work and Demolition							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
3	Division 3 - Concrete							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
4	Division 4 - Masonry							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
5	Division 5 - Metals							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
6	Division 6 - Wood, Plastic & Composite							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
7	Division 7 - Thermal and Moisture Protection							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
8	Division 8 - Openings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
9	Division 9 - Finishes							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
10	Division 10 - Specialties							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
11	Division 11 - Equipment							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
12	Division 12 - Furnishings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
13	Division 13 - Special Construction							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
14	Division 14 - Conveying Systems							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
21	Division 21 - Fire Suppression							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
22	Division 22 - Process Piping							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
23	Division 23- HVAC							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
26	Division 26 - Electrical Systems (35%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
27	Division 27- Instrumentation and Control Equipment (15%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
40	Division 40 - Process Integration							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -

EQ and Influent Pump Station BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
43	Division 43 - Process Gas and Liquid Handling							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
46	Division 46 - Water and Wastewater Equipment (140%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	Other							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	TOTAL							$ -

PROJECT NAME	ALASD Facility Plan
Alternative	7.1 mgd Submersible Pump Station

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 282,779	Capital =	$ 2,113,062	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 1,830,283			
Annual Operating Labor	$ 118,813			
Annual Operating Electricity	$ 6,742			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 118,813	O & M =	$ 244,368	
Annual Maintenance Non-Labor	$ -			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 2,357,430**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 2,000,000	$ 300,000	-	% Total Construction
Total Engineering Cost				**$ 300,000**	**$ 282,779**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	-	$ -	-	DIV 3-10, 12,13, factored in larger sludge holding tank
Process Piping	LS	1	-	$ -	-	DIV 22
Mechanical Equipment	LS	1	-	$ -	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	-	$ -	-	DIV 26
Instrumentation and Control Equipment	LS	1	-	$ -	-	DIV 27
Site Work	LS	1	-	$ -	-	DIV 2
Subtotal Bare Construction				**$ 2,000,000**	-	Cost for pump station, total will be $5.6M with contingencies
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	30%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	0.00%	10%		$ -	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$ -	-	
Total Construction Phase Cost				**$ 2,000,000**	**$ 1,830,283**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	10.00%	$ 9,336	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	7,159	$ 530	-	74.57 kW for 4,800 gpm influent pump, assuming similar power draw for 4,500 gpm pump, 4 days per year for 24 hrs/ day
Polymer	Pound	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 9,336	$ 118,813	
Subtotal Non-Labor Operating Costs - Electricity				$ 530	$ 6,742	
Subtotal Non-Labor Operating Costs - Other				$ -	$ -	
Total Operating Costs				**$ 9,866**	**$ 125,555**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	10.00%	$ 9,336	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
Check to include		$0	0.50%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$0	0.50%	$ -		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-	$ -	-	Membrane replacement every 10 years @ $1600/module, 208 modules for one train
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 9,336	$ 118,813	
Subtotal Annual Non-Labor Maintenance Costs				$ -	$ -	
Total Annual Maintenance Costs				**$ 9,336**	**$ 118,813**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
	Cyclic Replacement Costs						
Building/Structures	N	40	1.00	$ -	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ -	0	$ -	
Mechanical Equipment	N	20	1.00	$ -	0	$ -	
Electrical Equipment	N	20	1.00	$ -	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ -	0	$ -	
Totals						$ -	Always default to NO unless major equipment replacement in known to occur within useful lifespan

EQ and Influent Pump Station BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
2	Division 2 - Site Work and Demolition							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
3	Division 3 - Concrete							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
4	Division 4 - Masonry							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
5	Division 5 - Metals							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
6	Division 6 - Wood, Plastic & Composite							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
7	Division 7 - Thermal and Moisture Protection							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
8	Division 8 - Openings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
9	Division 9 - Finishes							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
10	Division 10 - Specialties							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
11	Division 11 - Equipment							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
12	Division 12 - Furnishings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
13	Division 13 - Special Construction							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
14	Division 14 - Conveying Systems							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
21	Division 21 - Fire Suppression							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
22	Division 22 - Process Piping							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
23	Division 23- HVAC							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
26	Division 26 - Electrical Systems (35%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
27	Division 27- Instrumentation and Control Equipment (15%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
40	Division 40 - Process Integration							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -

EQ and Influent Pump Station BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
43	Division 43 - Process Gas and Liquid Handling							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
46	Division 46 - Water and Wastewater Equipment (140%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	Other							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	TOTAL							$ -

PROJECT NAME	ALASD Facility Plan
Alternative	New Influent Pump Station

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 2,474,314	Capital =	$ 18,489,293	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 16,014,979			
Annual Operating Labor	$ 118,813			
Annual Operating Electricity	$ 621,932			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 118,813	O & M =	$ 859,558	
Annual Maintenance Non-Labor	$ -			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 19,348,851**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 17,500,000	$ 2,625,000	-	% Total Construction
Total Engineering Cost				**$ 2,625,000**	**$ 2,474,314**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	-	$ -	-	DIV 3-10, 12,13, factored in larger sludge holding tank
Process Piping	LS	1	-	$ -	-	DIV 22
Mechanical Equipment	LS	1	-	$ -	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	-	$ -	-	DIV 26
Instrumentation and Control Equipment	LS	1	-	$ -	-	DIV 27
Site Work	LS	1	-	$ -	-	DIV 2
Subtotal Bare Construction				**$ 17,500,000**	-	Cost for pump station, total will be $17.5M with contingencies (midpoint of $15M-$20M)
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	30%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	0.00%	10%		$ -	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$ -	-	
Total Construction Phase Cost				**$ 17,500,000**	**$ 16,014,979**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	10.00%	$ 9,336	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	660,392	$ 48,869	-	Total electricity costs for Alt 3 + Alt 4
Polymer	Pound	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 9,336	$ 118,813	
Subtotal Non-Labor Operating Costs - Electricity				$ 48,869	$ 621,932	
Subtotal Non-Labor Operating Costs - Other				$ -	$ -	
Total Operating Costs				**$ 58,205**	**$ 740,745**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	10.00%	$ 9,336	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
☐ Check to include		$0	0.50%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$0	0.50%	$ -		
☐ Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	0	$ -	-	Membrane replacement every 10 years @ $1600/module, 208 modules for one train
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 9,336	$ 118,813	
Subtotal Annual Non-Labor Maintenance Costs				$ -	$ -	
Total Annual Maintenance Costs				**$ 9,336**	**$ 118,813**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
	Cyclic Replacement Costs						
Building/Structures	N	40	1.00	$ -	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ -	0	$ -	
Mechanical Equipment	N	20	1.00	$ -	0	$ -	
Electrical Equipment	N	20	1.00	$ -	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ -	0	$ -	
Totals						$ -	Always default to NO unless major equipment replacement in known to occur within useful lifespan

EQ and Influent Pump Station BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
2	Division 2 - Site Work and Demolition							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
3	Division 3 - Concrete							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
4	Division 4 - Masonry							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
5	Division 5 - Metals							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
6	Division 6 - Wood, Plastic & Composite							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
7	Division 7 - Thermal and Moisture Protection							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
8	Division 8 - Openings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
9	Division 9 - Finishes							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
10	Division 10 - Specialties							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
11	Division 11 - Equipment							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
12	Division 12 - Furnishings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
13	Division 13 - Special Construction							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
14	Division 14 - Conveying Systems							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
21	Division 21 - Fire Suppression							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
22	Division 22 - Process Piping							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
23	Division 23- HVAC							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
26	Division 26 - Electrical Systems (35%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
27	Division 27- Instrumentation and Control Equipment (15%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
40	Division 40 - Process Integration							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -

EQ and Influent Pump Station BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
43	Division 43 - Process Gas and Liquid Handling							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
46	Division 46 - Water and Wastewater Equipment (140%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	Other							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	TOTAL							$ -

PROJECT NAME	ALASD Facility Plan	

ASSUMPTIONS

Engineering Economics Analysis Inputs	Value	Source/Comment
Base Year	2022	Common for all alternatives. Reference year for all cost data input. Year of NPV.
Planning Period End	2045	Common for all alternatives.
Analysis Horizon (number of years)	24	
Annual Inflation (per year)	3.0%	
Engineering and Administration	15%	Engineering Fee Estimates are for planning purposes only
Undeveloped Design Details	30%	Set to zero if cost is generated by cost group
Construction Contingency	10%	Set to zero if cost is generated by cost group
Useful Lives (years)	Useful Life (yr)	
Building/Structures	40	
Process Piping	30	
Mechanical Equipment	20	
Electrical Equipment	20	
Instrumentation and Control Equipment	15	

Operation and Mainteance Cost Inputs	Unit	Unit Cost	Source/Comment
Labor (Operations)	FTE	$ 93,359	1.4 x hourley wage of plant operator $32.06, 2,080 hrs per year
Natural Gas	MMBTU	$ 14.10	Rates vary, based off June 2022 rate of $1.41/ THM (10 THM per MMBTU)
Electricity	KWHr	$ 0.0740	Electricity bill provided by ALASD w/ demand charges
Polymer	Pound	$ 1.65	40% delivery concentration
Chlorine	Tons	$ 1,855.00	
Citric	Pound	$ 1.30	
Ferrous Sulfate	Gal	$ 2.28	12% delivery concentration
Sodium Bisulfite	Gal	$ 5.27	40% delivery concentration
Sodium Hypochlorite	Gal	$ 2.15	quoted cost from Hawkins in Fargo, ND, 12.5% concentration
Floc Aid	55 gal drum	$ 1,482.19	
Carbon (MicroC)	Gal	$ 3.24	
Land Application	Wet Tons	$ 40.00	
Disposal of Screenings & Grit	Tons	$ 127.50	Annual disposal cost for grit and screenings is $14,174 for 111.17 tons
Dewatering	Dry Tons	$ 85.00	
Labor	LS	1%	Percent of Equipment Cost
Materials	LS	1%	Percent of Equipment Cost

PROJECT NAME	ALASD Facility Plan			
Business Case Evaluation Summary				
Alternative #	**Descriptive Title**	**Total NPV**	**Capital Costs**	**O & M Costs**
1.1	Grit Processing (Relocate Screen Channel)	$ 1,366,773	$ 932,365	$ 434,409
1.2	Grit Processing (Expand Headworks Building)	$ 2,225,824	$ 1,791,416	$ 434,409
2.1	Screens (Replace 1 Screen)	$ 1,122,766	$ 653,335	$ 469,432
2.2	Screens (Replace 2 Screeens)	$ 2,053,456	$ 1,569,544	$ 483,912

PROJECT NAME	ALASD Facility Plan
Alternative	Grit Processing (Relocate Screen Channel)

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 124,773	Capital =	$ 932,365	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 807,592			
Annual Operating Labor	$ 237,626	O & M =	$ 434,409	
Annual Operating Electricity	$ 9,075			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 118,813			
Annual Maintenance Non-Labor	$ 68,895			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 1,366,773**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 882,477	$ 132,372	-	% Total Construction
Total Engineering Cost				**$ 132,372**	**$ 124,773**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	$ 4,560	$ 4,560	-	DIV 3-10, 12,13
Process Piping	LS	1	$ 41,768	$ 41,768	-	DIV 22
Mechanical Equipment	LS	1	$ 344,909	$ 344,909	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	$ -	$ -	-	DIV 26
Instrumentation and Control Equipment	LS	1	$ 222,824	$ 222,824	-	DIV 27
Site Work	LS	1	$ 16,280	$ 16,280	-	DIV 2
Subtotal Bare Construction				**$ 630,341**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	30.00%	30%		$ 189,102	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$ 63,034	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$ 252,136**	-	
Total Construction Phase Cost				**$ 882,477**	**$ 807,592**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	20.00%	$ 18,672	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	9,636	$ 713	-	3hp (2.2 kW) 12/7
Polymer	Pound	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 18,672	$ 237,626	
Subtotal Non-Labor Operating Costs - Electricity				$ 713	$ 9,075	
Subtotal Non-Labor Operating Costs - Other				$ (0)	$ -	
Total Operating Costs				**$ 19,385**	**$ 246,701**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	10.00%	$ 9,336	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
Check to include		$541,348	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$541,348	1.00%	$ 5,413		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-	$ -	-	
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 9,336	$ 118,813	
Subtotal Annual Non-Labor Maintenance Costs				$ 5,413	$ 68,895	
Total Annual Maintenance Costs				**$ 14,749**	**$ 187,708**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
	Cyclic Replacement Costs						
Building/Structures	N	40	1.00	$ 6,384	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 58,475	0	$ -	
Mechanical Equipment	N	20	1.00	$ 482,873	0	$ -	
Electrical Equipment	N	20	1.00	$ -	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 311,954	0	$ -	
Totals						$ -	Always default to NO unless major equipment replacement in known to occur within useful lifespan

Grit and Screens BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
2	Division 2 - Site Work and Demolition							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
3	Division 3 - Concrete							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
4	Division 4 - Masonry							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
5	Division 5 - Metals							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
6	Division 6 - Wood, Plastic & Composite							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
7	Division 7 - Thermal and Moisture Protection							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
8	Division 8 - Openings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
9	Division 9 - Finishes							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
10	Division 10 - Specialties							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
11	Division 11 - Equipment							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
12	Division 12 - Furnishings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
13	Division 13 - Special Construction							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
14	Division 14 - Conveying Systems							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
21	Division 21 - Fire Suppression							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
22	Division 22 - Process Piping							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
23	Division 23- HVAC							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
26	Division 26 - Electrical Systems (35%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
27	Division 27- Instrumentation and Control Equipment (15%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
40	Division 40 - Process Integration							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
43	Division 43 - Process Gas and Liquid Handling							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
46	Division 46 - Water and Wastewater Equipment (140%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	Other							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	TOTAL							$ -

PROJECT NAME	ALASD Facility Plan
Alternative	Grit Processing (Expand Headworks Building)

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 239,735	Capital =	$ 1,791,416	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 1,551,681			
Annual Operating Labor	$ 237,626	O & M =	$ 434,409	
Annual Operating Electricity	$ 9,075			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 118,813			
Annual Maintenance Non-Labor	$ 68,895			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 2,225,824**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 1,695,564	$ 254,335	-	% Total Construction
Total Engineering Cost				**$ 254,335**	**$ 239,735**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	$ 329,016	$ 329,016	-	DIV 3-10, 12,13
Process Piping	LS	1	$ 41,768	$ 41,768	-	DIV 22
Mechanical Equipment	LS	1	$ 344,909	$ 344,909	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	$ -	$ -	-	DIV 26
Instrumentation and Control Equipment	LS	1	$ 442,085	$ 442,085	-	DIV 27
Site Work	LS	1	$ 53,339	$ 53,339	-	DIV 2
Subtotal Bare Construction				**$ 1,211,117**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	30.00%	30%		$ 363,335	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$ 121,112	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$ 484,447**	-	
Total Construction Phase Cost				**$ 1,695,564**	**$ 1,551,681**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	20.00%	$ 18,672	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	9,636	$ 713	-	3hp (2.2 kW) 12/7
Polymer	Pound	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 18,672	$ 237,626	
Subtotal Non-Labor Operating Costs - Electricity				$ 713	$ 9,075	
Subtotal Non-Labor Operating Costs - Other				$ (0)	$ -	
Total Operating Costs				**$ 19,385**	**$ 246,701**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	10.00%	$ 9,336	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:				
Check to include		$541,348	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$541,348	1.00%	$ 5,413		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			and Construction contingencies
Other Non-Labor UD1	each	$ -	-	$ -	-	Froth generating pump replacement every 1-3 years, assumed replacement every 2 years
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 9,336	$ 118,813	
Subtotal Annual Non-Labor Maintenance Costs				$ 5,413	$ 68,895	
Total Annual Maintenance Costs				**$ 14,749**	**$ 187,708**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
	Cyclic Replacement Costs						
Building/Structures	N	40	1.00	$ 460,622	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 58,475	0	$ -	
Mechanical Equipment	N	20	1.00	$ 482,873	0	$ -	
Electrical Equipment	N	20	1.00	$ -	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 618,919	0	$ -	
Totals						$ -	Always default to NO unless major equipment replacement in known to occur within useful lifespan

Grit and Screens BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
2	Division 2 - Site Work and Demolition							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
3	Division 3 - Concrete							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
4	Division 4 - Masonry							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
5	Division 5 - Metals							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
6	Division 6 - Wood, Plastic & Composite							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
7	Division 7 - Thermal and Moisture Protection							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
8	Division 8 - Openings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
9	Division 9 - Finishes							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
10	Division 10 - Specialties							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
11	Division 11 - Equipment							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
12	Division 12 - Furnishings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
13	Division 13 - Special Construction							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
14	Division 14 - Conveying Systems							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
21	Division 21 - Fire Suppression							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
22	Division 22 - Process Piping							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
23	Division 23- HVAC							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
26	Division 26 - Electrical Systems (35%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
27	Division 27- Instrumentation and Control Equipment (15%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
40	Division 40 - Process Integration							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -

Grit and Screens BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
43	Division 43 - Process Gas and Liquid Handling							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
46	Division 46 - Water and Wastewater Equipment (140%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	Other							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	TOTAL							$ -

PROJECT NAME	ALASD Facility Plan
Alternative	Screens (Replace 1 Screen)

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 87,432	Capital =	$ 653,335	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 565,903			
Annual Operating Labor	$ 237,626	O & M =	$ 469,432	
Annual Operating Electricity	$ 37,124			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 118,813			
Annual Maintenance Non-Labor	$ 75,868			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 1,122,766**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 618,377	$ 92,757	-	% Total Construction
Total Engineering Cost				**$ 92,757**	**$ 87,432**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	$ -	$ -	-	DIV 3-10, 12,13
Process Piping	LS	1	$ -	$ -	-	DIV 22
Mechanical Equipment	LS	1	$ 324,779	$ 324,779	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	$ -	$ -	-	DIV 26
Instrumentation and Control Equipment	LS	1	$ 101,037	$ 101,037	-	DIV 27
Site Work	LS	1	$ 15,882	$ 15,882	-	DIV 2
Subtotal Bare Construction				**$ 441,698**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	30.00%	30%		$ 132,509	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$ 44,170	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$ 176,679**	-	
Total Construction Phase Cost				**$ 618,377**	**$ 565,903**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	20.00%	$ 18,672	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	39,420	$ 2,917	-	4hp motor, 2hp for screen compactor. 6hp (4.5 kW) per screen, one screen operating for 3.8 mgd
Polymer	Pound	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 18,672	$ 237,626	
Subtotal Non-Labor Operating Costs - Electricity				$ 2,917	$ 37,124	
Subtotal Non-Labor Operating Costs - Other				$ -	$ -	
Total Operating Costs				**$ 21,589**	**$ 274,750**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	10.00%	$ 9,336	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
Check to include		$596,142	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$596,142	1.00%	$ 5,961		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-	$ -	-	
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 9,336	$ 118,813	
Subtotal Annual Non-Labor Maintenance Costs				$ 5,961	$ 75,868	
Total Annual Maintenance Costs				**$ 15,297**	**$ 194,681**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
	Cyclic Replacement Costs						
Building/Structures	N	40	1.00	$ -	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ -	0	$ -	
Mechanical Equipment	N	20	1.00	$ 454,691	0	$ -	
Electrical Equipment	N	20	1.00	$ -	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 141,452	0	$ -	
Totals						**$ -**	Always default to NO unless major equipment replacement in known to occur within useful lifespan

Grit and Screens BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
2	Division 2 - Site Work and Demolition							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
3	Division 3 - Concrete							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
4	Division 4 - Masonry							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
5	Division 5 - Metals							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
6	Division 6 - Wood, Plastic & Composite							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
7	Division 7 - Thermal and Moisture Protection							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
8	Division 8 - Openings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
9	Division 9 - Finishes							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
10	Division 10 - Specialties							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
11	Division 11 - Equipment							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
12	Division 12 - Furnishings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
13	Division 13 - Special Construction							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
14	Division 14 - Conveying Systems							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
21	Division 21 - Fire Suppression							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
22	Division 22 - Process Piping							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
23	Division 23- HVAC							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
26	Division 26 - Electrical Systems (35%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
27	Division 27- Instrumentation and Control Equipment (15%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
40	Division 40 - Process Integration							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -

Grit and Screens BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
43	Division 43 - Process Gas and Liquid Handling							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
46	Division 46 - Water and Wastewater Equipment (140%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	Other							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	TOTAL							$ -

PROJECT NAME	ALASD Facility Plan
Alternative	Screens (Replace 2 Screeens)

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 210,043	Capital =	$ 1,569,544	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 1,359,501			
Annual Operating Labor	$ 237,626	O & M =	$ 483,912	
Annual Operating Electricity	$ 37,124			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 118,813			
Annual Maintenance Non-Labor	$ 90,348			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 2,053,456**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 1,485,564	$ 222,835	-	% Total Construction
Total Engineering Cost				**$ 222,835**	**$ 210,043**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	5,264	$ 5,264	-	DIV 3-10, 12,13, factored in larger sludge holding tank
Process Piping	LS	1	-	$ -	-	DIV 22
Mechanical Equipment	LS	1	879,457	$ 879,457	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	-	$ -	-	DIV 26
Instrumentation and Control Equipment	LS	1	134,716	$ 134,716	-	DIV 27
Site Work	LS	1	41,680	$ 41,680	-	DIV 2
Subtotal Bare Construction				**$ 1,061,117**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	30.00%	30%		$ 318,335	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$ 106,112	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$ 424,447**	-	
Total Construction Phase Cost				**$ 1,485,564**	**$ 1,359,501**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	20.00%	$ 18,672	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	39,420	$ 2,917	-	4hp motor, 2hp for screen compactor. 6hp (4.5 kW) per screen, one screen operating at 3.8 mgd
Polymer	Pound	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 18,672	$ 237,626	
Subtotal Non-Labor Operating Costs - Electricity				$ 2,917	$ 37,124	
Subtotal Non-Labor Operating Costs - Other				$ -	$ -	
Total Operating Costs				**$ 21,589**	**$ 274,750**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	10.00%	$ 9,336	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
Check to include		$1,419,842	0.50%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$1,419,842	0.50%	$ 7,099		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-	$ -	-	Membrane replacement every 10 years @ $1600/module, 208 modules for one train
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 9,336	$ 118,813	
Subtotal Annual Non-Labor Maintenance Costs				$ 7,099	$ 90,348	
Total Annual Maintenance Costs				**$ 16,435**	**$ 209,161**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Cyclic Replacement Costs: Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
Building/Structures	N	40	1.00	$ 7,370	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ -	0	$ -	
Mechanical Equipment	N	20	1.00	$ 1,231,240	0	$ -	
Electrical Equipment	N	20	1.00	$ -	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 188,602	0	$ -	
Totals						$ -	Always default to NO unless major equipment replacement in known to occur within useful lifespan

Grit and Screens BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
2	Division 2 - Site Work and Demolition							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
3	Division 3 - Concrete							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
4	Division 4 - Masonry							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
5	Division 5 - Metals							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
6	Division 6 - Wood, Plastic & Composite							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
7	Division 7 - Thermal and Moisture Protection							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
8	Division 8 - Openings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
9	Division 9 - Finishes							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
10	Division 10 - Specialties							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
11	Division 11 - Equipment							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
12	Division 12 - Furnishings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
13	Division 13 - Special Construction							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
14	Division 14 - Conveying Systems							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
21	Division 21 - Fire Suppression							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
22	Division 22 - Process Piping							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
23	Division 23- HVAC							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
26	Division 26 - Electrical Systems (35%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
27	Division 27- Instrumentation and Control Equipment (15%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
40	Division 40 - Process Integration							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -

Grit and Screens BCE

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
43	Division 43 - Process Gas and Liquid Handling							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
46	Division 46 - Water and Wastewater Equipment (140%)							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	Other							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	TOTAL							$ -

Appendix H: Liquids Treatment TM

Brown AND Caldwell

Brown and Caldwell

30 East 7th Street, Suite 2500
Saint Paul, MN 55101

T: 651.298.0710

Technical Memorandum

Prepared for: Alexandria Lakes Area Sanitary District

Project Title: Liquids Process Analysis

Project No.: 158466

Technical Memorandum

Subject: Primary, Secondary, and Tertiary Treatment Systems Alternative Evaluation

Date: December 28, 2022

To: Scott Gilbertson, ALASD

Troy Drewes, ALASD

From: Jennifer Gruman, P.E. Project Manager

Donavan Esping, P.E. Senior Process Engineer

Prepared by: ________________________________

Anndee Huff Chester, Ph.D., P.E.*

Reviewed by: ________________________________

Donavan Esping, P.E.*

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Signature: ________________________________

Name: Donavan G. Esping

Date: xxxxxxxxxxxxxxxxxxx License No. 22972

*Professional Engineer Registered in Specific States

Limitations:

This document was prepared solely for Alexandria Lakes Area Sanitary District in accordance with professional standards at the time the services were performed and in accordance with the contract between Alexandria Lakes Area Sanitary District and Brown and Caldwell dated 12/28/2022. This document is governed by the specific scope of work authorized by Alexandria Lakes Area Sanitary District; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Alexandria Lakes Area Sanitary District and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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List of Abbreviations

ALASD	Alexandria Lakes Area Sanitary District
AS	Activated Sludge
ADWF	average dry weather flow
AWWF	average wet weather flow
BC	Brown and Caldwell
BNR	biological nutrient removal
$cBOD_5$	5-day carbonaceous biochemical oxygen demand
COD	chemical oxygen demand
C	Celsius
d	day(s)
DAF	dissolved air flotation
EBPR	enhanced biological phosphorus removal
EQ	equalization
Fe	iron
$FeCl_3$	ferrous chloride
ft	foot/feet
g	gram
gal	gallon(s)
gpd	gallons per day
HFO	hydrous ferric oxides
hr	hour(s)
L	liter
lb	pound(s)
max	Maximum
MBR	membrane bioreactor
mg	milligram(s)
MG	million gallon(s)
mgd	million gallons per day
mL	milliliter
MLSS	mixed liquor suspended solids
MLR	mixed liquor return
Mo.	month
mol	mole
N	nitrogen
No.	number
NPV	net present value
OHO	ordinary heterotrophic organisms
O&M	operation and maintenance
P	phosphorus
PHWWF	Peak hour wet weather flow
PIWWF	Peak instantaneous wet weather flow
RAS	return activated sludge
RO	reverse osmosis
s	seconds
SAF	suspended air flotation
SC	secondary clarifier
SLR	solids loading rate
SOR	surface overflow rate
SRT	solids retention time
SVI	sludge volume index
TM	technical memorandum
TN	total nitrogen
TP	total phosphorus
TS	total solids
TSS	total suspended solids
VSR	volatile solids reduction
WAS	waste activated sludge
WWTF	Wastewater Treatment Facility
yr	Year

Section 1: Executive Summary

This Technical Memorandum (TM) presents the results of the Alexandria Lakes Area Sanitary District (ALASD) wastewater treatment facility (WWTF) liquid stream alternative analysis addressing primary, secondary, and tertiary treatment systems. Facility evaluations for the plant influent pump station, flow equalization, headworks, effluent disinfection, and solids processing systems are addressed in separate TMs.

A technology screening workshop was conducted with ALASD staff on May 31, 2022 to review viable liquid stream technologies with respect to the ALASD's goals listed below and their proven record of operation.

- Meet water quality criteria for current and future operations as defined in Table 1-1.
- Address aging infrastructure and equipment
- Provide capacity for future growth

To address these goals, over 25 liquid stream technologies were reviewed for their ability to achieve the Treatment Level 1 effluent criteria and then sequentially be expanded to meet Treatment Level 2 goals for potential future total chloride requirements. Treatment Level 1 total phosphorus (TP) mass loading criteria is based upon the proposed annual limit in ALASD's existing National Pollutant Discharge Elimination system (NPDES) permit if Adaptive Lake Management Plan activities do not result in attaining water quality standards in Lake Winona.

Table 1-1. ALASD Key Effluent Water Quality Criteria

Treatment Level	Parameter	Averaging Period	Criteria
Level 1	Total Suspended Solids (TSS)	Monthly	339 kg/d <15 mg/L[a]
	Carbonaceous biological oxygen demand (cBOD5)	Monthly	282 kg/d <11 mg/L[a]
	Total Nitrogen (TN)	Monthly	8 mg TN/L
	Total Phosphorus (TP)	Annual Monthly	665 kg/yr 0.11 mg/L[a]
Level 2	Treatment Level 1 with Total Chlorides, mg/L	Daily Max	252 mg/L

a. Concentration of permitted monthly mass loading using the projected 2045 annual wet weather flow of 5.7 mgd.
b. Concentration of permitted annual mass loading using the projected 2045 annual average design flow of 4.3 mgd.

Based upon the technology screening process the following liquid stream treatment configurations were selected for further evaluation to meet Treatment Level 1.

- Alternative 1: Conventional 5-stage BNR with continuous backwash deep bed filters
- Alternative 2: Membrane Bioreactors (MBRs) with Primary Treatment
- Alternative 3: Membrane Bioreactors without Primary Treatment

Table 1-2 summarizes the comparative costs, facility requirements, and predicted effluent quality for each alternative. Capital costs for Treatment Level 1 Alternative 1 are 15 percent less than Alternatives 2 and 3 which are approximately equal. The net present value for Alternative 1 is 20 percent less than both Alternatives 2 and 3. Additional cost details are provided in Appendix A which contains the business case evaluations for each alternative.

Table 1-2. ALASD WWTF Liquid Stream Alternative Evaluation Comparative Costs, Process Sizing, and Predicted Effluent Quality – Treatment Level 1

Item	Units	Alternative 1 5-stage BNR with filters	Alternative 2 MBRs with Primary Treatment	Alternative 3 MBRs without Primary Treatment
Capital Cost[a]	$ Millions	$46	$54	$54
Annual operating costs [a,b]	$ Millions	$0.18	$0.37	$0.40
Net Present Value [a]	$ Millions	$50	$59	$60
Process Tankage Summary				
Fine Screening (New)				
Type	--	--	1 mm	2 mm
Capacity	mgd	--	2 @ 9.0 mgd	2 @ 9.0 mgd
Primary Clarifiers	No.	3 @ 45’ (1 new)	3 @ 45’ (1 new)	--
BNR Basins				
Total Volume	MG	3.55 (1.71 new)	2.24 (0.76 new)	3.19 (1.71 new)
Aerobic/Total SRT	days	9/18.4	9/16.8	9/16.5
Step Feed, Q>8 MGD	Percent Total	100%	NA	NA
Mixed liquor recycle pumping	mgd	400%	250%	150%
BNR Solids Separation				
Type	--	Final Clarifiers	Membrane filtration	Membrane Filtration
Peak flow	mgd	10.2	9.5	9.5
Units	--	2 @ 45’ 2 @ 75’ (1 new)	4 trains with 7 cassettes (new) [c]	4 trains with 7 cassettes (new) [c]
RAS capacity-total	mgd	4.1	21	21
Deep Bed Filtration				
Type	--	Single stage deep-bed continuous backwash	--	--
Firm capacity	mgd	9.7	--	--
Ferrous sulfate dose	gpd	21	27	28
Predicted Effluent Quality				
Monthly Ammonia (Average/Max month)	mg-N/L	0.3/1.2	0.6/0.14	1.1/0.25
Monthly TP	mg-P/L	<0.09	<0.09	<0.09
Monthly TN	mg-N/L	6/5	5/6	6/7

a. Cost presented in 2022 dollars
b. Annual operation and maintenance in first year of operation - 2035
c. Based Upon SUEZ/Veolia ZeeWeed 500EV cassettes

Treatment Level 2 requirements were estimated for each of the Treatment Level 1 technologies (Conventional BNR with filtration and MBRs). A high-level analysis of the following alternatives was completed to define order-of-magnitude costs and general facility needs. The analysis assumes current influent chloride concentrations are reduced by 40 percent through chloride reduction activities such as high efficiency softeners, Alexandria Light and Power City water softening, or equal.

- Alternative 4: Alternative 1 with Microfiltration and Reverse Osmosis (MF/RO)
- Alternative 4A: Alternative 1 with Nanofiltration and Reverse Osmosis (NF/RO)
- Alternative 5: Alternative 2 with Reverse Osmosis (RO)

Table 1-3 summarizes Treatment Level 2 comparative order-of-magnitude costs and general facility requirements. Alternative 5 has the lowest capital cost and net present value. Table 1-3 also shows Alternatives 4A and 5 combined costs for Treatment Level 1 and 2 are also the same with Alternative 5 being simpler as it has less unit processes to operate.

Table 1-3. ALASD WWTF Liquid Stream Alternative Evaluation Comparative Costs and Process Sizing – Treatment Level 2

Item	Units	Alternative 4 Alternative 1 with MF/RO	Alternative 4A Alternative 1 with NF/RO	Alternative 5 Alternative 2 with RO
Treatment Level 2 Order-of-Magnitude Costs				
Capital Cost[a]	$ Millions	$53	$50	$42
Annual operating costs[a,b]	$ Millions	$6.7	$5.7	$5.5
Net Present Value[a]	$ Millions	$140	$123	$110
Microfiltration or Nanofiltration				
Number of trains	--	4	4	--
Capacity per train	mgd/train	1.1	1.1	--
Reverse Osmosis				
Number of trains	--	4	4	4
Capacity per train	mgd/train	1.0	1.0	1.0
Combined Treatment Level 1 and 2 Order-of-Magnitude Costs				
Capital Cost[a]	$ Millions	$100	$97	$95
Annual operating costs[a,b]	$ Millions	$6.9	$5.9	$5.9
Net Present Value[a]	$ Millions	$190	$173	$170

a. Cost presented in 2022 dollars
b. Annual operation and maintenance in first year of operation - 2035

Each of the Treatment Level scenarios and alternatives were reviewed and discussed in detail during a September 20, 2022 workshop with ALASD and BC staff. Based on the review of the treatment alternatives and costs, Alternative 2: MBR with Primary Treatment was selected as the preferred alternative to meet Treatment Level 1 effluent water quality and Alternative 5: MBR with RO was selected to meet chloride reduction criteria established under Treatment Level 2. This pathway forward provides ALASD with the most robust treatment process which is critical given recent high industrial loadings have caused nitrification toxicity and poor sludge quality issues, provides excellent phosphorus removal to meet projected lower phosphorus discharge requirements, provides the most “phasable“ approach to minimize near-term capital improvements, and supports the simplest and least expensive path forward to reduce chloride discharges using on-site treatment.

Additionally, the proposed approach is a good fit to meet potential future treatment needs related to sulfate discharge and the District is embarking on PFAS monitoring which may also play a role in the future need for the MBR with RO treatment scheme.

Section 2: Introduction

This TM presents the combined primary, secondary and tertiary treatment systems alternative analysis to meet the effluent water quality goals presented in Table 1-1 at Year 2045 projected plant influent flows and loadings presented in *Influent Flows and Loadings Technical Memorandum* (BC, 2022). In addition, existing infrastructure in need of replacement or refurbishment is included in facility costing to define overall costs for each alternative. This TM presents the following material:

- Section 2 – Introduction
- Section 3 – Basis of Analysis
- Section 4 - Treatment Level 1 Facility Evaluations
- Section 5 - Treatment Level 2 Facility Evaluations
- Section 6 - Recommendation

Plant influent pump station, flow equalization, headworks, dewatering, solids handling, and effluent disinfection are addressed in other evaluations.

2.1 Existing Facility

The ALASD WWTF has a rated average wet weather flow capacity of 4.1 mgd and an annual average flow of 3.1 mgd. The ALASD WWTF liquid stream process consists of influent pumping, screening, grit removal, two 45-foot circular primary clarifiers, two-pass activated sludge aeration basins, two 55-foot secondary clarifiers, one 75-foot secondary clarifier, cloth disk filtration, and chlorine disinfection. Phosphorus removal is accomplished with ferrous sulfate dosing to the end of the aeration basins and/or mixed liquor splitter box.

Primary solids are thickened in the primary clarifiers while waste activated sludge (WAS) is thickened by a dissolved air flotation (DAF) thickener prior to feeding the aerobic digestion system. Digester effluent is dewatered with a centrifuge for land application and centrate is routed to primary clarifier effluent. Figure 2-1 provides an overall site layout of the WWTF.

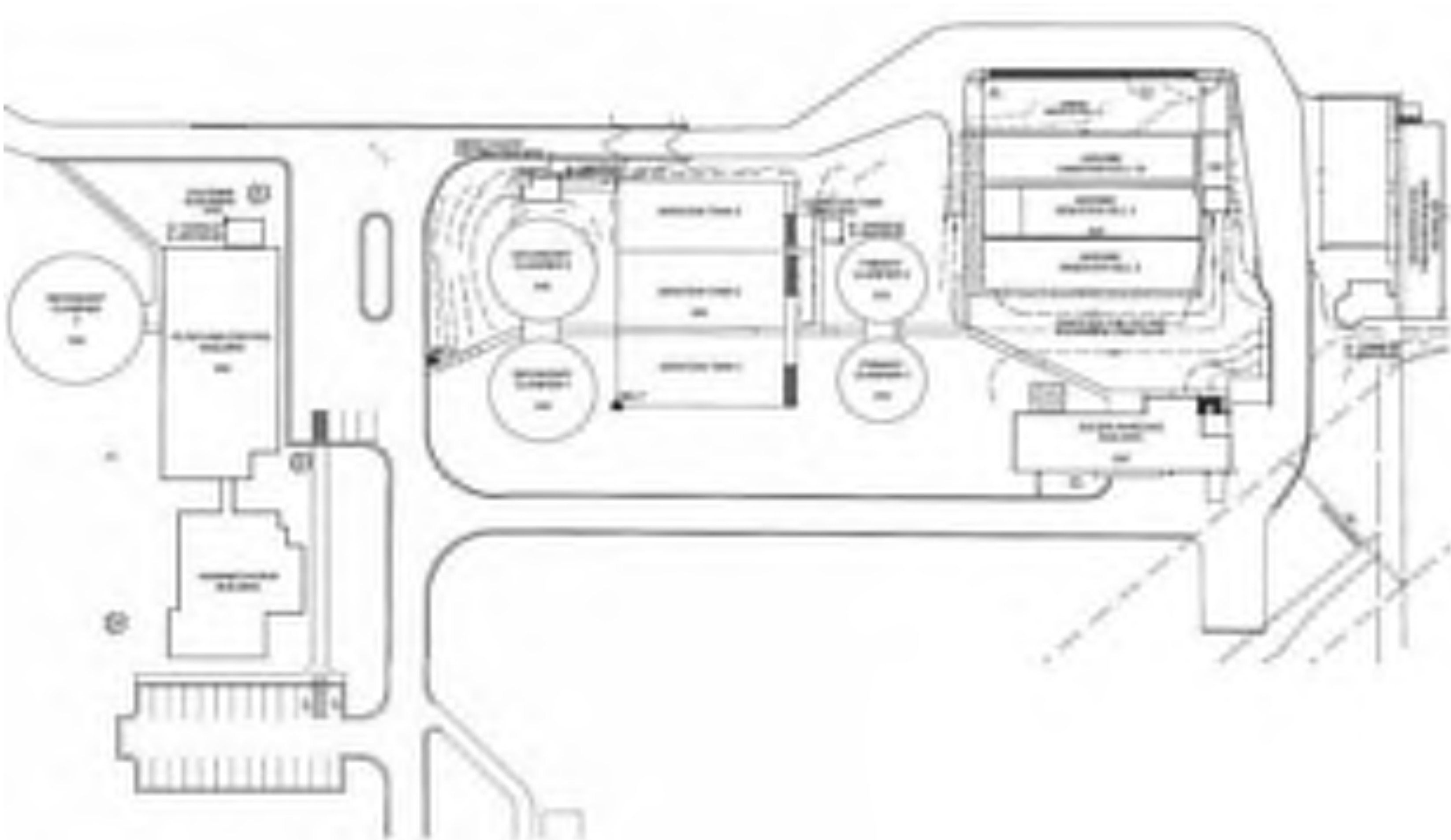


Figure 2-1. ALASD WWTF site layout

Section 3: Basis of Analysis

This section summarizes the basis of analysis and assumptions used for the alternative evaluation.

3.1 Effluent Water Quality

Two water quality treatment levels were used as criteria for the alternative evaluation. Treatment Level 1 focuses on effluent TP and TN reduction while Treatment Level 2 focuses on effluent chloride reduction. The treatment levels are summarized in Table 1-1.

3.2 Influent Flows and Loadings

Treatment Level 1 facility requirements were defined using the BioWin™ wastewater treatment plant simulator loaded with a 90-day influent flow and loading itinerary. The influent itinerary was developed using historical plant operating data projected to Year 2045 influent flows and loadings (BC, 2022). The itinerary is divided into three 30-day segments to evaluate plant treatment performance and system capacity includes the following conditions.

- Day 0-30: Maximum month flows and loadings at minimum month temperatures
- Day 30-60: Annual average flows, loadings at average month temperatures
- Day 60-90: Maximum month flows and loadings at maximum month temperatures

The maximum week and day flows and loadings were incorporated into Day 0-30 and 60-90 itineraries. Influent conditions are summarized in Table 3-1. The analysis assumes an influent flow equalization (EQ) basin is added to the current flow scheme resulting in a peak influent flow of 9.5 mgd to the plant headworks. Flows greater than 9.5 mgd including the 2045 projected peak hour and peak instantaneous wet weather flows (PHWWF and PIWWFs) of 10.9 mgd and 16.6 mgd are routed to the EQ basin and returned to the plant when flow subsides.

Table 3-1. ALASD WWTF Alternative Evaluation Influent Itinerary Conditions

Parameter	Units	Day 0-30 Maximum month flows and loadings, minimum month temperature	Day 30-60 Annual average conditions	Day 60-90 Maximum month loadings with corresponding flows, maximum month temperature
Flow	mgd	5.7	4.3	5.7
COD	lb/d	35,800	23,800	35,800
TKN	lb N/d	1,780	1,550	1,780
TP	lb P/d	210	190	210
Temperature	degrees C	10.7	14.8	19.7
Objective		System sizing and nitrification	Average O&M	Peak aeration demands

3.3 Key Design Parameters

Several design parameters used in this analysis include the following:

- Process redundancy needs were defined as the following based upon BC experience at other similar facilities:
  - Alternative 1 assumes all primary clarifiers, aeration basins, final clarifiers are in service during critical loadings period of maximum month loading and peak flows. Tertiary filtration systems assume one filter train is out-of-service during peak flow conditions.
  - Alternatives 2 and 3, the membrane bioreactor (MBR) alternatives, assume one BNR train and one membrane train are out of service during critical maximum month loading conditions.
- BioWin default nitrification kinetics resulting in a design aerobic SRT of 9 days.
- Alternative 1 90th percentile design sludge volume index (SVI) value of 125 mL/g.
- Assume sludge thickening via suspend air flotation (SAF) or DAF followed by aerobic digestion and centrifuge dewatering.

