To: Michael J. Campfield, P.E.
Matanuska-Susitna Borough

From: Christopher Clark, P.E., HDR
J. Ryan Moyers, P.E., HDR

Date: February 19, 2013 (Revised March 19 & May 20, 2013)

Subject: Preliminary Engineering Technical Memorandum – Update to the 2007 Septage Handling and Disposal Plan

HDR Alaska

Memorandum

Background and Introduction

In 2006, HDR was contracted by the Matanuska-Susitna Borough (MSB) Public Works Department to develop a Septage Handling and Disposal Plan (2007 Study) that would assess the current septage handling and treatment practices in the Borough, and develop MSB-based alternatives for the future. The resulting septage study evaluated four (4) alternatives including maintaining the existing hauling practices (Option 1), installing a septage consolidation facility and bulk haul to Anchorage (Option 2), constructing a co-treatment facility with the City of Palmer (Option 3), and constructing an independent regional septage facility (Option 4) to handle current and future septage loads in the MSB.

HDR's 2007 Study recommended that two of the four options be further explored; constructing a co-treatment facility with the City of Palmer (Option 3) and constructing an independent regional septage facility (Option 4). Both options would make the MSB independent of the Municipality of Anchorage (MOA) for septage disposal which may be advantageous in the future. The costs of these alternatives, as given in the 2007 Study, were found to be comparable to the 2007 cost of transporting and disposing of septage in Anchorage. The 2007 Study estimated that a regional septage treatment facility could be paid off in 20 years if septage haulers paid $166 for each load of septage that was disposed at the regional facility. This analysis did not take into account potential grants or funding that may be available to the MSB for the project, and represented the feasibility of a MSB-based septage treatment and disposal facility funded solely by the MSB.

In 2010, the MSB, in cooperation with the Cities of Palmer and Wasilla, completed a Regional Wastewater and Septage Treatment Study to address the short term regulatory compliance and capacity needs for the Palmer and Wasilla wastewater treatment plants (WWTP). Additionally, this study addressed the long-term regional needs for a wastewater and septage treatment system in the core area between Palmer and Wasilla. Long-term solutions presented in the 2010 study included either improvements to the City of Palmer WWTP to accommodate 4.0 million gallons per day (MGD) or constructing a new regional 4.0MGD WWTP at a central location. The total project cost of constructing a regional wastewater and septage facility including conveyance piping was estimated to be $119 to $132 million and was dependent upon the location and the treatment process selected. The 2010 Regional Wastewater and Septage Study did not evaluate separate septage treatment options but included septage receiving and pretreatment facilities at the larger regional WWTP alternatives. The septage receiving station considered in the 2010 study consisted of a dual bay septage receiving area with hot water wash stations and pretreatment facilities (including coarse screening, flow attenuation, fine screening and grit removal, and metering of the septage flows into the larger wastewater treatment process). The septage receiving /pretreatment station alone was estimated to cost approximately $7,133,000 (2010 dollars). The MSB Assembly formed a Wastewater and Septage Advisory Board to begin long-term wastewater and septage treatment planning.

The MSB has chosen to revisit the options available for an MSB-based regional septage facility. In 2012, the MSB Assembly adopted a resolution (2012-RS-083) that endorsed continued planning for a regional wastewater treatment facility. The resolution indicated that the MSB will be 'selecting a site for a future regional wastewater treatment facility that will be used at a minimum for future septage service'. As the MSB begins to seek funding for the site selection it has requested HDR complete an update to the 2007 Study cost estimates. Due to modifications to the fee structure at the septage receiving facilities in Anchorage, increases in fuel prices, and general operational changes, the updated cost estimates for the septage treatment facility have changed significantly from those calculated in 2007. Updating the cost information from 2007 to the present day ensures that current information is available for the planning process and provides more meaningful information to determine the feasibility of a septage treatment facility in the MSB.

This memorandum provides planning level costs for an independent regional septage facility including updated cost for the aerated lagoon system for secondary wastewater treatment as presented in the 2007 Study (Option 4), as well as a conceptual level analysis of an advanced treatment system (activated sludge process) capable of achieving more stringent tertiary treatment requirements if surface water discharge is required. This analysis has been completed using the same design criteria (projected flows, wastewater characteristics, etc.) provided in the 2007 Study.

Design Criteria

Septage is the concentrated sewage settled in the bottom of a septic tank and contains 70 percent of the suspended solids, oil, and grease of sewage. Septage is a highly variable organic waste that often contains large amounts of grease, grit, hair, and debris and is characterized by an objectionable odor and appearance, a resistance to settling and dewatering, and the potential to foam. These characteristics make septage difficult to handle and treat. The major reason for providing adequate treatment and disposal systems is to protect public health and the environment, as septage may harbor disease-causing viruses, bacteria, and parasites.

Factors that affect the physical characteristics of septage include septic tank size, design, and pumping frequency, user habits, water supply characteristics and piping materials, the presence of water conservation fixtures and garbage disposals, the use of household chemicals and water softeners, and climate. Septage must be pumped from a septic tank on a periodic basis depending on sewage production and the size of the septic tank. This memorandum uses the population growth and septage loading and strength as defined in the 2007 Study. The recommended rate of pump-out is every 12 to 24 months according to haulers operating within MSB. In 2005, approximately 13.6 million gallons of septage was pumped within the MSB annually. Based on HDR's 2007 Study it was estimated that septage production would increase to 38.1 million gallons per year by 2030. The design criteria from the 2007 Study are outlined in Tables 1 through 3 below.

Table 1 – 2030 Influent Raw Septage Flows and Loading

Flow	BOD		TSS	
GPD	mg/L	lbs/day	mg/L	lbs/day
238,000	2,255	4,482	7,138	14,178

Table 2 - 2030 Pretreated Septage Flows and Loading

Flow	BOD		TSS		Ammonia-N		Temperature (°C)	
GPD	mg/L	lbs/day	mg/L	Min	mg/L	lbs/day	Min	Max
238,000	500	994	500	994	50	99	8	15

Table 3 - 2030 Design Effluent Criteria[1]

<table>
<tr><th>Parameter</th><th>Units</th><th>Secondary Limits (Average Monthly)</th><th colspan="2">Tertiary Limits (Average Monthly)</th></tr>
<tr><td>Biological Oxygen Demand (BOD_5)</td><td>mg/L</td><td>30</td><td colspan="2">15</td></tr>
<tr><td>Total Suspended Solids (TSS)</td><td>mg/L</td><td>30</td><td colspan="2">15</td></tr>
<tr><td rowspan="2">Ammonia as (N)</td><td rowspan="2">mg/L</td><td rowspan="2">-</td><td>Summer</td><td>Winter</td></tr>
<tr><td>1.7</td><td>8.7</td></tr>
<tr><td>Fecal Coliform</td><td>FC/100 ml</td><td>20</td><td colspan="2">20</td></tr>
<tr><td>pH</td><td>S.U.</td><td>6.5-8.5</td><td colspan="2">6.5-8.5</td></tr>
</table>

[1] Effluent criteria based on City of Palmer's current Alaska Pollutant Discharge Elimination System (APDES) permit.