3.4 ALASD BioWin Model Update and Validation

ALASD's existing BioWin model was updated to BioWin Version 6.2 and then validated using daily operation data from January 1, 2017, to April 30, 2022, and influent wastewater characterization data collected in March 2022 (Appendix B). Figure 3-1 shows the updated ALASD WWTF whole-plant BioWin configuration. Updates were completed for the model validation and are described below.

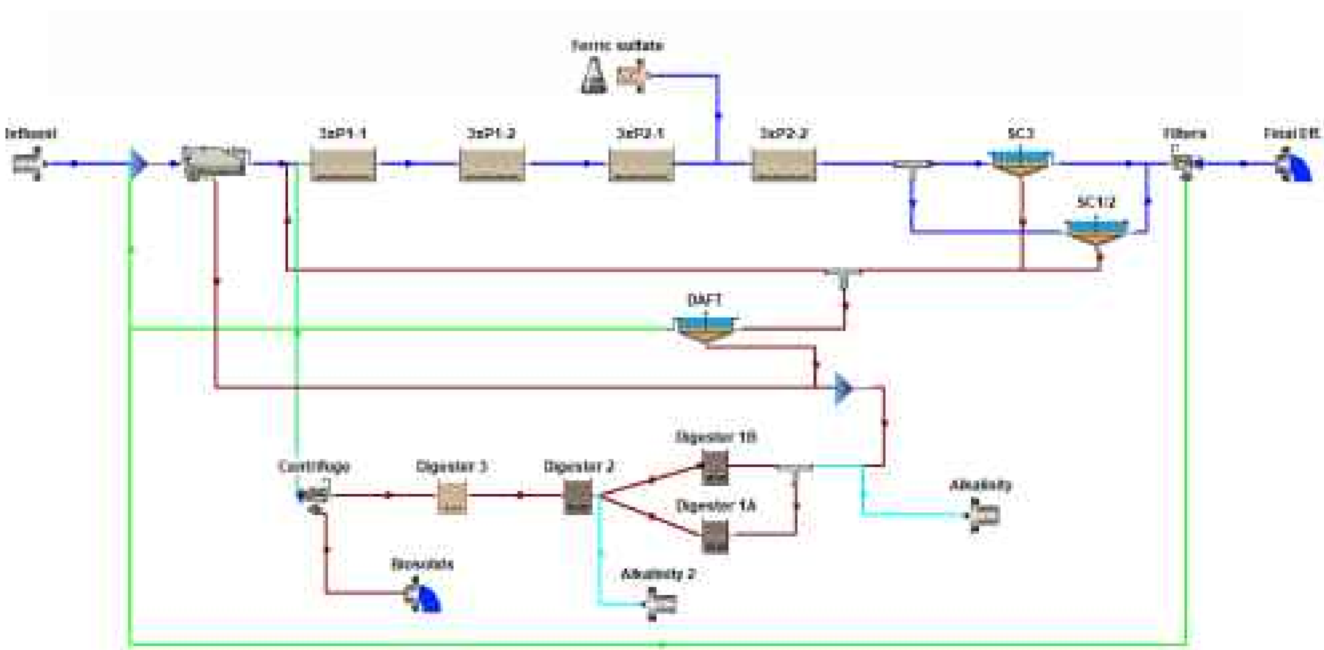


Figure 3-1. BioWin validation flow schematic of ALASD WWTF

3.3.1 BioWin Model Updates

The following key updates were performed to validate the BioWin model to existing data:

- Influent wastewater characteristics were updated to match March 2022 sampling data. Most parameters were within 5 to 10 percent of the existing ALASD BioWin model except the fraction of readily biodegradable COD which was increased from 14.5 percent to 28 percent as a result of increased soluble COD loadings from industrial sources.
- Digester kinetics were updated to improve the correlation with denitrification (digester effluent nitrates) at low or no dissolved oxygen. Parameters updated included reducing the general hydrolysis rate from 2.1/day to 0.8/day, settling the ordinary heterotrophic organisms (OHO) fermentation rate and activated sludge (AS) fermentation growth factors to BioWin default values, and increasing the OHO DO half saturation constant from 0.05 to 0.085 mg/L.
- Primary clarifier TSS removal rate was decreased from 50 to 35 percent during high flows (roughly 4 mgd) to improve the correlation between predicted and reported MLSS.
- BioWin 6.0 and later uses a new chemical phosphorus precipitation model which required adjustment to match plant effluent phosphorus discharges. To match the predicted effluent TP and PO4-P at the reported ferric sulfate dosing rates, the high ferric active site factor was set to 8 mol-site/mol-HFO and the low ferric active site factor was set to 4.8 mol-site/mol-HFO.
- Like past ALASD models, alkalinity was added to digester influent and Digester 2 as needed to maintain pH above 6.0.

Appendix C contains the BioWin model validation charts, which compare the plant measured data (square icons) and the simulated (line) values. The model shows that the BioWin predicted the plant measured data well.

Section 4: Treatment Level 1: Existing Permit with Total Nitrogen (TN) of 8 mg-N/L

This section presents the three alternatives selected to meet the current permit discharge requirements and monthly TN requirement of 8 mg-N/L. The TP mass loading criteria is based upon the proposed annual limit in ALASD's existing National Pollutant Discharge Elimination system (NPDES) permit if Adaptive Lake Management Plan activities do not result in attaining water quality standards in Lake Winona.

- Alternative 1: Conventional 5-Stage BNR with continuous backwash deep bed filters
- Alternative 2: MBRs with primary treatment
- Alternative 3: MBRs without primary treatment

Facility descriptions below are based upon requirements for Year 2045 projected flows and loadings. All alternatives include influent equalization to maintain peak flows to the liquid stream processes below 9.5 mgd. The existing ponds, if lined, may work well for flow equalization of large wet weather events and is further evaluated in the *Headworks TM*.

4.1 Alternative 1: Conventional 5-stage BNR with continuous backwash deep bed filters

This alternative converts the existing activated sludge system with chemical phosphorus removal to a conventional 5-stage BNR system. The 5-stage BNR system biologically removes both nitrogen and phosphorus and includes the following zones: anaerobic, anoxic, aerobic, followed by another, smaller anoxic zone, and a final aerobic polishing zone as shown in Figure 4-1. A RAS denitrification zone is also provided to reduce the return nitrate load in the RAS stream to the anaerobic selector to maintain steady enhanced biological phosphorus removal (EBPR).

Primary effluent is fed directly to the anaerobic zone except during wet weather flow when influent flows greater than 8 mgd are step fed directly to the latter half of the first aerobic zone to reduce final clarifier solids loading rates (SLRs) to acceptable levels. The internal recycle, or mixed liquor return (MLR), is paced at 400 percent of the plant influent flow up to 21 mgd to provide a source of nitrate for biological denitrification in the first anoxic zone. The second anoxic zone further reduces nitrate to achieve the target effluent water quality criteria. Return activated sludge (RAS) from the secondary clarifier is flow paced at 50 percent of the influent flow to the anaerobic zone.

To consistently achieve effluent TP discharges less than 0.1 mg/L, new single-stage deep-bed continuous backwash filters replace the existing cloth media filters. This configuration doses ferrous sulfate at roughly 20 gpd for chemical phosphorus polishing as needed. Key process design data for Alternative 1 are summarized in Table 4-1.

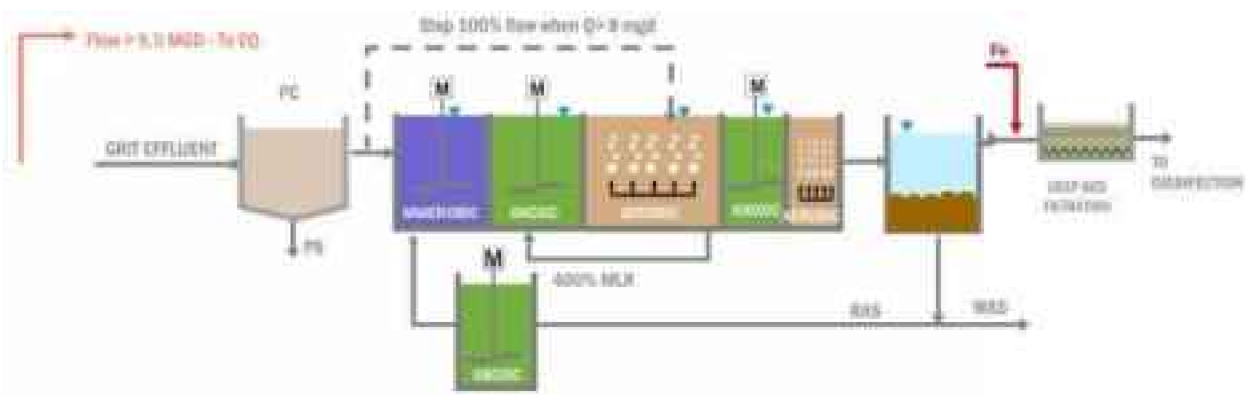


Figure 4-1. Alternative 1: 5-Stage BNR with RAS Denitrification

Key improvements to implement Alternative 1 are shown in Figure 4-2 and include the following:

- A new primary clarifier splitter structure upstream of the primary settling tanks.
- One new 45-foot primary clarifier adjacent to the existing primary settling tanks. Replace existing primary clarifier collectors.
- Three 5-Stage BNR trains which include converting the existing aeration tanks into one 1.15 MG BNR train plus two new 1.2 MG BNR trains. As noted above each train includes a MLR pump station and piping to route flow back to the first anoxic zone as shown in Figure 4-3. Anaerobic and anoxic zones are separated using concrete baffle walls and mixers with submersible mixers. New fine pore aeration and control systems are provided in each aerated zone.
- A new RAS splitter structure to route RAS to each BNR train RAS denitrification zone.

- One new 75-foot diameter secondary clarifier with a 14-foot sidewater depth.
- Replacement of the existing final clarifier RAS pumps to increase overall RAS capacity to 5.8 mgd. Final clarifier 1 and 2 pumping capacity is increased to 1.0 mgd/clarifier and final clarifier 3 and 4 (new) pumping capacity is increased to 1.9 mgd/clarifier. The new secondary clarifier RAS pumps are located in the existing Filter and Control Building.
- Expansion of the existing Solids Handling Building to house blower expansion of two additional 3,000 scfm blowers and an additional primary sludge pump and grinder.
- New Filter Building to house the new deep bed continuous backwash filters and ferrous sulfate storage and chemical metering pumps.
- Modifications to the existing solids thickening and aerobic digestion facility are not required with this alternative.
- As mentioned above, large wet weather flow equalization is also required for this alternative but is discussed in the future *Headworks TM*.

Figure 4-2. Alterative 1 Site layout for 5-stage BNR improvements

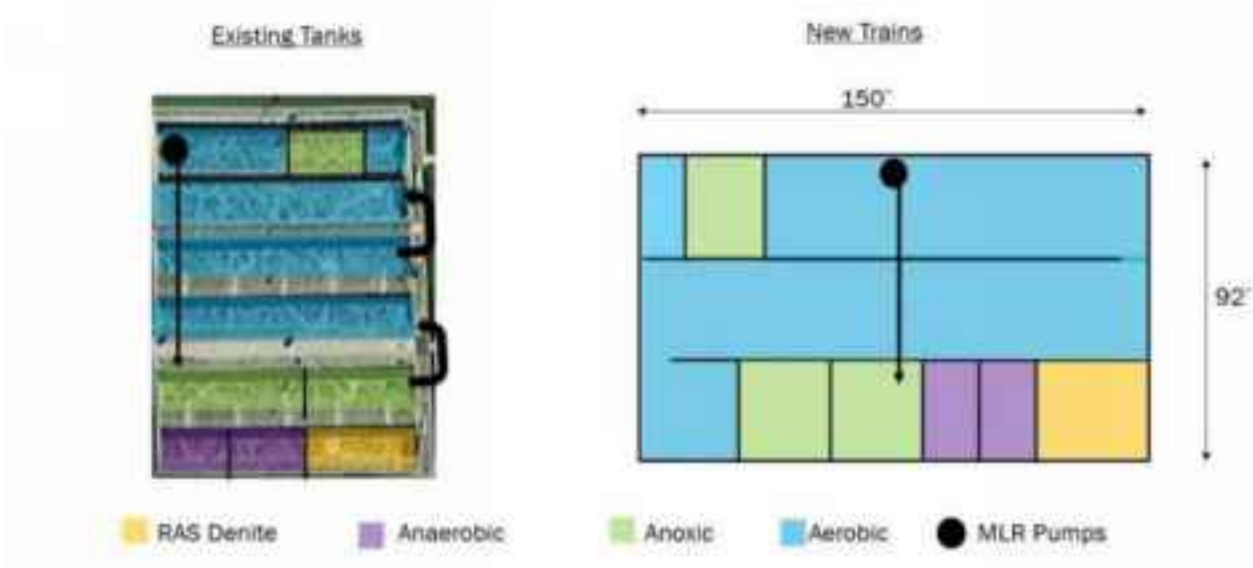


Figure 4-3. Alterative 1: 5-Stage BNR Train layout

Table 4-1. Treatment Level 1 Key Process Design Data (Year 2045)

Items	Units	Alternative 1 5-stage BNR with filters	Alternative 2 MBRs with Primary Treatment	Alternative 3 MBRs without Primary Treatment
Influent Flow				
Average	mgd	4.3	4.3	4.3
Peak hour wet weather flow	mgd	9.5	9.5	9.5
Primary Clarifiers				
Number	--	2-Exisiting, 1-New	2-Existing, 1-New	None
Diameter	feet	45	45	-
Average SOR	gal/ft^2-d	900	900	-
PHWWF SOR	gal/ft^2-d	2,100	2,000	-
BNR Tanks				
Total volume	MG	3.6	1.8	2.85
Number of trains	No.	3	5	5
Additional RAS Denitrification	MG	Combined w/ BNR	0.36	0.36
Solids retention time				
Total	d	18.4	16.8	16.5
Anaerobic	d	1.5	1.5	1.6
Aerobic	d	9.0	9.0	9.0
Anoxic (RAS/1st/2nd)	d	3.7/2.5/1.0	3.9/2.3/-	3.4/2.5/-
Maximum month MLSS	mg/L	4,200	8,500	8,600
Aeration airflow (average/peak)	scfm	3,400/8,400	3,400/7,100	5,000/10,300
BNR Solids Separation				
Type	--	Secondary Clarifiers	Membrane filtration	Membrane filtration
Number	No.	2 - Existing at 55’ 1 - Existing at 75’ 1 - New (75')	4 trains with 7 cassettes (new)[a]	4 trains with 7 cassettes (new)[a]
RAS	mgd/clarifier or total	1.0 for 55’1.9 for 75’	21	21
Design SVI	mL/g	125	NA	NA
MLSS at PHWWF	mg/L	3,400	12,000	12,000
PHWWF SOR	gal/ft^2-d	730	-	-
Peak hour SLR	lb/ft^2-d	36	-	-
Deep-Bed Continuous Backwash Filters				
Type	--	Single-stage	-	-
Total flow	mgd	9.7	None	None
Hydraulic loading	gal/ft^2-min	4.0	-	-
Average ferrous sulfate usage	gal/d	21	27	28
Annual solids production to digesters	lb TSS/d	10,500	10,350	8,500
Annual dewatering feed	lb TSS/d	6,100	6,260	6,180
Predicted Effluent Quality (average/max month)				
TP	mg/L	<0.09	<0.09	<0.09
TN	mg N/L	6/5	5/6	6/7
Ammonia	mg N/L	0.3/1.2	0.6/0.14	1.1/0.25

4.2 Alternative 2: Membrane Bioreactors (MBR) with Primary Treatment

Alternative 2 converts the existing activated sludge system into a 3-Stage BNR MBR system with a RAS deoxygenation/denitrification zone a shown in Figure 4-4. The secondary clarifiers and tertiary filters are replaced with a membrane filtration system for more efficient solids separation. The membrane system operates by separating mixed liquor suspended solids (MLSS) by microfiltration membranes producing better quality effluent than secondary clarification and tertiary filtration. Since membrane systems are not impacted by sludge settleability, the BNR system can operate at MLSS concentration of 2 to 2.5 times higher than conventional systems reducing the BNR bioreactor tankage requirements.

The membrane tank RAS flow of roughly 400 percent up to 21 mgd is recommended to maintain membrane tank TSS concentrations below 12,000 mg/L at peak loading conditions. BNR trains upstream of the membrane system have a MLR flow rate of 250 percent of the influent flow (up to 21 mgd). Additionally, 2-mm or 1-mm fine screens are required upstream of the BNR tanks to protect the membranes from debris.

Metal salt such as ferrous sulfate, alum, or equal is primarily dosed to the digesters to reduce phosphate returns in the dewatering centrate. Metal salt addition to the digesters is beneficial since it reduces the inert solids in the liquids stream (reduces BNR tank volume) and provides more stable EBPR operations. A small amount of metal salt addition may also be needed in the liquid stream just upstream of the MBR to meet effluent TP discharges based upon plant loadings. This analysis assumes ferrous sulfate is used for consistency with past operations and can be re-evaluated in detailed design. Additionally, carbon (Micro C or equal) addition to the RAS denitrification zones can be used to reduce nitrate in the anaerobic zone which would maximize EBPR performance.

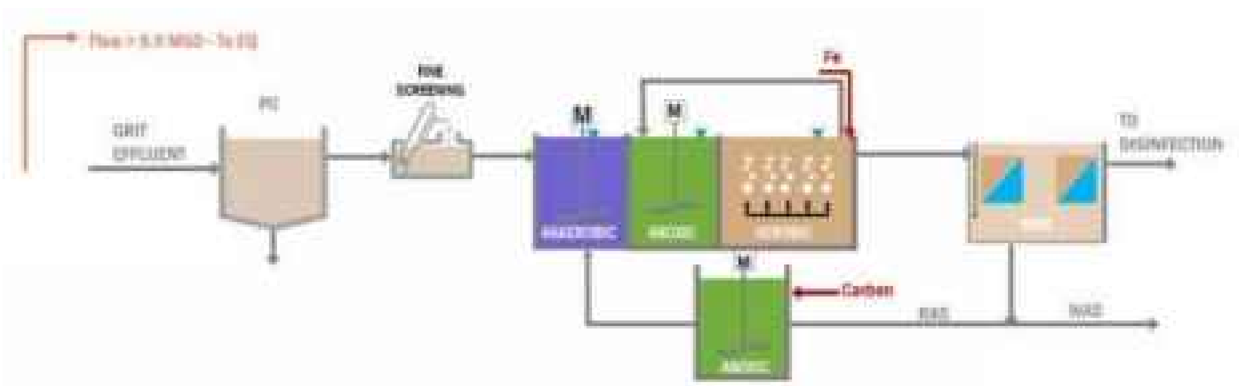


Figure 4-4. Alternative 2: MBR with Primary Treatment

Key improvements to implement Alternative 2 are shown in Figure 4-5 and include the following:

- A new primary clarifier splitter structure upstream of the primary settling tanks.
- One new 45-foot primary clarifier adjacent to the existing primary settling tanks. Replace existing primary clarifier collectors.
- Two new 9.5 mgd 2-mm fine screens housed in a new building located between the primary clarifiers and BNR tanks.

- Five 3-Stage BNR trains which include the existing aeration tanks being converted to three 0.36 MG BNR trains plus two new 0.36 MG BNR trains. Each BNR train includes a 2.9 mgd MLR pump station and piping to route flow back to the first anoxic zone as shown in Figure 4-6. Anaerobic and anoxic zones are separated using concrete baffle walls and mixers with submersible mixers. New fine pore aeration and control systems are provided in each aerated zone.
- Convert the existing 55-foot secondary clarifiers into 0.35 MG RAS deoxygenation/ denitrification basins.
- Modify or provide a new PE/RAS splitter structure to route flow to each BNR train.
- Add a new membrane filtration facility including a new building to enclose the submerged membrane units, four new membrane tanks each housing 7 membrane cassettes with room for two additional future cassettes, 4 new permeate pumps, chemical systems, and other ancillary equipment as shown in Figure 4-6. New 21 mgd RAS pump station to be located in the existing Filter and Control Building.
- Expansion of the existing Solids Handling Building to house blower expansion of one additional 3,300 scfm blower and an additional primary sludge pump and grinder.
- Convert the exiting 75-foot secondary clarifier to an equalization tank for centrate. stabilization to minimize the impacts of digester recycles on EBPR performance and stability. Further evaluation is recommended during detailed design.
- Modifications to the existing solids thickening and aerobic digestion facility are not required with this alternative.
- As mentioned above, large wet weather flow equalization is also required for this alternative but is discussed in the future *Headworks TM*.

Figure 4-5. Alterative 2 MBR with Primary Treatment site layout

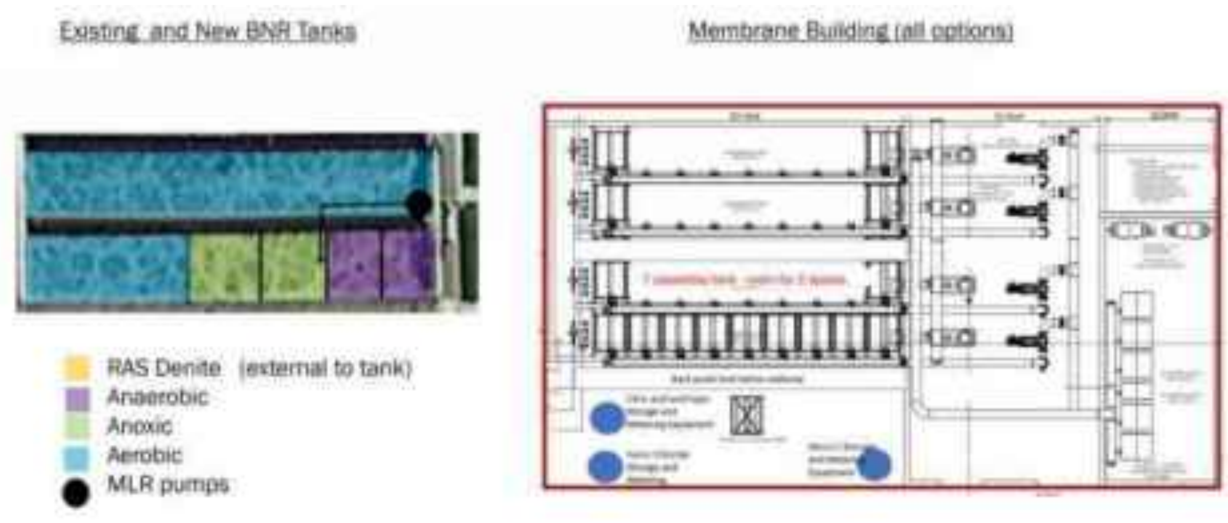


Figure 4-6. Alterative 2 bioreactor and membrane tank layout

4.3 Alternative 3: MBR without Primary Treatment

Alternative 3 is essentially the same as Alternative 2 except it eliminates the primary clarifiers from the process flow scheme as shown in Figure 4-7. Removing the primary clarifiers requires the BNR train volumes to be much larger with a total of 5 trains at 0.57 MG each. The secondary clarifiers and tertiary filters are again replaced with a MBR filtration system.

Again, metal salt is dosed to the digesters to control phosphorus in the centrate and carbon can be dosed to the RAS denitrification to remove nitrate. Flow equalization and fine screens would also be required as indicated previously.

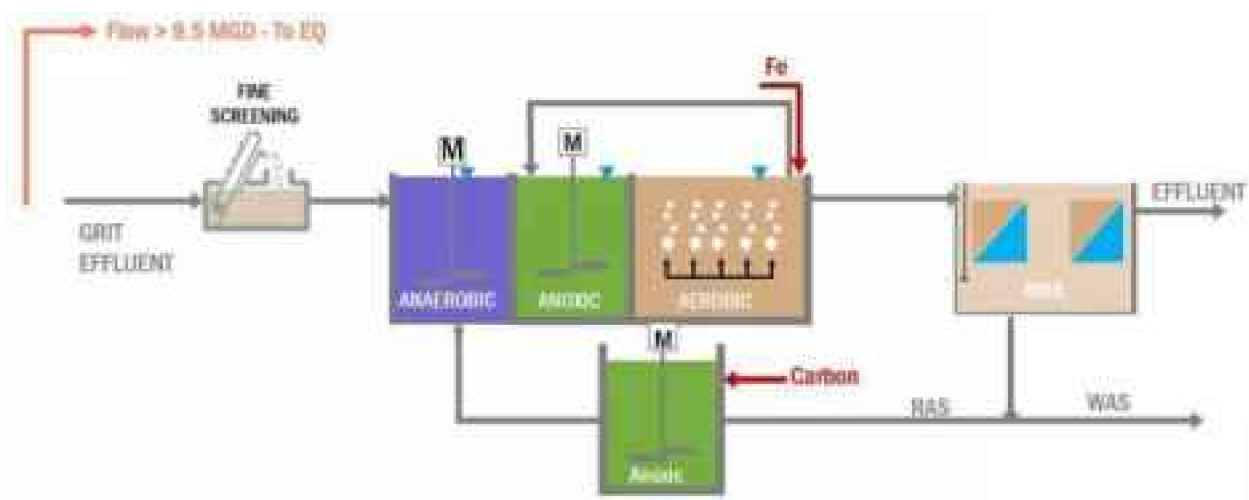


Figure 4-7. Alternative 3: MBR without Primary Treatment

Key improvements to implement Alternative 3 are shown in Figure 4-8 and include the following:

- Two new 9.5 mgd 1-mm fine screens housed in a New Fine Screenings Building upstream of the MBR.
- Convert the two existing 55-foot secondary clarifiers to RAS deoxygenation/denitrification basins.
- Five 5-Stage BNR trains which include the existing aeration tanks being converted to three new 0.57 BNR trains and two new 0.57 BNR trains. Each BNR train includes a 1.7 mgd MLR pump station and piping to route flow back to the first anoxic zone as shown in Figure 4-9. Anaerobic and anoxic zones are separated using concrete baffle walls and mixers with submersible mixers. New fine pore aeration and control systems are provided in each aerated zone.
- New membrane filtration facility as described under Alternative 2 (Figure 4-6).
- New RAS pumps to accommodate the MBR system and increase overall RAS capacity to 350 percent of influent flow up to 21 mgd. MBR pumping capacity RAS flow rate to 7 mgd per tank.
- Convert the exiting 75-foot secondary clarifier to centrate equalization tank to minimize the impacts to the MBR system and the impact of digester recycles on EBPR performance and stability.
- Expansion of the existing Solids Handling Building to house blower expansion of four additional 3,700 scfm blowers.
- As mentioned above, large wet weather flow equalization is also required for this alternative but is discussed in a separate TM.

Figure 4-8. Alterative 3: MBR without Primary Treatment site layout

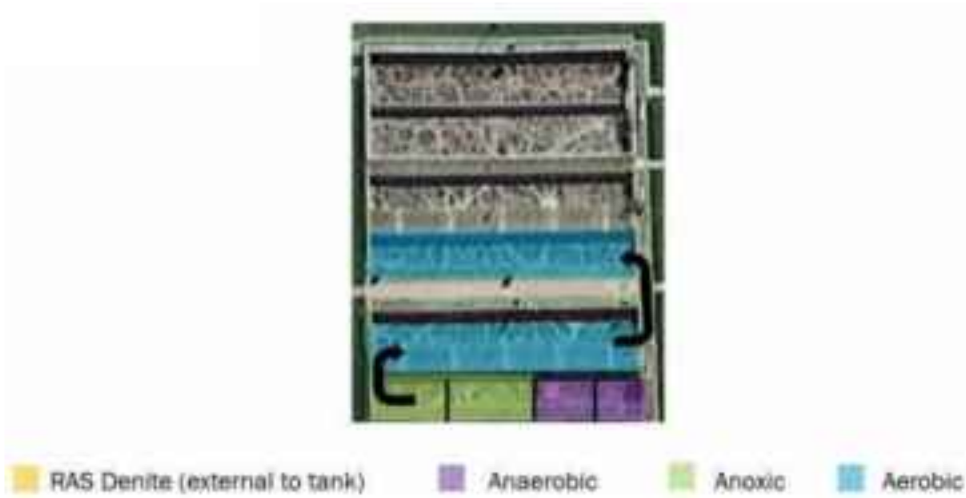


Figure 4-9. Alterative 3 BNR tank configuration

4.4 Economic Evaluation

Table 4-2 summarizes the capital costs, annual operating costs, and the net present value (NPV) of each Treatment Level 1 alternative. The capital costs and NPV for Alternative 1 are approximately 15 to 20 percent lower than Alternative 2 and 3 for Treatment Level 1. Treatment Level 2 in Section 5 shows the costs are roughly equal if chloride reduction is also considered.

Table 4-2. Treatment Level 1 Comparative Costs

Item	Units	Treatment Level 1		
		Alternative 1 5-stage BNR with filters	Alternative 2 MBRs with Primary Treatment	Alternative 3 MBRs without Primary Treatment
Capital Cost [a]	$ Millions	$46	$54	$54
Annual operating costs [a,b]	$ Millions	$0.18	$0.37	$0.40
Net Present Value [a]	$ Millions	$50	$59	$60

a. Cost presented in 2022 dollars

b. Annual operation and maintenance in first year of operation - 2035

A breakdown of the capital and annual O&M costs are provided in Appendix D. The key differences in operations costs between Alternatives 2 and 3 and Alternative 1 is increased energy requirements for the membrane filtration system ($40,000 to $50,000 annually) and membranes replacement costs, adding approximately $250,000 annually when spreading the replacement costs over a 15-

year period, though membrane salvage values is $125,000 annually bringing annual costs to $125,000. The business case evaluations for each alternative are provided in Appendix A.

4.5 Treatment Level 1 Sensitivity Analysis

A sensitivity analysis was performed on the Treatment Level 1 alternatives to evaluate the system requirements if the effluent TP monthly water quality criteria is reduced to 0.08 mg/L (mass loading limit at AWWF). The alternatives evaluated included:

- Alternative 1A: Alternative 1 with 2-stage deep-bed continuous backwash filters
- Alternative 2A: MBRs with primary treatment and Chemical phosphorus removal
- Alternative 2B: Alternative 2 with single stage continuous backwash filters

The findings of this sensitivity analysis are presented in Appendix E and in general concludes the following:

- Reducing TP discharges to 80 percent of the target effluent criteria (0.065 mg P/L) on a continuous basis presents a higher risk of permit non-compliance and near the edge of the best available of technology-based limits.
- Alternative 1A capital costs and NPV increase by roughly $5 Million dollars
- Alternative 2A using EBPR is at risk with the lower limits and may require the facility to convert to chemical phosphorus removal. If chemical phosphorus removal is required the NPV increases by $10 million,
- Alternative 2B NPV is essentially the same as Alternative 2A.

Section 5: Treatment Level 2

This section provides a high-level analysis of the facility requirements and cost to reduce total chloride levels to a daily maximum discharge of 252 mg/L. This analysis assumes the reported plant influent total chlorides concentrations from 2017 through 2021 (Figure 5-1) remain the same at future projected average flow and then decrease by 40 percent in the future as a result of chloride minimization efforts such as more efficient water softeners, ALP water softening or equal (Figure 5-2)

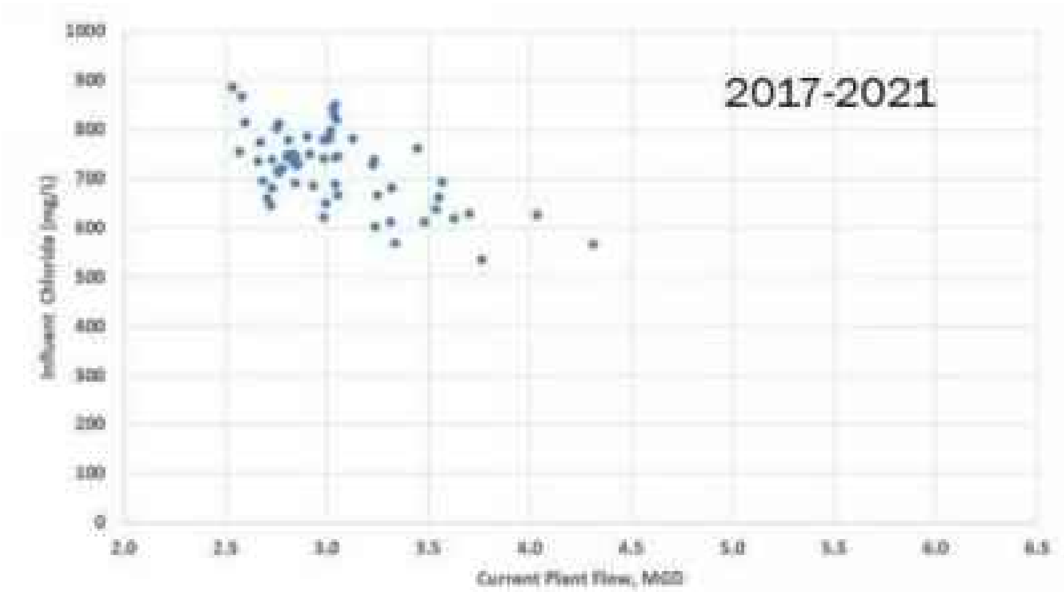


Figure 5-1. Plant influent total chloride concentrations (2017-2021)

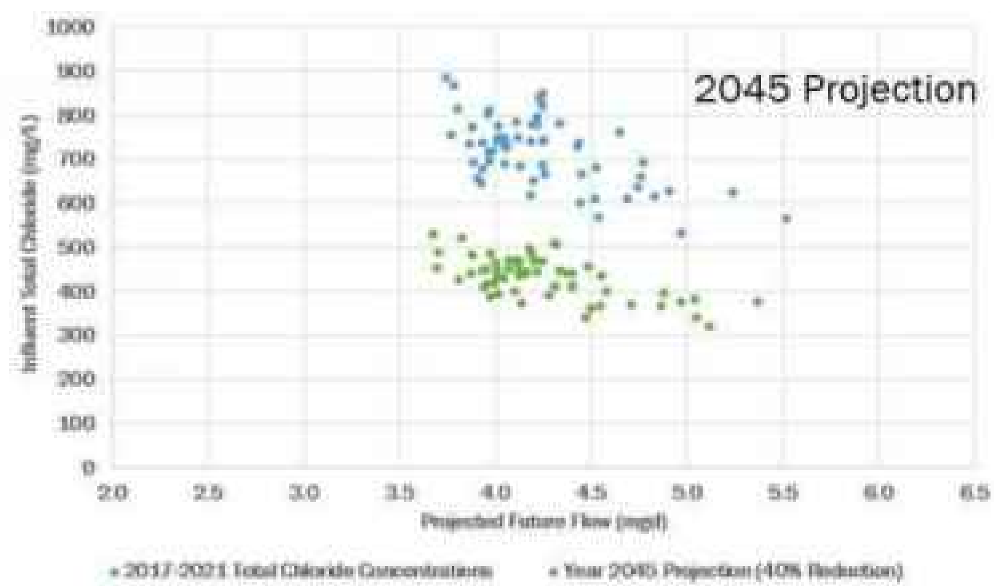


Figure 5-2. Projected Year 2045 influent total chloride concentrations (green markers)

This analysis assumes chloride reduction is completed through reverse osmosis and either microfiltration or nanofiltration is provided upstream for RO system pretreatment. For each alternative it is assumed reverse osmosis reduces chloride concentration by 98 percent and the chloride reduction system treats a baseline of flow through the RO system to achieve a blended RO/non-treated effluent of 215 mg/L. The analysis the influent total chloride mass loading of 18,000 lb/d through flows of 7 mgd and then assumes the chloride concentrations remain constant at 300 mg/L as shown in the blue line in Figure 5-3.

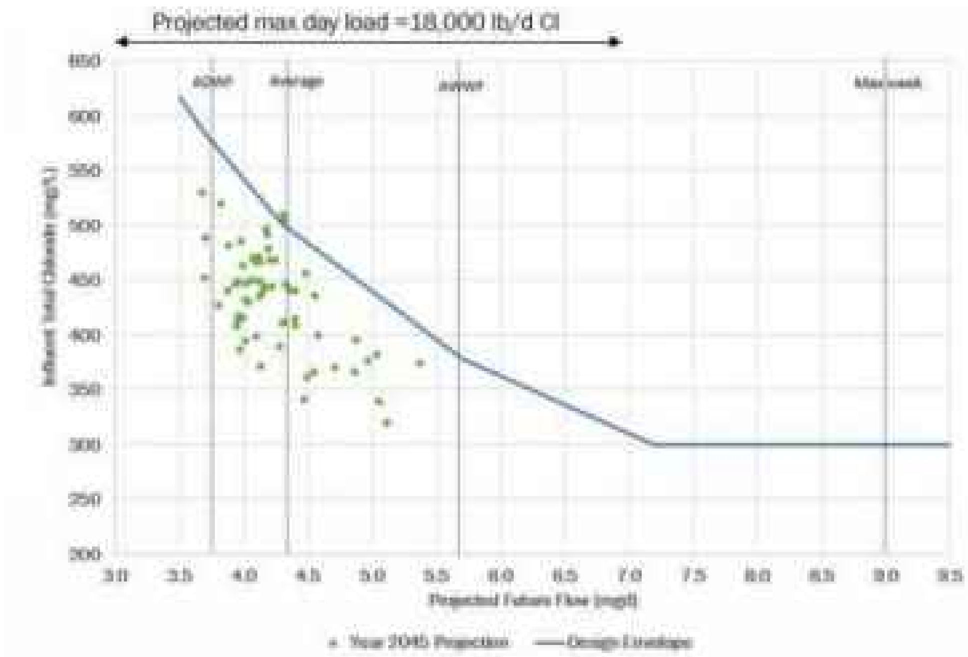


Figure 5-3. Projected Year 2045 influent total chloride maximum day design concentrations (blue Line)

Treatment Level 2 requirements were estimated for each of Treatment Level 1 technologies (Conventional BNR with filtration and MBRs) and included the following alternatives:

- Alternative 4: Alternative 1 with Microfiltration and Reverse Osmosis (MF/RO)
- Alternative 4A: Alternative 1 with Nanofiltration and Reverse Osmosis (NF/RO)
- Alternative 5: Alternative 2 with Reverse Osmosis (RO)

Each alternative assumes an RO concentrate management system consisting of an evaporator and crystallizer is used to remove excess water from the RO brine so the captured solids can be landfilled as non-hazardous waste.

Alternative 4 adds conventional microfiltration followed by reverse Osmosis (MF/RO) after or in parallel to the tertiary continuous backwash filters for chloride reduction. Alternative 4A adds nanofiltration and reverse osmosis (NF/RO) to Alternatives 1’s flow scheme. The advantage of this flow configuration is the divalent cations such as calcium and magnesium pass through the nanofiltration system resulting in lower loadings to the RO feed and downstream RO concentrate management system. Alternative 5 is representative of adding RO to Alternative 2 or 3's MBR configuration.

Table 1-3 summarizes Treatment Level 2 comparative order-of-magnitude costs and general facility requirements. Annual operating costs are based upon treating an average flow of 2.5 mgd. Alternative 5 has the lowest capital cost and net present values. Table 1-3 also shows Alternatives 4A and 5 combined costs for Treatment Level 1 and 2 are also the same with Alternative 5 being simpler as it has less unit processes to operate.

Table 5-1. ALASD WWTF Liquid Stream Alternative Evaluation Comparative Costs and Process Sizing – Treatment Level 2

Item	Units	Alternative 4 Alternative 1 with MF/RO	Alternative 4A Alternative 1 with NF/RO	Alternative 5 Alternative 2 with RO
Order-of-Magnitude Capital Costs[a]				
Filtration	$ Millions	$11	$13	--
Reverse Osmosis	$ Millions	$15	$15	$15
Concentrate Management	$ Millions	$27	$21[c]	$27
Total	$ Millions	$53	$50	$42
Annual operating costs[b]				
Filtration	$ Millions	$1.2	$1.7	--
Reverse Osmosis	$ Millions	$2.4	$2.4	$2.4
Concentrate Management	$ Millions	$3.1	$1.5[c]	$3.1
Total	$ Millions	$6.7	$5.7	$5.5
Net Present Value[a]	$ Millions	$140	$123	$110
Microfiltration or Nanofiltration				
Number of trains	--	4	4	--
Capacity per train	mgd/train	1.1	1.1	--
Reverse Osmosis				
Number of trains	--	4	4	4
Capacity per train	mgd/train	1.0	1.0	1.0
Combined Treatment Level 1 and 2 Order-of-Magnitude Costs				
Capital Cost[a]	$ Millions	$100	$97	$96
Annual operating costs[a,b]	$ Millions	$6.9	$5.9	$6.0
Net Present Value[a]	$ Millions	$190	$173	$170

Cost presented in 2022 dollars

Annual operation and maintenance in first year of operation - 2035

a. Capital costs based upon the following: Microfiltration cost of $2.6/gpd capacity, nanofiltration costs of $3/gpd capacity, reverse osmosis of $3.4/gpd capacity and RO concentrate management of $6.1/gpd capacity

b. Annual O&M costs based upon the following: Microfiltration cost of $0.0014/gallon treated, nanofiltration cost of $0.0020/gallon treated, reverse osmosis of $0.0027/gallon treated and RO concentrate management of $0.0035/gallon treated

c. NF/RO concentrate management capital costs of $4.9/gpd capacity and annual O&M of $0.0018/gal treated

Section 6: Recommendations

Each of the Treatment Level scenarios and alternatives were reviewed and discussed in detail during a September 20, 2022 workshop with ALASD and BC staff. Based on the review of the treatment alternatives and costs, Alternative 2: MBR with Primary Treatment was selected as the preferred alternative to meet Treatment Level 1 effluent water quality and Alternative 5: MBR with RO was selected to meet chloride reduction criteria established under Treatment Level 2. This pathway forward provides ALASD with the most robust treatment process which is critical given recent high industrial loadings have caused nitrification toxicity and poor sludge quality issues, provides excellent phosphorus removal to meet projected lower phosphorus discharge requirements, provides the most "phasable" approach to minimize near-term capital improvements, and supports the simplest and least expensive path forward to reduce chloride discharges using on-site treatment.