Septage Handling and Disposal Alternatives

This section provides updated evaluation and costs of two primary septage handling and disposal alternatives from the 2007 Study:

- Option 1 – Maintain Existing Hauling Practices
- Option 4 – Construct an Independent Regional Septage Facility

Option 1 – Maintain Existing Hauling Practices

The 2007 Study included a detailed analysis of the cost associated with the current septage hauling practices. In 2005, the estimated costs associated with hauling and disposal of septage were estimated at $825,000 and the current (2013) cost of transport and disposal of MSB septage is estimated at $1.4 million per year. This cost is a compilation of labor for the round trip from the MSB to the septage receiving facility in Anchorage, the cost of running and maintaining the septage trucks, and the current AWWU tipping fee. By 2030, the increase in septage production in the MSB will bring the total transport and disposal cost to an estimated $4.6 million per year. This cost is paid directly by septage haulers, and indirectly by MSB residents with septic tanks, who currently (2013) pay an average of $250 for each 1,000 gallon septic tank pumping.

In addition to direct costs to haulers and MSB residents, there are other important factors which affect the sustainability of the septage hauling practice and the triple bottom line to the MSB. The advantages of keeping existing haul practices include:

- *No capital and O&M costs to the MSB*

  Septage haulers and residents will continue to meet the cost of septage handling and disposal at no additional cost to the MSB.

- *No additional land use*

  No land will be occupied with treating and handling septage that could be used for other development.

- *No ADEC regulations*

  No additional permits are required for meeting EPA and ADEC regulations for storing, treating, or discharging septage.

The disadvantages of keeping existing haul practices include:

- *Reliance on MOA and being less able to adapt to changes in regulatory environment*

  The MSB is dependent on the MOA to continue to accept septage from outside of the MOA. If the MOA changes its policy the MSB would need to seek other disposal options. The timeframe for this might not be ideal for the MSB. The MSB could be forced into choosing a less efficient and economic solution at a time when funding is difficult to obtain.

- *Cost efficiency*

  The current cost of transporting septage comprises 72% of the total cost of transport and disposal costs. Designed around a competitive tipping fee in comparison to the existing disposal costs, a regional septage treatment facility could pay for itself.

- *Environmental Impact*

  Without a regional septage facility, MSB septage flows will continue to be treated only to the current primary treatment level of the Asplund WWTP. Furthermore septage hauled to Anchorage accounts for 1.1 million miles per year travelled on the Glenn Highway between Palmer and Anchorage. This contributes to wear and tear on the roadway network (and subsequently increased costs to maintain) as well as increased burning of fossil fuels.

Using the population predictions developed in the 2007 Study, HDR has updated current septage production and associated costs based on the 2013 MSB population, hauling costs (fuel) and current AWWU tipping fees (Table 4).

Table 4 - Turpin Street Disposal Estimated Cost (Option 1)

Transport and Disposal Cost - AWWU Turpin Street	Year 2005	Year 2013	Year 2030
Estimated Annual Septage Production (gallons/year)	13,596,389	17,761,301	38,102,185
No. of Average Hauler Loads (2,867 gallons per load)	4,742	6,195	13,290
Annual Mileage for Septage Delivery (miles)	379,390	495,607	1,063,193
Annual Fuel Consumption (gallons/year)	75,878	99,121	212,639
Cost per Trip	**$174**	**$229**	**$348**[3]
Annual Disposal Cost	**$825,200**	**$1,418,700**	**$4,624,900**

1. Septic haulers pay a monthly customer charge of $7.46, plus a usage charge of $21.66 per 1,000 gallons of estimated discharge per trip (these fee's includes AWWU's proposed 2013 rate hike). Estimated discharge is calculated at 87% of tank capacity for most of the year. During the times when seasonal weight restrictions are in effect, the estimated discharge is calculated at 50% of tank capacity.
2. Year 2013 cost of hauling is $172 per trip for fuel, and operations and maintenance and does not include the AWWU tipping fee.
3. Year 2030 disposal cost per trip has been estimated based on a 2.5% annual increase from current cost per trip.

Option 4 – Construct an Independent Regional Septage Facility

In an effort to gain independence from the MOA and avoid hauling septage to Anchorage, the 2007 Study evaluated the construction costs associated with an independent regional septage treatment facility (Option 4 in the 2007 Study). For consistency with the 2007 Study, this update memorandum continues to identify an independent regional septage facility as Option 4.

The following elements are required for Option 4:

- Site for the independent treatment facility
- Receiving and pretreatment facility
- Secondary/tertiary treatment facility
- Effluent discharge location – subsurface (percolation cell) or surface discharge
- Solids handling
- Discharge permit

Option 4 is further broken down in this memorandum as Option 4A, 4B, or 4C as shown in Figure 1 depending on the level of treatment and method of disposal.

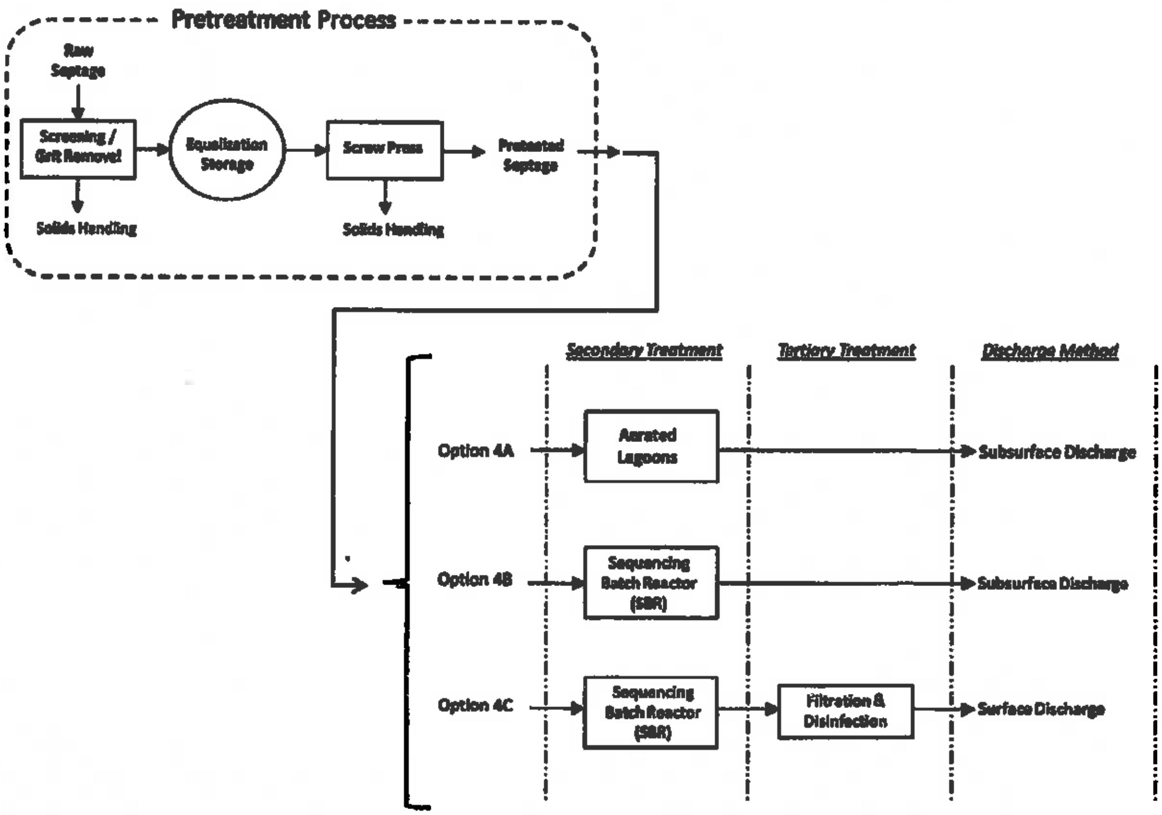

Figure 1 - Independent Regional Septage Treatment Facility Process Flow Options.

Option 4 Septage Receiving and Pretreatment

Regardless of the treatment process selected for secondary or tertiary treatment of the septage flows, septage receiving and pretreatment facilities will be required to remove a portion of the solids from the high-strength septage to create a more manageable/treatable wastewater flow. Removing septage solids through pretreatment and sending only the liquid portion to the wastewater treatment facility significantly reduces the waste load to the treatment facility and allows for design of downstream treatment processes more typical of domestic wastewater flows and strength.

Receiving station and odor control

A receiving station must be built at the septage pretreatment site to receive septage from the hauling trucks. The primary functions of a receiving station are the transfer of septage from hauler trucks, preliminary treatment of septage (i.e. screening and grit removal), and storage and equalization of septage flows. Receiving station design should encourage simple and reliable operation, and have the flexibility to accommodate varying flow and loading conditions. Odor control is essential for any waste handling operation, especially in the case of septage. Septage processing can result in the release of odors causing complaints from local residents. For septage receiving units, the best approach to control odors is to cover the sources of odor emissions and to exhaust this air to a suitable control system. Due to the concern of odor problems associated with septage receiving, only septage receiving units that provide a completely enclosed system should be investigated.

Equalization

An equalization tank is used at treatment plants to control influent flow rates and allows for a reduction in required downstream unit process capacity. The cost for a 150,000-gallon equalization tank is provided in the pretreatment cost estimate.

Septage conditioning

Septage has poor dewatering characteristics and needs conditioning prior to dewatering. The conditioning process must fundamentally alter the sludge structure so that the solid and liquid portions are more easily separated. This is typically accomplished through chemical means and the amount of chemical required is based on the load and its characteristics. A combination of lime and ferric chloride has been successfully used as well as certain polymers. The current trend in conditioning is to use polymers, and for this memorandum it will be assumed that polymers will be used for conditioning the septage prior to solid/liquid separation.

Solid/liquid separation

A number of mechanical septage dewatering systems are available. The degree of dewatering accomplished is a function of conditioning chemical, admixtures of other sludges, and the dewatering process used. Typically, dewatered septage (sludge cake) has a solids content of approximately 20 to 40 percent. Feasible options for the MSB include using screw or rotary presses. Standard equipment for septage dewatering includes a sludge feed pump, a polymer makeup system, a control panel, miscellaneous field instrumentation, a conveyor, and a truck/disposal bin. A screw press can produce Class A or Class B biosolids, depending on the process and the required product.

The requirements for Class A and Class B biosolids are outlined in EPA regulations 40 CFR Part 503. Class A biosolids contain no detectible levels of pathogens and have been treated to meet vector attraction reduction requirements. Class B biosolids have been treated but still may contain pathogens. There are buffer, public access, and crop harvesting restrictions for Class B biosolids. Either Class A or Class B biosolids from the screw press can be disposed of at the MSB landfill, but if the landfill is the ultimate disposal site it would not be worth the extra cost to produce the class A solids. Class A biosolids can be land applied as well as distributed to the public as fertilizer and offer more options for ultimate disposal than Class B biosolids. Producing Class A biosolids may provide cost savings and flexibility for biosolids management depending on the treatment process and the quality of the final product, and can generate revenue in some cases (distributed to the public as fertilizer, etc.). However, Class A solids treatment technologies generally require increased capital and operations and maintenance (O&M) costs for processing. Class B biosolids have historically been the predominant class of biosolids produced in the US. The cost estimate provided in Table 5 below for the septage pretreatment system assumes Class B biosolids as the basis of design but also includes an additional option for achieving Class A solids.

A conservative concentration of 500 mg/L for both BOD and TSS is assumed for the pretreated septage (the liquid filtrate from the screw press) based on estimated performance data received from the manufacturer of the FKC screw press and pretreatment equipment. This pretreated septage is further treated as described in following sections of this memorandum. Figure 2 below provides a general schematic of the pretreatment process described above and Figure 3 provides a typical screw press dewatering process flow diagram utilizing polymer for sludge conditioning (Class B solids option).