Additionally proposed approach is a good fit to meet potential future treatment needs related to sulfate discharge and the District is embarking on PFAS monitoring which may also play a role in the future need for the MBR with RO treatment scheme.

Section 7: Membrane Bioreactor Facility Tours

Both ALASD and BC staff participated in six MBR facility tours in the greater Atlanta Georgia area. Notes from each facility, including an overview of facility flows and effluent requirements, major processes, and detailed information on MBR system and recommendations, are included in Appendix F.

A summary of the key observations and takeaways from the site visits which should be further considered and/or evaluated during detailed design include the following:

1. Most plants used influent flow equalization to maintain a relatively constant flow to the BNR system throughout the day citing improved performance and ease of operation. Further evaluation of using the existing 75-foot secondary clarifier (460,000 gallons) for equalizing centrate as proposed plus equalizing influent diurnal flows/loadings should be evaluated. All flow equalization systems had odor control.
2. Screening is critical for successful operation. Detailed design should consider using 5 mm (vs 6 mm) perforated plates for the first screens and 1 mm screens for the fine screens if possible. Use of self-dumping hoppers (Hippo Hopper or equal) should be considered for collecting fine screenings which can then be unloaded via a fork truck into the main dumpster. Also, consider hot water spray to help remove grease.
3. The proposed Ovivo Ozzy Cup style fine screens and screenings slewing troughs were covered at both plants to contain/minimize spray water mist. Care should be taken to provide smooth transitions where the two screenings slewing channels will meet and around corners.
4. There are different schools of thought on the benefits of re-screening a portion of the RAS flow which ranged from 0 to 25 percent of the RAS flow. This should be further evaluated in detailed design.
5. Most plants used WEMCO grit cyclones and classifiers which produced a nice clean and dry grit. Consider classifier in detailed design.
6. Several plants reported issues with submersible mixers after 7-10 years. For cost savings these mixers were being replaced with Wilo brand mixers. In general, plants with surface mounted mixers (Invent or equal) were very happy with their performance and should be considered for detailed design.
7. One plant cited issues with using reversing rotary lobe pumps for permeate/backpulse

duties and other plants indicated they work very well. Initial thoughts are pump issues were related to programming on how fast the pumps are reversed. Plant with dedicated centrifugal pumps for permeate and backpulse operations had no reported operating issues. Detailed design should evaluate which approach best fits ALASD.

8. One plant identified the backpulse water storage tank was too small and backpulse cycles could also impact UV operations if excess flow is routed from the mainstream flow for backpulsing. This should be evaluated in detail to ensure sufficient volume is provided. Also – plant identified backpulse piping welds were corroding at the point of NaOCL addition. Plants replaced piping with PVC and issues have disappeared.
9. In general, provide ability to measured total RAS flow and consider ability to measure individual RAS pump flow in detailed design.
10. Consider grating over MBR tanks for walking in detailed design.
11. Scum accumulation was present in RAS Deox/denite tanks similar to tanks being proposed at ALASD. Ability to move scum to next tank or remove scum is needed – particularly in MN where scum freezes in mats.
12. Consider adding an emergency overflow from the RAS Deox/denite tank(s) to the influent wet weather flow equalization basin in detailed design.
13. All facilities subscribed to the SUEZ (now Veolia) “InSight” program in which SUEZ reviews the membrane operations monthly and provide reports on membrane performance and operation. Plant staff found this valuable to identify issues and/or confirm operating performance and needs.
14. Several plants used ferric chloride for phosphorus removal. They recently changed to alum and found membrane maintenance was much improved due to lower fouling rates.
15. All membrane plants reported fecal coliform counts in the MBR permeate were minimal/negligible (less than 200 /100 mL or even 23 counts/1000 mL). All plants ran their UV systems due to regulatory requirements, not meeting permit requirements. Design should consider hypochlorite for disinfection to save capital and operating costs.

References

Brown and Caldwell (BC). 2022. *Influent Flows and Loadings Technical Memorandum.* August 2.

Appendix A: Business Case Evaluations

Date Checked	Checked By	Job Number	By	Date	Calc No
11/4/2022	Don Esping	158466			
Project			Subject		
ALASD Facility Plan					

About This Calculation:

Author or Custodian	Anndee Huff Chester
Version	Final
Version Date	11/4/2022
Purpose	This spreadsheet compares business case evaluation (BCE) costs for the following alternatives:
General Approach	Input given values into the yellow cells in the proceeding calculations sheets. Calculated values will populate in the green cells. Calculations were performed in order to determine applicable costs.
Assumptions and Limitations	Alternative 1 - 5 Stage BNR Alternative 2 - 2 A/O MBR Alternative 2a - A/O MBR with Chemical P Removal Alternative 3 - No PST with MBR
General Instructions For Use	User Input: User input values Calculated: Calculated values
References or Resources	**Ten State Standards:** https://www.health.state.mn.us/communities/environment/water/docs/tenstates/tenstatestan2014.pdf

PROJECT NAME	ALASD Facility Plan			
ASSUMPTIONS				
Engineering Economics Analysis Inputs		Value		Source/Comment
Base Year		2022		Common for all alternatives. Reference year for all cost data input. Year of NPV.
Planning Period End		2045		Common for all alternatives.
Analysis Horizon (number of years)		24		
Annual Inflation (per year)		3.0%		
Engineering and Administration		15%		Engineering Fee Estimates are for planning purposes only
Undeveloped Design Details		0%		Set to zero if cost is generated by cost group
Construction Contingency		0%		Set to zero if cost is generated by cost group
Useful Lives (years)		Useful Life (yr)		
Building/Structures		40		
Process Piping		30		
Mechanical Equipment		20		
Electrical Equipment		20		
Instrumentation and Control Equipment		15		
Operation and Mainteance Cost Inputs	Unit	Unit Cost		Source/Comment
Labor (Operations)	FTE	$ 93,359		1.4 x hourley wage of plant operator $32.06, 2,080 hrs per year
Natural Gas	MMBTU	$ 14.10		Rates vary, based off June 2022 rate of $1.41/ THM (10 THM per MMBTU)
Electricity	KWHr	$ 0.0740		Electricity bill provided by ALASD w/ demand charges
SAF Polymer	lbs	$ 1.65		Estimated using *SAF Chemicals for liquids BCE only.xlsx*
Chlorine	Tons	$ 1,855.00		
Citric	lbs	$1.30		Vendor quote (Hawkins)
Membrane Replacement Costs	LS	$ 250,000.00		Vendor recommends every 15 years
Membrane Salvage Costs	LS	$ (125,000.00)		Salvage cost per vendor/Don.
Ferrous Sulfate	Gal	$ 2.28		12% Fe delivery concentration
Alum (Aluminum Sulfate Solution)	Gal	$ -		
SAF Floc aid/foam	Gal	$ -		LS provided in each alternative.
Sodium Bisulfite	Gal	$ 5.27		40% delivery concentration
Sodium Hypochlorite	Gal	$ 2.15		quoted cost from Hawkins in Fargo, ND, 12.5% concentration
Carbon (MicroC)	Gal	$ 3.25		quoted cost MicroC 2000 from EOSi in Denver, CO. Includes delivery.
Land Application	Wet Tons	$ 40.00		
Disposal of Screenings & Grit	Tons	$ 127.50		Annual disposal cost for grit and screenings is $14,174 for 111.17 tons
Dewatering	Dry Tons	$ 85.00	de	
Labor	LS	1%		Percent of Equipment Cost
Materials	LS	1%		Percent of Equipment Cost

PROJECT NAME	ALASD Facility Plan
Alternative	ALT 1

New Project/Improvement Time Line — Comments/Notes

Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 5,746,065	Capital =	$ 46,386,065	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 40,640,000			
Annual Operating Labor	$ 463,371	O & M =	$ 3,173,071	
Annual Operating Electricity	$ 1,610,757			
Annual Operating Non-Labor Other	$ 196,310			
Annual Maintenance Labor	$ 463,371			
Annual Maintenance Non-Labor	$ 439,262			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 49,559,135**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 40,640,000	$ 6,096,000	-	% Total Construction
Total Engineering Cost				**$ 6,096,000**	**$ 5,746,065**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	$ -	$ -	-	DIV 3-10, 12,13
Process Piping	LS	1		$ -	-	DIV 22
Mechanical Equipment	LS	1		$ -	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1		$ -	-	DIV 26
Instrumentation and Control Equipment	LS	1	$ -	$ -	-	DIV 27
Site Work	LS	1	$ -	$ -	-	DIV 2
Subtotal Bare Construction				$ 40,640,000	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	0%		$ -	-	Included in cost estimate numbers
Construction Contingency	0.00%	0%		$ -	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$ -	-	
Total Construction Phase Cost				**$ 40,640,000**	**$ 37,191,357**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	0.39	$ 36,410	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	1,710,365	$ 126,567	-	See Elec Breakdown Tab
SAF Polymer	lbs	$ 1.65	0	$ -	-	For SAF. Baseline - leave at 0. For Dewatering: Baseline - leave at 0.
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	lbs	$ 1.30	0	0	-	No MBR system.
Membrane Replacement Costs	LS	$ 250,000.00	0	$ -	-	No membranes
Ferrous Sulfate	Gal	$ 2.28	6,765	$ 15,425	-	From Biowin. Converted from ferric sulfate to ferrous sulfate. See Iron Calc Tab.
SAF Floc aid/foam	Gal	$ -	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.25	0	$ -	-	BioWin no carbon.
Land Application	Wet Tons	$ 40.00	0	$ -	-	Baseline
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	0	$ -	-	Baseline
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 36,410	$ 463,371	
Subtotal Non-Labor Operating Costs - Electricity				$ 126,567	$ 1,610,757	
Subtotal Non-Labor Operating Costs - Other				$ 15,425	$ 196,310	
Total Operating Costs				**$ 178,402**	**$ 2,270,438**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	0.39	$ 36,410	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
☐ Check to include		$0	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$3,451,550	1.00%	$ 34,516		
☑ Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each				-	
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 36,410	$ 463,371	
Subtotal Annual Non-Labor Maintenance Costs				$ 34,516	$ 439,262	
Total Annual Maintenance Costs				**$ 70,925**	**$ 902,633**	

PROJECT NAME	ALASD Facility Plan
Alternative	ALT 2

New Project/Improvement Time Line — Comments/Notes

Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 6,628,334	Capital =	$ 53,508,334	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 46,880,000			
Annual Operating Labor	$ 478,326	O & M =	$ 5,715,663	
Annual Operating Electricity	$ 2,178,291			
Annual Operating Non-Labor Other	$ 2,102,394			
Annual Maintenance Labor	$ 478,326			
Annual Maintenance Non-Labor	$ 478,326			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 59,223,997**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 46,880,000	$ 7,032,000	-	% Total Construction
Total Engineering Cost				**$ 7,032,000**	**$ 6,628,334**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	-	$ -	-	DIV 3-10, 12,13
Process Piping	LS	1		$ -	-	DIV 22
Mechanical Equipment	LS	1		$ -	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1		$ -	-	DIV 26
Instrumentation and Control Equipment	LS	1	-	$ -	-	DIV 27
Site Work	LS	1	-	$ -	-	DIV 2
Subtotal Bare Construction				$ 46,880,000	-	RAS splitter (0.45M) + Clarifier mods to mixing tanks (0.38M) - RAS basins/splitter ($2.4M) = $1.6 M savings (Comment from D
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	0%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	0.00%	0%		$ -	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$ -	-	
Total Construction Phase Cost				**$ 46,880,000**	**$ 42,901,841**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	0.40	$ 37,585	-	Match to 1% maintenance cost
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	2,312,996	$ 171,162	-	See Elec Breakdown tab.
SAF Polymer	lbs	$ 1.65	0	$ -	-	For SAF. Baseline - set to 0. For dewatering - assume negligible.
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	lbs	$ 1.30	3,166	$ 4,116	-	Vendor: 306 gal/year. SG is 1.24.
Membrane Replacement Costs	LS	$ 250,000.00	1	$ 250,000	-	
Membrane Salvage Costs	LS	$ (125,000.00)	1	$ (125,000)	-	
Ferrous Sulfate	Gal	$ 2.28	8,741	$ 19,931	-	From Biowin. Converted from ferric sulfate to ferrous sulfate. See Iron Calc Tab.
SAF Floc aid/foam	Gal	$ -	0	$ -	-	For SAF. Baseline - set to 0.
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	4,925	$ 10,589	-	Vendor quote.
Carbon (MicroC)	Gal	$ 3.25		$ -	-	From Biowin.
Land Application	Wet Tons	$ 40.00	139	$ 5,562	-	Baseline
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	0	$ -	-	Baseline
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 37,585	$ 478,326	
Subtotal Non-Labor Operating Costs - Electricity				$ 171,162	$ 2,178,291	
Subtotal Non-Labor Operating Costs - Other				$ 165,198	$ 2,102,394	
Total Operating Costs				**$ 373,945**	**$ 4,759,011**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	0.40	$ 37,585	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
☐ Check to include		$0	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$3,758,500	1.00%	$ 37,585		
☑ Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-	$ -	-	Per year membrane replacement cost (15 year)
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 37,585	$ 478,326	
Subtotal Annual Non-Labor Maintenance Costs				$ 37,585	$ 478,326	
Total Annual Maintenance Costs				**$ 75,170**	**$ 956,652**	

PROJECT NAME	ALASD Facility Plan
Alternative	ALT 2A

New Project/Improvement Time Line — Comments/Notes

Year of Planning Phase Expenditure	2022
Year of Design Phase Expenditure	2024
Year of Major Construction Cost	2025
First Year of Operation	2027

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 7,281,553	Capital =	$ 58,781,553	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 51,500,000			
Annual Operating Labor	$ 530,718	O & M =	$ 11,659,985	
Annual Operating Electricity	$ 2,515,126			
Annual Operating Non-Labor Other	$ 7,552,706			
Annual Maintenance Labor	$ 530,718			
Annual Maintenance Non-Labor	$ 530,718			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 70,441,539**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 51,500,000	$ 7,725,000	-	% Total Construction
Total Engineering Cost				**$ 7,725,000**	**$ 7,281,553**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	-	$ -	-	DIV 3-10, 12,13
Process Piping	LS	1		$ -	-	DIV 22
Mechanical Equipment	LS	1		$ -	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1		$ -	-	DIV 26
Instrumentation and Control Equipment	LS	1	-	$ -	-	DIV 27
Site Work	LS	1	-	$ -	-	DIV 2
Subtotal Bare Construction				$ 51,500,000	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	0%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	0.00%	0%		$ -	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$ -	-	
Total Construction Phase Cost				**$ 51,500,000**	**$ 47,129,795**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	0.45	$ 41,702	-	Match to 1% maintenance cost
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	2,670,661	$ 197,629	-	Blowers: 130 kW
SAF Polymer	lbs	$ 1.65	11,655	$ 19,231	-	Estimate based off SAF poly and Dewater poly tabs. Includes both SAF and Dewatering.
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	lbs	$ 1.30	3,166	$ 4,116	-	Vendor: 306 gal/year. SG is 1.24.
Membrane Replacement Costs	LS	$ 250,000.00	1.000	$ 250,000	-	
Membrane Salvage Costs	LS	$ (125,000.00)	1.000	$ (125,000)		
Ferrous Sulfate	Gal	$ 2.28	149,954	$ 341,895	-	From Biowin. Converted from ferric sulfate to ferrous sulfate. See Iron Calc Tab.
Alum (Aluminum Sulfate Solution)	Gal	$ -	-	$ -	-	
SAF Floc aid/foam	Gal	$ -	1,346	$ 1,346	-	Estimated from SAF Floc aid tab.
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	4,925	$ 10,589	-	Vendor quote.
Carbon (MicroC)	Gal	$ 3.25	0	$ -	-	From BioWin
Land Application	Wet Tons	$ 40.00	1,425	$ 57,014	-	Estimated on Land app Dewater Iron Calc Tab
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	403	$ 34,272	-	
Other Non Labor	each	$ -	-	$ -	-	Estimated on Land app Dewater Iron Calc Tab
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 41,702	$ 530,718	
Subtotal Non-Labor Operating Costs - Electricity				$ 197,629	$ 2,515,126	
Subtotal Non-Labor Operating Costs - Other				$ 593,462	$ 7,552,706	
Total Operating Costs				**$ 832,793**	**$ 10,598,550**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	0.45	$ 41,702	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
☑ Check to include		$0	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$4,170,175	1.00%	$ 41,702		
☑ Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-	$ -	-	Per year membrane replacement cost (15 year)
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 41,702	$ 530,718	
Subtotal Annual Non-Labor Maintenance Costs				$ 41,702	$ 530,718	
Total Annual Maintenance Costs				**$ 83,404**	**$ 1,061,435**	

PROJECT NAME	ALASD Facility Plan
Alternative	ALT 3

New Project/Improvement Time Line — Comments/Notes

Year of Planning Phase Expenditure	2022
Year of Design Phase Expenditure	2024
Year of Major Construction Cost	2025
First Year of Operation	2027

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 6,708,926	Capital =	$ 54,158,926	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 47,450,000			
Annual Operating Labor	$ 420,471	O & M =	$ 5,975,451	
Annual Operating Electricity	$ 2,107,314			
Annual Operating Non-Labor Other	$ 2,606,724			
Annual Maintenance Labor	$ 420,471			
Annual Maintenance Non-Labor	$ 420,471			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 60,134,378**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 47,450,000	$ 7,117,500	-	% Total Construction
Total Engineering Cost				**$ 7,117,500**	**$ 6,708,926**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	-	$ -	-	DIV 3-10, 12,13
Process Piping	LS	1		$ -	-	DIV 22
Mechanical Equipment	LS	1		$ -	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1		$ -	-	DIV 26
Instrumentation and Control Equipment	LS	1	-	$ -	-	DIV 27
Site Work	LS	1	-	$ -	-	DIV 2
Subtotal Bare Construction				$ 47,450,000	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	0%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	0.00%	0%		$ -	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$ -	-	
Total Construction Phase Cost				**$ 47,450,000**	**$ 43,423,472**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	0.35	$ 33,039	-	Match to 1% maintenance cost
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	2,237,630	$ 165,585	-	
SAF Polymer	lbs	$ 1.65	6,604	$ 10,897	-	Estimate based off SAF poly and Dewater poly tabs. Includes both SAF and Dewatering.
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	lbs	$ 1.30	3,166	$ 4,116	-	Vendor: 306 gal/year. SG is 1.24.
Membrane Replacement Costs	LS	$ 250,000.00	1.000	$ 250,000	-	Per year membrane replacement cost (15 year)
Membrane Salvage Costs	LS	$ (125,000.00)	1	$ (125,000)	-	
Ferrous Sulfate	Gal	$ 2.28	8,986	$ 20,487	-	From Biowin. Converted from ferric sulfate to ferrous sulfate. See Iron Calc Tab.
SAF Floc aid/foam	Gal	$ -	4,100	$ 4,100	-	Estimated from SAF Floc aid tab.
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	4,925	$ 10,589	-	Vendor quote.
Carbon (MicroC)	Gal	$ 3.25		$ -	-	From BioWin
Land Application	Wet Tons	$ 40.00	741	$ 29,637	-	Estimated on Land app Dewater Iron Calc Tab
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	0	$ -	-	Estimated on Land app Dewater Iron Calc Tab
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 33,039	$ 420,471	
Subtotal Non-Labor Operating Costs - Electricity				$ 165,585	$ 2,107,314	
Subtotal Non-Labor Operating Costs - Other				$ 204,826	$ 2,606,724	
Total Operating Costs				**$ 403,450**	**$ 5,134,509**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	0.35	$ 33,039	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
☑ Check to include		$0	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$3,303,900	1.00%	$ 33,039		
☑ Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-		-	
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Administrative Overhead at 0 %				$ -	-	Treated as Labor
Subtotal Annual Labor Maintenance Costs				$ 33,039	$ 420,471	
Subtotal Annual Non-Labor Maintenance Costs				$ 33,039	$ 420,471	
Total Annual Maintenance Costs				**$ 66,078**	**$ 840,942**	

Appendix B: Wastewater Characterization Sampling

Raw Influent Data

Date	Total Flow mgd	COD mg/L	SCOD mg/L	ffCOD mg/L	VFAs mg/L as COD	cBOD5 mg/L	sBOD5 mg/L	TKN mg/L as N	sTKN mg/L as N	NH3 mg/L as N	(Grab) Nitrate as N, mg/L	Total P mg/L as P	Soluble P mg/L as P	OrthoP mg/L as P	TSS mg/L	VSS mg/L	pH	Temp deg C	Mg mg/L	Ca mg/L
3/7/2022	3.09	536	196	154	28.6	184	71	38.7	27.4	22.4	0.00	4.4	2.91	2.43	251	216	7.33	12.6	38.9	113
3/8/2022	3.00	682	336	295	20.4	250	178	36.90	24.2	18.3	0.54	4.49	2.97	2.47	270	235	7.21	12.4	36.9	107
3/9/2022	3.13	664	335	299	47.3	220	142	38.20	26.2	20	0.44	4.47	2.72	2.46	242	223	7.1	12.9	41.7	118
3/10/2022	3.05	753	351	308	45.8	295	169	38.10	23.9	19.4	0.15	4.81	2.97	2.65	280	256	7.14	12.8	40.8	117
3/11/2022	3.03	658	283	236	15.4	249	112	38.50	26	20.3	0.28	5.56	3.19	3.06	266	242	7.6	11.7	40.0	111
3/12/2022	3.09	603	237	188	25.5	188	58	40.00	25.4	21.4	0.08	5.77	3.44	3.17	281	246	7.33	11.6	40.5	111.0
3/13/2022	3.01	693	251	207	44.1	212	76	39.90	25.1	20.8	0.08	5.18	3.15	2.85	312	265	7.2	12.5	40.9	113.0
Average	**3.0**	**656**	**284**	**241**	**32**	**228**	**115**	**39**	**25**	**20**	**0.0**	**5.0**	**3.0**	**2.7**	**272**	**240**	**7.0**	**12**	**40**	**113**
Median	**3.1**	**664**	**283**	**236**	**28.6**	**220**	**112**	**38.5**	**25.4**	**20.3**	**0.2**	**4.8**	**3.0**	**2.6**	**270**	**242**	**7.2**	**12.5**	**41**	**113**
Minimum	**3.0**	**536**	**196**	**154**	**15.4**	**184**	**58**	**36.9**	**23.9**	**18.3**	**0.0**	**4.4**	**2.7**	**2.4**	**242**	**216**	**7.1**	**11.6**	**37**	**107**
Maximum	**3.1**	**753**	**351**	**308**	**47.3**	**295**	**178**	**40.0**	**27.4**	**22.4**	**0.5**	**5.8**	**3.4**	**3.2**	**312**	**265**	**7.6**	**12.9**	**42**	**118**

Ratios

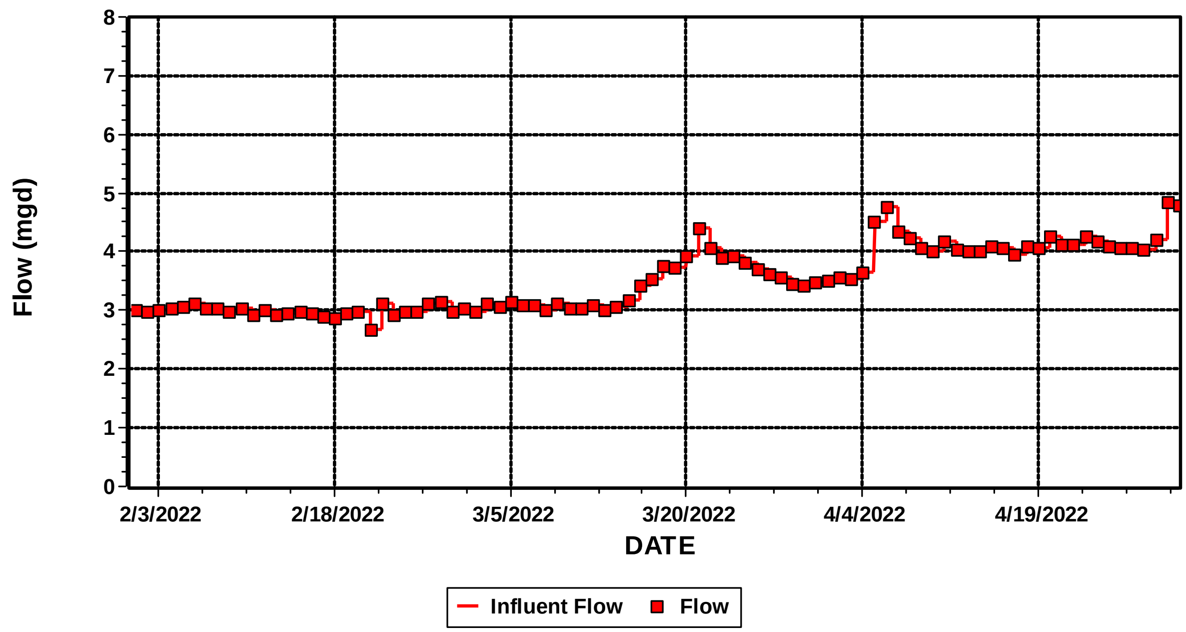
	GENERAL				SOLIDS CHARACTERIZATION							
Date	TKN:COD	TP:TKN	COD:TP	cBOD5: TSS	sTKN:TKN	ISS	Fcvxi/s pCOD:VSS	pN:VSS	pP:VSS	FupN pN/pCOD	FupP pP:pCOD	Fna NH3:TKN
3/7/2022	0.07	0.114	121	0.73	0.71	35	1.57	0.052	0.013	0.033	0.008	0.58
3/8/2022	0.05	0.122	152	0.93	0.66	35	1.47	0.054	0.012	0.037	0.008	0.50
3/9/2022	0.06	0.117	149	0.91	0.69	19	1.48	0.054	0.014	0.036	0.009	0.52
3/10/2022	0.05	0.126	157	1.05	0.63	24	1.57	0.055	0.014	0.035	0.009	0.51
3/11/2022	0.06	0.144	118	0.94	0.66	24	1.55	0.053	0.018	0.034	0.012	0.53
3/12/2022	0.07	0.144	105	0.67	0.64	35	1.49	0.059	0.017	0.040	0.012	0.54
3/13/2022	0.06	0.130	134	0.68	0.63	47	1.67	0.056	0.016	0.033	0.010	0.52
Average	**0.06**	**0.13**	**133.56**	**0.84**	**0.66**	**31.29**	**1.54**	**0.05**	**0.02**	**0.04**	**0.01**	**0.53**
Median	**0.06**	**0.13**	**133.78**	**0.91**	**0.66**	**35.00**	**1.55**	**0.05**	**0.01**	**0.04**	**0.01**	**0.52**
Minimum	**0.05**	**0.11**	**104.51**	**0.67**	**0.63**	**19.00**	**1.47**	**0.05**	**0.01**	**0.03**	**0.01**	**0.50**
Maximum	**0.07**	**0.14**	**156.55**	**1.05**	**0.71**	**47.00**	**1.67**	**0.06**	**0.02**	**0.04**	**0.01**	**0.58**

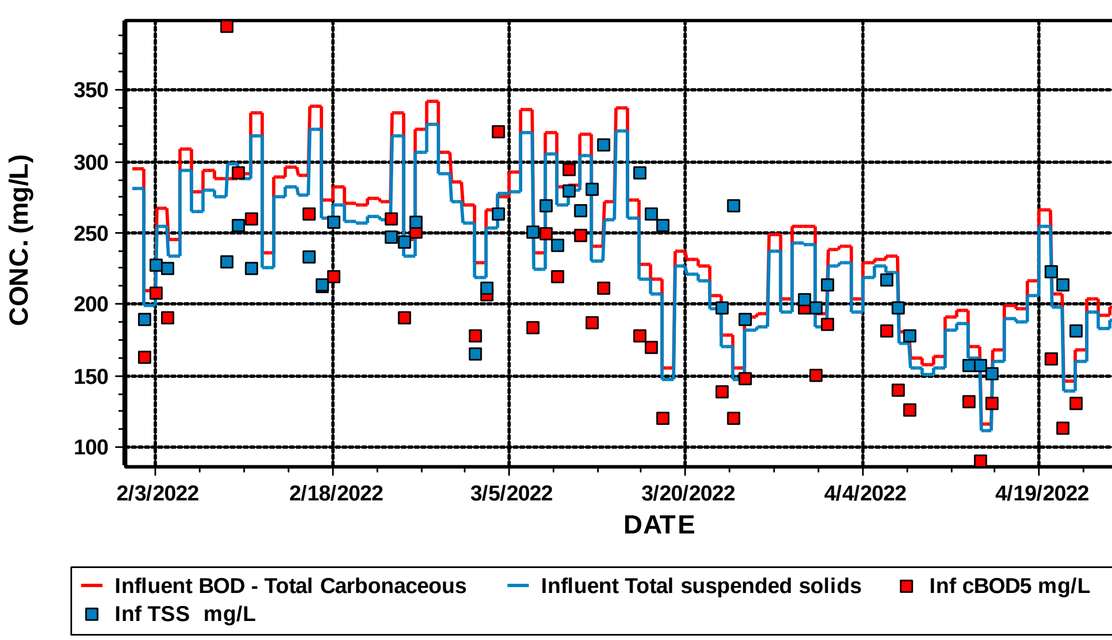
Ratios

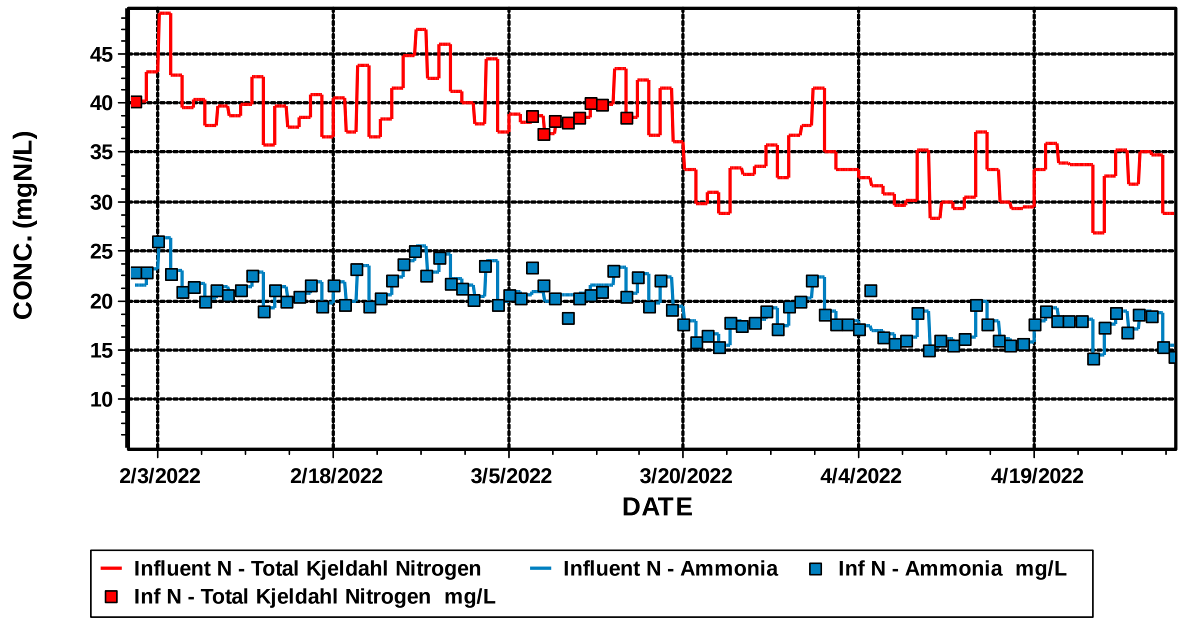
	COD FRACTIONS											
Date	COD:cBOD	SCOD:COD	RBCOD	colCOD	Fbs	Fus	VFA:RBCOD	Fpo4 PO4-P:TP	ISS:COD	COD:TSS	FFCOD: SCOD	Fxnb
3/7/2022	2.9	0.37	96	42	0.18	0.11	0.30	0.24	0.065	2.1	0.79	0.56
3/8/2022	2.7	0.49	241	41	0.35	0.08	0.08	0.24	0.051	2.5	0.88	0.52
3/9/2022	3.0	0.50	243	36	0.37	0.08	0.19	0.27	0.029	2.7	0.89	0.49
3/10/2022	2.6	0.47	253	43	0.34	0.07	0.18	0.20	0.032	2.7	0.88	0.62
3/11/2022	2.6	0.43	176	47	0.27	0.09	0.09	0.18	0.036	2.5	0.83	0.57
3/12/2022	3.2	0.39	130	49	0.22	0.10	0.20	0.22	0.058	2.1	0.79	0.69
3/13/2022	3.3	0.36	152	44	0.22	0.08	0.29	0.11	0.068	2.2	0.82	0.66
Average	2.90	0.43	184.34	43.14	0.28	0.09	0.19	0.21	0.048	2.42	0.84	0.59
Median	2.91	0.43	175.70	43.00	0.27	0.08	0.19	0.22	0.051	2.47	0.83	0.57
Minimum	2.55	0.36	96.00	36.00	0.18	0.07	0.08	0.11	0.029	2.14	0.79	0.49
Maximum	3.27	0.50	252.80	49.00	0.37	0.11	0.30	0.27	0.068	2.74	0.89	0.69

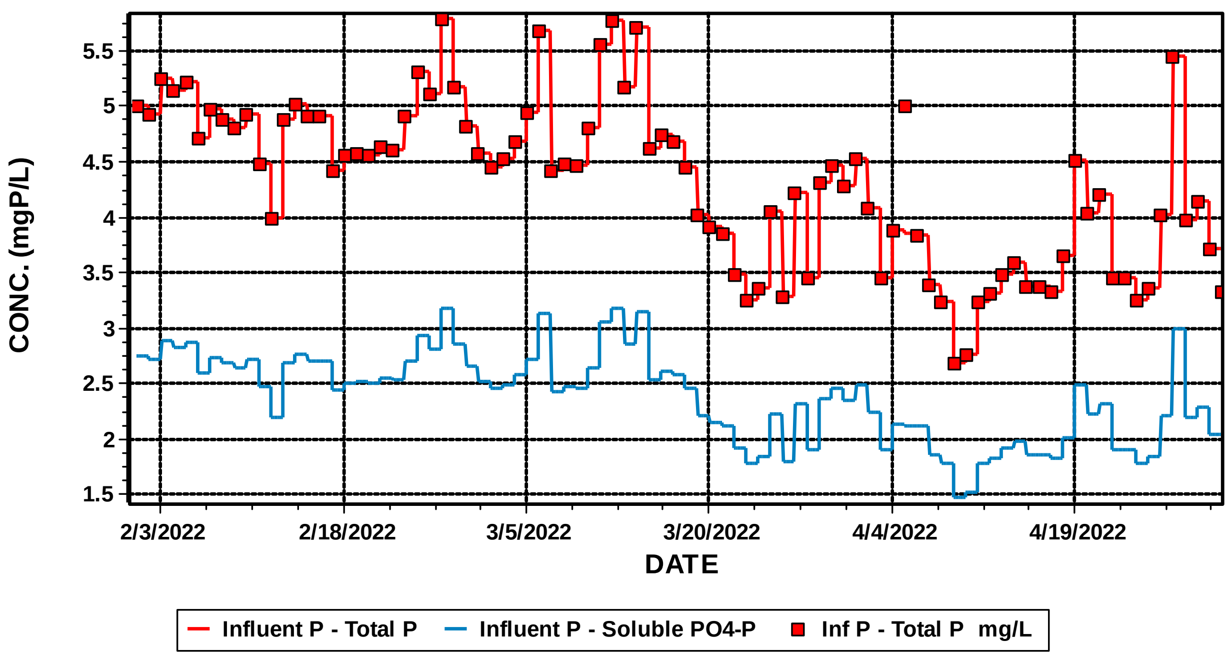
Appendix C: BioWin Model Validation Figures

Influent

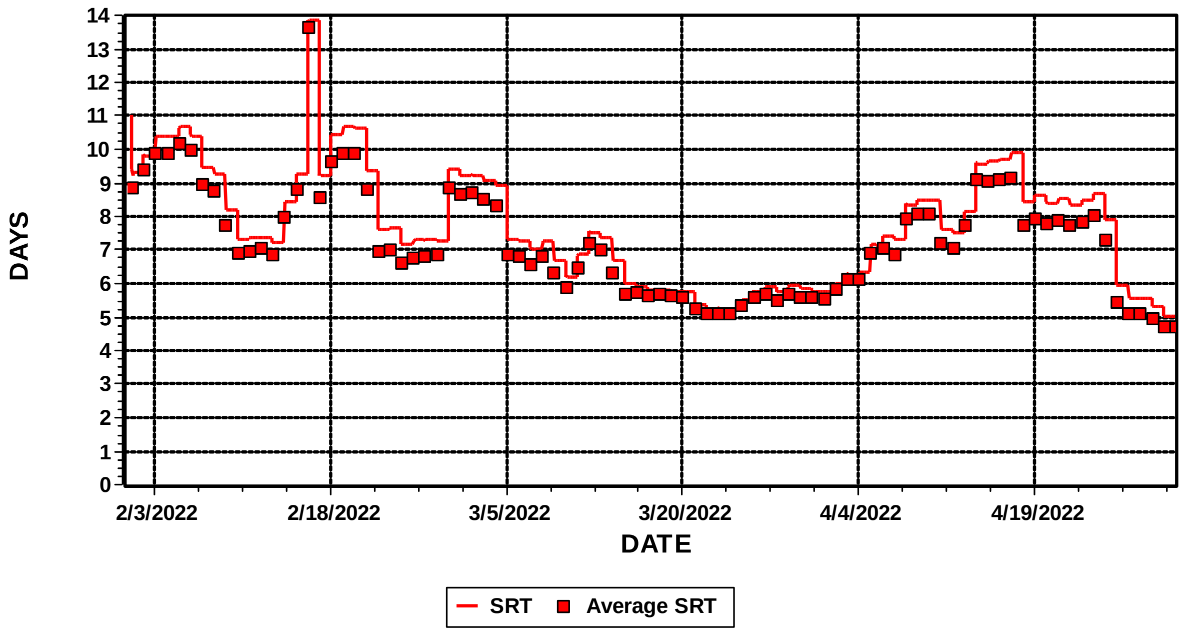

Flow (mgd)
8
7
6
5
4
3
2
1
0
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Influent Flow
Flow

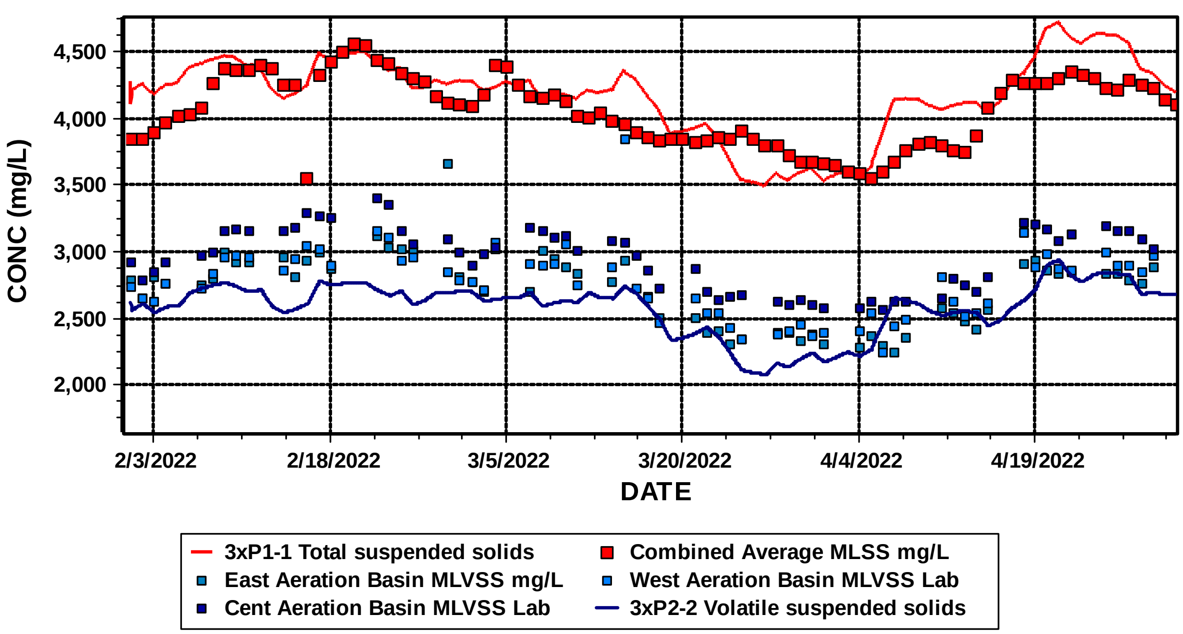

CONC. (mg/L)
350
300
250
200
150
100
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Influent BOD - Total Carbonaceous
Influent Total suspended solids
Inf cBOD5 mg/L
Inf TSS mg/L