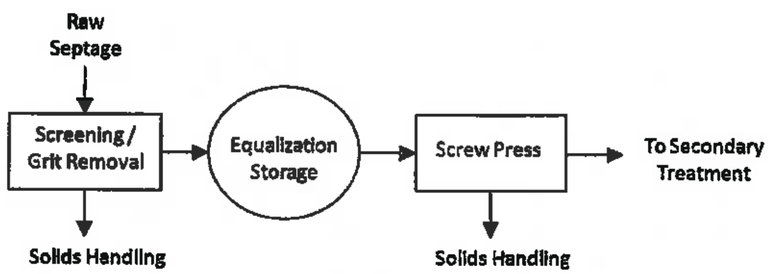

Figure 2 - Pretreatment Process

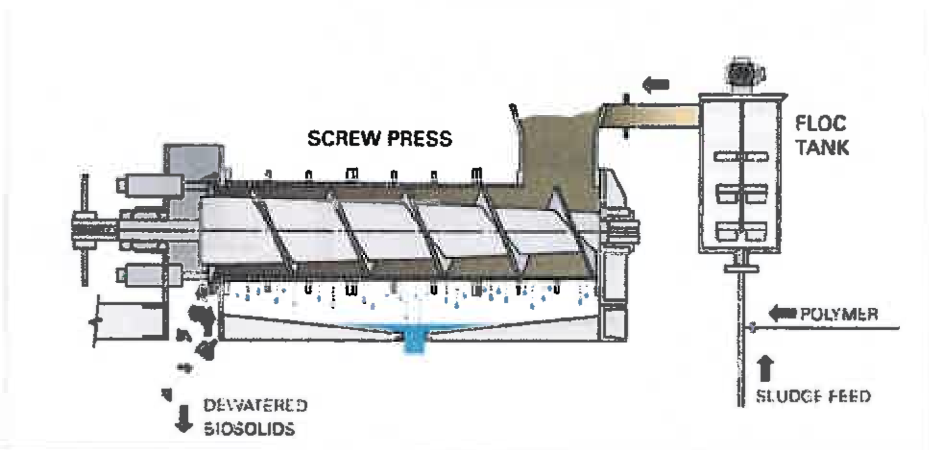

Figure 3 - Typical Screw Press Dewatering Process Flow Diagram

In general, a screw press is a contained unit where sludge that has been conditioned with a polymer is fed onto a screw-like drum that spins and transports sludge towards a discharge point. While the screw conveyor slowly turns, the screw pitch and drum diameter are decreased, which increases pressure on the sludge. The increased pressure forces water from the sludge, which is then filtered through small wire screening. A screw press can generally achieve high dewatered solids concentrations and offers very low maintenance and simple operation. A skid-mounted system is available that includes the screw press, flocculation tank, sludge pump, control panel, and polymer system (This skid-mounted system is the basis for the 'Screw Press' item in the Table 5 cost estimate.)

As discussed above, Class A biosolids can also be produced with the screw press equipment. In this process, lime is added to liquid biosolids to raise the pH to 12 to meet EPA vector attraction reduction requirements. The lime treated biosolids are then flocculated with polymer, pre-thickened in a rotary screen thickener, and then fed to a steam heated screw press. Inside the screw press the biosolids are dewatered and heated to meet EPA pathogen reduction requirements. Screw press outlet consistencies are usually 30 to 50% dry solids. Figure 4 below provides a typical screw press dewatering process flow diagram for Class A biosolids production. Equipment required for the Class A option includes the screw press mounted on a skid, flocculation tank, rotary screen thickener (RST), lime bag dump station with lime conveyor and inductor tank, boiler skid, Class A control panel, 15-foot screw conveyor, sludge pump, lime/sludge mixing tank, a recirculation pump, and polymer system.

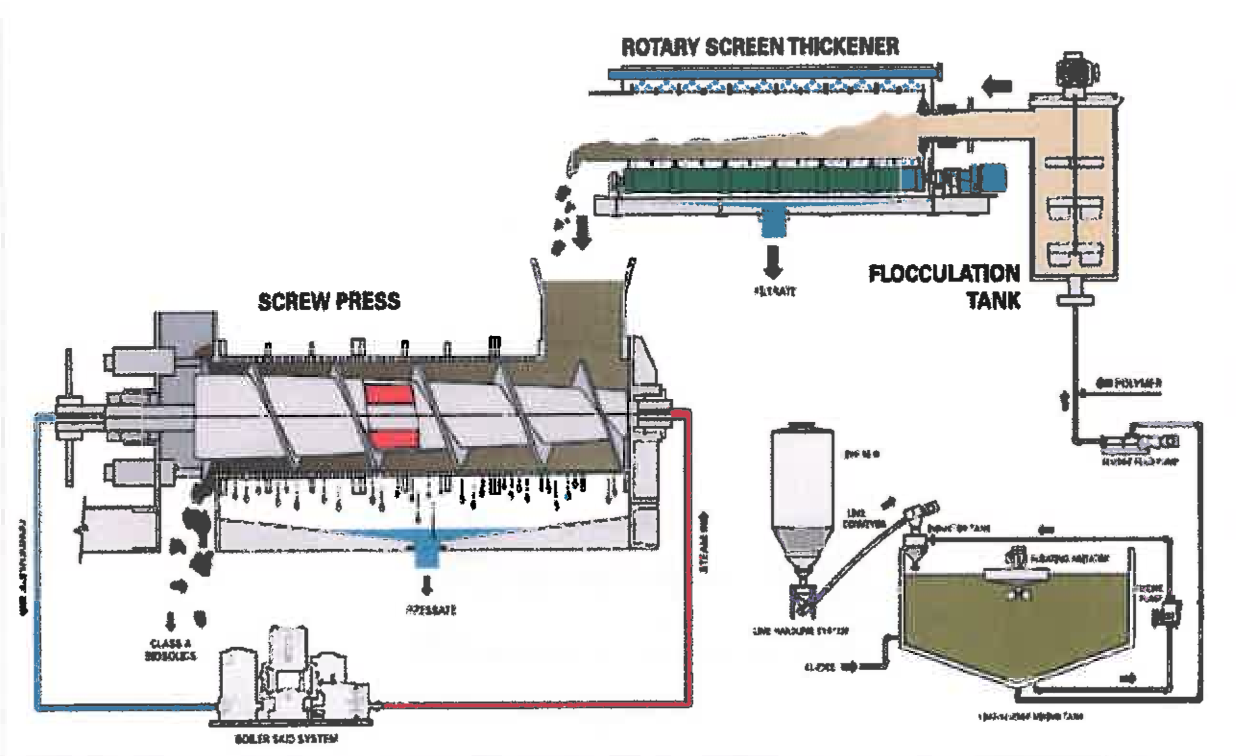

Figure 4 - Simultaneous Dewatering and Pasteurization –Class A Process

Costs for the receiving and pretreatment processes of a septage treatment facility are estimated in Table 5. The cost for pretreatment as presented in Table 5 is applied to each of the secondary and tertiary treatment process alternatives evaluated in the following sections.

Table 5 – Pretreatment Order of Magnitude Capital Cost Estimate

Item	Item Detail	Quantity	Unit	Unit Price	Total
Septage Pretreatment	Influent Screening	1	LS	$225,000	$225,000
	Grit Removal	1	LS	$200,000	$200,000
	Equalization Storage / Concrete Structure	430	CY	$900	$387,000
	Odor Control Towers and Fans	1	EA	$213,800	$213,800
	Screw Press	1	EA	$1,100,000	$1,100,000
	Screw Press - Class A Biosolids Option	1	LS	$400,000	$400,000
	Treatment Building	1,215	SF	$225	$273,400
	Misc. Site Work	1	15% of	$2,799,175	$419,900
	Misc. Equipment	1	20% of	$2,799,175	$559,800
				Subtotal [1,2]	**$3,778,900**

1. Per the Association of Advancement of Cost Estimating, Recommended Practice 17R-97 for Planning Level project this constitutes a Class 5 cost estimate with a Value of 5 with an implied Accuracy Range is +50% to -25%
2. This probable construction cost is an Order of Magnitude cost opinion in 2013 dollars, and does not include inflation, financing costs or operation and maintenance costs. This opinion assumes that a local general contractor will prime the project. It has been prepared for guidance in project evaluation and funding at the time of the estimate. Contractor bids and final construction costs will depend on actual labor and material costs, actual site conditions, productivity, fuel and expendable pricing, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from this estimate.

Option 4A – Secondary Treatment by Aerated Lagoons

As previously presented in the 2007 Study, one option for secondary treatment of pretreated septage is an aerated lagoon system. This memorandum provides updated costs to the 2007 Study's aerated lagoon secondary treatment option. This design is based around peak BOD and TSS loading coming to the plant between the months of May through October (identified in the 2007 Study as the 'summer months' when septage hauling is approximately 3 times more than in the 'winter months' of November through April.) Aerated lagoons can be operated on a flow-through or solids recycle basis, with oxygen for wastewater conversion provided through surface aerators of diffused air units. Depending on the hydraulic detention time of the lagoon, effluent water quality can achieve up to 95 percent BOD removal with most of the solids settling out prior to discharge. Lagoon type systems are common for wastewater treatment in Alaska, however, limited operational flexibility and cold climate conditions make it more difficult, if not impossible, to meet higher tertiary treatment requirements outlined in the following section. Figure 5 below shows a general design schematic for a typical cold climate aerated lagoon system.

Options for discharge of treated effluent from an aerated lagoon include discharge to percolation cells or constructed wetlands. The treatment design evaluated in the 2007 Study assumed secondary treatment of wastewater would be required and the conceptual design was for BOD and TSS removal only; which is typical of cold climate lagoon systems. Based on recent regulatory changes, if the MSB seeks to discharge the treated effluent to a surface water (stream, river, etc.) this could result in more stringent permit limits. Depending on the receiving stream, more restrictive effluent limits could include the requirement to achieve some level of nutrient removal. Wastewater treatment facilities in Alaska that discharge to receiving waters that contain salmon are receiving more stringent seasonal limits for ammonia nitrogen when spawning may occur. Nitrogen is not typically removed in a secondary treatment process, especially a cold climate aerated lagoon system. The removal of nitrogen from the wastewater stream is achieved through biological processes called nitrification/denitrification. If nitrification/denitrification is necessary for the discharge permit (dependent upon ADEC requirements) then this design (2007 Option 4) may need to be modified into a lagoon activated sludge system (as discussed in the 2010 Regional Wastewater and Septage Treatment Study). In general, to achieve biological nitrogen removal in an aerated lagoon system several operating conditions must be maintained including temperature control (warmer temperatures are required to achieve nitrification), removal of settled solids from the lagoon bottom, and the recycling of beneficial microbes (activated sludge) back into the treatment process.

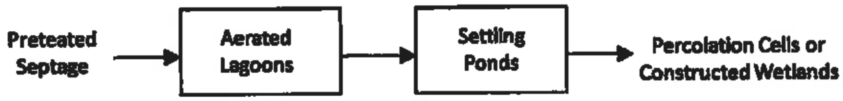

Figure 5 – Option 4A Septage Filtrate Aerated, Partially Mixed Lagoon Treatment Process

Table 6 shows the design criteria for the aerated lagoon system. Equipment typically required for aerated lagoons includes lining systems, inlet and outlet structures, hydraulic controls, floating dividers and baffles, and aeration equipment.

Table 6 – 2030 Design Criteria for Conventional Septage Treatment

Aeration Requirement:	993 lb X 2.25 = 2,235 lb/day
Volume Requirement:	3.84 million gallons (514,016 ft^3 with effective depth of 9 feet)
Aeration Area:	1.31 acres x 2 (approximately 3 acres total req'd)
Configurations:	Four aerated lagoon cells operated in series or parallel, followed by settling ponds.
Discharge	To percolation cell or constructed wetlands

Advantages and disadvantages of aerated, partial mix lagoons are listed below[1]:

[1] EPA Wastewater Technology Fact Sheet – Aerated, Partial Mix Lagoons

Aerated Lagoon Process Advantages

- An aerated lagoon can usually discharge throughout the winter
- Sludge disposal may be necessary but the quantity will be relatively small compared to other secondary treatment processes
- Aerated lagoons are relatively simple treatment processes compared to advanced treatment alternatives (more simple operation, less equipment typically, less maintenance, etc.)

Aerated Lagoon Process Disadvantages

- Aerated lagoons are not typically effective in removing ammonia nitrogen or phosphorous, unless designed for nitrification (challenging in cold climates)
- Effluent nitrate levels may cause ground water contamination – unless designed for nitrification/denitrification
- Reduced rates of biological activity occur during cold weather
- Mosquito and similar insect vectors can be a problem if vegetation on the dikes and berms is not properly maintained

- Sludge accumulation rates will be higher in cold climates because low temperature inhibits anaerobic reactions
- Would need to be converted/changed to a lagoon activated sludge (LAS) process to achieve reliable, significant biological nitrogen removal
- Many of the advantages typically cited for aerated lagoons (reduced capital costs, ease and cost of operation and maintenance, etc.) are not as prevalent if the system has to be converted to a more complex LAS process. The LAS system more closely resembles other, mechanical treatment processes in terms of equipment required, operational complexity, etc.

The primary disadvantage of aerated lagoon systems is the lack of ability to achieve enhanced (tertiary) treatment required to meet lower effluent limits if surface water discharge is required. As this will be a new facility and not a retro-fit to an existing lagoon system such as the City of Palmer WWTP, mechanical treatment options should be evaluated due to their ability to provide enhanced treatment and offer more operational flexibility compared to aerated lagoon systems. In order to provide a cost comparison between these more advanced treatment processes and the conventional aerated lagoon process, two alternatives (one secondary and one tertiary) are evaluated in following section of this memorandum.

Table 7 – Option 4A Aerated Lagoon Order of Magnitude Capital Cost Estimate

Item	Item Detail	Quantity	Unit	Unit Price	Total
Lagoon Treatment	Excavation	50,767	CY	$5.00	$253,800
	Load and Haul Excavated Material	25,384	CY	$10.2	$257,800
	Backfill with Selective Material	12,692	CY	$3.7	$47,500
	Structural Fill	6,346	CY	$25.7	$162,800
	Membrane Liner and Geotextile Fabric	198,632	SF	$5.6	$1,115,500
	Insulated Lagoon Covers (4-inch, installed)	165,527	SF	$5.6	$929,600
	Gravel Drain Bed	10,153	CY	$18.0	$183,100
	Aeration Equipment - Blowers	2	EA	$40,000	$80,000
	Aeration Equipment - Pipe	11,423	FT	$20	$228,500
Sludge Storage Facilities	Covered Sludge Storage Area	1,600	SF	$125	$200,000
Constructed Percolation Cells or Wetlands	Vegetation Planting	87	1,000 SF	$400	$34,800
	Excavation	25,384	CY	$5.00	$126,900
	Load and Haul Excavated Material	12,692	CY	$10.2	$128,900
	Backfill with Selective Material	6,346	CY	$3.7	$23,700
	Structural Fill	3,173	CY	$25.7	$81,400
	Membrane liner and Geotextile Fabric	43,560	SF	$5.6	$244,600
	Discharge Permit Plan Approval and Permit	80	HR	$150	$12,000
	Monitoring Wells	4	EA	$7,500	$30,000
Miscellaneous	Yard Piping	1	5% of	$4,140,982	$207,000
	Misc. Site Work	1	15% of	$4,140,982	$621,100
	Misc. Equipment	1	20% of	$4,140,982	$828,200
				Subtotal	$5,797,400