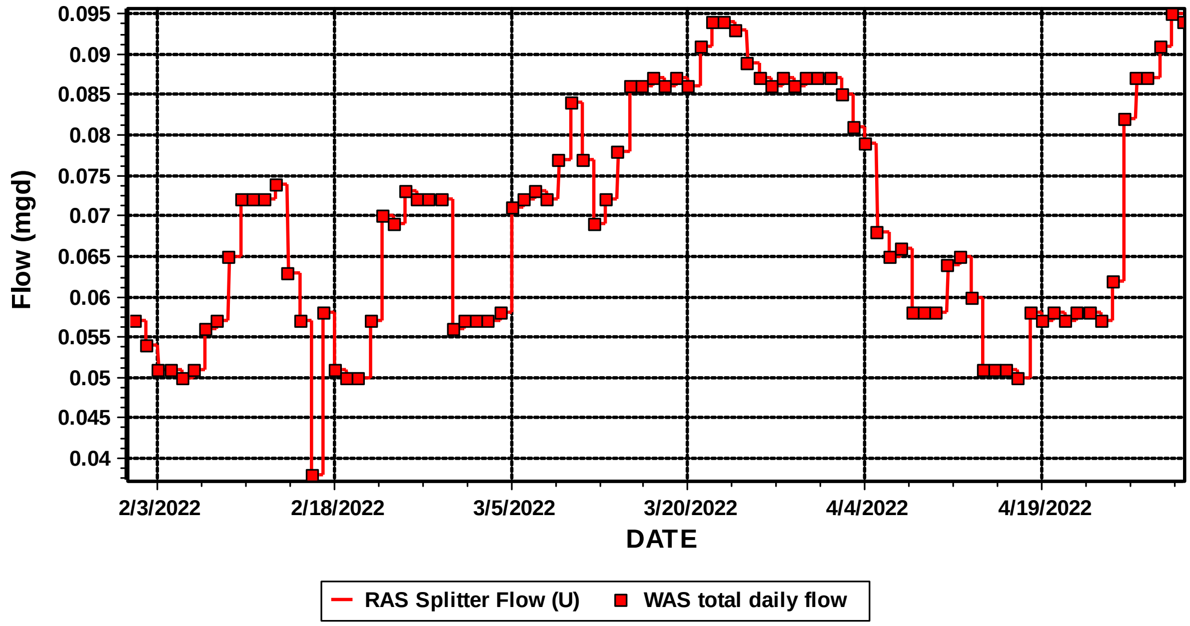

CONC. (mgN/L)
45
40
35
30
25
20
15
10
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Influent N - Total Kjeldahl Nitrogen
Influent N - Ammonia
Inf N - Ammonia mg/L
Inf N - Total Kjeldahl Nitrogen mg/L

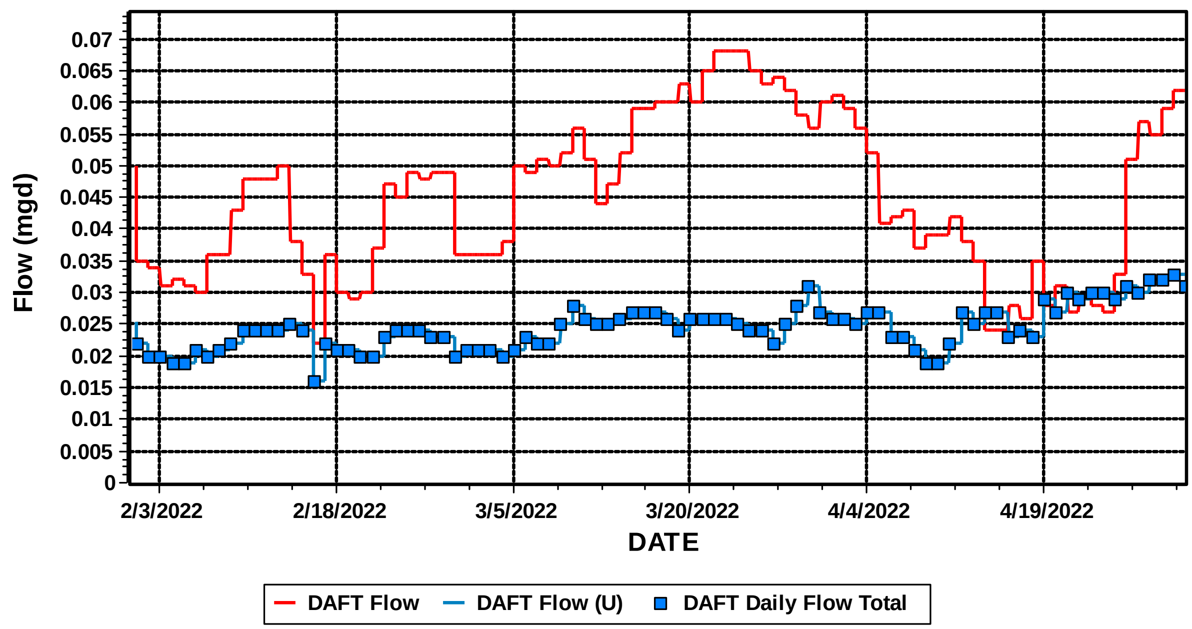

CONC. (mgP/L)
5.5
5
4.5
4
3.5
3
2.5
2
1.5
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Influent P - Total P
Influent P - Soluble PO4-P
Inf P - Total P mg/L

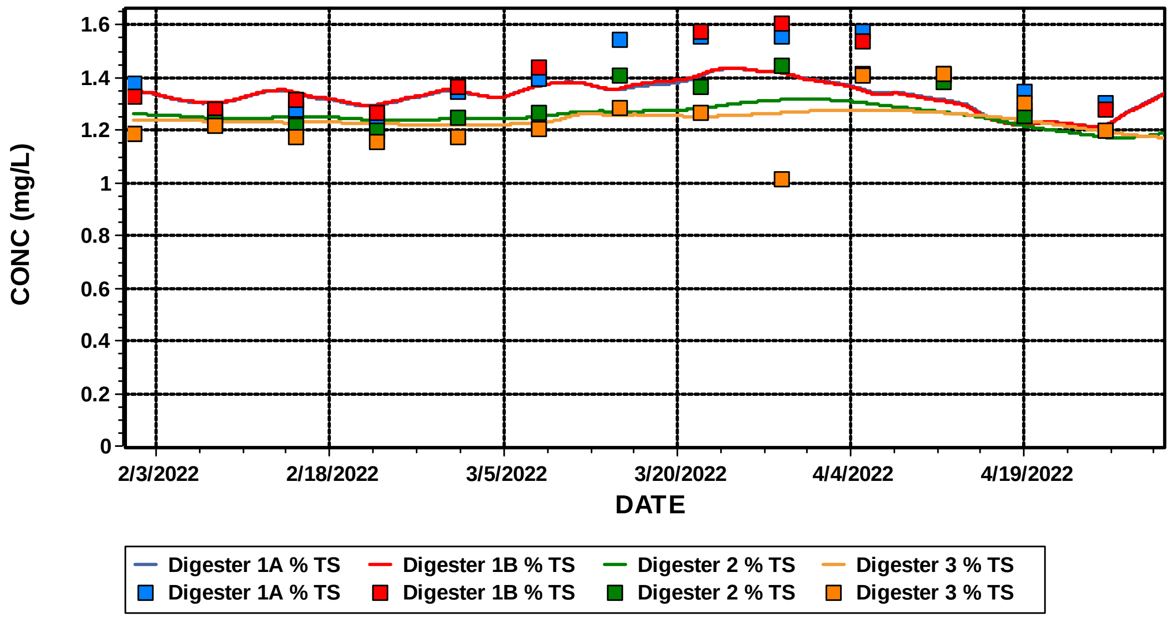
Operations data



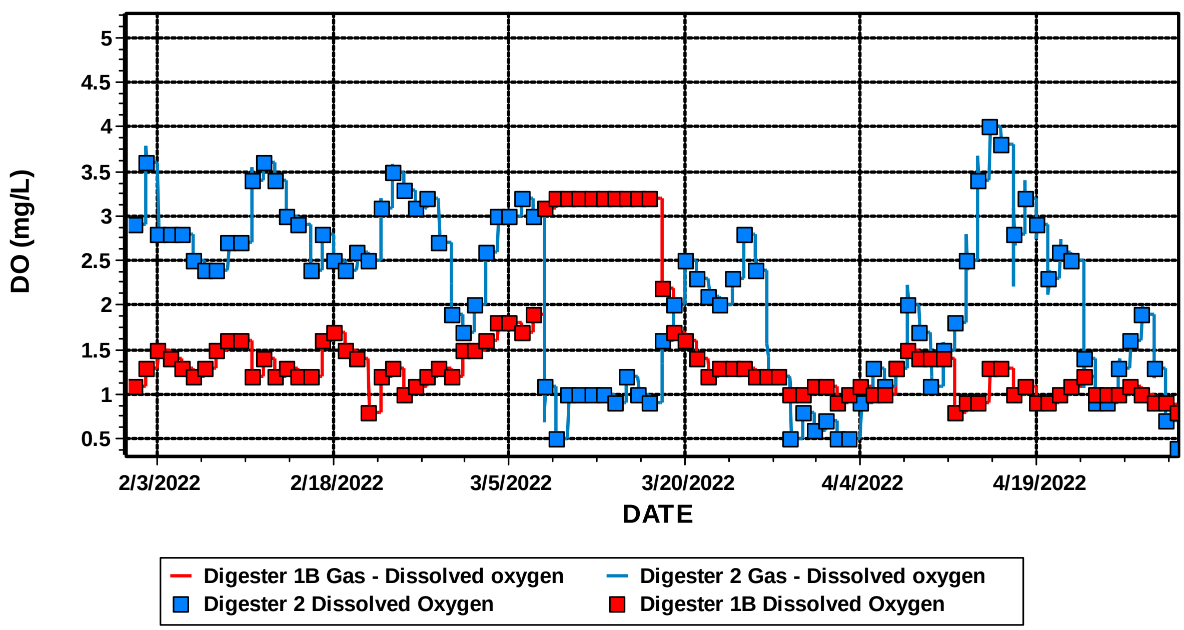



0.095
0.09
0.085
0.08
0.075
0.07
0.065
0.06
0.055
0.05
0.045
0.04
Flow (mgd)
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
RAS Splitter Flow (U)
WAS total daily flow

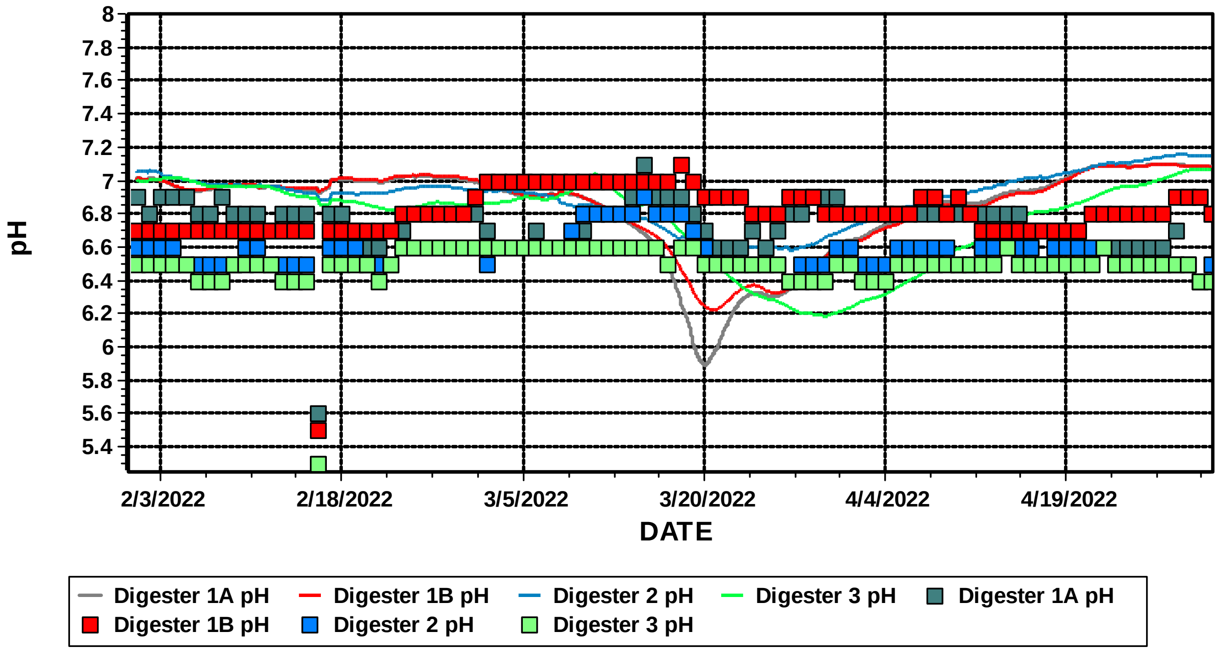

0.07
0.065
0.06
0.055
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Flow (mgd)
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
DAFT Flow
DAFT Flow (U)
DAFT Daily Flow Total



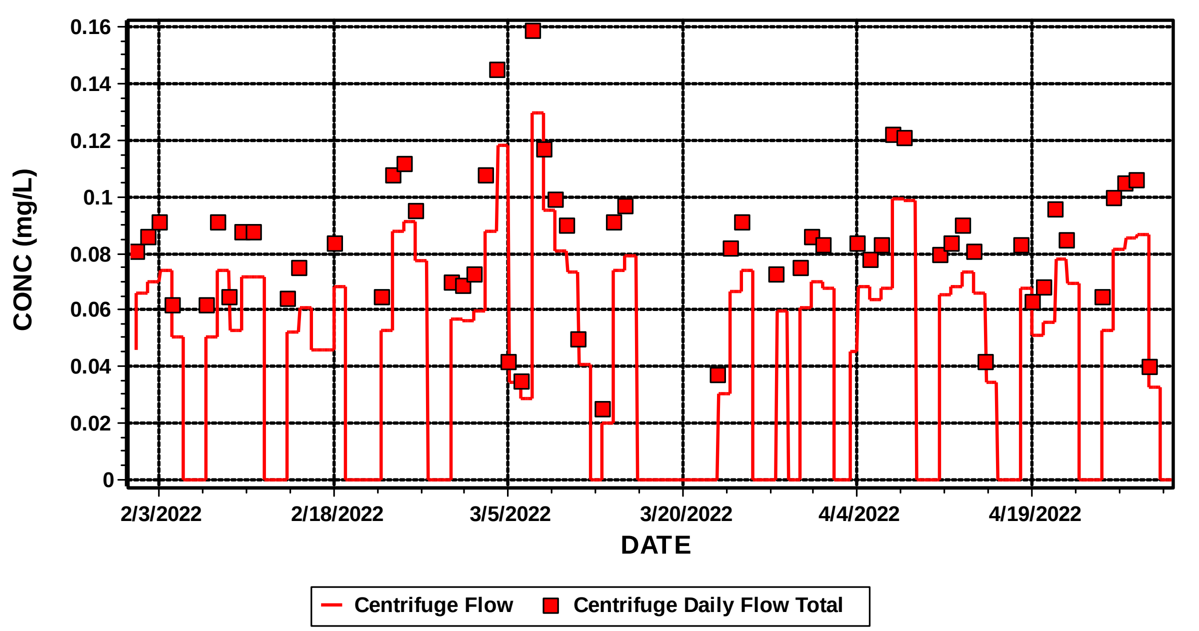
CONC (mg/L)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Digester 1A % TS
Digester 1B % TS
Digester 2 % TS
Digester 3 % TS
Digester 1A % TS
Digester 1B % TS
Digester 2 % TS
Digester 3 % TS



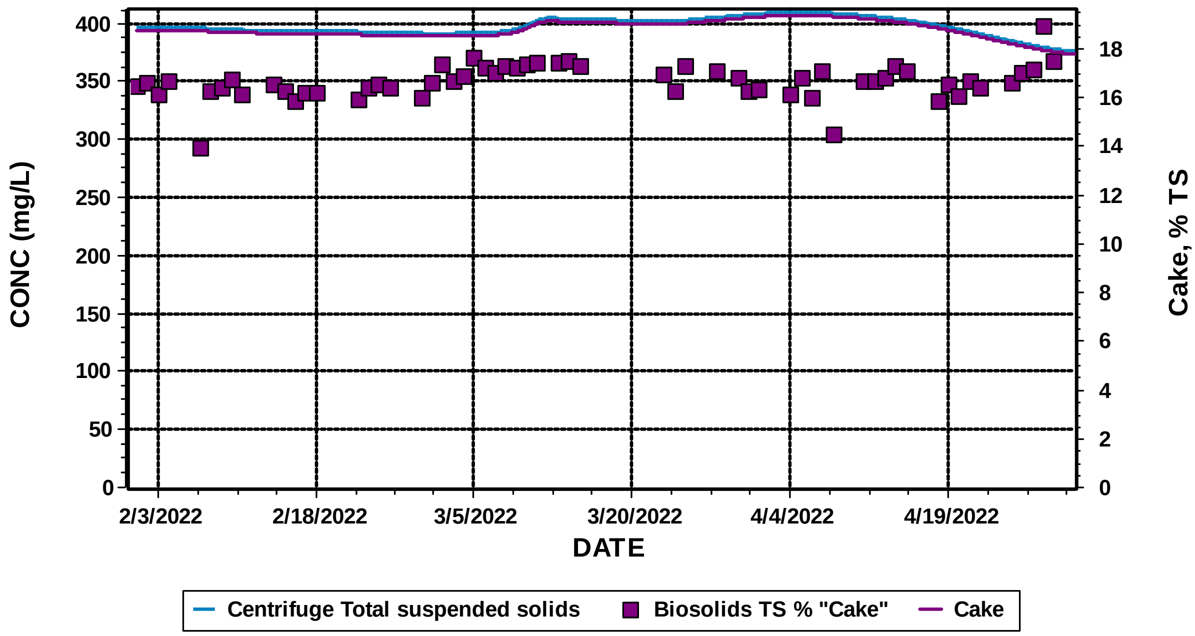
DO (mg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Digester 1B Gas - Dissolved oxygen
Digester 2 Gas - Dissolved oxygen
Digester 2 Dissolved Oxygen
Digester 1B Dissolved Oxygen



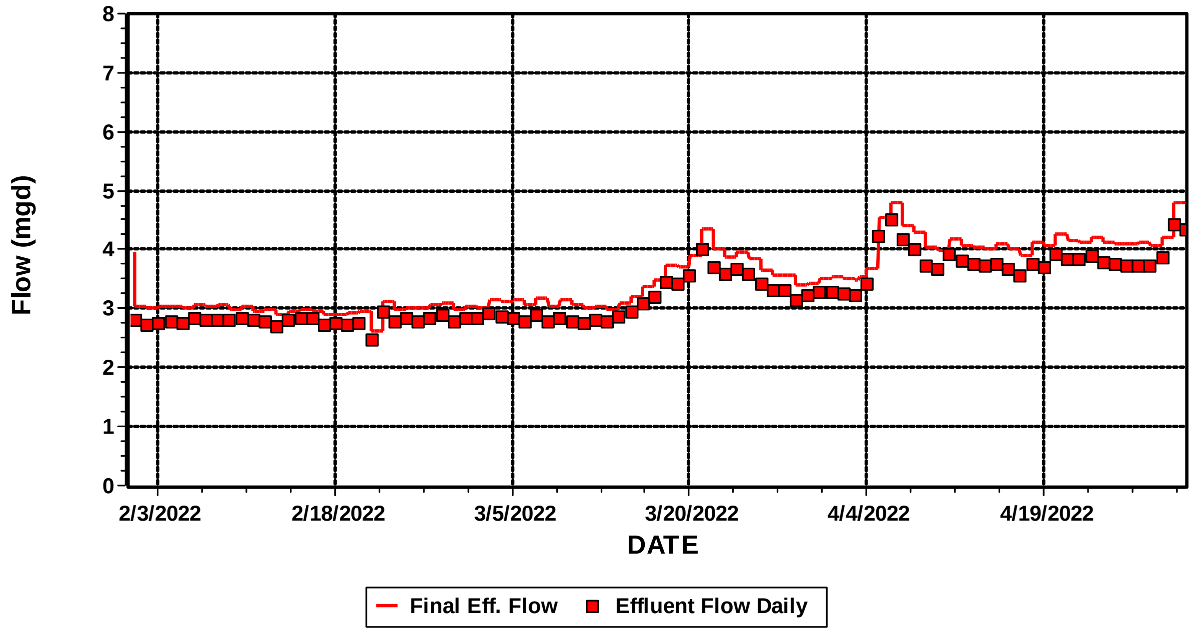
pH
8
7.8
7.6
7.4
7.2
7
6.8
6.6
6.4
6.2
6
5.8
5.6
5.4
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Digester 1A pH
Digester 1B pH
Digester 2 pH
Digester 3 pH
Digester 1A pH
Digester 1B pH
Digester 2 pH
Digester 3 pH

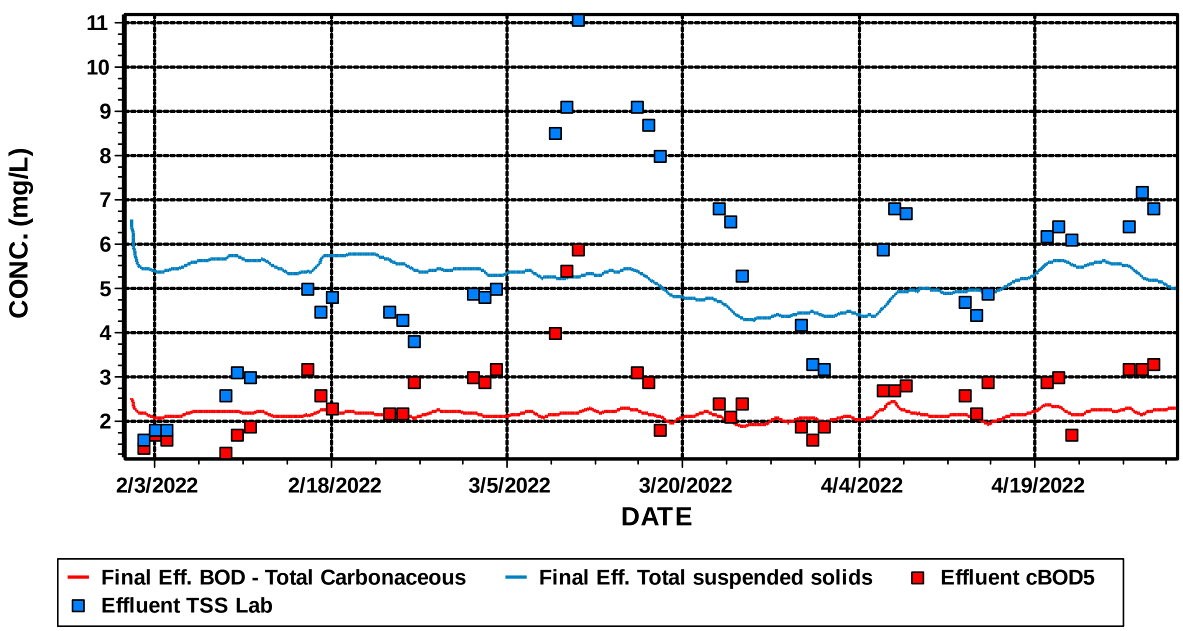


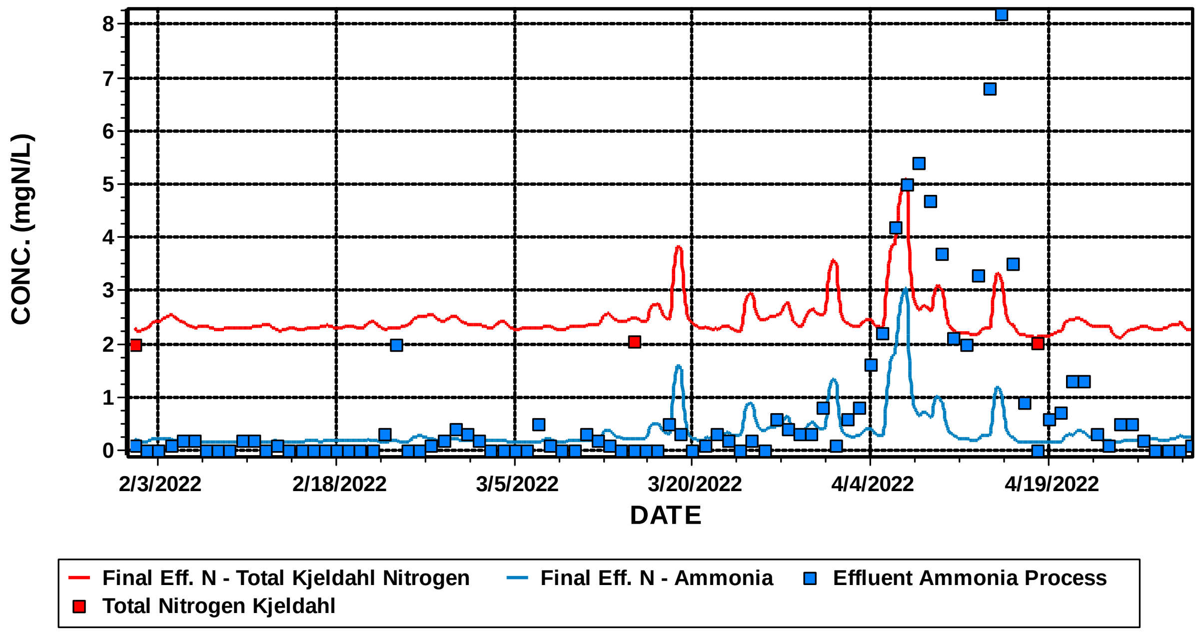
CONC (mg/L)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Centrifuge Flow
Centrifuge Daily Flow Total


CONC (mg/L)
400
350
300
250
200
150
100
50
0
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
18
16
14
12
10
8
6
4
2
0
Cake, % TS
Centrifuge Total suspended solids
Biosolids TS % "Cake"
Cake

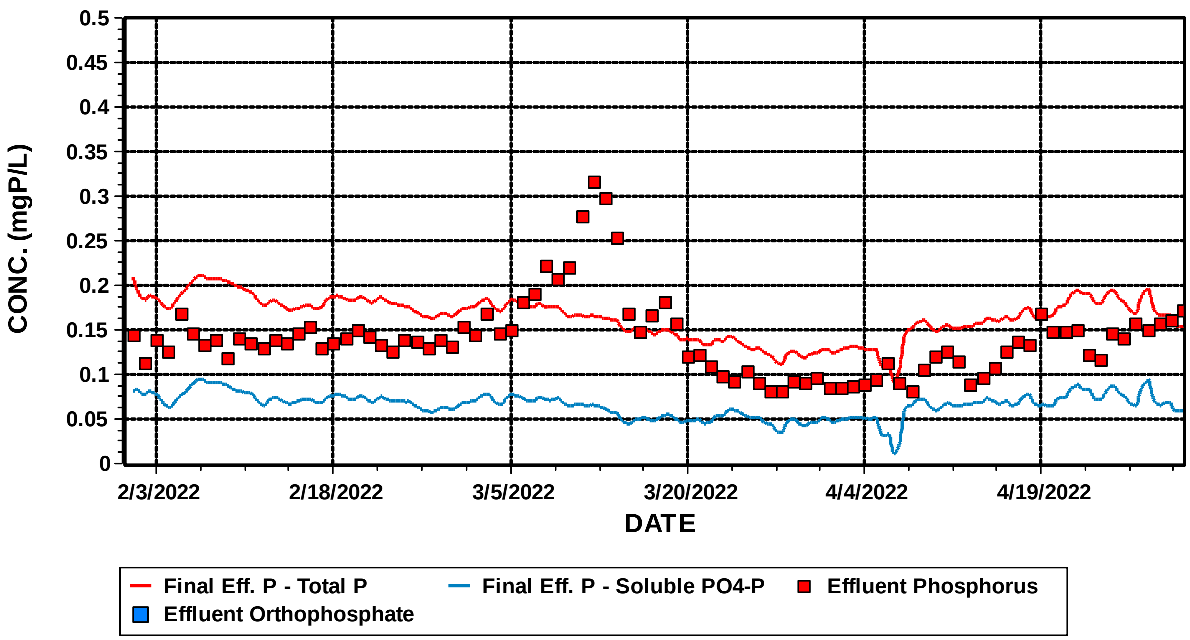
Effluent


Flow (mgd)
8
7
6
5
4
3
2
1
0
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Final Eff. Flow
Effluent Flow Daily

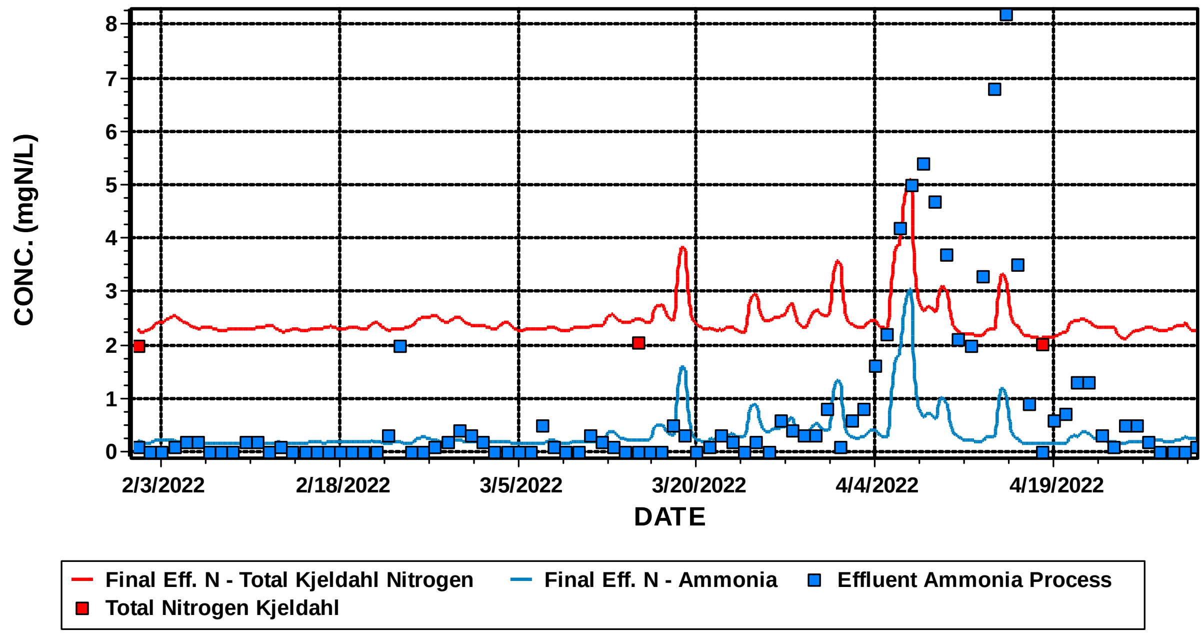

CONC. (mg/L)
11
10
9
8
7
6
5
4
3
2
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Final Eff. BOD - Total Carbonaceous
Final Eff. Total suspended solids
Effluent cBOD5
Effluent TSS Lab

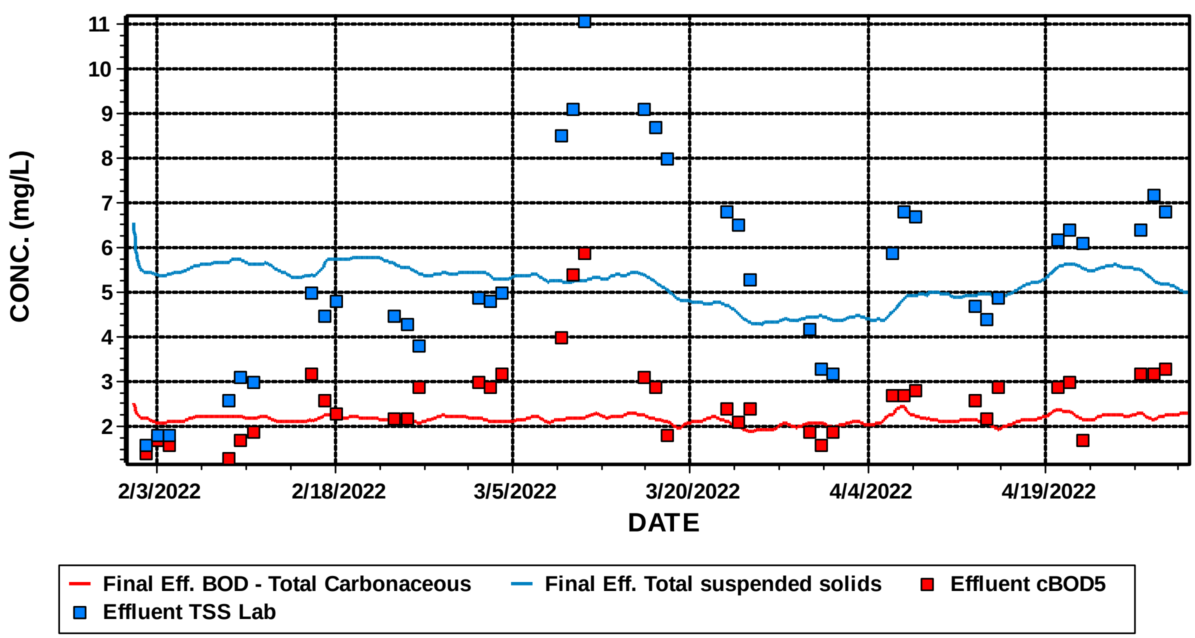


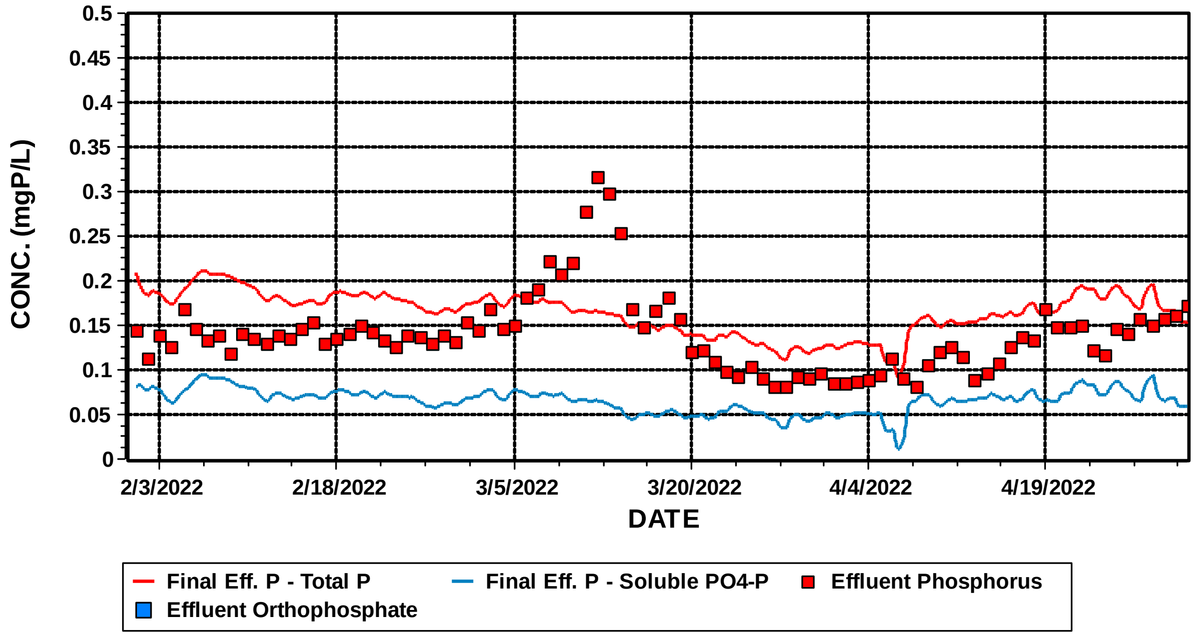
CONC. (mgN/L)
0
1
2
3
4
5
6
7
8
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Final Eff. N - Total Kjeldahl Nitrogen
Final Eff. N - Ammonia
Effluent Ammonia Process
Total Nitrogen Kjeldahl



CONC. (mgP/L)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Final Eff. P - Total P
Final Eff. P - Soluble PO4-P
Effluent Phosphorus
Effluent Orthophosphate


CONC. (mgN/L)
0
1
2
3
4
5
6
7
8
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Final Eff. N - Total Kjeldahl Nitrogen
Final Eff. N - Ammonia
Effluent Ammonia Process
Total Nitrogen Kjeldahl


CONC. (mg/L)
2
3
4
5
6
7
8
9
10
11
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Final Eff. BOD - Total Carbonaceous
Final Eff. Total suspended solids
Effluent cBOD5
Effluent TSS Lab


0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
CONC. (mgP/L)
2/3/2022
2/18/2022
3/5/2022
3/20/2022
4/4/2022
4/19/2022
DATE
Final Eff. P - Total P
Final Eff. P - Soluble PO4-P
Effluent Phosphorus
Effluent Orthophosphate

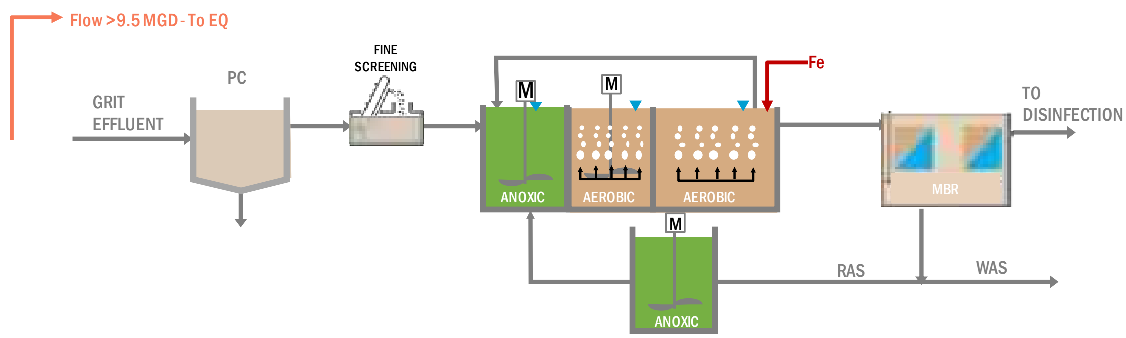
Appendix D: Capital and Operations and Maintenance Cost

Item	Alternative 1 5-stage BNR with filters	Alternative 2 MBRs with Primary Treatment	Alternative 3 MBRs without Primary Treatment
Construction Cost			
Primary Clarifiers			
New Clarifier/splitter	$2,175,000	$2,175,000	--
Replacement/Rehabilitation	$1,920,000	$1,920,000	--
Fine Screenings Building	--	$5,090,000	$5,090,000
BNR Tanks			
Modifications to existing	$2,420,000	$ 4,700,000	$ 4,442,000
New	$10,920,000	$ 4,950,000	$ 8,200,000
Re-purpose Secondary Clarifiers	--	$ 576,000	$ 576,000
Final Clarifiers			
New	$3,330,000	--	--
Replacement/Rehabilitation	$1,785,000	--	--
Membrane Filtration Building	--	$ 20,200,000	$ 20,710,000
Blower Expansion	$3,220,000	$ 2,100,000	$ 3,210,000
Tertiary Filters	$9,700,000	--	--
Site Allowances	$5,170,000	$ 5,170,000	$ 5,170,000
Total Construction Cost	**$40,640,000**	**$46,881,000**	**$47,398,000**
Engineering and Admininstration at 15%	$6,100,000	$7,030,000	$7,110,000
Total Capital Costs	**$47,000,000**	**$54,000,000**	**$55,000,000**

Item	Alternative 1	Alternative 2	Alternative 3
Labor (Operations)	$ 36,400	$ 37,600	$ 33,000
Electricity	$ 126,600	$ 171,200	$ 165,600
Ferrous Sulfate	$ 15,400	$ 19,900	$ 20,500
Citric Acid	$ -	$ 4,100	$ 4,100
Sodium Hypochlorite	$ -	$ 10,600	$ 10,600
Membrane Replacement Costs	$ -	$ 250,000	$ 250,000
Membrane Salvage Costs	$ -	$ (125,000)	$ (125,000)
SAF Floc aid/foam	$ -	$ -	$ 4,100
Carbon (MicroC)	$ -	$ -	$ -
Land Application	$ -	$ 5,600	$ 29,600
Dewatering	$ -	$ -	$ -
Maintenance Labor	$ 36,300	$ 37,600	$ 33,000
Maintenance Materials Costs	$ 36,300	$ 37,600	$ 33,000
Total	**$ 251,000**	**$ 449,200**	**$ 469,400**

Appendix E: Liquid Stream Alternative 1 Sensitivity Analysis Slides

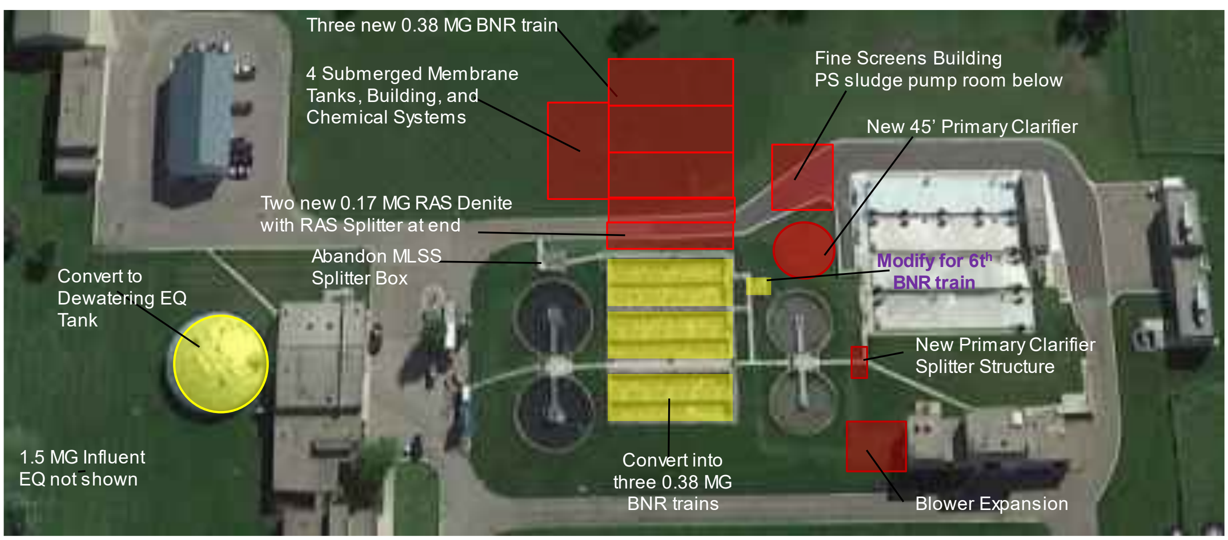
Alternative 2A – Chemical P MBRs with Primary Treatment



- Fe addition for P control
- Alt 2 anoxic zone becomes a swing zone and MLR return now routed to head of tank
- Fe addition to digesters for phosphate return loads– impacts N and P performance
- Dewatering recycles route to small EQ (North FST or old CCT) to minimize impacts on liquid stream.