Table 8 – Order of Magnitude Cost Estimate for Pretreatment and Aerated Lagoon Treatment

Summary of Costs		
Aerated Lagoon Capital Cost (Secondary Treatment)		$5,797,400
Pretreatment Capital Costs		$3,778,900
Total Capital Cost		$9,576,300
Preliminary Engineering and Design (10%)	0.1	$957,700
Construction Management (10%)	0.1	$957,700
Direct Allocation & Allocated Funds During Construction Charges (17%)	0.17	$1,628,000
Administration (5%)	0.05	$478,800
Contingency (25%)	0.25	$2,394,100
Total Capital Construction Costs		**$15,992,200**
Payoff Period (yr)	20.00	
Interest Rate	1.5%	
Capital Cost to Payoff Each Year		$931,500
Estimated Annual O&M[3]		$440,000
Equivalent Annual Cost [1,2]		**$1,371,500**

1. Per the Association of Advancement of Cost Estimating, Recommended Practice 17R-97 for Planning Level project this constitutes a Class 5 cost estimate with a Value of 5 with an implied Accuracy Range is +50% to -25%
2. This probable construction cost is an Order of Magnitude cost opinion in 2013 dollars, and does not include future inflation, financing costs or operation and maintenance costs. This opinion assumes that a local general contractor will prime the project. It has been prepared for guidance in project evaluation and funding at the time of the estimate. Contractor bids and final construction costs will depend on actual labor and material costs, actual site conditions, productivity, fuel and expendable pricing, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from this estimate.
3. Estimated Annual O&M costs have been updated from the 2007 Study (as presented in Appendix 8 of the original study). Costs have been updated to include increases in chemical costs, power costs, etc.

Options 4B and 4C – Secondary Treatment by Sequencing Batch Reactor (SBR)

More advanced wastewater treatment processes such as an activated sludge process would be necessary to achieve better effluent water quality than what is possible from an aerated lagoon. There are a number of available activated sludge process alternatives including conventional activated sludge, lagoon activated sludge, sequencing batch reactor, and membrane bioreactor. The determination of the best available technology for a regional septage treatment facility would be impacted by the final site selected, discharge limits, etc. and should be evaluated in a more detailed engineering study. In order to provide a preliminary cost comparison between an advanced treatment process and the conventional aerated lagoon process presented in the 2007 study, a conceptual design cost estimate has been developed for a sequencing batch reactor.

A sequencing batch reactor (SBR) is an activated sludge batch-treatment process (fill-and-draw). The process involves fives steps including filling, aeration, settling, decanting and idling which all occur in the same tank in sequential order. SBRs can be designed and operated to enhance removal of nitrogen, phosphorus, and ammonia, in addition to removing TSS and BOD. The intermittent flow SBR accepts influent only at specified intervals and, in general, follows the five-step sequence. There are usually two units in parallel with one unit open for intake while the other runs through the remainder of the cycle.

Option 4B consists of the SBR directly followed by discharge to a percolation cell (or constructed wetland). The advantage of this method of secondary treatment is that it requires a much smaller site than a lagoon.

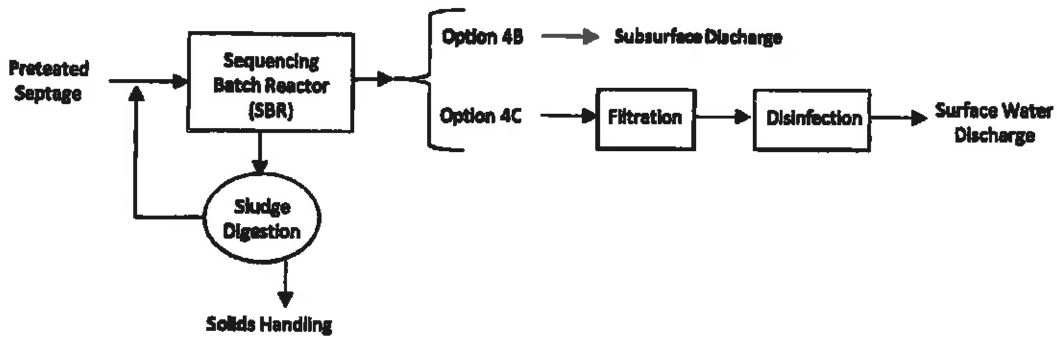

Figure 4 – Septage Filtrate Sequencing Batch Reactor Treatment Process

An SBR with filtration and disinfection (Option 4C) will typically produce an effluent of less than 15 mg/L BOD, 15 mg/L TSS, and 2 mg/L total nitrogen. These values will allow the proposed wastewater treatment plant to discharge to surface water discharge based on the assumed tertiary treatment requirements (15 mg/L BOD and TSS discharge limits). Solids produced by the system can be further treated for beneficial use (biosolids/composting) or delivered to the MSB landfill for disposal. See Attachment A to this report with design information from Aqua-Aerobic Systems, Inc., a manufacturer of one SBR system available.

Table 9 - 2030 Design Criteria for SBR Treatment [1]

Basin Geometry	38ft x 38ft x 21ft (W x L x D)
Number of Basins	2
Number of Cycles	2 per day
Treatment Cycle Duration	12.0 hrs
Food to Mass	0.198 lbs COD/lb MLSS-day
MLSS Concentration	4,500 mg/L
Hydraulic Retention Time	1.905 days
Solids Retention Time	8.4 days
Oxygen Required	2,940 lb/day
Air Flowrate/Basin	472 SCFM
Post-SBR Equalization	56,000 gallons
AquaDisk Total Filter Area	43.2 ft^2
AquaDisk Total Max Flow	165.4 gpm

[1] AquaSBR (2012)

Advantages and disadvantages of aerated, partial mix lagoons are listed below[1]:

SBR Process Advantages

- Equalization, primary clarification (in most cases), biological treatment, and secondary clarification can be achieved in a single reactor vessels
- With filtration and disinfection components the SBR process can produce effluent meeting tertiary limits
- No secondary clarifiers and return activated sludge lines

- Operating flexibility and control
- Reduced plant footprint
- Potential capital cost savings by eliminating clarifiers and other equipment

SBR Process Disadvantages

- Increased level of sophistication is required (compared to conventional lagoon systems) including supervisory control and data acquisition computer systems
- Higher level of maintenance associated with more sophisticated controls, automated switches, and automated valves
- Potential of discharging floating or settled sludge during the draw or decant phase with some SBR configurations
- Potential plugging of aeration devices during selected operating cycles, depending on the aeration system used by the manufacturer
- Potential requirement for equalization after the SBR, depending on the downstream processes

[1] EPA Wastewater Technology Fact Sheet – Sequencing Batch Reactors

Two cost estimates are presented in Tables 10 through 13. The first two tables represent the preliminary order of magnitude cost associated with Option 4B – a mechanical wastewater treatment process (SBR without filtration or disinfection) which can achieve secondary effluent limits similar to the aerated lagoon configuration. Tables 12 and 13 present the preliminary order of magnitude cost associated with Option 4C – a mechanical wastewater treatment process (SBR with filtration and disinfection) which can achieve tertiary effluent limits that would likely be required for any new wastewater treatment facility discharging to surface water.