Brown and Caldwell 22

Alternative 2A – Chemical P MBRs with Primary Clarifiers



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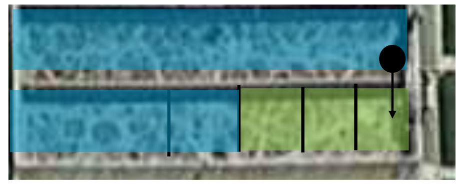
Alternative 2A: MLE BNR Train Layout

Year 2045

- Ferric sulfate usage increases to 465 gpd

Item	Units	Alt 2A– ChemP MBR with Primaries
Primary sludge	lb/d	5100
WAS	lb/d	6500
TWAS	lb/d	6370
Digester feed	lb/d	11460
Dewatering feed	lb/d	8,600

Existing and New Tanks



RAS denite (external to tank)
Anoxic
Aerobic
MLR pumps

Treatment Level 1 Sensitivity -Cost Comparison (Preliminary)

TP < 0.08 mg/L , TN < 8 mgN/L

Item	Alternative 1A: 5-Stage BNR wit 2-Stage Filters	Alternative 2A: Chemical MBR wit Primaries	Alternative 2B: Bio-P MBR *with Tertiary Filters*
Capital Cost	$50,500,000	$58,800,000	$65,900,000
2035 Annual O&M cost	$270,000	$960,000	$635,000
Net Present Value	$54,900,000	$72,000,000	$74,900,000

Cost presented in 2022 dollars
EQ costs not included

- Alternative 1 capital costs are roughly 15 to 20 percent lower than MBR alternatives
- Alternative 1 NPV is roughly 25 percent lower than MBR alternatives

Appendix F: MBR Facility Tour Notes

30 East 7th Street, Suite 2500
St Paul, MN 55101

T: 651.298.0710
F: 651.298.1931

Memorandum

Prepared for: ALEXANDRIA LAKE AREA SANITARY DISTRICT (ALASD)

Project Title: Facility Plan

Project No.: 158466

Subject: MBR Site Tours

Date: December 8, 2022

To: Scott Gilbertson and Troy Drewes, ALASD

From: Tracy Ekola, P.E. Brown and Caldwell

Prepared by: Anndee Huff Chester and Don Esping, P.E., Brown and Caldwell

This memorandum summarizes the observations and discussions during six wastewater treatment facility site visits in the Greater Atlanta area to observe membrane bioreactor (MBR) systems. Scott Gilbertson and Troy Drewes of ALASD and Don Esping and Anndee Huff Chester of Brown and Caldwell attended each site visit. The site visits occurred between November 28 - 30, 2022.

A summary of the key observations and takeaways from the site visit which should be further considered and/or evaluated during detailed design include the following:

1. Most plants used influent flow equalization to maintain a relatively constant flow to the BNR system throughout the day citing improved performance and ease of operation. Further evaluation of using the existing 75-foot secondary clarifier (460,000 gallons) for equalizing centrate as proposed plus equalizing influent diurnal flows/loadings should be evaluated. All flow equalization systems had odor control.
2. Screenings is critical for successful operation. Detailed design should consider using 5 mm (vs 6 mm) perforated plates for the first screens and 1 mm screens for the fine screens if possible. Use of self-dumping hoppers (Hippo Hopper or equal) should be considered for collecting fine screenings which can then be unloaded via a fork truck into the main dumpster. Also, consider hot water spray to help remove grease.
3. The proposed Ovivo Ozzy Cup style fine screens and screenings slewing troughs were covered at both plants to contain/minimize spray water mist. Care should be taken to provide smooth transitions where the two screenings slewing channels will meet and around corners.
4. There different schools of thought on the benefits of re-screening a portion of the RAS flow which ranged from 0% to 25% of the RAS flow. This should be further evaluated in detailed design.
5. Most plants used WEMCO grit cyclones and classifiers which produced a nice clean and dry grit. Consider classifier in detailed design.

6. Several plants reported issues with submersible mixers after 7-10 years. For cost savings these mixers were being replaced with Wilo brand mixers. In general, plants with surface mounted mixers (Invent or equal) were very happy with their performance and should be considered for detailed design.
7. One plant cited issues with using reversing rotary lobe pumps for permeate/backpulse duties and other plants indicated they work very well. Initial thoughts are pump issues were related programming on how fast the pumps are reversed. Plant with dedicated centrifugal pumps for permeate and backpulse operations had no reported operating issues. Detailed design should evaluate which approach best fits ALASD.
8. One plant identified the backpulse water storage tank was too small and backpulse cycles could also impact UV operations if excess flow is routed from the mainstream flow for backpulsing. This should be evaluated in detail to ensure sufficient volume is provided. Also – plant identified backpulse piping welds were corroding at the point of NaOCL addition. Plants replaced piping with PVC and issues have disappeared.
9. In general, provide ability to measured total RAS flow and consider ability to measure individual RAS pump flow in detailed design.
10. Consider grating over MBR tanks for walking in detailed design.
11. Scum accumulation was a present on a RAS Deox/denite tanks similar to being proposed at ALASD, Ability to move scum to next tank or remove scum is needed – particularly in MN where scum freezes in mats.
12. Consider adding an emergency overflow from the RAS Deox/denite tank(s) to the influent wet weather flow equalization basin in detailed design.
13. All facilities subscribed to the SUEZ (now Veolia) "InSight" program in which SUEZ reviews the membrane operations monthly and provide reports on membrane performance and operation. Plant staff found this valuable to identify issues and/or confirm operating performance and needs.
14. Several plants used ferric chloride for phosphorus removal. They recently changed to alum and found membrane maintenance was much improved due to lower fouling rates.
15. All membrane plants reported fecal coliform counts in the MBR permeate were minimal/negligible (less than 200 /100 mL or even 23 counts/1000 mL). All plants ran their UV systems due to regulatory requirements, not meeting permit requirements. Design should consider hypochlorite for disinfection to save capital and operating costs.

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Facility	Indian Creek WRF, Henry County Water Authority, Locust Grove, Georgia
Date	November 28, 2022
Plant Contact	Tour: Matt and Buster James (Buster) Cook (james.cook@hcwa.com)
Observations	

- Design Flows: Average 1.5 MGD, Peak 3 MGD
- Effluent limits: 0.3 mg P/L total phosphorus (monthly), 1.0 mgN/L ammonia (monthly)
- Plant was last upgraded 3 years ago to include the MBR system.
- Headworks at this facility includes fines screens (2 mm drum screen, Lackeby) and grit removal. Previous fine screens (WesTec) had issues with cracking after only a year of operation. Additionally, current pumping configuration with grit system (Smith and Loveless) is an issue. Plant will switch to a submersible pump in the grit vortex soon.
- Aeration basins A2O (anaerobic, anoxic/swing zone, aerobic) system with a RAS deoxygenation tank. Plant experiences issues with the flow splitting into different BNR trains. DO in the aerobic zone is operated at approximately 2 to 3 mg/L. The RAS deoxygenation tank also has an emergency overflow to headworks and pond. Alum and caustic are dosed at the head of the aeration basins and alum is dosed again at the aeration basin outfall, just upstream of the membrane bioreactor tanks. Alum dose is 240 gal per day. MLSS is typically operated around 7,500 mg/L, wasting is controlled based on MLSS concentration. System seems a little undersized or possible short circuiting may be occurring. Weirs between zones and at end of aeration basin seem to help with foam. Diaphragm pumps for chemical feed system have issues.
- MBR system includes 4 tanks with 4 cassettes each. Membranes are SUEZ. Entire membrane tanks were covered with removable panels since tanks are located outside under an awning. Permeate, RAS, WAS and drain pumps are all located in basement next to membrane tanks. Blowers are positive displacement on VFDs. Totes for hypo and citric are located in separate enclosed rooms for recovery and maintenance cleans. WAS flow rate is approximately 55,000 gpd at 0.8 to 0.85 percent solids. Overall, facility is happy with SUEZ membranes.
- Participating in the SUEZ InSight program is recommended. Additionally, facility was very happy with customer service provided by SUEZ for troubleshooting and that the parts facility was located locally in Atlanta.
- Disinfection with UV (Trojan 300). Fecal count is very low out of the MBR system.
- Digestion system consists of 4 tanks in series and is operated aerobically with occasional decants. Digesters will typically pass the SOUR test.

General Layout	Fine Screen
	
Screenings Dewatering and Self Dumping Hoppers	A2O Basins
	
RAS Deox Tank	MLSS Channel
	

Membrane Tanks – Covered

Permeate Pumps

RAS Pumps

Blowers

Control Panel

UV

Facility	Johns Creek Environmental Campus, Fulton County, Alpharetta, Georgia
Date	November 29, 2022
Plant Contact	Kelly Comstock (BC Project Manager, KComstock@BrwnCald.com) OP Shukla (Fulton County, OP.Shukla@fultoncountyga.gov) Brandon Ward (Fulton County, brandon.ward@fultoncountyga.gov) Douglas Worsham (Veolia, douglas.worsham@veolia.com) Chris (Operator, Veolia)
Observations	

- Design Flows: 12 to 15 mgd annual average; peak flows 33.7 mgd. Inline capacity allows for 22 mgd treatment capacity. Treatment plant came on-line in 2009 (13 years) and has the original membranes.
- Effluent limits: Total phosphorus is 0.3 mgP/L, TAN is 0.5 mgN/L and NOx-N is 5 mgN/L (monthly limits). There is no TN limit. Fecal coliform is 23/100 mL and E.C. is 126/100 mL.
- Staff typically consists of 2 operators and 1 manager with on call maintenance. Facility is staffed 24/7.
- All outdoor basins (primaries and BNR) are covered for odor control with GAC and wet scrubbers due to proximity to neighborhood.
- Primaries clarifiers are rectangular and have submerged launders as tank level can raise 3' during high flow events. Plant recommended primary clarifier to help with MBR operation..
- Fine screens are 1 mm center flow band screens. Type of screen not recommended by facility. Screenings are sluiced to the same compactor as used for the course screens (6 mm). Facility suggested to consider upsizing chopper pump used to pump screenings.
- BNR basins are A2O configuration with MLR to second anoxic zone and RAS deoxygenation for Bio P removal. Basins are 26' deep. Original Flygt mixers in the anaerobic/anoxic zones were replaced with Wilo mixers. Aeration basins have fine bubble diffusers that have been in use for 13 years. Air piping is stainless steel. About 10% of the RAS is rescreened with the fine screen. The SRT is approximately 15 days total. MLSS in the aeration basins is around 8,000-9,000 mg/L.. Running RAS at 3Q is ideal for biological processes, but 4Q reduces contact time and improves the TMP across the membranes. Scum removal includes buckets and spray nozzles; scum removal before the MBR is important.
- Alum) is fed for P trimming. Alum dosing controlled using a Phosphax analyzer, however, most phosphorus is removed via Bio P.
- MBR System is with first generation SUEZ LEAP. MBR tanks are operated around 10,500 mg/L MLSS. Cleaning routine includes hypo cleans at 200 ppm for a short period with back pulsing three times weekly and a citric acid clean once weekly in situ. Maintenance cleans occur less frequently, average once a year and include a 1 day soak at 500 ppm hypo. Switching from Ferric to Alum has helped improve membrane maintenance. Crane clearance to lift membranes over process piping is recommended, as well as easy access to transport in and out of building as needed. Set down location for inspections are also highly recommended. Pipe and pump gallery for MBR system is located in basement and plant staff noted there are some concerns with RAS flooding in the tunnels. Separate backpulse pumps (Gould, centrifugal) and tank are also used for back pulsing periodically. Some of the backwash piping corroded due to NaOCl settling along a pipe joints which was replaced with PVC piping throughout. Centrifugal aeration blowers are muti-stage. SUEZ has algorithm for controlling operation of MBR system TMP is used at the indicator for cleaning (3-5 psi TMP).
- There is 3 ft of "in-line" EQ in aeration basins, primary clarifiers, and MBR tanks.
- Disinfection is UV. Plant runs UV based upon regulatory need for running it. Plant reports fecal coliform counts are met without UV in operation.
- Digesters are aerobic. Solids average around 3 % TS and are composted or landfilled.

<table>
<tr><td>MBR Education Display`</td><td>Covered Basins and Odor Control Piping</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Covered MBR Tanks</td><td>Overhead view of gallery</td></tr>
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</table>

MBR Blowers	Pipe and pump gallery – RAS and permeate pumps
	
SCADA	Odor control and UV channel
	

Facility	Little River Water Reclamation Facility, Fulton County, Woodstock, Georgia
Date	November 28, 2022
Plant Contact	OP Shukla (Fulton County, OP.Shukla@fultoncountyga.gov) Brandon Ward (Fulton County, brandon.ward@fultoncountyga.gov) Douglas Worsham (Veolia, douglas.worsham@veolia.com) Chris (Operator, Veolia)
Observations	

- Design Flows: 0.7 mgd annual average, 2.0 mgd peak flows, plant capacity is 2.6 mgd.
- Facility was upgraded in 2019-2020.
- Flow equalization consists of in-tank storage plus a parallel 36-inch sewer pipeline at head of facility. There is also an empty basin within the facility for additional capacity.
- Headworks include coarse and fine screens in series. Fine screens are 1 mm drum screens which work well. Hot water spray helps remove grease. During start up, ML was rescreened and years of buildup and trash in system caused issues with fine screens.
- Activated sludge process is a five-stage Bardenpho configuration but does not operate the 2nd anoxic zone. Aerobic zones can operate in SND, but currently operating at 3 to 4 mg/L DO. There are two trains and a RAS deoxygenation tank. Mixers are hyperbolic mixers. Similar to JCEC, all basins are covered and extensive odor control is in place due to proximity to neighbors.
- Feed forward pump station to pump mixed liquor to MBR tanks. They cannot measure RAS flow.
- Facility was designed to use ferric but switched to alum to reduce membrane fouling.
- MBR system has 4 tanks, all covered with grating for walking. Membranes are SUEZ hollow fiber. Foaming in the MBR tanks is not an issue at this facility, an overflow weir into channel helps prevent foam. MBR awing height allows for a large overhead crane with plenty of clearance to perform membrane inspection and maintenance. System includes a backpulse tank. Filling back pulse tank can cause upsets with UV. Membrane permeate cycles are 12 minutes which includes a 30 second back pulse.
- Permeate pumps are the Broeder pumps and operate at 90% during back washes with fast ramp-up and 25% during normal. Fast ramp up may be causing operational issues.
- Disinfection is UV.
- Solids are thickened with membrane thickening to 3 %. System operates in a batch process.
- Overall, operators are happy with facility and hollow fiber membranes.

Fine screens (drum screens, Roto-Sieve)	Course Screens
	
Aeration Basins	Membrane Tanks (Covered)
	

Permeate pumps (Borger) and Scour Blowers	Chemical storage tanks
	
Aeration Blowers	UV Disinfection
	
SCADA	
	

Facility	Fowler Water Reclamation Facility, Forsythe County, Cummings Georgia
Date	November 28, 2022
Plant Contact	John Marshall (Forsyth County, JWMarshall@forsythco.com) 678.776.5611
Observations	

- Design Flows: Average flow of 5 mgd, Future Design Capacity of 7.5 mgd.
- Effluent limits: 0.13 mgP/L Total Phosphorus
- Plant has large EQ tank with 4 MG of storage to provide constant flow to plant, including shaving off diurnal peaks. Jet mixers in the EQ tank for mixing. EQ flow splits after fine screens.
- Headworks includes Ovivo drum screens (from 2017) Initial shaft broke on fine screen but has operated well since replacement. Ovivo compactor and works nicely and processes both coarse and fine screens. Course screens are 6 mm and fine screens are 1.5 mm. Facility also had septage receiving station which is sent to EQ basin.
- Aeration basins are 3 stage basins with ML recycle (3 trains). Recycles include anoxic to anaerobic (2Q), aerobic to anoxic (2Q), and MBR to aerobic (4Q). Flow control values are used for RAS distribution. Anaerobic and anoxic zones are covered for odor control. The mixers used in these zones are Flygt and have required maintenance. MLSS is typically operated around 8,000 mg/L, targeting concentrations below 10,000 mg/L. MLSS is measured daily. Caustic is dosed in the beginning of the basins, alum is fed at the end of the aerobic zone (200 gpd), just upstream of the MBR tanks. Foam/scum troughs are located at the end of the aeration basins and work moderately well. Scum gets stuck in collection channel after the membrane tanks. Design consideration to put in drains and mud values into aeration tanks for draining and foam troughs along the length of the basins, not just at the end. Outlet to the MBR basins is located below water surface to prevent scum from entering the membrane tanks but this traps foam in the aeration basins, causing foam to build up.
- Membranes system consists of 6 tanks, each with three cassettes. Membranes are SUEZ hollow fiber. RAS pumps for this system are submersible (in tank) and have one online spare (two pumps in one tank). Permeate/backpulse pumps are Borger pumps on VFDs and work well since installation in 2017. Back pulse tank is located outside and is automatically filled routinely with plant effluent. Size of backwash tank is based on timing between backwash events. Additional backwash tank for redundancy would be beneficial. Back pulse events occur every 12 minutes for 30 seconds. Relax mode is also an option but have found that back pulsing is better for improving TMP. Cassettes were initially inspected quarterly but are now inspected only semi-annually. Maintenance clean schedule is once per week with hypo and recovery cleans occur twice per year with both hypo and citric for 12 hours.
- MBR system did experience issues with fibers and hairs when fine screens were not working properly. John recommended upsizing the MBR system to allow for "gentle" membranes use and to factor in maintenance cleans and tanks offline. Additionally, during start up, it's a good idea to re-screen MLSS before installing membranes cassettes.
- Positive displacement blowers are located outside under cover. There are four membrane aeration and four are for process air.
- UV disinfection system really nice, no flume needed as system is contained.
- Sludge digestion is aerobic.
- Effluent is pumped a significant distance. Effluent pond on site for backup.
- SUEZ InSight provides plant monthly reports on membrane performance.

Fine screens – Ovivo (Bracket Green) Drum Screen	Screenings troughs and compactor
	
Covered Anaerobic Zones	Uncovered Aerobic Zone and Scum Trough
	
Covered Membrane Tank and Piping	Backup Effluent Pond
	

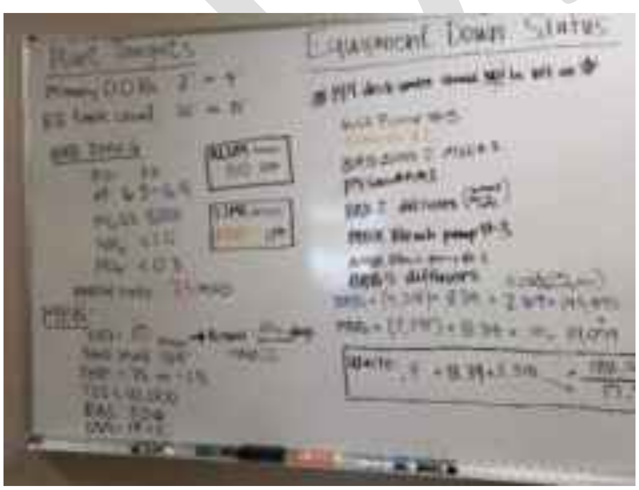
Permeate Pump and Piping	Backpulse Water Tank
	
Aeration Blowers	Centrifuge – Andritz Decanter
	
Submersible RAS pumps	EQ Tank with Odor Control
	

Facility	Yellow River Water Reclamation Facility, Gwinnette County, Lilburn Georgia
Date	November 30, 2022
Plant Contact	Jeremy Scott Ben Bagwell (Yellow River Superintendent, ben.bagwell@gwinettcounty.com)
Observations	

- Design Flows: Average Flow 15 mgd, Design Capacity of 25 mgd. Current flow after storm event was upwards of 30 mgd.
- Effluent limits: 0.3 mgP/L total phosphorus (monthly), 1.0 mg/L TAN (monthly), Fecal coliform 2/100mL (discharges to source used for drinking water)
- Headworks includes coarse screens and grit removal.
- Rectangular primary settling tanks. Plant staff liked the rotating scum beach flights to remove scum and foam. Sludge and scum is pumped to another facility for solids handling.
- Two very large EQ tanks are used to regulate diurnal flows and wet weather events. Flow split for EQ tanks is after primaries, but before fine screens.
- Fine screens (2 mm) are pumped back to headworks to be compacted with course screenings (5 mm). Very little fine screenings (fill small dumpster every 3-4 days). Fine screenings line to head-works is flushed 1/month to prevent build-up. Grit and screenings are very dry, every once in awhile screenings need to be unstuck in compactor shoot. Lime is added just downstream of the fine screens (1100 ppm).
- Aeration basin configuration is anaerobic zone, anoxic zone, swing zone, and aerobic zone (5 trains). Approximately 25% of the RAS flow is rescreened. There is no RAS deox. Basins are oper-ated at about 5,000 mg/L MLSS and DO of 3 mg/L. All basins are covered for odor control and/or to prevent debris from entering except aerobic zones. Foam collection at end of basins consist of troughs that flows into a channel that flushes with plant water when trough tilt. Alum is added just upstream of membrane tanks (80 ppm).
- Membrane system (SUEZ hollow fiber) was installed in 2009 – original equipment in service. Re-cent service by SUEZ was performed to “tighten up” the membranes. There are 9 tanks with 10 cas-settes each and room for two spare cassettes. TSS in membrane tanks is around 10,000 mg/L or less. RAS flow rate is 3Q. Each permeate line has a flow meter and a turbidity meter to monitor membrane performance. Membranes are operated in relax mode for 3 cycles followed by one back pulse. Membranes are pulled at random once a month for inspection. Maintenance cleans occur weekly. Three weeks will be performed with hypo followed by one week using citric acid. Every 6 months a recovery clean is performed where membranes are soaked in citric or hypo for 24 hours. There is no backwash tank, back wash is just pulled from the permeate line.
- Chemicals are stored in two separate rooms with grating over secondary containment for good use of space.
- Permeate is fed to a stand-pipe which then flows by gravity to UV disinfection.

5 mm Drum Screens	Screenings troughs and compactor
	
Screens Handling	Primary Settling Tank Scum Collection "Scum Beach"
	
Covered Primary Settling and Odor Control Piping	Large EQ Tanks in Distance and Primary Effluent Piping
	

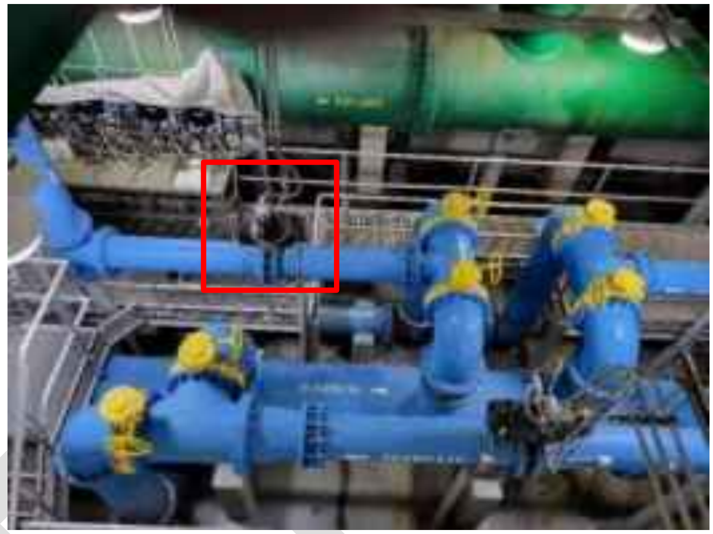
Fine Screens	Fine Screenings Handling/Pumps
	
Covered Anaerobic Zones	Aeration Basin - Aerobic Zone
	
RAS Pumps	Permeate Pumps with Flow and Turbidity Meter Setup
	

Membrane Tanks and Bridge Crane	
	
Permeate piping to Standpipe	Blowers
	
Plant Operations	Chemical Storage
	

Facility	Linwood Water Reclamation Facility , Gainesville , Georgia
Date	November 30, 2022
Plant Contact	Dewayne Cooper (Gainesville, DCooper@gainesvillega.gov) Jeremy Garmon (Gainesville, jgarmon@gainesvillega.gov)
Observations	

- Design Flows: 3 mgd annual average, 6.25 mgd peak weekly
- Effluent limits: Ammonia 0.5 mg/L monthly, Total Phosphorus 0.13 mg/L monthly, Fecal Coliform 23 monthly
- Plant upgrades were completed in 2007. Membrane replacements occurred in phases, half in 2017 and half in 2020.
- Coarse screen (3/8" or 9 mm) is a Tiger Shark Multi Rake Screen with compactor at influent pump station before being pumped uphill to headworks.
- Vortex grit removal and classifier before fine screens (2 mm, band screens). After fine screens, flow goes to EQ tank. Facility has had issues with their Hydrodyne screens and don't recommend.
- EQ tank capacity is 7 MG and provides constant flow through the rest of the facility. Jet mixing is used to keep wastewater mixed, aeration, and prevent septic conditions. Facility highly recommends EQ to help with membrane performance.
- Flow from EQ tanks goes to rapid mixing basin where flow mixes with RAS and is dosed with Mag and Alum. Currently testing PHOS-SORB in lieu of alum which appears to have reduce alum dose by 50% and MgOH by 50% (alkalinity). Facility performs phosphorus removal with chemical removal only. Have used QuatKill to remove quaternary ammonium which has impacted nitrification.
- Aeration tanks (4 tanks, typically 3 in operation) include anoxic zones followed by aerobic zones. DO is roughly 3 mg/L at the front and 5 to 7 at the back of the tank. Anoxic tanks use constant speed submersible mixers (Initially Flygt, replaced with Wilo). MLSS concentration is usually operated around 10,000 mg/L. Basins are not covered and they do not have issues with debris, like leaves, entering MBR. For scum removal, they turn off air in second half of the aeration tanks, this pushes foam into troughs at end of tank for removal.
- MBR system uses the 500D ZeeWeed Modules and consists of 4 trains with 9 cassettes per train. A siphon system is used to control the permeate flow instead of permeate pumps. An ejector system is used to create negative vacuum pressure to initiate the siphon. RAS pumps operate at 4Q and flow to the rapid mixing channel. Back pulse water is pulled from a final effluent wet well or "service water tank". Blowers are on VFDs which facility recommends, but they don't recommend the brand of blowers (Gardner-Denver). Recommendation also to not let operators walk into membrane area with anything in their pockets since any objects that fall into tanks can damage membranes. Every six months facility performs a recovery clean and visually inspects membranes. Repair kit to fix broken fibers is very easy to use if you can find the broken membrane. Typical membrane cycle is run in relax mode for 30-45 seconds, then production for 600 seconds. Only use back pulse occasionally. Facility has a membrane dip tank, but have never used it. Recommend to plan garage doors and crane for membrane (and other equipment) replacement.
- Back-up generator is similar to size needed at ALASD (1750 kW).
- Wasting rate is usually around 2% and is sent to the sludge holding tanks for thickening and further dewatering with a filter belt press.
- Disinfection in done with UV (Aquaray).
- Post aeration tanks are located outside

Fine Screens (Hydrodyne Band Screens– not recommended by facility)	Screenings Pumps and Compactors
	
Bioreactors (Anoxic in forfront)	Equalization Tank
	
Ejector System to create Siphon	Indoor Membrane Tanks (Covered)
	

MBR Siphon Piping and Valves	Permeate Flow Control Valves
	
Blowers for Process and Membrane Air	RAS Pumps
	

Final Effluent Wetwell and Backpulse Pumps	Service Water and Backpulse pumps
	
New Effluent Sampling	Outfall at Lake
	

Appendix I: Solids Processing TM

Technical Memorandum

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Prepared for: Alexandria Lake Area Sanitary District (ALASD)

Project Title: ALASD Wastewater Treatment Facility Plan

Project No.: 158466

Technical Memorandum

Subject: Solids Alternatives Evaluation

Date: December 20, 2021

To: Scott Gilbertson and Troy Drewes

From: Jennifer Gruman, Brown and Caldwell

Prepared by: Kellie Schaefer, E.I.T. and David Muenzner, P.E.

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List of Abbreviations

AAF	Annual Average Flow
ALASD	Alexandria Lake and Sanitary District
BCE	Business Case Evaluation
BNR	Biological Nutrient Removal
DAF	Dissolved Air Flotation
ft	foot/feet
ft^3/day	cubic feet per day
gpm	gallons per minute
hp	horsepower
in	inch(es)
lbs/day	pounder per day
lbs/hr	pounds per hour
LS1	lift station one
MG	million gallons
mgd	million gallons per day
NPV	Net Present Value
O&M	Operations and Maintenance
SAF	Suspended Air Flotation
sec	seconds
sqft	square feet
TM	Technical Memorandum
TSS	Total Suspended Solids
WAS	Waste Activated Sludge
WWTF	wastewater treatment facility

Executive Summary

This Technical Memorandum (TM) evaluated alternatives for solids processing, including thickening, digestion, dewatering, and the biosolids storage pad. Each alternative assumes a projected solids loading for 2045 conditions. Liquids alternatives that were assumed for the purposes of this TM include Liquids Alternative 1 - 5-stage Biological Nutrient Removal (BNR), Liquids Alternative 2 - Membrane Bioreactor (MBR) with Primary Clarifiers, and Liquids Alternative 3 - MBR without Primary Clarifiers. Liquids Alternatives 1 and 2 have similar projected solids stream loadings for 2045 operations, while Liquids Alternative 3 has different projected values.

The alternatives that were evaluated Include:

- Thickening
    - Suspended Air Flotation (SAF) (Alternative 1A)
    - Membrane Thickening (Alternative 1B)
- Digestion
    - Replace 100-ton Chiller with 125-Ton Chiller for Liquids Alternatives 1 and 2 (Alternative 2A)
    - Replace 100-Ton Chiller for Liquids Alternative 3 (Alternative 2B)
    - Replace Chiller with Spiral Heat Exchanger (Effluent Water Cooling) for Liquids Alternative 3 (Alternative 2C)
    - Replace Chiller with Spiral Heat Exchanger (City Water Cooling) for Liquids Alternative 3 (Alternative 2D)
- Dewatering
    - Centrifuge (Alternative 3A)
    - Screw Press (Alternative 3B)
- Biosolids Storage
    - Reclaim Existing Biosolids Storage Pad (Alternative 4A)
        - With Partial Fabric Cover (Alternative 4A.1)
        - With Partial Steel Cover (Alternative 4A.2)
    - Construct a New Biosolids Storage Pad
        - With Partial Fabric Cover (Alternative 4B.1)
        - With Partial Steel Cover (Alternative 4B.2)

The following are the recommendations for each process.

- Thickening:

  Alternative 1A – SAF is the recommended alternative due to the lowest life cycle cost and ability to repurpose the existing DAF.

- Digestion:

  Alternative 2A – Replace 100-Ton Chiller with 125-Ton Chiller is the recommended alternative (based on the selection of Liquids Alternative 2). This recommendation includes a complete replacement of the fine bubble diffuser system and header piping for all four cells and the replacement of the buried air pipe from the blowers to headers.
- Dewatering:

  Alternative 3A – Centrifuge is the recommended alternative due to the lowest life cycle cost, higher solids capture, and operator familiarity with the technology.
- Biosolids Storage Pad:

  Alternative 4A.1 – Reclaim Existing Biosolids Storage Pad and Construct Partial Fabric Cover is the recommended alternative. This alternative is less costly than constructing a pad in a new location and the added cover will provide flexibility for biosolids drying. This alternative also keeps the pad in an inconspicuous location that does not draw public attention.

A summary of the capital costs for each recommended alternative is in Table ES-1.

Table ES-1. Summary of Capital Costs

Recommended Alternative	Capital Cost
Alternative 1A - SAF	$0.6M
Alternative 2A - Replace 100-Ton Chiller with 125-Ton Chiller	$2.2M
Alternative 3A - Centrifuge	$4.3M
Alternative 4A.1 - Reclaim Existing Biosolids Storage Pad w/Partial Fabric Cover	$0.7M
TOTAL	**$7.8M**

Section 1: Introduction

1.1 Background

The solids processing systems consist of dissolved air flotation (DAF) thickening, aerobic digestion, and centrifuge dewatering. Additionally, there is a biosolids storage pad that stores dewatered sludge prior to land application.

Dissolved air flotation (DAF) is currently used to thicken waste activated sludge (WAS) prior to feeding to the aerobic digesters. The DAF and supporting equipment are located in the Headworks and Thickening Building. In 2021, the steel DAF tank was refurbished, with minor leaks repaired and the interior and exterior recoated. Additionally, the internal baffling that had been damaged by corrosion was repaired. ALASD staff have also upgraded the DAF operation through the addition of a polymer in the WAS feed, resulting in more consistent performance, better solids capture, and reduced underflow solids. The thickened waste activated sludge (TWAS) is fed into the digesters at an average of 2.7 percent total solids (TS).

Aerobic digestion is used to treat a combination of primary and thickened waste activated sludge (TWAS) to reduce volatile solids and pathogens to Class B solids requirements. There are currently four digester cells, with cells 2 and 3 being constructed in 1976, cell 1B in 1999, and cell 1A in 2014. Fine bubble membrane diffusers are used for aeration and mixing. To keep the digesters below 30 degrees Celsius, a 100-ton chiller with two 1,000,000 BTU/hr sludge-to-glycol heat exchangers are used to cool a sludge flow of 350 gpm from the digesters.

The dewatering system consists of a single Alfa-Laval ALDEC G2-100 centrifuge, which is located on the second level of the Solids Handling Building and was installed in 2008. The centrifuge receives aerobically digested sludge from the digesters via two progressing cavity pumps. A polymer feed system was installed in 2008 and is located in the maintenance room of the Solids Handling Building, adjacent to the truck loadout area. The centrifuge is rated for a solids loading of 2,000 lbs/hr at 1.5 percent total solids (TS) sludge feed. The centrifuge is operated four to five days per week for a 6-8 hour shift per day. Dewatered cake is dropped through a chute and into the bed of a dump truck located in the loadout bay. The centrifuge can generate a cake ranging from 20-22 percent TS.

The biosolids storage pad is approximately 200 feet by 220 feet (44,000 square feet) with bituminous pavement surfacing and perimeter bituminous curb and wood barrier. The bituminous pavement surfacing is estimated to be at least 20 years old and has deteriorated to a condition that a simple bituminous pavement overlay is no longer feasible. The perimeter bituminous curb and wood barrier are also deteriorated and provide little containment function.

Section 2: Alternatives Evaluation

Alternatives were evaluated for thickening, digestion, dewatering, and the biosolids storage pad. Each alternative assumes a projected solids loading for 2045 conditions. Liquids alternatives that were assumed for the purposes of this TM include Liquids Alternative 1 - 5-stage Biological Nutrient Removal (BNR), Liquids Alternative 2 - Membrane Bioreactor (MBR) with Primary Clarifiers, and Liquids Alternative 3 - MBR without Primary Clarifiers. Liquids Alternatives 1 and 2 have similar projected solids stream loadings for 2045 operations, while Liquids Alternative 3 has different projected values.

2.1 Thickening Alternatives

The WAS must be thickened ahead of the aerobic digesters to provide adequate hydraulic retention time to achieve the required vector attraction reduction. However, oxygen transfer is hampered in the digesters when the sludge is too thick, which can cause upsets in the aerobic digestion process. The paragraphs below describe the solids thickening alternatives that were evaluated.

2.1.1 Alternative 1A - Suspended Air Flotation (SAF) Thickening

The suspended air flotation (SAF) thickening process uses an anionic surfactant to generate a froth containing microscopic bubbles. Unlike the dissolved air flotation thickening principal, air is not dissolved in water and is not dependent on pressure to generate the bubbles. The microscopic bubbles in the SAF froth consists of about 40 percent air and the anionic charge created by the surfactant attracts the biological floc. The SAF froth air bubbles are stable in water and tend to avoid coalescing, making them ideal for the flotation thickening process.

Froth is generated by mixing surfactant and water with a mixer that pulls air into the mixture. A recirculating pump recycles the froth through the generator to produce a uniform, micro-bubble mixture. Feed sludge is conveyed to a serpentine flocculation unit where polymer is injected. The froth is mixed with the sludge and polymer solution immediately upstream of the flotation tank. The micro-bubbles attract biological floc and float to the tank surface, where, like a DAF unit, the thickened sludge product is skimmed from the surface. SAF units have a much higher hydraulic and solids loading rate compared to DAF units, and therefore have more capacity for a given footprint as summarized in Table 2-2.

Table 2-2: Comparison of SAF versus DAF

Alternative	Solids Loading Rate (Average/Peak) lb/hr/ft^2	Hydraulic Loading Rate gpm/ft^2
DAF	3.0/4.5	5.5
SAF	20/30	20

The flotation tank utilized by the SAF process is nearly identical to that utilized for the DAF process, making the current arrangement at ALASD suitable for retrofit. The existing pressurization pumps, saturation tank, and air compressor would be removed and replaced with the serpentine flocculation unit and froth generator. The polymer system currently used for the DAF operation would likely be adequate for the SAF process, as it is anticipated that the SAF system will use up to 40 percent less polymer than the current DAF system. A SAF thickening system can achieve the 2.25 percent thickened sludge required for the digesters.

SAF thickening would be provided by Heron Innovators as a sole-source procurement.

2.1.2 Alternative 1B – Membrane Thickening

The membrane thickening system proposed for ALASD consists of one membrane train with four membrane cassettes and spare space to add a fifth cassette. A thickened sludge storage tank equipped with aeration to keep the sludge mixed and aerated is provided with enough volume to accommodate a complete batch. The thickening system includes a duty and standby permeate pump, a duty and standby aeration blower for membrane agitation and sludge storage tank mixing/aeration, and a duty and standby drain pump to convey TWAS to the holding tank. Both citric acid and sodium hypochlorite are required for membrane cleaning. It is assumed that the membrane bioreactor (MBR) chemical clean in place equipment will be used for the membrane thickening clean in place operations, so no stand-alone chemical pumps, chemical storage tanks, or soak tanks are required for this operation (if a MBR system is being used for liquids treatment). It is also assumed that the membrane thickening system will be located in the same building as the MBR system. Two new TWAS pumps will be provided to convey TWAS to the aerobic digesters. Manufacturers of membrane thickening systems include Suez and Ovivo.

A membrane thickening system can achieve a thickened sludge from 2.25 to 3 percent TS. The advantage of this type of thickening is that the desired total solids of the sludge is precisely controlled during the batch process. See Figure 2-3 of a typical membrane thickener process flow diagram. Operating in batch mode does require a sludge storage tank so that thickened sludge can be fed continuously to the digestion process

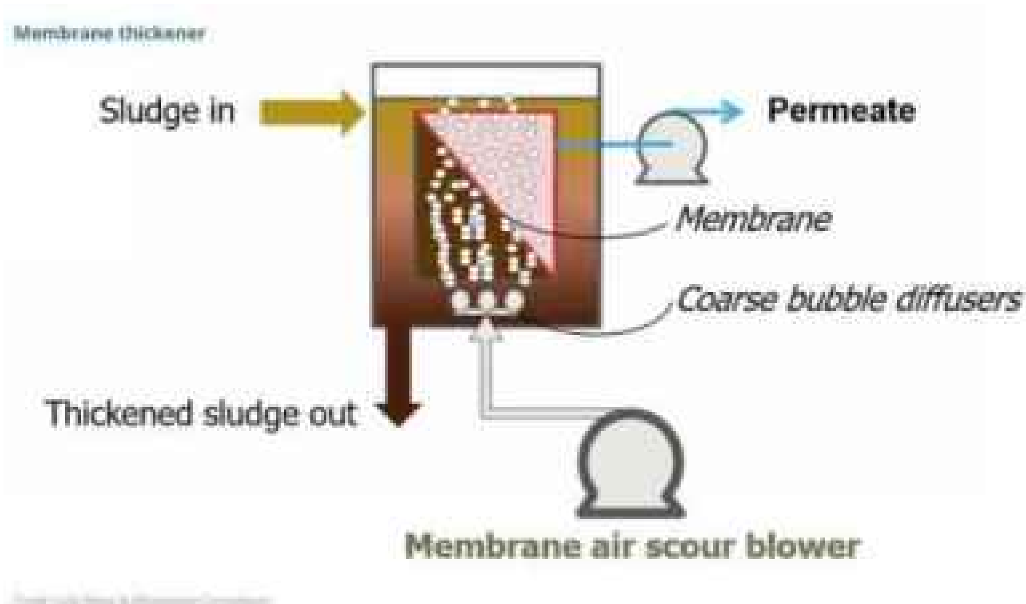

Figure 2-3. Membrane Thickening Process Flow Diagram

2.2 Digestion Alternatives

The existing digester cells require replacement of all the fine bubble diffusers and internal tank piping, and the chiller has reached the end of its useful life. A medium bubble diffuser system was considered as an alternative to the existing fine bubble system as these systems can accommodate thicker sludge, thereby reducing the digester volume required for treatment. However, since no further expansion of the digester volume is required for treatment (see paragraph below) and the air requirement for the medium bubble system is higher than the fine bubble system and exceeds the capacity of one existing blower, it was determined to not be cost effective. All digester alternatives assume a complete replacement of the fine bubble diffuser system and header piping for all four cells and the replacement of the buried air pipe from the blowers to headers. The fine bubble diffuser system evaluated for these digestion alternatives was the Sanitaire Silver Series diffusers. Other fine bubble diffuser suppliers include SSI Aeration and Aerostrip.

The two digestion alternatives that were compared were digester operations for MBRs with and without primary clarifiers. The analysis for Liquids Alternatives 1 and 2 included replacing the existing chiller with a larger chiller unit, and Liquids Alternative 3 considered either replacing the existing chiller with the same size unit or changing the cooling technology to spiral heat exchangers (HEX).

The solids stream analysis for the 2045 solids loading conditions determined that the four existing digester cell volumes meet the sludge retention time (SRT) requirement of a minimum of 20 days and the specific oxygen uptake rate (SOUR) of less than 1.5 mg oxygen/ g TSS-hr, meeting vector attraction reduction requirements. If the SRT is less than 20 days at peak solids loadings, the percent TS of the thickened sludge feed can be increased, or a baffle can be installed in cell 3 to prevent short circuiting and achieve the necessary pathogen reduction. Airflow requirements for all alternatives are also met with the two existing Turblex blowers that are each rated for 4,500 scfm. While blower replacement was not analyzed for this TM as the Turblex blowers have been well maintained and still perform well, ALASD may consider replacing the blowers in the future with a different blower technology, such as turbo-style blowers.