Table 10 – Option 4B SBR (Secondary Treatment) Order of Magnitude Capital Cost Estimate

Item	Item Detail	Quantity	Unit	Unit Price	Total
SBR Treatment	Treatment Building	9,600	SF	$225	$2,160,000
	SBR Equipment (Diffusers, Blowers, Decanter, Transfer Pumps, etc.)	1	LS	$725,000	$725,000
	Digester Equipment (Diffusers, Blowers, Transfer Pumps, etc.)	1	LS	$350,000	$350,000
	Concrete Tanks (2 x SBR + 1 x Digester)	565	CY	$900.00	$508,500
Sludge Storage Facilities	Covered Sludge Storage Area	1,600	SF	$125	$200,000
Constructed Percolation Cells or Wetlands	Vegetation Planting	87	1,000 SF	$400	$34,800
	Excavation	25,384	CY	$5.00	$126,900
	Load and Haul Excavated Material	12,692	CY	$10.2	$128,900
	Backfill with Selective Material	6,346	CY	$3.7	$23,700
	Structural Fill	3,173	CY	$25.7	$81,400
	Membrane liner and Geotextile Fabric	43,560	SF	$5.6	$244,800
	Discharge Permit Plan Approval and Permit	80	HR	$150	$12,000
Miscellaneous	Yard Piping	1	5% of	$4,596,100	$229,800
	Misc. Site Work	1	15% of	$4,596,100	$689,400
	Misc. Equipment	1	20% of	$4,596,100	$919,200
				Subtotal	**$6,434,600**

Table 11 – Order of Magnitude Cost Estimate for Pretreatment and SBR Secondary Treatment

Summary of Costs		
SBR Only Capital Cost (Secondary Treatment)		$6,434,600
Pretreatment Capital Costs		$3,778,900
Total Capital Cost		$10,213,400
Preliminary Engineering and Design (10%)	0.1	$1,021,300
Construction Management (10%)	0.1	$1,021,300
Direct Allocation & Allocated Funds During Construction Charges (17%)	0.17	$1,736,300
Administration (5%)	0.05	$510,700
Contingency (25%)	0.25	$2,553,400
Total Capital Construction Costs		**$17,056,500**
Payoff Period (yr)	20.00	
Interest Rate	1.5%	
Capital Cost to Payoff Each Year		$993,500
Estimated Annual O&M[3]		$500,000
Equivalent Annual Cost [1,2]		**$1,493,500**

1. Per the Association of Advancement of Cost Estimating, Recommended Practice 17R-97 for Planning Level project this constitutes a Class 5 cost estimate with a Value of 5 with an implied Accuracy Range is +50% to -25%
2. This probable construction cost is an Order of Magnitude cost opinion in 2013 dollars, and does not include future inflation, financing costs or operation and maintenance costs. This opinion assumes that a local general contractor will prime the project. It has been prepared for guidance in project evaluation and funding at the time of the estimate. Contractor bids and final construction costs will depend on actual labor and material costs, actual site conditions, productivity, fuel and expendable pricing, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from this estimate.

3. Detailed Operation and Maintenance costs have not been developed for this conceptual design memorandum. An estimated annual value of $500,000 has been used for analysis based on chemical costs, power usage, sludge disposal, sampling and monitoring, and maintenance from similar sized SBR facilities. A detailed evaluation of site specific O&M costs should be included in the Preliminary Engineering for the facility.

Table 12 – Option 4C SBR (Tertiary Treatment) Order of Magnitude Capital Cost Estimate

Item	Item Detail	Quantity	Unit	Unit Price	Total
SBR Treatment	Treatment Building	16,000	SF	$225	$3,600,000
	SBR Equipment (Diffusers, Blowers, Decanter, Transfer Pumps, etc.)	1	LS	$725,000	$725,000
	Digester Equipment (Diffusers, Blowers, Transfer Pumps, etc.)	1	LS	$350,000	$350,000
	Equalization Basin Equipment and Tertiary Disk Filters	1	LS	$300,000	$300,000
	Concrete Tanks (2 x SBR + 1 x Digester)	565	CY	$900.00	$508,500
	Concrete Tanks (Post-Equalization Basin)	74	CY	$900.00	$66,600
	UV Disinfection	1	LS	$100,000	$100,000
	Outfall Pipe	1,000	LF	$150	$150,000
	Discharge Permit Plan Approval and Permit	80	HR	$150	$12,000
Sludge Storage Facilities	Covered Sludge Storage Area	1,600	SF	$125	$200,000
Miscellaneous	Yard Piping	1	5% of	$6,012,100	$300,605
	Misc. Site Work	1	15% of	$6,012,100	$901,815
	Misc. Equipment	1	20% of	$6,012,100	$1,202,420
				Subtotal	$8,416,940

Table 13 – Order of Magnitude Cost Estimate for Pretreatment and SBR Tertiary Treatment

Summary of Costs		
SBR, Filtration, and Disinfection Capital Cost (Tertiary Treatment)		$8,416,900
Pretreatment Capital Costs		$3,778,900
Total Capital Cost		$12,195,800
Preliminary Engineering and Design (10%)	0.1	$1,219,600
Construction Management (10%)	0.1	$1,219,600
Direct Allocation & Allocated Funds During Construction Charges (17%)	0.17	$2,073,300
Administration (5%)	0.05	$609,800
Contingency (25%)	0.25	$3,049,000
Total Capital Construction Costs		$20,367,000
Payoff Period (yr)	20.00	
Interest Rate	1.5%	
Capital Cost to Payoff Each Year		$1,186,300
Estimated Annual O&M[3]		$650,000
Equivalent Annual Cost [1,2]		$1,836,300

1. Per the Association of Advancement of Cost Estimating, Recommended Practice 17R-97 for Planning Level project this constitutes a Class 5 cost estimate with a Value of 5 with an implied Accuracy Range is +50% to -25%
2. This probable construction cost is an Order of Magnitude cost opinion in 2013 dollars, and does not include future inflation, financing costs or operation and maintenance costs. This opinion assumes that a local general contractor will prime the project. It has been prepared for guidance in project evaluation and funding at the time of the

estimate. Contractor bids and final construction costs will depend on actual labor and material costs, actual site conditions, productivity, fuel and expendable pricing, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from this estimate.