2.2.1 Alternative 2A – Replace 100-ton Chiller with 125-Ton Chiller (Liquids Alternatives 1 and 2)

This alternative assumes a mixed feed of primary sludge and WAS to the digesters. Spiral HEX units are not recommended for use with primary sludge due to concerns with ragging and fouling with fats, oils, and greases, so it was assumed that the existing tube-in-tube HEX units would continue to be used.

Due to higher cooling requirements for the 2045 solids loading projections for Liquids Alternatives 1 and 2, a 125-ton chiller unit would be required. The existing sludge-to-glycol HEX units are only rated for 1,000,000 BTU/hr cooling capacity, and additional cooling capacity would be required for 2045 loadings. For the purposes of this evaluation, the HEX addition is assumed to be a cost incurred in a later project, as cooling needs can be met through 2038 conditions with the existing equipment. ALASD expressed concern with chiller compressor and control board redundancy, which is not met with the current chiller unit. ALASD may consider a modular chiller unit to address this concern. Modular Trane scroll or screw units have a cooling capacity of up to 80 tons each, with multiple units installed to achieve the necessary cooling capacity. See Figure 2-1 for a modular chiller layout. Other modular chiller suppliers are Arctic and Nexus.

Figure 2-1. Modular Chiller Layout

2.2.2 Alternative 2B – Replace 100-Ton Chiller (Liquids Alternative 3)

This alternative assumes a 100 percent WAS feed to the digesters due to removal of the primary clarifiers, resulting in a decrease in solids loading, airflow, and cooling requirements. As with Alternative 1A, Alternative 1B assumes replacement of the chiller with a new chiller unit. Due to lower cooling requirements, the chiller would be replaced with a unit of the same size as the existing chiller (100-tons) and would utilize the existing sludge-to-glycol HEX units, with no additional units required in the future.

2.2.3 Alternative 2C – Replace Chiller with Spiral Heat Exchanger (Effluent Water Cooling) (Liquids Alternative 3)

Since Liquids Alternative 3 eliminates primary sludge feed to the digestion process, spiral heat exchangers can be considered as a cooling alternative. Spiral HEXs are more efficient than tube-in-tube style HEX units due to the longer sludge to water contact path. Sludge and water flows are separated by a thin piece of metal wound in a cylinder to maximize the surface area between the cooling water and sludge. Due to the longer contact time, a large temperature differential between the sludge and cooling water is not required to achieve the desired cooling, unlike the tube-in-tube style HEX units. Sludge is recirculated back into the digesters, and the cooling water can be returned to any part of the liquids stream or into the effluent. Suppliers of spiral HEXs include Alfa-Laval and Nexson. For this alternative, the cooling liquid was assumed to be plant effluent water with a maximum temperature of 21 degrees Celsicu, which represents the worst case summer conditions. The cooling requirements with effluent water can be achieved by using a spiral HEX with a cooling capacity of 600,000 BTU/hr and a cooling water flow rate of 350 gpm. Figure 2-2 shows a depiction of a spiral HEX.

Figure 2-2. Spiral Heat Exchanger

2.2.4 Alternative 2D – Replace Chiller with Spiral Heat Exchanger (City Water Cooling) (Liquids Alternatives 3)

This alternative is the same as Alternative 1C, except that city water would be used as the cooling water instead of effluent water. City water was assumed to be at 14 degrees Celsius, so a smaller spiral HEX unit is needed compared to Alternative 1C. According to ALP utilities, commercial city water rates for 2022 are $2.90 per 1,000 gallons from June-September and $2.75 per 1,000 gallons from October-May. Due to the high cost of city water, this alternative was determined to not be cost effective.

2.2.5 Digestion Alternatives Comparison

Table 2-1 presents a summary of the preliminary design criteria for the digester alternatives

Table 2-1. Digestion Alternatives Design Criteria (2045)

Description	Alt 1A – MBR w/Primary Clarifiers	Alt 1B/1C/1D – MBR wo Primary Clarifiers
Digester Cells	4	4
Digester Cell Capacity (MG)	0.38	0.38
Digester Feed Solids (% TS)	2.25	2.25
Cooling Sludge Flow (gpm)	350	350
Digester Temperature (C^0)	30	30
SRT, Average (Days)	27	42
SRT, Max Month (Days)	19	28
Digester Feed, Average (lbs TSS/Day)	10,500	8,570
Digester Feed, Max Month (lbs TSS/Day)	15,400	12,580
Digester Effluent, Average (lbs TSS/Day)	6,150	6,160
Digester Effluent, Max Month (lbs TSS/Day)	9,130	9,070
Average Volatile Solids Reduction (%)	47	32
Total Average Airflow (scfm)	3,120	1,600
Summer Cooling Requirement (kBTU/hr)	1,640	1,220
Winter Cooling Requirement (kBTU/hr)	1,170	690

2.3 Dewatering Alternatives

Two alternatives were evaluated for dewatering. The first alternative continues to utilize the existing centrifuge but adds a second centrifuge for redundancy. The second alternative replaces the centrifuge with screw press technology.

Digested sludge composed exclusively of biological sludge (i.e., no primary sludge component) is typically more difficult to dewater than blended primary and WAS sludge. For Liquids Alternative 3 (MBR without primaries), it is anticipated that polymer demand will increase 10 percent for both dewatering alternatives compared to Liquids Alternatives 1 and 2.

2.3.1 Alternative 3A - Centrifuge

This alternative assumes a second centrifuge would be installed to provide redundancy for dewatering operations. The Alfa Laval Aldec G3-115 was used for the centrifuge design criteria. Other centrifuge suppliers include Andritz, Centrysis, and Flottweg.

It is assumed that ALASD will operate the centrifuge three days per week for up to six hours per day during maximum month conditions. The new unit would have a larger capacity but the same horsepower as the existing G2-100 centrifuge. Since the new centrifuge would be redundant, no new centrifuge feed pumps would be required, and the two existing pumps would continue to be utilized for both centrifuges.

BC reviewed the existing structure of the Solids Handling Building and concluded that it would not be practical to locate the new centrifuge on the upper level, adjacent to the existing centrifuge. The structure could be made to support the additional weight of a second centrifuge, but the existing columns and footings would need to be strengthened, requiring extensive excavation and temporary dewatering facilities to allow the existing truck bay to be out of service. For this alternative, it was assumed that the adjacent single story polymer room would be demolished and replaced with a two-story structure with a footprint of approximately 550 sqft, allowing the new centrifuge to be installed on the second level with a new truck bay located underneath. The polymer equipment, which is at the end of its useful life and requires replacement, would be moved to the open truck bay adjacent to the existing centrifuge drop chute.

During the review meeting with ALASD, the possibility of installing the new centrifuge at grade in the unused truck bay with an inclined screw conveyor to lift cake into the back of the dump truck was discussed. Although this is likely a more cost-effective approach, the life cycle costs assumed the more conservative structural approach to the existing building. Further evaluation can be completed during detailed design to evaluate the cost of a new building in lieu of renovations to the existing building. See Figure 2-4 for a typical centrifuge.

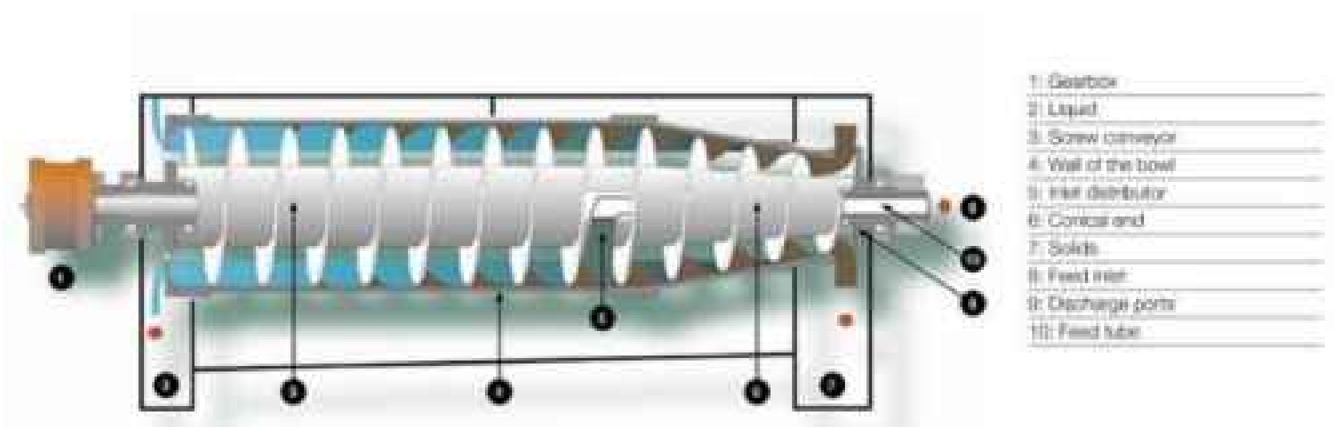

Figure 2-4. Centrifuge

2.3.2 Alternative 3B - Screw Press

During the solids alternatives screening, it was determined the only other technology to be considered for dewatering is a screw press. Other dewatering technologies, such as belt filter presses, require larger footprints, produce more odors, or are more maintenance intensive. Screw presses have become more popular for sludge dewatering in recent years due to the relatively small horsepower requirement and the ability to operate without the need for operator intervention. The Schwing Bioset FSP 903 was the selected model for the screw press design criteria. Other screw press suppliers include Andritz and Centrysis.

Screw presses consist of an internal flighted conveyor, like a centrifuge, but with the spacing between flights decreasing as the sludge is conveyed to the outlet. The screw conveyor operates inside a wedge-wire screen that allows the pressate to drain from the sludge. An adjustable position plug is located on the discharge end of the unit to allow the operator to increase or decrease the backpressure on the cake, thereby allowing control over the cake dryness. A reaction tank is located upstream of the screw press feed where polymer is mixed with the feed sludge to form floc prior to introduction into the unit.

For this alternative, it was assumed that the adjacent single story polymer room would be demolished and replaced with an approximately 1,200 square foot, two-story structure allowing both screw presses to be installed on the second level with a new truck bay located underneath. The polymer equipment, which is at the end of its useful life and requires replacement, would be moved to the open truck bay adjacent to the existing centrifuge drop chute.

While the horsepower of a screw press may be a fraction of that required for centrifuges, they generally will not generate a cake with the same dryness as centrifuges and the solids capture is expected to be 90 percent or less. In addition, screw presses have a much larger footprint than a comparable centrifuge, requiring not only more space for installation but larger lay down areas for removing components for maintenance. See Figure 2-5 for a depiction of a typical screw press.

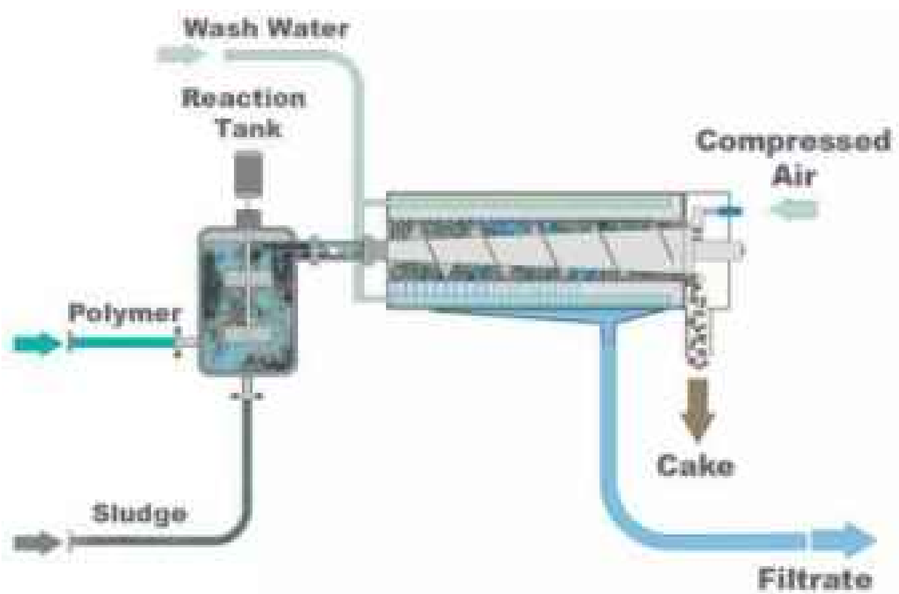

Figure -25. Screw Press

2.3.3 Dewatering System Design Comparison

Table 2-4 presents a summary of the preliminary design criteria for the dewatering alternatives.

Table 2-4. Dewatering System Design Criteria

Description	Centrifuge (Alfa-Laval Aldec G3-115)	Screw Press (Schwing Bioset FSP 903)
Number of Units	2 (1 new, 1 existing)	2
Length (in)	256	304
Width (in)	42	64

Table 2-4. Dewatering System Design Criteria		
Description	Centrifuge (Alfa-Laval Aldec G3-115)	Screw Press (Schwing Bioset FSP 903)
Height (in)	57	82
Energy Requirement (HP)	180	19
Capacity @ 2.5% Digested Sludge (dry lbs/ hr)	2,123	1,712
Polymer feed rate (lbs/day) Liquids Alt 1&2/ Alt 3	63.6/70	63.6/70
Cake % Solids	>20%	<20%

2.4 Biosolids Storage Pad Alternatives

ALASD operates the centrifuge 4 to 5 days per week for roughly 6 hours per day and generates 2 to 3 truckloads of cake per day. The cake generated at ALASD is land applied on a select number of farm fields. Cake is either hauled out to the fields directly, hauled to storage located at the fields, or stored on the biosolids storage pad located at the WWTF, depending on the time of year.

The existing biosolids storage pad is approximately 200 feet by 220 feet (44,000 square feet). The recommended biosolids storage area size is 30,000 square feet based on projected biosolids production and a maximum six-month storage period. The excess area is currently being used for other purposes including chemical tank storage and drying solids from vacuum truck sludge following pump station cleaning.

2.4.1 Alternative 4A - Reclaim Existing Biosolids Storage Pad

The first alternative is to remove the existing perimeter bituminous curb and wood barrier, reclaim the existing bituminous surfacing, construct 3-ft to 4-ft cast-in-place concrete bunker walls on the south and west sides of the pad, and resurface the pad with bituminous pavement. Bituminous pavement reclamation is a rehabilitation method in which the full thickness of the bituminous pavement is pulverized and blended with a portion of the underlying granular base material to provide an upgraded homogeneous base material. The upgraded base material would provide a stronger foundation for the new bituminous pavement surfacing. The proposed concrete bunker walls would provide downgradient containment for stormwater runoff and loading equipment. An advantage of the existing biosolids storage pad location is that it is in an inconspicuous location hidden from public. A disadvantage of this alternative is that trucks hauling biosolids to and from the existing pad location must drive through the whole WWTF site.

2.4.1.1 Alternative 4A.1 – Construct Partial Fabric Cover

This alternative includes all work included in Alternative 1 plus constructing a 15,000 square foot fabric cover structure supported by concrete piers and an additional cast-in-place bunker wall inside the cover structure. The fabric cover structure would provide cover over approximately half of the biosolids storage area to provide drying flexibility. The additional bunker wall would protect the fabric cover structure, prevent stormwater runoff from entering the covered area, and provide containment for loading biosolids inside the structure.

2.4.1.2 Alternative 4A.2 – Construct Partial Steel Cover

This alternative includes all work included in Alternative 2A except constructing a steel cover structure instead of a fabric cover structure.

2.4.2 Alternative 4B – Construct New Biosolids Storage Pad Closer to WWTF

This alternative includes constructing a new biosolids storage pad southwest of the Headworks Building. Constructing the pad in this location would minimize truck hauling at the WWTF site. The new pad would have bituminous pavement surfacing and 3-ft to 4-ft cast-in-place concrete walls on two sides for downgradient stormwater runoff containment and biosolids loading. The new pad would be approximately the same size as the existing pad so it could be used for storage as well. Drainage would be by a stormwater catch basin with gravity piping to the Headworks Building.

An advantage of this alternative is that truck hauling within the WWTF site would be minimized. A disadvantage of this alternative is that it would be located in view of public and the visible biosolids piles may draw unwanted attention.

2.4.2.1 Alternative 4B.1 - Construct Partial Fabric Cover

This alternative includes all work included in Alternative 3 plus constructing the 15,000 square foot fabric cover structure and additional cast-in-place bunker wall inside the cover structure described Alternative 4A.

2.4.2.2 Alternative 4B.2 - Construct Partial Steel Cover

This alternative includes all work included in Alternative 4A except constructing a steel cover structure instead of a fabric cover structure.

2.5 Cost Assumptions and Summary

A BCE was developed to evaluate costs for thickening, dewatering, and digestion for three separate liquids system alternatives. The following assumptions, as summarized in Table 2-6, were used for all alternatives.

Table 2-6. BCE Assumptions

Description	Value
Base Year	2022
Planning Period End	2045
Undeveloped Design Details	30%
Construction Contingency	10%
Electricity Cost	$0.074 per kWhr
Building/Structures Useful Life	40 Years
Process Piping Useful Life	30 Years
Mechanical Equipment Useful Life	20 Years
Electrical Equipment Useful Life	20 Years
Instrumentation and Control Equipment Useful Life	15 Years

a. Engineering fee estimates are for planning purposes only

Based on proposed design conditions for each alternative, the following costs for each option were calculated and are shown in Table 2-7. Cost comparison inputs were based on equipment quotes from manufacturers, chemical and energy consumption assumptions, and construction cost estimates. The detailed BCEs are located in Attachment A.

Table 2-7. BCE Summary

Alternative	Capital Costs	O & M Costs	Total NPV with Adjustment
Thickening			
Alternative 1A – SAF (Liquids Alt 1&2)	$0.6M	$1.3M	$1.9M
Alternative 1A – SAF (Liquids Alt 3)	$0.6M	$1.7UpdatedM	$2.3M
Alternative 1B – Membrane Thickening (Liquids Alt 1& 2)	$6.3M	$1.5M	$7.8M
Alternative 1B – Membrane Thickening (Liquids Alt 3)	$6.5M	$1.5M	$8.0M
Digestion			
Alternative 2A – Replace 100-ton Chiller with 125-ton Chiller (Liquids Alt 1 & 2)	$2.0M	$2.1M	$4.2M
Alternative 2B – Replace 100-ton Chiller (Liquids Alt 3)	$1.9M	$2.1M	$4.0M
Alternative 2C – Replace Chiller with Spiral HEX using Effluent Water (Liquids Alt 3)	$1.6M	$2.1M	$3.8M
Alternative 2D - Replace Chiller with Spiral HEX using City Water (Liquids Alt 3)	$1.6M	$8.8M	$10.4M
Dewatering			
Alternative 3A – Centrifuge (Liquids Alt 1&2)	$4.3M	$5.0M	$9.3M
Alternative 3A – Centrifuge (Liquids Alt 3)	$4.3M	$5.5M	$9.8M
Alternative 3B – Screw Press (Liquids Alt 1&2)	$5.8M	$5.0M	$10.8M
Alternative 3B – Screw Press (Liquids Alt 3)	$5.8M	$5.5M	$11.3M

The total biosolids storage pad costs include a breakdown of capital costs into biosolids storage and miscellaneous storage costs as shown in Table 2-8. O&M and total NPV were not included for the biosolids storage pad alternatives as O&M is assumed not to change with the biosolids storage pad upgrades.

Table 2-8. Biosolids Storage Pad BCE Summary

Alternative	Capital Cost	Miscellaneous Storage Area Cost	Total Capital Cost
Alternative 4A - Reclaim Existing Biosolids Storage Pad	$0.2M	$0.1M	$0.3M
Alternative 4A.1 - Reclaim Existing Biosolids Storage Pad + Partial Fabric Cover	$0.7M	$0.1M	$0.8M
Alternative 4A.2 - Reclaim Existing Biosolids Storage Pad + Partial Steel Cover	$0.9M	$0.1M	$0.9M

Table 2-8. Biosolids Storage Pad BCE Summary			
Alternative 4B - New Biosolids Storage Pad Closer to WWTF	$0.3M	$0.1M	$0.4M
Alternative 4B.1 - New Biosolids Storage Pad Closer to WWTF + Partial Fabric Cover	$0.9M	$0.1M	$0.9M
Alternative 4B.2 - New Biosolids Storage Pad Closer to WWTF + Partial Steel Cover	$1.0M	$0.1M	$1.1M

Section 3: Summary of Recommendations

Advantages and disadvantages for each alternative are summarized in Table 3-1.

Table 3-1. Alternatives Comparison

Alternative	Advantages	Disadvantages
Thickening		
Alternative 1A - SAF	• Existing DAF easily modified • Lower capital cost • SLR up to 20 - 30 lb/sf-hr (vs. 2-3 with DAF) • Operational costs similar to DAF • 40-60% less polymer than DAF • Higher TWAS solids concentration	• Sole source • Newer technology (fewer installations) with less operating data • Frothing agent required (Floc Aid) • Froth generating pump replacement every 1 to 3 years
Alternative 1B – Membrane Thickening	• Use same membrane equipment as MBRs • Eliminates polymer use • Simplifies operation/maintenance • Not sensitive to SVI	• Higher capital cost • Requires chemical cleaning • Lower TWAS solids concentration
Digestion		
Alternative 2A – Replace 100-Ton Chiller with 125-Ton Chiller (Liquids Alt 1 & 2)	• Utilizes existing HEX units	• More heat produced results in higher cooling requirements • Highest capital cost • Chiller is still required for cooling • Spiral HEXs ae not recommended with primary sludge
Alternative 2B – Replace 100-Ton Chiller (Liquids Alt 3)	• Utilizes existing HEX units • Smaller chiller required	• Chiller is still required for cooling
Alternative 2C – Replace Chiller with Spiral HEX w/Effluent Water Cooling (Liquids Alt 3)	• Eliminates need for chiller • In-plant reuse • Lowest capital cost	• Larger spiral HEX units required for effluent water cooling • Effluent water piping upgrades are required
Alternative 2D - Replace Chiller with Spiral HEX w/City Water Cooling (Liquids Alt 3)	• Eliminates need for chiller	• City water piping upgrades required • Highest O&M due to city water demand

Table 3-1. Alternatives Comparison		
Alternative	**Advantages**	**Disadvantages**
	• Smaller spiral HEX units required for cooler city water	
Dewatering		
Alternative 3A – Centrifuge	• Staff familiarity • More compact footprint, smaller building expansion • Higher solids capture (~95%)	• Higher energy usage • Bowl and scroll rebuild requires shipment off-site • Sensitive to grit • More mechanically complex • Requires lifting device for rotating assembly removal
Alternative 3B – Screw Press	• Lower energy usage • Dewatering continues during wash cycle • Lower operating cost	• New technology for ALASD • Increased footprint over centrifuge, larger building expansion • Lower solids capture (~90%) • Reaction tank upstream • Large components require lifting device
Biosolids Storage Pad		
Alternative 4A – Reclaim Existing Biosolids Storage Pad	• Lower capital cost • Use existing space • Use existing drainage system • Less public visibility	• Longer travel distance from solids building
Alternative 4B – New Biosolids Storage Pad Closer to WWTF	• Shorter travel distance from solids building	• Higher capital cost • Incorporate drainage to a stormwater catch basin with gravity piping and route to the headworks building • More public visibility

3.1 Recommendations

The following are the recommendations for each process.

3.1.1 Thickening

Alternative 1A – SAF is the recommended alternative due to the lowest life cycle cost and ability to repurpose the existing DAF.

3.1.2 Digestion

Alternative 2A – Replace 100-Ton Chiller with 125-Ton Chiller is the recommended alternative (based on the selection of Liquids Alternative 2). This recommendation includes a complete replacement of the fine bubble diffuser system and header piping for all four cells and the replacement of the buried air pipe from the blowers to headers.

3.1.3 Dewatering

Alternative 3A – Centrifuge is the recommended alternative due to the lowest life cycle cost, higher solids capture, and operator familiarity with the technology.

3.1.4 Biosolids Storage Pad

Alternative 4A.1 – Reclaim Existing Biosolids Storage Pad and Construct Partial Fabric Cover is the recommended alternative. This alternative is less costly than constructing a pad in a new location and the added cover will provide flexibility for biosolids drying. This alternative also keeps the pad in an inconspicuous location that does not draw public attention.

Attachment A: Business Case Evaluation

PROJECT NAME	ALASD Facility Plan			
ASSUMPTIONS				
Engineering Economics Analysis Inputs			Value	Source/Comment
Base Year			2022	Common for all alternatives. Reference year for all cost data input. Year of NPV.
Planning Period End			2045	Common for all alternatives.
Analysis Horizon (number of years)			24	
Annual Inflation (per year)			3.0%	
Engineering and Administration			15%	Engineering Fee Estimates are for planning purposes only
Undeveloped Design Details			30%	Set to zero if cost is generated by cost group
Construction Contingency			10%	Set to zero if cost is generated by cost group
Useful Lives (years)			Useful Life (yr)	
Building/Structures			40	
Process Piping			30	
Mechanical Equipment			20	
Electrical Equipment			20	
Instrumentation and Control Equipment			15	
Operation and Mainteance Cost Inputs	Unit		Unit Cost	Source/Comment
Labor (Operations)	FTE	$	93,359	1.4 x hourley wage of plant operator $32.06, 2,080 hrs per year
Natural Gas	MMBTU	$	14.10	Rates vary, based off June 2022 rate of $1.41/ THM (10 THM per MMBTU)
Electricity	KWHr	$	0.0740	Electricity bill provided by ALASD w/ demand charges
Polymer	Pound	$	1.65	40% delivery concentration
Chlorine	Tons	$	1,855.00	
Citric	Pound	$	1.30	
Ferrous Sulfate	Gal	$	2.28	12% delivery concentration
Sodium Bisulfite	Gal	$	5.27	40% delivery concentration
Sodium Hypochlorite	Gal	$	2.15	quoted cost from Hawkins in Fargo, ND, 12.5% concentration
Floc Aid	55 gal drum	$	1,482.19	
Carbon (MicroC)	Gal	$	3.24	
Land Application	Wet Tons	$	40.00	
Disposal of Screenings & Grit	Tons	$	127.50	Annual disposal cost for grit and screenings is $14,174 for 111.17 tons
Dewatering	Dry Tons	$	85.00	
Labor	LS		1%	Percent of Equipment Cost
Materials	LS		1%	Percent of Equipment Cost

PROJECT NAME	ALASD Facility Plan			
Business Case Evaluation Summary				
Alternative #	**Descriptive Title**	**Total NPV**	**Capital Costs**	**O & M Costs**
1	SAF (Alt 1 and 2)	$ 1,909,236	$ 634,678	$ 1,274,558
2	SAF (Alt 3)	$ 2,279,040	$ 634,678	$ 1,644,361
3	Membrane Thickening (Alt 1 and 2)	$ 7,765,819	$ 6,293,189	$ 1,472,630
3	Membrane Thickening (Alt 3)	$ 7,987,690	$ 6,515,061	$ 1,472,630

PROJECT NAME	ALASD Facility Plan
Alternative	SAF (Alt 1 and 2)

New Project/Improvement Time Line — Comments/Notes

Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 84,935	Capital =	$ 634,678	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 549,743			
Annual Operating Labor	$ 237,626	O & M =	$ 1,274,558	
Annual Operating Electricity	$ 79,941			
Annual Operating Non-Labor Other	$ 631,430			
Annual Maintenance Labor	$ 190,371			
Annual Maintenance Non-Labor	$ 135,190			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 1,909,236**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 600,719	$ 90,108	-	% Total Construction
Total Engineering Cost				**$ 90,108**	**$ 84,935**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	38,446	$ 38,446	-	DIV 3-10, 12,13
Process Piping	LS	1	$ 93,712	$ 93,712	-	DIV 22
Mechanical Equipment	LS	1	$ 374,849	$ 374,849	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	$ 93,712	$ 93,712	-	DIV 26
Instrumentation and Control Equipment	LS	1	-	$ -	-	DIV 27
Site Work	LS	1	-	$ -	-	DIV 2
Subtotal Bare Construction				**$ 600,719**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	30%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	0.00%	10%		$ -	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$ -	-	
Total Construction Phase Cost				**$ 600,719**	**$ 549,743**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	20.00%	$ 18,672	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	84,884	$ 6,281	-	Operations are 24 hrs/ day, 365 days/ year. Includes 2x TWAS and pressurization pumps (1 operating) @ 5hp, froth motor @ 3hp (9.69 kW)
Polymer	Pound	$ 1.65	27,375	$ 45,169	-	Assuming 50% reduction in polymer with SAF is approximately 30 lbs/day active polymer
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	3.0	$ 4,447	-	Dose of 0.42 gpd
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 18,672	$ 237,626	
Subtotal Non-Labor Operating Costs - Electricity				$ 6,281	$ 79,941	
Subtotal Non-Labor Operating Costs - Other				$ 49,615	$ 631,430	
Total Operating Costs				**$ 74,569**	**$ 948,997**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	0.10	$ 9,336	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost ☐ Check to include		Total Equip Cost: $562,273	Applied %: 1.00%	$ 5,623	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost ☐ Check to include		$562,273	1.00%	$ 5,623		Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Froth Generator Pump	each	$ 10,000.00	1	$ 5,000	-	Froth generating pump replacement every 1-3 years, assumed replacement every 2 years
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 14,959	$ 190,371	
Subtotal Annual Non-Labor Maintenance Costs				$ 10,623	$ 135,190	
Total Annual Maintenance Costs				**$ 25,581**	**$ 325,561**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
	Cyclic Replacement Costs						
Building/Structures	N	40	1.00	$ 38,446	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	#REF!	0	$ -	
Mechanical Equipment	N	20	1.00	$ 93,712	0	$ -	
Electrical Equipment	N	20	1.00	$ 374,849	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 93,712	0	$ -	
Totals						**$ -**	Always default to NO unless major equipment replacement in known to occur within useful lifespan

PROJECT NAME	ALASD Facility Plan
Alternative	SAF (Alt 3)

New Project/Improvement Time Line

		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 84,935	Capital =	$ 634,678	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 549,743			
Annual Operating Labor	$ 237,626			
Annual Operating Electricity	$ 79,941			
Annual Operating Non-Labor Other	$ 1,001,233			
Annual Maintenance Labor	$ 190,371	O & M =	$ 1,644,361	
Annual Maintenance Non-Labor	$ 135,190			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 2,279,040**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 600,719	$ 90,108	-	% Total Construction
Total Engineering Cost				**$ 90,108**	**$ 84,935**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	38,446	$ 38,446	-	DIV 3-10, 12,13
Process Piping	LS	1	$ 93,712	$ 93,712	-	DIV 22
Mechanical Equipment	LS	1	$ 374,849	$ 374,849	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	$ 93,712	$ 93,712	-	DIV 26
Instrumentation and Control Equipment	LS	1	-	$ -	-	DIV 27
Site Work	LS	1	-	$ -	-	DIV 2
Subtotal Bare Construction				**$ 600,719**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	30%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	0.00%	10%		$ -	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$ -	-	
Total Construction Phase Cost				**$ 600,719**	**$ 549,743**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	20.00%	$ 18,672	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	84,884	$ 6,281	-	Operations are 24 hrs/ day, 365 days/ year. Includes 2x TWAS and pressurization pumps (1 operating) @ 5hp, froth motor @ 3hp (9.69 kW)
Polymer	Pound	$ 1.65	43,800	$ 72,270	-	Assuming 50% reduction in polymer with SAF is approximately 48 lbs/day active polymer
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	4	$ 6,403	-	Dose of 0.65 gpd
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 18,672	$ 237,626	
Subtotal Non-Labor Operating Costs - Electricity				$ 6,281	$ 79,941	
Subtotal Non-Labor Operating Costs - Other				$ 78,673	$ 1,001,233	
Total Operating Costs				**$ 103,626**	**$ 1,318,800**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	0.10	$ 9,336	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:				
Check to include		$562,273	1.00%	$ 5,623	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$562,273	1.00%	$ 5,623		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ 10,000.00	1	$ 5,000	-	Froth generating pump replacement every 1-3 years, assumed replacement every 2 years
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 14,959	$ 190,371	
Subtotal Annual Non-Labor Maintenance Costs				$ 10,623	$ 135,190	
Total Annual Maintenance Costs				**$ 25,581**	**$ 325,561**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
	Cyclic Replacement Costs						
Building/Structures	N	40	1.00	$ 38,446	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	#REF!	0	$ -	
Mechanical Equipment	N	20	1.00	$ 93,712	0	$ -	
Electrical Equipment	N	20	1.00	$ 374,849	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 93,712	0	$ -	
Totals						$ -	Always default to NO unless major equipment replacement in known to occur within useful lifespan

PROJECT NAME	ALASD Facility Plan
Alternative	Membrane Thickening (Alt 1 and 2)

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 842,181	Capital =	$ 6,293,189	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 5,451,008			
Annual Operating Labor	$ 237,626	O & M =	$ 1,472,630	
Annual Operating Electricity	$ 395,992			
Annual Operating Non-Labor Other	$ 27,961			
Annual Maintenance Labor	$ 193,756			
Annual Maintenance Non-Labor	$ 617,295			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 7,765,819**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 5,956,464	$ 893,470	-	% Total Construction
Total Engineering Cost				**$ 893,470**	**$ 842,181**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	1,070,000	$ 1,070,000	-	DIV 3-10, 12,13
Process Piping	LS	1	951,539	$ 951,539	-	DIV 22
Mechanical Equipment	LS	1	1,903,078	$ 1,903,078	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	-		-	DIV 26
Instrumentation and Control Equipment	LS	1	1,141,847	$ 1,141,847	-	DIV 27
Site Work	LS	1	890,000	$ 890,000	-	DIV 2
Subtotal Bare Construction				**$ 5,956,464**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	30%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	0.00%	10%		$ -	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$ -	-	
Total Construction Phase Cost				**$ 5,956,464**	**$ 5,451,008**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	20.00%	$ 18,672	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	420,480	$ 31,116	-	96kwh for 12 hrs per day for thickening
Polymer	Pound	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Pound	$ 1.30	61	$ 79	-	61 gallons per year at 50% solution
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	985	$ 2,118	-	985 gal/yr @ 10.3% solution (assuming degradation)
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 18,672	$ 237,626	
Subtotal Non-Labor Operating Costs - Electricity				$ 31,116	$ 395,992	
Subtotal Non-Labor Operating Costs - Other				$ 2,197	$ 27,961	
Total Operating Costs				**$ 51,984**	**$ 661,579**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72		$ -	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
Check to include		$3,044,925	0.50%	$ 15,225	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$3,044,925	0.50%	$ 15,225		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Membranes	each	$ 332,800.00	0	$ 33,280	-	Membrane replacement every 10 years @ $1600/module, 208 modules for one train
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 15,225	$ 193,756	
Subtotal Annual Non-Labor Maintenance Costs				$ 48,505	$ 617,295	
Total Annual Maintenance Costs				**$ 63,729**	**$ 811,051**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
	Cyclic Replacement Costs						
Building/Structures	N	40	1.00	$ 1,070,000	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 951,539	0	$ -	
Mechanical Equipment	N	20	1.00	$ 1,903,078	0	$ -	
Electrical Equipment	N	20	1.00	$ -	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 1,141,847	0	$ -	
Totals						$ -	Always default to NO unless major equipment replacement in known to occur within useful lifespan

PROJECT NAME	ALASD Facility Plan
Alternative	Membrane Thickening (Alt 3)

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 871,873	Capital =	$ 6,515,061	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 5,643,188			
Annual Operating Labor	$ 237,626	O & M =	$ 1,472,630	
Annual Operating Electricity	$ 395,992			
Annual Operating Non-Labor Other	$ 27,961			
Annual Maintenance Labor	$ 193,756			
Annual Maintenance Non-Labor	$ 617,295			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 7,987,690**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 6,166,464	$ 924,970	-	% Total Construction
Total Engineering Cost				**$ 924,970**	**$ 871,873**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	1,260,000	$ 1,260,000	-	DIV 3-10, 12,13, factored in larger sludge holding tank
Process Piping	LS	1	951,539	$ 951,539	-	DIV 22
Mechanical Equipment	LS	1	1,903,078	$ 1,903,078	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	-		-	DIV 26
Instrumentation and Control Equipment	LS	1	1,141,847	$ 1,141,847	-	DIV 27
Site Work	LS	1	910,000	$ 910,000	-	DIV 2
Subtotal Bare Construction				**$ 6,166,464**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	30%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	0.00%	10%		$ -	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$ -	-	
Total Construction Phase Cost				**$ 6,166,464**	**$ 5,643,188**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	20.00%	$ 18,672	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	420,480	$ 31,116	-	96kwh for 12 hrs per day for thickening
Polymer	Pound	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Pound	$ 1.30	61	$ 79	-	61 gallons per year at 50% solution
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	985	$ 2,118	-	985 gal/yr @ 10.3% solution (assuming degradation)
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 18,672	$ 237,626	
Subtotal Non-Labor Operating Costs - Electricity				$ 31,116	$ 395,992	
Subtotal Non-Labor Operating Costs - Other				$ 2,197	$ 27,961	
Total Operating Costs				**$ 51,984**	**$ 661,579**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72		$ -	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
Check to include		$3,044,925	0.50%	$ 15,225	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$3,044,925	0.50%	$ 15,225		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Membranes	each	$ 332,800.00	0	$ 33,280	-	Membrane replacement every 10 years @ $1600/module, 208 modules for one train
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 15,225	$ 193,756	
Subtotal Annual Non-Labor Maintenance Costs				$ 48,505	$ 617,295	
Total Annual Maintenance Costs				**$ 63,729**	**$ 811,051**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Cyclic Replacement Costs: Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
Building/Structures	N	40	1.00	$ 1,260,000	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 951,539	0	$ -	
Mechanical Equipment	N	20	1.00	$ 1,903,078	0	$ -	
Electrical Equipment	N	20	1.00	$ -	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 1,141,847	0	$ -	
Totals						**$ -**	Always default to NO unless major equipment replacement in known to occur within useful lifespan

PROJECT NAME	ALASD Facility Plan			
ASSUMPTIONS				
Engineering Economics Analysis Inputs			Value	Source/Comment
Base Year			2022	Common for all alternatives. Reference year for all cost data input. Year of NPV.
Planning Period End			2045	Common for all alternatives.
Analysis Horizon (number of years)			24	
Annual Inflation (per year)			3.0%	
Engineering and Administration			15%	Engineering Fee Estimates are for planning purposes only
Undeveloped Design Details			30%	Set to zero if cost is generated by cost group
Construction Contingency			10%	Set to zero if cost is generated by cost group
Useful Lives (years)			Useful Life (yr)	
Building/Structures			40	
Process Piping			30	
Mechanical Equipment			20	
Electrical Equipment			20	
Instrumentation and Control Equipment			15	
Operation and Mainteance Cost Inputs	Unit	Unit Cost		Source/Comment
Labor (Operations)	FTE	$	93,359	1.4 x hourley wage of plant operator $32.06, 2,080 hrs per year
Natural Gas	MMBTU	$	14.10	Rates vary, based off June 2022 rate of $1.41/ THM (10 THM per MMBTU)
Electricity	KWHr	$	0.0740	Electricity bill provided by ALASD w/ demand charges
Polymer	Pound	$	1.65	40% delivery concentration
Chlorine	Tons	$	1,855.00	
Citric	Pound	$	1.30	
Ferrous Sulfate	Gal	$	2.28	12% delivery concentration
Sodium Bisulfite	Gal	$	5.27	40% delivery concentration
Sodium Hypochlorite	Gal	$	2.15	quoted cost from Hawkins in Fargo, ND, 12.5% concentration
Floc Aid	55 gal drum	$	1,482.19	
Carbon (MicroC)	Gal	$	3.24	
Land Application	Wet Tons	$	40.00	
Disposal of Screenings & Grit	Tons	$	127.50	Annual disposal cost for grit and screenings is $14,174 for 111.17 tons
Dewatering	Dry Tons	$	85.00	
Labor	LS		1%	Percent of Equipment Cost
Materials	LS		1%	Percent of Equipment Cost

PROJECT NAME	ALASD Facility Plan			
Business Case Evaluation Summary				
Alternative #	**Descriptive Title**	**Total NPV**	**Capital Costs**	**O & M Costs**
1	Fine Bubble Diffuser w/ Primary Clarifiers, Existing HEX + New 125 ton Chiller	$ 4,147,206	$ 1,999,966	$ 2,147,239
2	Fine Bubble Diffusers w/o Primary Clarifiers, Existing HEX + New 100 ton Chiller	$ 3,998,543	$ 1,880,378	$ 2,118,165
3	Fine Bubble Diffusers w/o Primary Clarifiers, New Spiral HEX (Effluent Water)	$ 3,775,457	$ 1,637,871	$ 2,137,586
4	Fine Bubble Diffusers w/o Primary Clarifiers, New Spiral HEX (City Water)	$ 10,344,679	$ 1,595,800	$ 8,748,879

PROJECT NAME	ALASD Facility Plan
Alternative	Fine Bubble Diffuser w/ Primary Clarifiers, Existing HEX + New 125 ton Chiller

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 267,644	Capital =	$ 1,999,966	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 1,732,323			
Annual Operating Labor	$ 237,626	O & M =	$ 2,147,239	
Annual Operating Electricity	$ 1,471,884			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 237,626			
Annual Maintenance Non-Labor	$ 200,103			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 4,147,206**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 1,892,956	$ 283,943	-	% Total Construction
Total Engineering Cost				**$ 283,943**	**$ 267,644**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	$ -	$ -	-	DIV 3-10, 12,13
Process Piping	LS	1	$ 307,161	$ 307,161	-	Includes digester aeration pipe replacement (14" Ductile Iron Pipe, 180' long)
Mechanical Equipment	LS	1	$ 754,684	$ 754,684	-	Includes new 125 ton high efficiency chiller unit at $245,000 and fine bubble diffuser system at $294,060
Electrical Equipment	LS	1	$ 61,250	$ 61,250	-	Budget for chiller electrical upgrade (25%)
Instrumentation and Control Equipment	LS	1	$ 60,000	$ 60,000	-	Electrical and I&C for diffuser replacement
Site Work	LS	1	$ 169,016	$ 169,016	-	Diffuser and HEX demolition, and blower air pipe replacement
Subtotal Bare Construction				**$ 1,352,111**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	30.00%	30%		$ 405,633	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$ 135,211	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$ 540,844**	-	
Total Construction Phase Cost				**$ 1,892,956**	**$ 1,732,323**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	20.00%	$ 18,672	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	1,562,905	$ 115,655	-	30 hp (22.37 kW) motor for chiller and one (1) 350 gpm pump at 10 hp. Assumes cooling 65% of time in summer (119 days) and 30% of time in winter (55 days).
Polymer	Pound	$ 1.65	-	$ -	-	One (1) 250 hp blowers operating six days per week (shut off periodically to recover alkalinity/ control foaming).
Chlorine	Tons	$ 1,855.00	-	$ -	-	Two (2) recirculation pumps at 7.5 hp, operates 24/7.
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 18,672	$ 237,626	
Subtotal Non-Labor Operating Costs - Electricity				$ 115,655	$ 1,471,884	
Subtotal Non-Labor Operating Costs - Other				$ -	$ -	
Total Operating Costs				**$ 134,327**	**$ 1,709,510**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	20.00%	$ 18,672	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
Check to include		$1,572,333	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$1,572,333	1.00%	$ 15,723		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-	$ -	-	
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 18,672	$ 237,626	
Subtotal Annual Non-Labor Maintenance Costs				$ 15,723	$ 200,103	
Total Annual Maintenance Costs				**$ 34,395**	**$ 437,729**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
	Cyclic Replacement Costs						
Building/Structures	N	40	1.00	$ -	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 430,026	0	$ -	
Mechanical Equipment	N	20	1.00	$ 1,056,558	0	$ -	
Electrical Equipment	N	20	1.00	$ 84,000	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 84,000	0	$ -	
Totals						$ -	Always default to NO unless major equipment replacement in known to occur within useful lifespan

PROJECT NAME	ALASD Facility Plan
Alternative	Fine Bubble Diffusers w/o Primary Clarifiers, Existing HEX + New 100 ton Chiller

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 251,640	Capital =	$ 1,880,378	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 1,628,738			
Annual Operating Labor	$ 237,626	O & M =	$ 2,118,165	
Annual Operating Electricity	$ 1,457,215			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 237,626			
Annual Maintenance Non-Labor	$ 185,698			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 3,998,543**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 1,779,766	$ 266,965	-	% Total Construction
Total Engineering Cost				**$ 266,965**	**$ 251,640**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	$ -	$ -	-	DIV 3-10, 12,13
Process Piping	LS	1	$ 307,161	$ 307,161	-	Includes digester aeration pipe replacement (14" Ductile Iron Pipe, 180' long)
Mechanical Equipment	LS	1	$ 686,084	$ 686,084	-	Includes new 100 ton high efficiency chiller unit at $196,000 and fine bubble diffuser system at $294,060
Electrical Equipment	LS	1	$ 49,000	$ 49,000	-	Budget for chiller electrical upgrade (25%)
Instrumentation and Control Equipment	LS	1	$ 60,000	$ 60,000	-	Electrical and I&C for diffuser replacement
Site Work	LS	1	$ 169,016	$ 169,016	-	Diffuser and HEX demolition, and blower air pipe replacement
Subtotal Bare Construction				**$ 1,271,261**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	30.00%	30%		$ 381,378	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$ 127,126	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$ 508,504**	-	
Total Construction Phase Cost				**$ 1,779,766**	**$ 1,628,738**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	20.00%	$ 18,672	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	1,547,328	$ 114,502	-	25 hp (18.6 kW) motor for chiller and one (1) 350 gpm pump at 10 hp. Assumes cooling 65% of time in summer (119 days) and 30% of time in winter (55 days).
Polymer	Pound	$ 1.65	-	$ -	-	One (1) 250 hp blowers operating six days per week (shut off periodically to recover alkalinity/ control foaming).
Chlorine	Tons	$ 1,855.00	-	$ -	-	Two (2) recirculation pumps at 7.5 hp, operates 24/7.
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 18,672	$ 237,626	
Subtotal Non-Labor Operating Costs - Electricity				$ 114,502	$ 1,457,215	
Subtotal Non-Labor Operating Costs - Other				$ -	$ -	
Total Operating Costs				**$ 133,174**	**$ 1,694,841**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	20.00%	$ 18,672	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
Check to include		$1,459,143	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$1,459,143	1.00%	$ 14,591		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-	$ -	-	
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 18,672	$ 237,626	
Subtotal Annual Non-Labor Maintenance Costs				$ 14,591	$ 185,698	
Total Annual Maintenance Costs				**$ 33,263**	**$ 423,324**	

Major Cyclic Maintenance Replacement Costs

	Cyclic Replacement Costs						
Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
Building/Structures	N	40	1.00	$ -	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 430,026	0	$ -	
Mechanical Equipment	N	20	1.00	$ 960,518	0	$ -	
Electrical Equipment	N	20	1.00	$ 84,000	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 84,000	0	$ -	
Totals						$ -	Always default to NO unless major equipment replacement in known to occur within useful lifespan

PROJECT NAME	ALASD Facility Plan
Alternative	**Fine Bubble Diffusers w/o Primary Clarifiers, New Spiral HEX (Effluent Water)**

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 219,187	Capital =	$ 1,637,871	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 1,418,684			
Annual Operating Labor	$ 178,220	O & M =	$ 2,137,586	
Annual Operating Electricity	$ 1,627,674			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 178,220			
Annual Maintenance Non-Labor	$ 153,474			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 3,775,457**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 1,550,234	$ 232,535	-	% Total Construction
Total Engineering Cost				**$ 232,535**	**$ 219,187**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	$ -	$ -	-	DIV 3-10, 12,13
Process Piping	LS	1	$ 323,451	$ 323,451	-	Includes digester aeration pipe replacement (14" Ductile Iron Pipe, 180' long). Process piping for diffusers and spiral HEX
Mechanical Equipment	LS	1	$ 525,714	$ 525,714	-	Includes new spiral HEX at $81,450 and fine bubble diffuser system at $294,060
Electrical Equipment	LS	1	$ 12,218	$ 12,218	-	Budget for HEX upgrade (15%)
Instrumentation and Control Equipment	LS	1	$ 60,000	$ 60,000	-	Electrical and I&C for diffuser replacement
Site Work	LS	1	$ 185,928	$ 185,928	-	Diffuser and HEX demolition, and blower air pipe replacement
Subtotal Bare Construction				**$ 1,107,310**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	30.00%	30%		$ 332,193	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$ 110,731	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$ 442,924**	-	
Total Construction Phase Cost				**$ 1,550,234**	**$ 1,418,684**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	15.00%	$ 14,004	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	1,728,329	$ 127,896	-	two (2) 350 gpm pumps at 10 hp. Assumes cooling 65% of time in summer (119 days) and 30% of time in winter (55 days).
Polymer	Pound	$ 1.65	-	$ -	-	One (1) 250 hp blowers operating six days per week (shut off periodically to recover alkalinity/ control foaming).
Chlorine	Tons	$ 1,855.00	-	$ -	-	Two (2) recirculation pumps at 7.5 hp, operates 24/7.
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 14,004	$ 178,220	
Subtotal Non-Labor Operating Costs - Electricity				$ 127,896	$ 1,627,674	
Subtotal Non-Labor Operating Costs - Other				$ -	$ -	
Total Operating Costs				**$ 141,900**	**$ 1,805,893**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	15.00%	$ 14,004	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
Check to include		$1,205,936	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$1,205,936	1.00%	$ 12,059		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-	$ -	-	
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 14,004	$ 178,220	
Subtotal Annual Non-Labor Maintenance Costs				$ 12,059	$ 153,474	
Total Annual Maintenance Costs				**$ 26,063**	**$ 331,693**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Cyclic Replacement Costs: Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
Building/Structures	N	40	1.00	$ -	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 452,832	0	$ -	
Mechanical Equipment	N	20	1.00	$ 736,000	0	$ -	
Electrical Equipment	N	20	1.00	$ 84,000	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 84,000	0	$ -	
Totals						**$ -**	Always default to NO unless major equipment replacement in known to occur within useful lifespan

PROJECT NAME	ALASD Facility Plan
Alternative	Fine Bubble Diffusers w/o Primary Clarifiers, New Spiral HEX (City Water)

New Project/Improvement Time Line — Comments/Notes

Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 213,557	Capital =	$ 1,595,800	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 1,382,244			
Annual Operating Labor	$ 178,220	O & M =	$ 8,748,879	
Annual Operating Electricity	$ 1,627,674			
Annual Operating Non-Labor Other	$ 6,555,273			
Annual Maintenance Labor	$ 178,220			
Annual Maintenance Non-Labor	$ 209,493			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 10,344,679**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 1,510,415	$ 226,562	-	% Total Construction
Total Engineering Cost				**$ 226,562**	**$ 213,557**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	$ -	$ -	-	DIV 3-10, 12,13
Process Piping	LS	1	$ 323,451	$ 323,451	-	Includes digester aeration pipe replacement (14" Ductile Iron Pipe, 180' long). Process piping for diffusers and spiral HEX
Mechanical Equipment	LS	1	$ 500,024	$ 500,024	-	Includes new spiral HEX at $63,100 and fine bubble diffuser system at $294,060
Electrical Equipment	LS	1	$ 9,465	$ 9,465	-	Budget for HEX upgrade (15%)
Instrumentation and Control Equipment	LS	1	$ 60,000	$ 60,000	-	Electrical and I&C for diffuser replacement
Site Work	LS	1	$ 185,928	$ 185,928	-	Diffuser and HEX demolition, and blower air pipe replacement
Subtotal Bare Construction				**$ 1,078,868**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	30.00%	30%		$ 323,660	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$ 107,887	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$ 431,547**	-	
Total Construction Phase Cost				**$ 1,510,415**	**$ 1,382,244**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	15.00%	$ 14,004	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	1,728,329	$ 127,896	-	two (2) 350 gpm pumps at 10 hp. Assumes cooling 65% of time in summer (119 days) and 30% of time in winter (55 days).
Polymer	Pound	$ 1.65	-	$ -	-	One (1) 250 hp blowers operating six days per week (shut off periodically to recover alkalinity/ control foaming).
Chlorine	Tons	$ 1,855.00	-	$ -	-	Two (2) recirculation pumps at 7.5 hp, operates 24/7.
Citric	Pound	$ 1.30	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Floc Aid	55 gal drum	$ 1,482.19	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	City Water	$ 2.80	183,960	$ 515,088	-	June-September $2.90 per 1,000 gal, October-May $2.75 per 1,000 gal
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 14,004	$ 178,220	
Subtotal Non-Labor Operating Costs - Electricity				$ 127,896	$ 1,627,674	
Subtotal Non-Labor Operating Costs - Other				$ 515,088	$ 6,555,273	
Total Operating Costs				**$ 656,988**	**$ 8,361,166**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	15.00%	$ 14,004	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
Check to include		$1,166,116	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$1,166,116	1.00%	$ 11,661		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Water Meter Charge	each	$ 400.00	12	$ 4,800	-	'Assumed 6" water service meter ($400/month)
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 14,004	$ 178,220	
Subtotal Annual Non-Labor Maintenance Costs				$ 16,461	$ 209,493	
Total Annual Maintenance Costs				**$ 30,465**	**$ 387,713**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Cyclic Replacement Costs: Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
Building/Structures	N	40	1.00	$ -	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 452,832	0	$ -	
Mechanical Equipment	N	20	1.00	$ 700,034	0	$ -	
Electrical Equipment	N	20	1.00	$ 84,000	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 84,000	0	$ -	
Totals						$ -	Always default to NO unless major equipment replacement in known to occur within useful lifespan

PROJECT NAME	ALASD Facility Plan			
ASSUMPTIONS				
Engineering Economics Analysis Inputs		Value		Source/Comment
Base Year		2022		Common for all alternatives. Reference year for all cost data input. Year of NPV.
Planning Period End		2045		Common for all alternatives.
Analysis Horizon (number of years)		24		
Annual Inflation (per year)		3.0%		
Engineering and Administration		15%		Engineering Fee Estimates are for planning purposes only
Undeveloped Design Details		30%		Set to zero if cost is generated by cost group
Construction Contingency		10%		Set to zero if cost is generated by cost group
Useful Lives (years)		Useful Life (yr)		
Building/Structures		40		
Process Piping		30		
Mechanical Equipment		20		
Electrical Equipment		20		
Instrumentation and Control Equipment		15		
Operation and Mainteance Cost Inputs	Unit	Unit Cost		Source/Comment
Labor (Operations)	FTE	$ 93,359		1.4 x hourley wage of plant operator $32.06, 2,080 hrs per year
Natural Gas	MMBTU	$ 14.10		Rates vary, based off June 2022 rate of $1.41/ THM (10 THM per MMBTU)
Electricity	KWHr	$ 0.0740		Electricity bill provided by ALASD w/ demand charges
Polymer	lbs	$ 1.65		40% delivery concentration
Chlorine	Tons	$ 1,855.00		
Ferrous Sulfate	Gal	$ 2.28		12% delivery concentration
Sodium Bisulfite	Gal	$ 5.27		40% delivery concentration
Sodium Hypochlorite	Gal	$ 2.15		quoted cost from Hawkins in Fargo, ND, 12.5% concentration
Carbon (MicroC)	Gal	$ 3.24		
Land Application	Wet Tons	$ 40.00		
Disposal of Screenings & Grit	Tons	$ 127.50		Annual disposal cost for grit and screenings is $14,174 for 111.17 tons
Dewatering	Dry Tons	$ 85.00		
Labor	LS	1%		Percent of Equipment Cost
Materials	LS	1%		Percent of Equipment Cost

PROJECT NAME	ALASD Facility Plan			

Business Case Evaluation Summary

Alternative #	Descriptive Title	Total NPV	Capital Costs	O & M Costs
1	Centrifuge (Alts 1 and 2)	$ 9,286,283	$ 4,282,606	$ 5,003,677
2	Screw Press (Alts 1 and 2)	$ 10,843,168	$ 5,820,475	$ 5,022,693
3	Centrifuge (Alt 3)	$ 9,800,383	$ 4,282,606	$ 5,517,777
4	Screw Press (Alt 3)	$ 11,357,268	$ 5,820,475	$ 5,536,793

PROJECT NAME	ALASD Facility Plan
Alternative	Centrifuge (Alts 1 and 2)

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 573,116			Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 3,709,490	Capital =	$ 4,282,606	
Annual Operating Labor	$ 297,033			
Annual Operating Electricity	$ 118,120			
Annual Operating Non-Labor Other	$ 4,298,477			
Annual Maintenance Labor	$ 145,024	O & M =	$ 5,003,677	
Annual Maintenance Non-Labor	$ 145,024			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 9,286,283**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 4,053,460	$ 608,019	-	% Total Construction
Total Engineering Cost				**$ 608,019**	**$ 573,116**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	1,190,000	$ 1,190,000	-	DIV 3-10, 12,13
Process Piping	LS	1	584,380	$ 584,380	-	DIV 22
Mechanical Equipment	LS	1	1,460,949	$ 1,460,949	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	818,131	$ 818,131	-	DIV 26
Instrumentation and Control Equipment	LS	1	-	$ -	-	DIV 27
Site Work	LS	1	-	$ -	-	DIV 2
Subtotal Bare Construction				**$ 4,053,460**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	30%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	0.00%	10%		$ -	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$ -	-	
Total Construction Phase Cost				**$ 4,053,460**	**$ 3,709,490**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	25.00%	$ 23,340	-	Same as maintenance costs
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	125,424	$ 9,281	-	2x centrifuges (1 operating) @180hp (134 kW), operating 3 days per week for 6 hrs/day
Polymer	lbs	$ 1.65	58,035	$ 95,758	-	Average of 63.6 lbs/ day active polymer
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Tons	$ -	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	6,050	$ 242,000	-	Projected average of 6050 wet tons/year
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 23,340	$ 297,033	
Subtotal Non-Labor Operating Costs - Electricity				$ 9,281	$ 118,120	
Subtotal Non-Labor Operating Costs - Other				$ 337,758	$ 4,298,477	
Total Operating Costs				**$ 370,379**	**$ 4,713,630**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	-	$ -	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
Check to include		$2,279,080	0.50%	$ 11,395	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$2,279,080	0.50%	$ 11,395		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			and Construction contingencies
Other Non-Labor UD1	each	$ -	-	$ -	-	
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 11,395	$ 145,024	
Subtotal Annual Non-Labor Maintenance Costs				$ 11,395	$ 145,024	
Total Annual Maintenance Costs				**$ 22,791**	**$ 290,047**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Cyclic Replacement Costs: Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
Building/Structures	N	40	1.00	$ 1,190,000	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 584,380	0	$ -	
Mechanical Equipment	N	20	1.00	$ 1,460,949	0	$ -	
Electrical Equipment	N	20	1.00	$ 818,131	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ -	0	$ -	
Totals						**$ -**	Always default to NO unless major equipment replacement in known to occur within useful lifespan

PROJECT NAME	ALASD Facility Plan
Alternative	Screw Press (Alts 1 and 2)

New Project/Improvement Time Line

		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 778,920			Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 5,041,555	Capital =	$ 5,820,475	
Annual Operating Labor	$ 297,033			
Annual Operating Electricity	$ 12,270			
Annual Operating Non-Labor Other	$ 4,298,477			
Annual Maintenance Labor	$ 207,456	O & M =	$ 5,022,693	
Annual Maintenance Non-Labor	$ 207,456			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 10,843,168**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 5,509,043	$ 826,356	-	% Total Construction
Total Engineering Cost				**$ 826,356**	**$ 778,920**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	1,230,000	$ 1,230,000	-	DIV 3-10, 12,13
Process Piping	LS	1	1,018,820	$ 1,018,820	-	DIV 22
Mechanical Equipment	LS	1	2,037,639	$ 2,037,639	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	1,222,584	$ 1,222,584	-	DIV 26
Instrumentation and Control Equipment	LS	1	-	$ -	-	DIV 27
Site Work	LS	1	-	$ -	-	DIV 2
Subtotal Bare Construction				**$ 5,509,043**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	30%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	0.00%	10%		$ -	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$ -	-	
Total Construction Phase Cost				**$ 5,509,043**	**$ 5,041,555**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	25.00%	$ 23,340	-	Same as maintenance costs
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	13,029	$ 964	-	2x screw presses @ 10 hp, 2x reaction tanks @ 2 hp, 2x washwater pumps @ 2hp (1 screw press system operating @10.44kW), 4 days per week for 6 hrs per day
Polymer	lbs	$ 1.65	58,035	$ 95,758	-	Average of 63.6 lbs/day active polymer
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	6,050	$ 242,000	-	Projected average of 6050 wet tons/year
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 23,340	$ 297,033	
Subtotal Non-Labor Operating Costs - Electricity				$ 964	$ 12,270	
Subtotal Non-Labor Operating Costs - Other				$ 337,758	$ 4,298,477	
Total Operating Costs				**$ 362,062**	**$ 4,607,780**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	-	$ -	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
Check to include		$3,260,223	0.50%	$ 16,301	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$3,260,223	0.50%	$ 16,301		
Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-	$ -	-	
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 16,301	$ 207,456	
Subtotal Annual Non-Labor Maintenance Costs				$ 16,301	$ 207,456	
Total Annual Maintenance Costs				**$ 32,602**	**$ 414,913**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Cyclic Replacement Costs: Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
Building/Structures	N	40	1.00	$ 1,230,000	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 1,018,820	0	$ -	
Mechanical Equipment	N	20	1.00	$ 2,037,639	0	$ -	
Electrical Equipment	N	20	1.00	$ 1,222,584	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ -	0	$ -	
Totals						**$ -**	Always default to NO unless major equipment replacement in known to occur within useful lifespan

PROJECT NAME	ALASD Facility Plan
Alternative	Centrifuge (Alt 3)

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 573,116			Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 3,709,490	Capital =	$ 4,282,606	
Annual Operating Labor	$ 297,033			
Annual Operating Electricity	$ 118,120			
Annual Operating Non-Labor Other	$ 4,812,577			
Annual Maintenance Labor	$ 145,024	O & M =	$ 5,517,777	
Annual Maintenance Non-Labor	$ 145,024			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 9,800,383**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 4,053,460	$ 608,019	-	% Total Construction
Total Engineering Cost				**$ 608,019**	**$ 573,116**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	1,190,000	$ 1,190,000	-	DIV 3-10, 12,13
Process Piping	LS	1	584,380	$ 584,380	-	DIV 22
Mechanical Equipment	LS	1	1,460,949	$ 1,460,949	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	818,131	$ 818,131	-	DIV 26
Instrumentation and Control Equipment	LS	1	-	$ -	-	DIV 27
Site Work	LS	1	-	$ -	-	DIV 2
Subtotal Bare Construction				**$ 4,053,460**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	30%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	0.00%	10%		$ -	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$ -	-	
Total Construction Phase Cost				**$ 4,053,460**	**$ 3,709,490**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	25.00%	$ 23,340	-	Same as maintenance costs
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	125,424	$ 9,281	-	2x centrifuges (1 operating) @180hp (134 kW), operating 3 days per week for 6 hrs/day
Polymer	lbs	$ 1.65	63,875	$ 105,394	-	Average of 70 lbs/day active polymer
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Tons	$ -	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	6,819	$ 272,760	-	Projected average of 6819 wet tons/ year
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 23,340	$ 297,033	
Subtotal Non-Labor Operating Costs - Electricity				$ 9,281	$ 118,120	
Subtotal Non-Labor Operating Costs - Other				$ 378,154	$ 4,812,577	
Total Operating Costs				**$ 410,775**	**$ 5,227,730**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	-	$ -	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost ☐ Check to include		Total Equip Cost: $2,279,080	Applied %: 0.50%	$ 11,395	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs						
Materials at 1% of Total Equip Cost ☐ Check to include		Total Equip Cost: $2,279,080	Applied %: 0.50%	$ 11,395		Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Other Non-Labor UD1	each	$ -	-	$ -	-	
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 11,395	$ 145,024	
Subtotal Annual Non-Labor Maintenance Costs				$ 11,395	$ 145,024	
Total Annual Maintenance Costs				**$ 22,791**	**$ 290,047**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
	Cyclic Replacement Costs						
Building/Structures	N	40	1.00	$ 1,190,000	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 584,380	0	$ -	
Mechanical Equipment	N	20	1.00	$ 1,460,949	0	$ -	
Electrical Equipment	N	20	1.00	$ 818,131	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ -	0	$ -	
Totals						**$ -**	Always default to NO unless major equipment replacement in known to occur within useful lifespan

PROJECT NAME	ALASD Facility Plan
Alternative	Screw Press (Alt 3)

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 778,920	Capital =	$ 5,820,475	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 5,041,555			
Annual Operating Labor	$ 297,033	O & M =	$ 5,536,793	
Annual Operating Electricity	$ 12,270			
Annual Operating Non-Labor Other	$ 4,812,577			
Annual Maintenance Labor	$ 207,456			
Annual Maintenance Non-Labor	$ 207,456			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 11,357,268**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
Design Phase						
Consultant Fees		15%	$ 5,509,043	$ 826,356	-	% Total Construction
Total Engineering Cost				**$ 826,356**	**$ 778,920**	Engineering Fee Estimates are for planning purposes only
Construction						Fill out Construction Cost from ALT1 sheet
Building/Structures	LS	1	1,230,000	$ 1,230,000	-	DIV 3-10, 12,13
Process Piping	LS	1	1,018,820	$ 1,018,820	-	DIV 22
Mechanical Equipment	LS	1	2,037,639	$ 2,037,639	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	1,222,584	$ 1,222,584	-	DIV 26
Instrumentation and Control Equipment	LS	1	-	$ -	-	DIV 27
Site Work	LS	1	-	$ -	-	DIV 2
Subtotal Bare Construction				**$ 5,509,043**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	0.00%	30%		$ -	-	Uses Default % unless Input % is supplied
Construction Contingency	0.00%	10%		$ -	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$ -	-	
Total Construction Phase Cost				**$ 5,509,043**	**$ 5,041,555**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	25.00%	$ 23,340	-	Same as maintenance costs
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	13,029	$ 964	-	2x screw presses @ 10 hp, 2x reaction tanks @ 2 hp, 2x washwater pumps @ 2hp (1 screw press system operating @10.44kW), 4 days per week for 6 hrs per day
Polymer	lbs	$ 1.65	63,875	$ 105,394	-	Average of 70 lbs/day active polymer
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Citric	Tons	$ -	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Carbon (MicroC)	Gal	$ 3.24	-	$ -	-	
Land Application	Wet Tons	$ 40.00	6,819	$ 272,760	-	Projected average of 6819 wet tons/ year
Disposal of Screenings & Grit	Tons	$ 127.50	-	$ -	-	
Dewatering	Dry Tons	$ 85.00	-	$ -	-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 1% or Line 68
Subtotal Labor Operating Costs				$ 23,340	$ 297,033	
Subtotal Non-Labor Operating Costs - Electricity				$ 964	$ 12,270	
Subtotal Non-Labor Operating Costs - Other				$ 378,154	$ 4,812,577	
Total Operating Costs				**$ 402,458**	**$ 5,121,880**	

Annual Maintenance Costs Input

			Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs	FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs	$ 93,358.72	-	$ -	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost (Check to include)	Total Equip Cost: $3,260,223	Applied %: 0.50%	$ 16,301	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies
Annual Non-Labor Maintenance Costs					
Materials at 1% of Total Equip Cost (Check to include)	Total Equip Cost: $3,260,223	Applied %: 0.50%	$ 16,301		Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Construction contingencies

Other Non-Labor Costs:	Unit	Unit Cost	Annual Units	Annual Cost	NPV
Other Non-Labor UD1	each	$ -	-	$ -	-
Other Non-Labor UD2	each	$ -	-	$ -	-
Other Non-Labor UD3	each	$ -	-	$ -	-
Other Non-Labor UD4	each	$ -	-	$ -	-
Other Non-Labor UD5	each	$ -	-	$ -	-
Other Non-Labor UD6	each	$ -	-	$ -	-
Subtotal Annual Labor Maintenance Costs				$ 16,301	$ 207,456
Subtotal Annual Non-Labor Maintenance Costs				$ 16,301	$ 207,456
Total Annual Maintenance Costs				**$ 32,602**	**$ 414,913**

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
Building/Structures	N	40	1.00	$ 1,230,000	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 1,018,820	0	$ -	
Mechanical Equipment	N	20	1.00	$ 2,037,639	0	$ -	
Electrical Equipment	N	20	1.00	$ 1,222,584	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ -	0	$ -	
Totals						**$ -**	Always default to NO unless major equipment replacement in known to occur within useful lifespan

Appendix J: Disinfection TM

Technical Memorandum

370 Wabasha Street North
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Saint Paul, MN 55102

T: 651.298.0710

Prepared for: Alexandria Lake Area Sanitary District (ALASD)

Project Title: ALASD Wastewater Treatment Facility Plan

Project No.: 158466

Technical Memorandum

Subject: Disinfection Alternative Evaluation

Date: December 5, 2022

To: Scott Gilbertson and Troy Drewes

From: Jennifer Gruman, Brown and Caldwell

Prepared by: Kellie Schaefer, E.I.T.

Reviewed by: Tracy Ekola, P.E, and Jennifer Gruman, P.E.

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Executive Summary

This Technical Memorandum (TM) evaluates disinfection alternatives for the Alexandria Lake and Sanitary District (ALASD) wastewater treatment facility (WWTF). A business case evaluation (BCE) comparing the life-cycle costs of each alternative was completed for this TM.

The existing gaseous chlorine disinfection equipment at the ALASD WWTF is beyond its useful life and in need of replacement.

Due to health and safety concerns, a chlorine gas system was eliminated as a future alternative.

The four disinfection alternatives that were compared were:

- sodium hypochlorite/sodium bisulfite
- open-channel ultraviolet light (UV) disinfection
- closed vessel UV disinfection
- peracetic acid (PAA)

All alternatives assume an annual average flow (AAF) of 4.3 million gallons per day (mgd) and an equalized peak hour wet weather flow (PHWWF) of 9.5 mgd for 2045 projected design conditions.

The sodium hypochlorite alternative includes the addition of bulk storage tanks and peristaltic metering pumps for sodium hypochlorite as well as new sodium bisulfite equipment for dechlorination. The existing chlorine contact channel could continue to be used for this alternative.

The open-channel UV disinfection alternative has two possible configurations. Alternative 2A consists of retrofitting an open-channel UV system into the existing chlorine contact basins. Only one manufacturer (Trojan) can provide equipment to fit into the existing channels. Alternative 2B consists of constructing a new UV channel and could include several different suppliers of UV equipment.

The closed vessel UV disinfection alternative consists of pressurized vessels that contains UV lamps. Either two or three vessels would be required depending on the manufacturer.
The NPV for all of the alternatives are within 10% of each other. The recommended alternative will be based on the liquid treatment alternative that is selected and whether disinfection will be required by the MPCA. If disinfection is required, UV disinfection appears to be more favorable since no chemical handling will be required. However, with a MBR system, disinfection may not be required. MBR systems typically discharge zero fecal counts so disinfection is not usually necessary; however. backup facilities would be in place if needed. If only a back-up disinfection system is required, a sodium hypochlorite system would be recommended since this chemical is already required for MBR cleaning and could serve a dual purpose for disinfection, if needed.

Section 1: Introduction

1.1 Background

Gaseous chlorine is currently used for disinfection and sodium bisulfite is used for dechlorination. The chlorine contact tanks were part of the original construction of the plant while the three chlorinators were replaced in 2000. Additionally, a chlorine fume scrubber was installed in 2008 to mitigate the potential for a chlorine gas leak. The contact basins were also expanded in 2008 to provide a detention time of 15 minutes at a peak flow of 11.9 mgd. The chlorinator system is at the end of its useful life as chlorine gas is very corrosive. Dechlorination is provided by two metering pumps, which are in good condition.

ALASD and Brown and Caldwell staff visited three disinfection systems on September 12, 2022. All three of the facilities were owned and operated by Metropolitan Council of Environmental Services (MCES):

- Blue Lake Wastewater Treatment Plant (Shakopee, MN)– sodium hypochlorite/sodium bisulfite system
- Empire Wastewater Treatment Plant (Farmington, MN) – open-vessel UV system
- East Bethel Wastewater Treatment Plant (East Bethel, MN) – closed-vessel UV system

MCES staff provided tours of all their facilities and shared valuable operations and maintenance experience for each system.

Section 2: Alternatives Evaluation

Four disinfection alternatives were evaluated for disinfection at the ALASD WWTF: sodium hypochlorite, open channel UV disinfection, closed vessel UV disinfection and peracetic acid (PAA) disfinection. Gaseous chlorine was eliminated from consideration due to safety and security concerns. Each alternative assumes an AAF of 4.3 mgd and an equalized PHWWF of 9.5 mgd for the 2045 flow projections. Each alternative considers requirements under the current ALASD WWTF National Pollutant Discharge Elimination System (NPDES) permit and the Ten State Standards. The current NPDES permit requires treating the secondary effluent to a maximum of 200 fecal coliform per 100 milliliters (mL) effluent based on a calendar month geometric mean. Additionally, total residual chlorine is limited to 0.038 milligrams per liter (mg/L) as chlorine (Cl_2) daily. Disinfection is only required between April and October.

2.1 Alternative 1 - Sodium Hypochlorite

The first alternative assumes sodium hypochlorite for disinfection, followed by sodium bisulfite for dechlorination. Ten State Standards recommends a contact time of 15 minutes at design peak hourly flow. The existing contact basins were expanded in 2008 to handle a PHWWF of 11.9 mgd. Thus, the existing contact basins are adequately sized to provide the needed contact time with both basins in service. No additional modifications are recommended for this alternative. A condition assessment of the contact tanks was not performed but it is assumed that the concrete is in good condition.

Table 1 presents a summary of the preliminary key design criteria for the sodium hypochlorite disinfection system. Design criteria are in accordance with Ten States Standards. Doses for sodium hypochlorite and sodium bisulfite were based on recent chemical usage provided by ALASD. Dosing does not include potential RAS chlorination requirements.

Table 1. Sodium Hypochlorite Disinfection System Design Criteria

Description	Design Values
Total number of basins	2
Number of passes per basin	8
Design flow rate, MGD, both basins	10.9
Width (per pass), feet	7 to 8
Length (per pass), feet	23 to 27.5
Depth (per pass), feet	6

Table 1. Sodium Hypochlorite Disinfection System Design Criteria	
Description	Design Values
Maximum hypochlorite dose, mg/L as Cl_2	12
Average hypochlorite dose, mg/L as Cl_2	8
Minimum hypochlorite dose, mg/L as Cl_2	2
Maximum sodium bisulfite dose, mg/L	3.0
Average sodium bisulfite dose, mg/L	1.5
Minimum sodium bisulfite dose, mg/L	0.5
Total residual chlorine at outfall, mg/L as Cl_2	≤0.038
Average modal contact time at 4.3 mgd and 1 channel, minutes	22
Modal contact time at 9.5 mgd and 2 channels, minutes	39

Sodium hypochlorite solutions degrade over time, resulting in a loss of available chlorine. Generally, the higher the concentration of the sodium hypochlorite solution, the more rapid the degradation rate. Thus, a concentration of 11.5 percent sodium hypochlorite was used for sizing storage assuming a delivered concentration of 12.5 percent. Sodium bisulfite has a much longer shelf life than sodium hypochlorite and can be stored for up to several months. Bulk bisulfite was not assumed to degrade during the planned storage time.

Storage tank capacities were determined to provide an approximately two-week supply assuming average dosing at the PHWWF. Fiberglass-reinforced plastic (FRP) and reinforced thermos-plastic (RTP) are considered more reliable and longer lasting materials than high density polyethylene (HDPE) for sodium hypochlorite and sodium bisulfite storage. Due to widespread commercial availability, single wall FRP tanks are assumed for this evaluation. A second sodium bisulfite tank is included for redundancy.

Assuming the cloth-disk filters are removed in the Filter and Control Building, the sodium hypochlorite and sodium bisulfite storage and feed equipment could be placed in this area. Spill containment would also be provided to contain the contents of a storage tank in case of failure.

Peristaltic pumps are recommended as chemical feed pumps due to their ease of maintenance and proven reliability for disinfection applications. Peristaltic pumps are also able to meter accurately over a wide range of flows. Watson-Marlow peristaltic pumps were assumed for this analysis; alternative manufacturers include Perfilo and Verder. The existing sodium bisulfite pumps were installed in 2000 and are in good condition, however, replacement pumps were included in the BCE since they would need to be replaced during the planning period. The alternative also includes replacement of the RAS chlorination pumps.

Chemical induction mixers for sodium hypochlorite and diffusers with carrier water for sodium bisulfite were assumed for chemical mixing. A Gas Mastrrr mixer was sized for this application and included in the BCE. Water Champ is also an alternative manufacturer of induction mixers.

Table 2 presents a design summary for the chemical addition systems.

Table 2. Chemical Addition System Design Criteria		
Description	Sodium Hypochlorite	Sodium Bisulfite
Bulk concentration	11.5% by volume [a]	40% by volume
Average dose rate	8 mg/L as Cl_2	1.5 mg/L
Number of storage tanks	3	2 (1 existing)
Storage tank capacity	5,500 gallons per tank (16,500 gallons total)	750 gallons per tank (1,500 gallons total)
Chemical feed rate (gpd) at 4.3 mgd and average dose	260	12
Chemical feed rate (gpd) at 9.5 mgd and maximum dose	861	54
Days storage at 4.3 mgd, days	42	62
Days storage at 9.5 mgd, days	19	2
Number of chemical induction mixers	1 duty, 1 standby	N/A
Chemical induction mixer size, each	5 HP	N/A
Number of peristaltic pumps	1 duty, 1 standby	1 duty, 1 standby
Peristaltic pumps flow rate, gpm	0.05-0.69	0.003-0.04

a. *Delivered Hypochlorite concentration of 12.5% with a degraded concentration of 11.5% was used for sizing calculations to be conservative.*

2.2 Alternatives 2A/2B – Open Channel UV Disinfection

Two open channel UV disinfection alternatives were considered: retrofitting the existing chlorine channels (Alternative 2A) or constructing a new open channel (Alternative 2B). For these alternatives, the required UV dose is assumed to be 30 mJ/cm^2 at 55% UVT (UV transmittance at 254 nm). Also, the end of lamp life factor (LAF) is assumed to be 0.86 to account for lamp aging over time. The lamp fouling factor is conservatively estimated to be 0.85 to account for higher fouling due to the potential use of ferric chloride, which can exacerbate lamp sleeve fouling.

Trojan and Wedeco, two major suppliers of open-channel UV systems, were considered in this analysis. Additional manufacturers include Ozonia and Evoqua. The major components of an open channel UV disinfection system include lamps (with quartz sleeves), ballasts (which power the lamps), UV-intensity sensors, and an automatic wiping system. Low-pressure, high-output (LPHO) UV lamps are typically recommended for wastewater and reuse applications and are used in this evaluation. The useful life of an LPHO lamp varies from 10,000 – 14,000 hours, depending on the number of daily on/off cycles (frequent cycles may shorten lamp life); systems considered for this application have guaranteed lamp lives of 14,000 – 15,000 hours. The useful life of the entire UV system is assumed to be 20 years. Additional instrumentation and equipment, such as level sensors, UVT monitoring, and control gates, are included in cost assumptions.

The existing chlorine contact basins (Alternative 2A) can meet the UV system requirements and can be retrofitted to accommodate the Trojan 3000PlusUV system. The existing channel depth of six feet eliminates most other UV systems from being considered since they require a deeper channel. The horizontal placement of the Trojan 3000Plus lamps is ideal for this application.

Alternatively, a new channel could be constructed (Alternative 2B) and several UV systems could be used, including the Trojan 3000Plus, Trojan Signa and, Wedeco Duron 8. All of these systems could be accommodated by a deeper new channel which would allow for larger lamps and a reduction in lamp count and footprint.

For both alternatives, a redundant channel is not assumed. However, redundant lamp banks are provided. Additionally, a small sodium hypochlorite system for RAS chlorination is assumed as part of this alternative.

Table 3 presents a summary of the preliminary design criteria for an open channel UV system (based on the Trojan 3000Plus).

Table 3. Open Channel UV Disinfection System Design Criteria

Description	Design Values
UV dose, minimum, mJ/cm^2	30
Maximum total suspended solids, mg/L	30
UVT minimum	55% [a]
Lamp type	LPHO in quartz sleeves
Lamp power, W	250
End of lamp life factor (EOLL)	0.86
Lamp fouling factor	0.85
Number of channels	1
Flow per channel, mgd	9.5
Channel dimensions	Length: 23 ft Width: 13 ft Depth: 6 ft
Number of banks	2 (1 duty, 1 standby)
Number of lamps per bank	112
Total number of UV lamps	224
Lamp power draw at average flow of 4.3 mgd [b]	27.2
Peak power draw, kW	112
Headloss across UV channel at design flow, inches	0.5

a. *Ten State Standard is 55% UVT transmittance at 254 nm. Since the system would be new (no data available) 55% UVT was conservatively assumed. Data collection prior to design can be used to refine this value.*

b. *Power draw with one channel, two banks online at 43% power level.*

2.3 Alternative 3 – Closed Vessel UV Disinfection

The third disinfection alternative considered was a closed vessel UV system. As with open channel UV disinfection, the required UV dose is 30 mJ/cm^2 at 55% UVT. Closed vessel reactors are pressurized UV disinfection systems. This alternative is ideal for membrane bioreactor (MBR) treatment systems as the membrane effluent will be pressurized and can be directly fed to a closed vessel UV system. Pumping costs were not included in this evaluation and will be considered in the liquid treatment alternatives.

Trojan and Wedeco were both considered for this alternative. No redundant units were included in this alternative and the vessels provided can meet PHWWF. The UVT may be able to be increased depending on the secondary treatment alternative selected. This may require a fewer number of vessels or smaller vessels. It is assumed that this equipment would be located in the Filter and Control Building where the existing cloth-disk filters currently are. The vessels could also be located in the MBR building.

Table 4 presents a summary of the preliminary design criteria for the closed vessel UV system. Similar to Alternatives 2A/2B, a small sodium hypochlorite RAS chlorination is assumed.

Table 4. Closed Vessel UV Disinfection System Design Criteria

Description	Design Value	
UV dose, minimum, mJ/cm^2	30	
Maximum Total Suspended Solids, mg/L	30	
UVT minimum	55%	
Lamp type	LPHO in quartz sleeves	
End of lamp life factor (EOLL)	0.86	
Lamp fouling factor	0.85	
	Trojan Fit 72AL75	Wedeco LBX 1500
Number of vessels	**2 duty**	**3 duty**
Maximum flow per vessel, mgd	7.2	4.2
Vessel dimensions, per vessel	Length: 7.5 ft Diameter: 1.6 ft	Length: 7.9 ft Diameter: 2.8 ft
Lamp Power, W	250	315
Number of lamps per vessel	72	60
Total number of UV lamps	144	180
Lamp power draw at average flow of 4.3 mgd, kW	18	18.9
Peak power draw, kW	36	56.7
Maximum operating pressure, psi	65	145

Figure 1 shows a schematic of the Trojan Fit UV system.

Figure 1. Trojan Fit UV System

2.4 Alternative 4 – Peracetic Acid

Evaluation of peracetic acid (PAA) as an alternative disinfectant to chlorine could potentially provide a more cost-effective alternative to chlorine or UV disinfection. Currently, no facility in the state using it was identified, so ALASD would need to work with the MPCA to negotiate permitting requirements if switching to PAA. Generally, the PAA residual in the effluent must be low enough to not be toxic or harmful to humans, animals, plants, or aquatic life. To pursue PAA as a disinfection alternative, bench-testing is recommended to verify the contact time and dosage amounts needed to meet the treatment goal and toxicity testing to confirm a PAA residual would not elevate aquatic life toxicity from the final effluent. Pilot testing would likely be required by MPCA to confirm adequate treatment is achieved and confirm permit requirements can be met.

Due to these reasons, PAA was not fully evaluated for ALASD at this time, but additional background and pilot testing information is provided below if this alternative is pursued in the future.

2.4.1 Background

PAA is growing in popularity as an alternative disinfectant. It has been used for wastewater disinfection for nearly two decades in Europe and has more recently been implemented in North America at a growing number of locations. The first PAA product was approved by the U.S. Environmental Protection Agency (EPA) in 2006, with the first large, full-scale municipal application in 2012.

Peracetic acid (or peroxyacetic acid), PAA, is a clear, and colorless liquid that is produced by a reaction between acetic acid and hydrogen peroxide. The food industry is the largest user of PAA for disinfection of meat and produce to reduce *Escherichia coli* (*E. coli*), salmonella, and listeria. It has a very high oxidation potential, allowing it to disinfect and oxidize organic chemicals. Due to its reactivity, PAA does not persist in the environment and rapidly breaks down into acetic acid (vinegar) and hydrogen peroxide, which then decomposes to oxygen and water. Thus, it typically does not require quenching to achieve target residual concentrations of PAA.

Several PAA solutions are registered by the U.S. Environmental Protection Agency (USEPA) and include mixtures that contain 12% - 22%, by weight, of PAA. Commercial-grade PAA solutions exist in equilibrium concentrations with water, hydrogen peroxide, and acetic acid (Figure 2). PAA solutions approved for wastewater disinfection have a pH of less than 2, so many metals, polymers, and elastomers will degrade when exposed to PAA, and it is important to properly store the chemical. PAA should be stored out of direct sunlight, and where temperatures do not exceed 86ºF. Table 5 shows the approximate shelf life of 15% PAA formulations. PAA disinfection efficacy is governed by the contact time and dose.

Figure 2. Equilibrium Solution of Commercial Solution-Grade PAA

Table 5. Shelf Life of 15% PAA Solutions	
Temperature	Approximate Shelf Life
<86ºF	1 year
<100ºF	4 months
<110ºF	1 month

Some drivers for using PAA disinfection in wastewater treatment are:

- Low aquatic toxicity and fast decomposition kinetics.
- Lower capital cost due to a smaller physical footprint and PAA can be implemented in existing structures if there is enough contact time available.
- More stable chemical than sodium hypochlorite (i.e., slower decay kinetics)
- Ease of operation and maintenance; quenching is not required, unlike chlorine which would require dechlorination.
- Ease of repurposing existing infrastructure.
- There are currently no national water quality criteria for PAA. However, in many states such as Florida, Georgia, and Oregon, there is a 1.0 mg/L of PAA residual criterion for receiving waters. This criterion is dependent on the mixing zone policies and is modified on a case-by-case basis.

2.4.2 Assessment of PAA Efficacy and Requirements

To evaluate potential implementation of PAA, a phased evaluation approach is recommended: 1) bench-scale testing to confirm proper dose delivery and perform initial toxicity tests to inform a feasibility analysis and cost estimate; 2) on-site pilot testing to demonstrate efficacy and confirm system sizing over time across a range of operating conditions; and 3) full-scale implementation with continuous monitoring and optimization of dosing.

Bench-scale jar testing is used to identify the proper range of PAA dose required for a prescribed contact time and treatment goal. Typical doses of PAA for secondary effluent range from approximately 0.5 - 3.5 mg/L to meet permit requirements (Water Environmental Federation, 2020). Typical contact times range from ~15 – 30 minutes. If an acceptable dosage scenario is identified, this testing would be followed by toxicity testing at the selected design dosage and residence time. A second set of jar tests should be done to collect data for toxicity testing.

If bench-scale testing confirmed PAA can be effective and can meet toxicity requirements at a cost-effective dose, a pilot study with full plant flow would likely need to be carried out in coordination with MPCA to test PAA in the treatment plant to verify long-term efficacy and (assumed low to no) impact to aquatic health. Some site preparations will be required to allow PAA suppliers to deliver the equipment and totes. Spill management controls including containments for totes and PPE are also important in case there is a spill of the chemical. Power and water, including an eyewash station will be required. A portable eyewash/shower can be used if potable water is not readily available.

In summary, bench-scale testing is needed to verify the dosages needed to achieve the required disinfection at the design contact time of 2 - 5 minutes. Toxicity testing would then also be needed at the selected dosage(s) to confirm the residual PAA would not elevate aquatic life toxicity of the finished effluent beyond the permit limits.

2.5 Cost Assumptions and Summary

A BCE was developed to evaluate costs for disinfection. The following assumptions, as summarized in Table 6, were used for both alternatives.

Table 6. BCE Assumptions

Description	Value
Base year	2022
Planning period end	2045
Analysis horizon (number of years)	20
Annual inflation	3.0%
Undeveloped design details	30%
Construction contingency	10%
Electricity	$0.074/kW-hr
Sodium bisulfite	$5.27/gallon
Sodium hypochlorite	$2.15/gallon
Building/structures useful life	40 Years
Process piping useful life	30 Years
Mechanical equipment useful life	20 Years
Electrical equipment useful life	20 Years
Instrumentation and control equipment useful life	15 Years

Based on proposed design conditions for each alternative, the following costs for each option were calculated and are shown in Table 7. Cost comparison inputs were based on equipment quotes from manufacturers, chemical and energy consumption assumptions, and construction cost estimates. The detailed BCE is located in Attachment A.

Table 7. BCE Summary

Alternative	Capital Costs	O & M Costs	Total NPV with Adjustment
Sodium Hypochlorite	$622,000	$1,738,000	$2,360,000
UV (Retrofit)	$1,728,000	$800,000	$2,528,000
UV (New Channel)	$2,098,000	$800,000	$2,898,000
UV (Closed Vessel)	$1,831,000	$763,000	$2,594,000

Section 3: Summary of Recommendations

Advantages and disadvantages for each alternative are summarized in Table 8 below.

Table 8. Disinfection Alternatives Comparison

	Alternative 1 - Sodium Hypochlorite	Alternative 2A/2B - UV (Open Channel)	Alternative 3 - UV (Closed Vessel)
Ad-vantages	• Low maintenance • Low energy consumption • Existing contact tanks and building space can be used • Can continue to be used for RAS chlorination	• No chemical addition • Simple operations	• No chemical addition • Simple operations • Smallest footprint • Ideal for MBR effluent (already pressur-ized) • Smaller energy consumption compared to open channel UV system
Disad-vantages	• Requires chemical handling and addition • Higher operations costs for increased chemi-cal purchasing and delivery • Potential for chemical cost volatility • Requires quenching	• Higher energy consumption • Higher maintenance costs (lamp cleaning and replacement) • Performance cam be impacted by high TSS and coagulant residual • Requires additional RAS chlorination system • Only one manufacturer available for retrofit in existing channel (2A)	• Maintenance is greater compared to an open channel UV system due to access • Requires additional pressuriza-tion/pumping system if MBR is not im-plemented • Requires additional RAS chlorination system

3.1 Recommendation

The NPV for all of the alternatives are within 10% of each other. The recommended alternative will be based on the liquid treatment alternative that is selected and whether full-time disinfection will be required. UV dis-infection appears to be the most favorable alternative since no chemical handling will be required. With a MBR system, disinfection may not be required. Typically MBR systems discharge zero fecal counts; however, back-up disinfection facilities would be required. If only a back-up disinfection system is required, a sodium hypochlorite system would be recommended since this chemical is already required for MBR cleaning and could serve a dual purpose for disinfection, if ever needed.

Attachment A: Business Case Evaluation

PROJECT NAME	ALASD Facility Plan		
ASSUMPTIONS			
Engineering Economics Analysis Inputs		Value	Source/Comment
Base Year		2022	Common for all alternatives. Reference year for all cost data input. Year of NPV.
Planning Period End		2045	Common for all alternatives.
Analysis Horizon (number of years)		24	
Annual Inflation (per year)		3.0%	
Engineering and Administration		15%	Engineering Fee Estimates are for planning purposes only
Undeveloped Design Details		30%	
Construction Contingency		10%	
Useful Lives (years)		Useful Life (yr)	
Building/Structures		40	
Process Piping		30	
Mechanical Equipment		20	
Electrical Equipment		20	
Instrumentation and Control Equipment		15	
Operation and Mainteance Cost Inputs	Unit	Unit Cost	Source/Comment
Labor (Operations)	FTE	$ 93,359	1.4 x hourley wage of plant operator ($32.06) for 2,080 hours per year
Natural Gas	MMBTU	$ 14.10	Rates vary, based off June 2022 rate of $1.41/ THM (10 THM per MMBTU)
Electricity	KWHr	$ 0.0740	Electricity bill provided by ALASD w/ demand charges
Polymer	lbs	$ 1.65	40% delivery concentration
Chlorine	Tons	$ 1,855.00	
Ferrous Sulfate	Gal	$ 2.28	12% delivery concentration
Sodium Bisulfite	Gal	$ 5.27	40% delivery concentration
Sodium Hypochlorite	Gal	$ 2.15	quoted cost from Hawkins in Fargo, ND, 12.5% concentration
Carbon (MicroC)	Gal	$ 3.24	
Land Application	Wet Tons	$ 40.00	
Disposal of Grit & Screenings	Tons	$ 127.50	Annual disposal cost for grit and screenings is $14,174 for 111.17 tons
Dewatering	Dry Tons	$ 85.00	
Labor	LS	1.00%	Percent of Equipment Cost
Materials	LS	1.00%	Percent of Equipment Cost

PROJECT NAME	ALASD Facility Plan			
Business Case Evaluation Summary				
Alternative #	**Descriptive Title**	**Total NPV**	**Capital Costs**	**O & M Costs**
1	Sodium Hypochlorite	$ 2,359,611	$ 621,739	$ 1,737,872
2A	UV (Existing Contact Channel)	$ 2,527,581	$ 1,727,743	$ 799,837
2B	UV (New Channel)	$ 2,897,412	$ 2,097,575	$ 799,837
3	UV (Closed Vessel)	$ 2,593,982	$ 1,830,729	$ 763,253
4	UV (Closed Vessel) w/ Reuse	$ 5,795,503	$ 4,873,243	$ 922,260

PROJECT NAME	ALASD Facility Plan
Alternative	Sodium Hypochlorite

New Project/Improvement Time Line — Comments/Notes

Year of Planning Phase Expenditure	2022
Year of Design Phase Expenditure	2024
Year of Major Construction Cost	2025
First Year of Operation	2027

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 83,204	Capital =	$621,739	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 538,535			
Annual Operating Labor	$ 118,813	O & M =	$ 1,737,872	
Annual Operating Electricity	$ 23,732			
Annual Operating Non-Labor Other	$ 1,476,513			
Annual Maintenance Labor	$ 118,813			
Annual Maintenance Non-Labor	$ -			
Maintenance Replacement	$ -			
TOTAL NPV	**$2,359,611**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
						Fill out Construction Cost from ALT1 sheet
Design Phase						
Consultant Fees	% Construction	15%	$ 588,472	$ 88,271	-	
Total Engineering Cost				**$ 88,271**	**$ 83,204**	Engineering Fee Estimates are for planning purposes only
Construction						
Building/Structures	LS	1	60,489	$60,489	-	DIV 3-10, 12,13
Process Piping	LS	1	59,975	$59,975	-	DIV 22
Mechanical Equipment	LS	1	199,916	$199,916	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	69,971	$69,971	-	DIV 26
Instrumentation and Control Equipment	LS	1	29,987	$29,987	-	DIV 27
Site Work	LS	1	-	$0	-	DIV 2
Subtotal Bare Construction				**$420,337**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	30.00%	30%		$126,101	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$42,034	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$168,135**	-	
Total Construction Phase Cost				**$ 588,472**	**$ 538,535**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	0.1	$ 9,336	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	25,200	$ 1,865	-	5 hp for mixer. Assumes one mixer operating 24 hours per day, April - October (210 days)
Polymer	lbs	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	2,310	$ 12,174	-	Projected usage of 11 gpd based on a 1.5 mg/L dose for 3.8 mgd midpoint projected influent flow, April - October, rounded up to nearest 1000 gal.
Sodium Hypochlorite	Gal	$ 2.15	48,300	$ 103,845	-	Projected usage of 230 gpd based on a 8 mg/L dose for 3.8 mgd midpoint projected influent flow, April - October, rounded up to nearest 1000 gal.
Land Application	Wet Tons	$ 40.00	-	$ -	-	
Disposal of Grit & Screenings	Tons	$ 127.50	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 0.5% or Line 68
Subtotal Labor Operating Costs				$ 9,336	$ 118,813	
Subtotal Non-Labor Operating Costs - Electricity				$ 1,865	$ 23,732	
Subtotal Non-Labor Operating Costs - Other				$ 116,019	$ 1,476,513	
Total Operating Costs				**$ 127,219**	**$ 1,619,059**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	0.10	$ 9,336	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
☐ Check to include		$419,823	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Contrustruction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$419,823	1.00%	$ -		
☐ Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			and Contrustruction contingencies
Other Non-Labor UD1	each	$ -	-	$ -	-	
Other Non-Labor UD2	each	$ -	-	$ -	-	
Other Non-Labor UD3	each	$ -	-	$ -	-	
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 9,336	$ 118,813	
Subtotal Annual Non-Labor Maintenance Costs				$ -	$ -	
Total Annual Maintenance Costs				**$ 9,336**	**$ 118,813**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
Building/Structures	N	40	1.00	$ 84,684	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 83,965	0	$ -	
Mechanical Equipment	N	20	1.00	$ 279,882	0	$ -	
Electrical Equipment	N	20	1.00	$ 97,959	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 41,982	0	$ -	
Totals						**$ -**	

Disinfection 1

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
2	Division 2 - Site Work and Demolition							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
				$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
3	Division 3 - Concrete							$ 60,489
03-31-05	Structural Concrete	30	cy	$0.00	$ -	$2,016.29	$ 60,489	$ 60,489
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
4	Division 4 - Masonry							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
5	Division 5 - Metals							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
6	Division 6 - Wood, Plastic & Composite							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
7	Division 7 - Thermal and Moisture Protection							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
8	Division 8 - Openings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
9	Division 9 - Finishes							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
10	Division 10 - Specialties							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
11	Division 11 - Equipment							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
12	Division 12 - Furnishings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
13	Division 13 - Special Construction							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
14	Division 14 - Conveying Systems							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
21	Division 21 - Fire Suppression							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
22	Division 22 - Process Piping							$ 59,975
22-05-00.10	Piping Allowance (30%)	1	ls	$59,974.74	$ 59.975	$0.00	$ -	$ 59.975
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
23	Division 23- HVAC							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
26	Division 26 - Electrical Systems							$ 69,971
26-00-00	Electrical (35%)	1	ls	$69,970.53	$ 69,970.53	$0.00	$ -	$ 69,971
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
27	Division 26 - Instrumentation and Control							$ 29,987
27-20-00.01	Instrumentation (15%)	1	ls	$29,987.37	$ 29,987.37	$0.00	$ -	$ 29,987
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
40	Division 40 - Process Integration							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
43	Division 43 - Process Gas and Liquid Handling							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
46	Division 46 - Water and Wastewater Equipment (140%)							$ 199,916
46-06-12	5500 gal Sodium Hypochlorite Storage Tank	3	ea	$0.00	$ -	$17,565.80	$ 52,697	$ 52,697
46-06-12	750 gal Sodium Bisulfite Storage Tank	1	ea	$0.00	$ -	$1,831.20	$ 1,831	$ 1,831

Disinfection 1

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
46-06-12	RAS chlorination pumps	2	ea	$0.00	$ -	$7.000.00	$ 14.000.00	$ 14.000
46-06-12	Sodium Bisulfite Pumps	2	ea	$0.00	$ -	$4.340.00	$ 8.680.00	$ 8.680
46-06-16	Hypochlorite Peristaltic Pumps	2	ea	$0.00	$ -	$17.647.00	$ 35.294	$ 35.294
46-06-14	Hypochlorite Induction Mixer, 5 hp	2	ea	$0.00	$ -	$43.706.60	$ 87.413	$ 87.413
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	Other							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	TOTAL							$ 420,337.14

PROJECT NAME	ALASD Facility Plan
Alternative	UV (Existing Contact Channel)

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 231,214	Capital =	$1,727,743	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 1,496,529			
Annual Operating Labor	$ 178,220	O & M =	$ 799,837	
Annual Operating Electricity	$ 129,104			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 178,220			
Annual Maintenance Non-Labor	$ 314,294			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 2,527,581**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
						Fill out Construction Cost from ALT2A sheet
Design Phase						
Consultant Fees	% Construction	15%	$ 1,635,298	$ 245,295	-	
Total Engineering Cost				$ 245,295	$ 231,214	Engineering Fee Estimates are for planning purposes only
Construction						
Building/Structures	LS	1	45,300	$45,300	-	DIV 3-10, 12,13
Process Piping	LS	1	10,969	$10,969	-	DIV 22
Mechanical Equipment	LS	1	731,234	$731,234	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	255,932	$255,932	-	DIV 26
Instrumentation and Control Equipment	LS	1	109,685	$109,685	-	DIV 27
Sitework	LS	1	14,950	$14,950	-	DIV 2
Subtotal Bare Construction				$1,168,070	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	30.00%	30%		$350,421	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$116,807	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				$467,228	-	
Total Construction Phase Cost				$ 1,635,298	$ 1,496,529	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	0.15	$ 14,004	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	137,088	$ 10,145	-	27.2 kW average power draw (assumes 24/7 power draw) April - October (210 days)
Polymer	lbs	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-		-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 0.5% or Line 68
Subtotal Labor Operating Costs				$ 14,004	$ 178,220	
Subtotal Non-Labor Operating Costs - Electricity				$ 10,145	$ 129,104	
Subtotal Non-Labor Operating Costs - Other				$ -	$ -	
Total Operating Costs				$ 24,148	$ 307,324	

Annual Maintenance Costs Input

	Unit	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	0.15	$ 14,004	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost ☐ Check to include		Total Equip Cost: $1,535,592	Applied %: 1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Contrustruction contingencies
Annual Non-Labor Maintenance Costs						
Materials at 1% of Total Equip Cost ☐ Check to include		Total Equip Cost: $1,535,592	Applied %: 1.00%	$ -		Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Contrustruction contingencies
Other Non-Labor Costs:						
Lamps	each	$ 175.00	112	$ 19,600	-	$175/lamp @ 16,000 hrs. Assumed annual replacement of 50% of lamps (one duty, one standby channel).
Ballasts	each	$ 450.00	6	$ 2,520	-	$450/ballast @ 5yrs. Assumed replacement of 50% of ballasts (one duty, one standby channel) every 5 years.
Sleeves	each	$ 75.00	22	$ 1,680	-	$75/sleeve @ 10yrs. Assumed replacement of 50% of sleeves (one duty, one standby channel) every 10 years.
Wiper	each	$ 8.00	112	$ 896	-	$8/ring @ 2000 wipes. Assumed annual replacement of 50% of rings (one duty, one standby channel) to be conservative.
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 14,004	$ 178,220	
Subtotal Annual Non-Labor Maintenance Costs				$ 24,696	$ 314,294	
Total Annual Maintenance Costs				$ 38,700	$ 492,513	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
Building/Structures	N	40	1.00	$ 63,420	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 15,356	0	$ -	
Mechanical Equipment	N	20	1.00	$ 1,023,728	0	$ -	
Electrical Equipment	N	20	1.00	$ 358,305	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 153,559	0	$ -	
Totals						$ -	

Disinfection 1

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
2	Division 2 - Site Work and Demolition							$ 14,950
31-23-16.42	Demolition	299	sf	$50.00	$ 14,950.00	$0.00	$ -	$ 14,950
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
3	Division 3 - Concrete							$ 45,300
03-11-13	Misc Concrete	30	cy	$1,510.00	$ 45,300	$0.00	$ -	$ 45,300
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
4	Division 4 - Masonry							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
5	Division 5 - Metals							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
6	Division 6 - Wood, Plastic & Composite							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
				$0.00	$ -	$0.00	$ -	$ -
7	Division 7 - Thermal and Moisture Protection							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
8	Division 8 - Openings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
9	Division 9 - Finishes							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
10	Division 10 - Specialties							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
11	Division 11 - Equipment							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
12	Division 12 - Furnishings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
13	Division 13 - Special Construction							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
14	Division 14 - Conveying Systems							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
21	Division 21 - Fire Suppression							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
22	Division 22 - Process Piping							$ 10,969
22-05-00.10	Piping, Process (1.5%)	1	ls	$10,968.52	$ 10,968.52	$0.00	$ -	$ 10,969
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
23	Division 23- HVAC							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
26	Division 26 - Electrical Systems							$ 255,932
26-00-00	Electrical (35%)	1	ls	$255,932.04	$ 255,932.04	$0.00	$ -	$ 255,932
	-	-	-	$0.00	$ -	$0.00		$ -
27	Division 27 - Instrumentation and Control Equipment							$ 109,685
27-20-00.01	Instrumentation (15%)	1	ls	$109,685.16	$ 109,685.16	$0.00	$ -	$ 109,685
	-	-	-	$0.00	$ -	$0.00		$ -
40	Division 40 - Process Integration							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
43	Division 43 - Process Gas and Liquid Handling							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
46	Division 46 - Water and Wastewater Equipment							$ 731,234
46-06-00	UV System	1	ls	$0.00	$ -	$665,403.20	$ 665,403	$ 665,403
46-06-08	Isolation Slide Gates	2	ea	$0.00	$ -	$25,000.00	$ 50,000.00	$ 50,000
46-06-16	750 gallon tank (RAS chlorination)	1	ea	$0.00	$ -	$1,831.20	$ 1,831.20	$ 1,831

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP. Unit $	CONSTRUCTION EQUIP. Equipment Cost	MATERIALS Unit $	MATERIALS Material Cost	TOTAL COST
46-06-12	RAS chlorination pumps	2	ea	$0.00	$ -	$7,000.00	$ 14,000.00	$ 14,000
	Other							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	TOTAL							$ 1,168,070.12

PROJECT NAME	ALASD Facility Plan
Alternative	UV (New Channel)

New Project/Improvement Time Line		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 280,706	Capital =	$ 2,097,575	Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 1,816,869			
Annual Operating Labor	$ 178,220	O & M =	$ 799,837	
Annual Operating Electricity	$ 129,104			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 178,220			
Annual Maintenance Non-Labor	$ 314,294			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 2,897,412**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
						Fill out Construction Cost from ALT2B sheet
Design Phase						
Consultant Fees	% Construction	15%	$ 1,985,341	$ 297,801	-	
Total Engineering Cost				**$ 297,801**	**$ 280,706**	Engineering Fee Estimates are for planning purposes only
Construction						
Building/Structures	LS	1	197,167	$197,167	-	DIV 3-10, 12,13
Process Piping	LS	1	36,562	$36,562	-	DIV 22
Mechanical Equipment	LS	1	731,234	$731,234	-	DIV 11, 14, 21, 23, 40, 43, 46
Electrical Equipment	LS	1	255,932	$255,932	-	DIV 26
Instrumentation and Control Equipment	LS	1	109,685	$109,685	-	DIV 27
Sitework	LS	1	87,521	$87,521	-	DIV 2
Subtotal Bare Construction				**$1,418,101**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	30.00%	30%		$425,430	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$141,810	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$567,240**	-	
Total Construction Phase Cost				**$ 1,985,341**	**$ 1,816,869**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	0.15	$ 14,004	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	137,088	$ 10,145	-	27.2 kW average power (assumes 24/7 power draw) April - October (210 days)
Polymer	lbs	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-		-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 0.5% or Line 68
Subtotal Labor Operating Costs				$ 14,004	$ 178,220	
Subtotal Non-Labor Operating Costs - Electricity				$ 10,145	$ 129,104	
Subtotal Non-Labor Operating Costs - Other				$ -	$ -	
Total Operating Costs				**$ 24,148**	**$ 307,324**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	0.15	$ 14,004	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost ☐ Check to include		Total Equip Cost: $1,535,592	Applied %: 1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Contrustruction contingencies
Annual Non-Labor Maintenance Costs						
Materials at 1% of Total Equip Cost ☐ Check to include		Total Equip Cost: $1,535,592	Applied %: 1.00%	$ -		Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Contrustruction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Lamps	each	$ 175.00	112	$ 19,600	-	$175/lamp @ 16,000 hrs. Assumed annual replacement of 50% of lamps (one duty, one standby channel).
Ballasts	each	$ 450.00	6	$ 2,520	-	$450/ballast @ 5yrs. Assumed replacement of 50% of ballasts (one duty, one standby channel) every 5 years.
Sleeves	each	$ 75.00	22	$ 1,680	-	$75/sleeve @ 10yrs. Assumed replacement of 50% of sleeves (one duty, one standby channel) every 10 years.
Wiper	each	$ 8.00	112	$ 896	-	$8/ring @ 2000 wipes. Assumed annual replacement of 50% of rings (one duty, one standby channel) to be conservative.
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 14,004	$ 178,220	
Subtotal Annual Non-Labor Maintenance Costs				$ 24,696	$ 314,294	
Total Annual Maintenance Costs				**$ 38,700**	**$ 492,513**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
	Cyclic Replacement Costs						
Building/Structures	N	40	1.00	$ 276,034	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 51,186	0	$ -	
Mechanical Equipment	N	20	1.00	$ 1,023,728	0	$ -	
Electrical Equipment	N	20	1.00	$ 358,305	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 153,559	0	$ -	
Totals						$ -	

Disinfection 1

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
2	Division 2 - Site Work and Demolition							$ 87,521
31-23-16.42	Excavation	1,000	bcy	$2.87	$ 2,870.00	$0.00	$ -	$ 2,870
31-23-23.18	Hauling excavated material	1,200	lcy	$32.24	$ 38,688.00	$0.00	$ -	$ 38,688
31-05-16.10	Aggregate for earthwork	800	lcy	$55.34	$ 44,272.00	$0.00	$ -	$ 44,272
01-54-36.50	Mobilization/ demobilization equipment	2	ea	$686.87	$ 1,373.74	$0.00	$ -	$ 1,374
31-22-16.10	UV Foundation Grading	100	sy	$3.17	$ 317.00	$0.00	$ -	$ 317
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
3	Division 3 - Concrete							$ 197,167
03-31-05.35	UV Foundation (2" x 4.6' x 25.3')	100	cy	$705.04	$ 70,504	$0.00	$ -	$ 70,504
03-11-13	1' Concrete Walls	50	cy	$1,510.00	$ 75,500	$0.00	$ -	$ 75,500
03-21-10	2' Concrete Walls	50	cy	$1,023.26	$ 51,163	$0.00	$ -	$ 51,163
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
4	Division 4 - Masonry							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
5	Division 5 - Metals							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
6	Division 6 - Wood, Plastic & Composite							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
				$0.00	$ -	$0.00	$ -	$ -
7	Division 7 - Thermal and Moisture Protection							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
8	Division 8 - Openings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
9	Division 9 - Finishes							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
10	Division 10 - Specialties							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
11	Division 11 - Equipment							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
12	Division 12 - Furnishings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
13	Division 13 - Special Construction							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
14	Division 14 - Conveying Systems							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
21	Division 21 - Fire Suppression							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
22	Division 22 - Process Piping							$ 36,562
22-05-00.10	Piping, Process (5%)	1	ls	$36,561.72	$ 36,561.72	$0.00	$ -	$ 36,562
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
23	Division 23- HVAC							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
26	Division 26 - Electrical Systems							$ 255,932
26-00-00	Electrical (35%)	1	ls	$255,932.04	$ 255,932.04	$0.00	$ -	$ 255,932
	-	-	-	$0.00	$ -	$0.00		$ -
27	Division 27 - Instrumentation and Control Equipment							$ 109,685
27-20-00.01	Instrumentation (15%)	1	ls	$109,685.16	$ 109,685.16	$0.00	$ -	$ 109,685
	-	-	-	$0.00	$ -	$0.00		$ -
40	Division 40 - Process Integration							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
43	Division 43 - Process Gas and Liquid Handling							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -

Disinfection 1

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
46	Division 46 - Water and Wastewater Equipment							$ 731,234
46-06-00	UV System	1	ls	$0.00	$ -	$665.403.20	$ 665.403	$ 665.403
46-06-08	Isolation Slide Gates	2	ea	$0.00	$ -	$25.000.00	$ 50.000.00	$ 50,000
46-06-16	750 gallon tank (RAS chlorination)	1	ea	$0.00	$ -	$1.831.20	$ 1.831.20	$ 1.831
46-06-12	RAS Chlorination Pumps	2	ea	$0.00	$ -	$7,000.00	$ 14,000.00	$ 14,000
	Other							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	TOTAL							$ 1,418,101.06

PROJECT NAME	ALASD Facility Plan
Alternative	UV (Closed Vessel)

New Project/Improvement Time Line

		Comments/Notes
Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 244,996			Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 1,585,733	Capital =	$ 1,830,729	
Annual Operating Labor	$ 178,220			
Annual Operating Electricity	$ 85,437			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 178,220	O & M =	$ 763,253	
Annual Maintenance Non-Labor	$ 321,377			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 2,593,982**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
						Fill out Construction Cost from ALT3 sheet
Design Phase						
Consultant Fees	% Construction	15%	$ 1,732,774	$ 259,916	-	
Total Engineering Cost				**$ 259,916**	**$ 244,996**	Engineering Fee Estimates are for planning purposes only
Construction						
Building/Structures	LS	1	15,100	$15,100	-	DIV 3-10, 12,13
Process Piping	LS	1	39,439	$39,439	-	DIV 22
Mechanical Equipment	LS	1	788,771	$788,771	-	DIV 11, 14, 21, 23, 40, 43, 46. Trojan 72AL75, 7.2 mgd per vessel, 2 duty @10.9 mgd
Electrical Equipment	LS	1	276,070	$276,070	-	DIV 26
Instrumentation and Control Equipment	LS	1	118,316	$118,316	-	DIV 27
Sitework	LS	1	-	$0	-	DIV 2
Subtotal Bare Construction				**$1,237,695**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	30.00%	30%		$371,309	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$123,770	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$495,078**	-	
Total Construction Cost						
Total Construction Phase Cost				**$ 1,732,774**	**$ 1,585,733**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	0.15	$ 14,004	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	90,720	$ 6,713	-	Assumes 24/7 power draw April - October. 250 W per lamp x 72 lamps for one vessel = 18 kW
Polymer	lbs	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-		-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 0.5% or Line 68
Subtotal Labor Operating Costs				$ 14,004	$ 178,220	
Subtotal Non-Labor Operating Costs - Electricity				$ 6,713	$ 85,437	
Subtotal Non-Labor Operating Costs - Other				$ -	$ -	
Total Operating Costs				**$ 20,717**	**$ 263,656**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	0.15	$ 14,004	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost ☐ Check to include		Total Equip Cost: $1,656,420	Applied %: 1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Contrustruction contingencies
Annual Non-Labor Maintenance Costs						
Materials at 1% of Total Equip Cost ☐ Check to include		Total Equip Cost: $1,656,420	Applied %: 1.00%	$ -		Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Contrustruction contingencies
Other Non-Labor Costs:	**Unit**	**Unit Cost**	**Annual Units**			
Lamps	each	$ 395.00	72	$ 19,773	-	$395/lamp @ 14,000 hrs/prorated after 9,000. Assumed annual replacement of 50% of lamps for two duty vessels
Sleeves	each	$ 790.00	4	$ 3,160	-	$790/sleeve @ 20yrs. Assumed replacement of 50% of sleeves every 20 years for two duty vessels
Wiper Rings	each	$ 29.00	72	$ 2,320	-	$29/ring @ 30,000 wipes. Assumed annual replacement of 50% of rings to be conservative.
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 14,004	$ 178,220	
Subtotal Annual Non-Labor Maintenance Costs				$ 25,253	$ 321,377	
Total Annual Maintenance Costs				**$ 39,256**	**$ 499,597**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Cyclic Replacement Costs Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
Building/Structures	N	40	1.00	$ 21,140	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 55,214	0	$ -	
Mechanical Equipment	N	20	1.00	$ 1,104,280	0	$ -	
Electrical Equipment	N	20	1.00	$ 386,498	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 165,642	0	$ -	
Totals						**$ -**	

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
2	Division 2 - Site Work and Demolition							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
3	Division 3 - Concrete							$ 15,100
03-11-13	Misc Concrete	10	cy	$1,510.00	$ 15,100	$0.00	$ -	$ 15,100
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
4	Division 4 - Masonry							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
5	Division 5 - Metals							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
6	Division 6 - Wood, Plastic & Composite							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
				$0.00	$ -	$0.00	$ -	$ -
7	Division 7 - Thermal and Moisture Protection							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
8	Division 8 - Openings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
9	Division 9 - Finishes							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
10	Division 10 - Specialties							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
11	Division 11 - Equipment							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
12	Division 12 - Furnishings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
13	Division 13 - Special Construction							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
14	Division 14 - Conveying Systems							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
21	Division 21 - Fire Suppression							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
22	Division 22 - Process Piping							$ 39,439
22-05-00.10	Piping, Process 5%)	1	ls	$39,438.56	$ 39,438.56	$0.00	$ -	$ 39,439
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
23	Division 23- HVAC							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
26	Division 26 - Electrical Systems							$ 276,070
26-00-00	Electrical (35%)	1	ls	$276,069.92	$ 276,069.92	$0.00	$ -	$ 276,070
	-	-	-	$0.00	$ -	$0.00		$ -
27	Division 27 - Instrumentation and Control Equipment							$ 118,316
27-20-00.01	Instrumentation (15%)	1	ls	$118,315.68	$ 118,315.68	$0.00	$ -	$ 118,316
	-	-	-	$0.00	$ -	$0.00		$ -
40	Division 40 - Process Integration							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
43	Division 43 - Process Gas and Liquid Handling							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
46	Division 46 - Water and Wastewater Equipment							$ 788,771
46-06-00	UV System	1	ls	$0.00	$ -	$772,940.00	$ 772,940	$ 772,940

Disinfection 1

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
46-06-16	750 gallon tank (RAS chlorination)	1	ea	$1.831.20	$ 1.831.20	$0.00	$ -	$ 1.831
46-06-12	RAS Chlorination Pumps	2	ea	$7.000.00	$ 14.000.00	$0.00	$ -	$ 14.000
	Other							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	TOTAL							$ 1,237,695.36

PROJECT NAME	ALASD Facility Plan
Alternative	UV (Closed Vessel) w/ Reuse

New Project/Improvement Time Line — Comments/Notes

Year of Planning Phase Expenditure	2022	
Year of Design Phase Expenditure	2024	
Year of Major Construction Cost	2025	
First Year of Operation	2027	

Summary of Alternative Results and Input of Sensitivity Adjustments

NPV Contributions	Total NPV			Comments/Notes
Design Phase	$ 652,158			Engineering Fee Estimates are for planning purposes only
Construction Phase	$ 4,221,085	Capital =	$ 4,873,243	
Annual Operating Labor	$ 178,220			
Annual Operating Electricity	$ 244,444			
Annual Operating Non-Labor Other	$ -			
Annual Maintenance Labor	$ 178,220	O & M =	$ 922,260	
Annual Maintenance Non-Labor	$ 321,377			
Maintenance Replacement	$ -			
TOTAL NPV	**$ 5,795,503**			

Project Planning, Design, and Construction Costs Input

Cost Item	Unit Description	No. of Units	Unit Cost	Extended Cost	NPV	Comments/Notes
						Fill out Construction Cost from ALT3 sheet
Design Phase						
Consultant Fees	% Construction	15%	$ 4,612,494	$ 691,874	-	
Total Engineering Cost				**$ 691,874**	**$ 652,158**	Engineering Fee Estimates are for planning purposes only
Construction						
Building/Structures	LS	1	15,100	$15,100	-	DIV 3-10, 12,13
Process Piping	LS	1	105,792	$105,792	-	DIV 22
Mechanical Equipment	LS	1	2,115,831	$2,115,831	-	DIV 11, 14, 21, 23, 40, 43, 46. Trojan 72AL75 3 duty, including reuse @ 10.9 mgd
Electrical Equipment	LS	1	740,541	$740,541	-	DIV 26
Instrumentation and Control Equipment	LS	1	317,375	$317,375	-	DIV 27
Sitework	LS	1	-	$0	-	DIV 2
Subtotal Bare Construction				**$3,294,638**	-	
Contingencies	Input %	Default %				
Undeveloped Design Details	30.00%	30%		$988,392	-	Uses Default % unless Input % is supplied
Construction Contingency	10.00%	10%		$329,464	-	Uses Default % unless Input % is supplied
Subtotal Contingencies				**$1,317,855**	-	
Total Construction Cost						
Total Construction Phase Cost				**$ 4,612,494**	**$ 4,221,085**	

Annual Operating Costs Input

Category	Unit of Measure	Unit Cost	Annual Units	Annual Cost	NPV	Comments/Notes
						Mid-point of 2035 @ 3.8 mgd
Labor (Operations)	FTE	$ 93,358.72	0.15	$ 14,004	-	
Natural Gas	MMBTU	$ 14.10	-	$ -	-	
Electricity	KWHr	$ 0.07	259,560	$ 19,207	-	Assumes 24/7 power draw April - October. 250 W per lamp x 206 lamps total (2 vessels)= 51.5 kW
Polymer	lbs	$ 1.65	-	$ -	-	
Chlorine	Tons	$ 1,855.00	-	$ -	-	
Ferrous Sulfate	Gal	$ 2.28	-	$ -	-	
Sodium Bisulfite	Gal	$ 5.27	-	$ -	-	
Sodium Hypochlorite	Gal	$ 2.15	-	$ -	-	
Land Application	Wet Tons	$ 40.00	-		-	
Other Non Labor	each	$ -	-	$ -	-	
Labor Operating Costs	each	$ -	-	$ -	-	Use 0.5% or Line 68
Subtotal Labor Operating Costs				$ 14,004	$ 178,220	
Subtotal Non-Labor Operating Costs - Electricity				$ 19,207	$ 244,444	
Subtotal Non-Labor Operating Costs - Other				$ -	$ -	
Total Operating Costs				**$ 33,211**	**$ 422,663**	

Annual Maintenance Costs Input

				Annual Cost	NPV	Comments/Notes
Annual Labor Maintenance Costs		FTE Cost:	FTE amount:			
Annual Labor Maintenance Costs		$ 93,358.72	0.15	$ 14,004	-	Use either line 134 or 135
Labor at 1% of Total Equip Cost		Total Equip Cost:	Applied %:			
☐ Check to include		$4,443,246	1.00%	$ -	-	Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Contrustruction contingencies
Annual Non-Labor Maintenance Costs		Total Equip Cost:	Applied %:			
Materials at 1% of Total Equip Cost		$4,443,246	1.00%	$ -		
☐ Check to include						Applied to Mechanical, Electrical and I&C Equipment with Undeveloped Design Details and Contrustruction contingencies
Other Non-Labor Costs:	Unit	Unit Cost	Annual Units			
Lamps	each	$ 395.00	108	$ 19,773	-	$395/lamp @ 14,000 hrs/prorated after 9,000. Assumed annual replacement of 50% of lamps for 3 duty vessels
Sleeves	each	$ 790.00	6	$ 3,160	-	$790/sleeve @ 20yrs. Assumed replacement of 50% of sleeves every 20 years for 3 duty vessels
Wiper Rings	each	$ 29.00	108	$ 2,320	-	$29/ring @ 30,000 wipes. Assumed annual replacement of 50% of rings to be conservative.
Other Non-Labor UD4	each	$ -	-	$ -	-	
Other Non-Labor UD5	each	$ -	-	$ -	-	
Other Non-Labor UD6	each	$ -	-	$ -	-	
Subtotal Annual Labor Maintenance Costs				$ 14,004	$ 178,220	
Subtotal Annual Non-Labor Maintenance Costs				$ 25,253	$ 321,377	
Total Annual Maintenance Costs				**$ 39,256**	**$ 499,597**	

Major Cyclic Maintenance Replacement Costs

Project Componet Type	Include (Y/N) Replacement Cost?	Useful Life (yr)	Replacement Cost Factor	Replacement Cost in Base Year $'s	Number of Replacements (Integer)	NPV of All Replacements	Comments/Notes
			Cyclic Replacement Costs				
Building/Structures	N	40	1.00	$ 21,140	0	$ -	Construction inflation rate used for inflation of all replacement costs and salvage values
Process Piping	N	30	1.00	$ 148,108	0	$ -	
Mechanical Equipment	N	20	1.00	$ 2,962,164	0	$ -	
Electrical Equipment	N	20	1.00	$ 1,036,757	0	$ -	
Instrumentation and Control Equipment	N	15	1.00	$ 444,325	0	$ -	
Totals						$ -	

Disinfection 1

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
2	Division 2 - Site Work and Demolition							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
3	Division 3 - Concrete							$ 15,100
03-11-13	Misc Concrete	10	cy	$1,510.00	$ 15,100	$0.00	$ -	$ 15,100
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
4	Division 4 - Masonry							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
5	Division 5 - Metals							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
6	Division 6 - Wood, Plastic & Composite							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
				$0.00	$ -	$0.00	$ -	$ -
7	Division 7 - Thermal and Moisture Protection							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
8	Division 8 - Openings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
9	Division 9 - Finishes							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
10	Division 10 - Specialties							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
11	Division 11 - Equipment							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
12	Division 12 - Furnishings							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
13	Division 13 - Special Construction							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
14	Division 14 - Conveying Systems							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
21	Division 21 - Fire Suppression							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
22	Division 22 - Process Piping							$ 105,792
22-05-00.10	Piping, Process 5%)	1	ls	$105,791.56	$ 105,791.56	$0.00	$ -	$ 105,792
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
23	Division 23- HVAC							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
26	Division 26 - Electrical Systems							$ 740,541
26-00-00	Electrical (35%)	1	ls	$740,540.92	$ 740,540.92	$0.00	$ -	$ 740,541
	-	-	-	$0.00	$ -	$0.00		$ -
27	Division 27 - Instrumentation and Control Equipment							$ 317,375
27-20-00.01	Instrumentation (15%)	1	ls	$317,374.68	$ 317,374.68	$0.00	$ -	$ 317,375
	-	-	-	$0.00	$ -	$0.00		$ -
40	Division 40 - Process Integration							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
43	Division 43 - Process Gas and Liquid Handling							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
46	Division 46 - Water and Wastewater Equipment							$ 2,115,831
46-06-00	UV System	1	ls	$0.00	$ -	$2,100,000.00	$ 2,100,000	$ 2,100,000

Disinfection 1

DIV-ITEM	Description	Quantity	Units	CONSTRUCTION EQUIP.		MATERIALS		TOTAL COST
				Unit $	Equipment Cost	Unit $	Material Cost	
46-06-16	750 gallon tank (RAS chlorination)	1	ea	$1.831.20	$ 1.831.20	$0.00	$ -	$ 1.831
46-06-12	RAS Chlorination Pumps	2	ea	$7.000.00	$ 14.000.00	$0.00	$ -	$ 14.000
	Other							$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	-	-	-	$0.00	$ -	$0.00	$ -	$ -
	TOTAL							$ 3,294,638.36

Appendix K: Supplemental Documents

To be provided in Final Facility Plan, if needed