3. Detailed Operation and Maintenance costs have not been developed for this conceptual design memorandum. An estimated annual value of $650,000 has been used for analysis based on chemical costs, power usage, sludge disposal, sampling and monitoring, and maintenance from similar sized SBR facilities. A detailed evaluation of site specific O&M costs should be included in the Preliminary Engineering for the facility.

Recommendation

A regional septage treatment facility offers MSB independent septage disposal and treatment ownership and management. While this memorandum does not include funding opportunities as part of the cost analysis, the MSB will likely be eligible for Alaska Clean Water Fund loans (current interest rate of 1.5%) as well as possible grants through the Alaska Department of Environmental Conservation's (ADEC) Municipal Grants and Loans Program and other Federal programs. Loans can finance up to 100 percent of a project's eligible costs for planning, design and construction of publicly owned facilities. If the MSB were to acquire a $17.1 million loan from ADEC at 1.5% interest, the treatment facility could pay for itself with tipping fees shown in Table 14. This analysis includes $500,000 per year in operating costs and illustrates the economic feasibility of a MSB regional septage treatment facility. The tipping fee in Table 14 represents the fee required to payoff a 1.5% loan based on the constant tipping fee from 2013 through the year listed and includes a 2.5% inflation rate. For example, to pay off a $17.1 million dollar loan with $500,000 per year operating expenditures by 2020 would require a tipping fee of $354. These tipping fees can be related to the cost of existing hauling practices (MOA disposal) of $229 per trip as shown in Table 4.

Table 14 - Tipping Fee Required for 1.5% Loan Repayment

Year	Deliveries per Year	Tipping Fee Required for Payoff ($17.1 Million)
2013	6,589	$2,703
2014	6,983	$1,360
2015	7,378	$912
2016	7,772	$689
2017	8,166	$555
2018	8,560	$466
2019	8,954	$402
2020	9,348	$354
2021	9,743	$318
2022	10,137	$288
2023	10,531	$264
2024	10,925	$244
Current Tipping Cost Shown in Table 4		**$229**
2025	11,319	$227
2026	11,713	$213
2027	12,108	$201
2028	12,502	$190
2029	12,896	$180
2030	13,290	$172

Table 15 - Memorandum Cost Summary

Alternative	Order of Magnitude Capital Cost	Estimated Annual O&M Costs	Equivalent Annual Cost
Option 1 - Do Nothing - Maintaining Existing Haul Practices	$0	$0	$1,418,700
Option 4A - Aerated Lagoon (Secondary Treatment)	$15,992,200	$440,000	$1,371,500
Option 4B - SBR (Secondary Treatment)	$17,056,500	$500,000	$1,493,500
Option 4C - SBR/Filtration/Disinfection (Tertiary Treatment)	$20,367,000	$650,000	$1,836,300

The costs in this memorandum do not include the purchasing of land or potential funding opportunities (grants and/or loans). It is important to reiterate that this memorandum is based on the 2030 population projections used in the 2007 Study. These projections may be high as the recent growth trends in the Borough have slowed. However, the costs of each facility in this memorandum are based on the quantity of septage treated which is also based on the projected population. Any changes in projected population will result in a scalable construction cost difference within reason.

Dependent upon on the final location of the regional septage treatment facility, treatment plant effluent water quality requirements could range from secondary to tertiary treatment and will be designated in an Alaska Pollutant Discharge Elimination System (APDES) permit from ADEC. The determination of the best available technology for a regional septage treatment facility would be impacted by the final site selected, discharge limits, etc. and should be evaluated in a more detailed engineering study.

Attachment A

Sequencing Batch Reactor – Manufacturer's Information

PROCESS DESIGN REPORT

AQUA-AEROBIC SYSTEMS, INC.

MATSU BOROUGH AK

Design#: 132885

Option: AquaSBR Preliminary Design

Designed By: Eric Roundy on Friday, December 14, 2012

The enclosed information is based on preliminary data which we have received from you. There may be factors unknown to us which would alter the enclosed recommendation. These recommendations are based on models and assumptions widely used in the industry. While we attempt to keep these current, Aqua-Aerobic Systems, Inc. assumes no responsibility for their validity or any risks associated with their use. Also, because of the various factors stated above, Aqua-Aerobic Systems, Inc. assumes no responsibility for any liability resulting from any use made by you of the enclosed recommendations.

Design Notes

Pre-SBR

- Pre-SBR treatment includes a Dissolved Air Floatation System or other system to remove the influent COD and TSS to the design influent parameters shown on the design summary.

- Neutralization is recommended/required ahead of the SBR if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Coarse solids removal/reduction is recommended prior to the SBR.

SBR

- The flow pattern is assumed to occur 24 hours/day over 7 days/week.

- The Maximum flow, as shown on the design, has been assumed as a hydraulic maximum and does not represent an additional organic load.

- The decanter performance is based upon a free-air discharge following the valve and immediately adjacent to the basin. Actual decanter performance depends upon the complete installation including specific liquid and piping elevations and any associated field piping losses to the final point of discharge. Modification of the high water level, low water level, centerline of discharge, and / or cycle structure may be required to achieve discharge of full batch volume based on actual site installation specifics.

Aeration

- The aeration system has been designed to provide 1.0 lbs O_2/lb COD applied and 4.6 lbs O_2/lb NH_3-N applied at the design average loading conditions.

Process/Site

- An elevation of 20 ft. has been assumed as displayed on the design.

- The anticipated effluent NH_3-N requirement is predicated upon an influent waste temperature of 8°C or greater. While lower temperatures may be acceptable for a short-term duration, nitrification below 10°C can be unpredictable, requiring special operator attention.

- Based on the information provided, the waste may be nutrient deficient. Nutrient addition is recommended to achieve a ratio of 100:5:1 (BOD:N:P).

- Sufficient alkalinity is required for nitrification, as approximately 7.1 mg alkalinity (as $CaCO_3$) is required for every mg of NH_3-N nitrified. If the raw water alkalinity cannot support this consumption, while maintaining a residual concentration of 50 mg/l, supplemental alkalinity shall be provided (by others).

- It is assumed that there are no substances in the influent stream that would be inhibitory for a biological system.

Anticipated

- It is assumed the influent COD is either directly, or biologically oxidizeable to the required discharge limits.

- Treatability study recommended to assure required effluent quality is achievable.

- Maximum fats, oils, and grease to the AquaSBR is 100 mg/l. Depending upon the nature of the FOG, reduction in activated sludge treatment is unpredictable. If an effluent FOG requirement exists, FOG should be reduced to the effluent limit required prior to biological treatment. High FOG levels may also cause poor settling and excessive foaming which can damage equipment and lead to effluent quality degradation.

Equipment

- The basin dimensions reported on the design have been assumed based upon the required volumes and assumed basin geometry. Actual basin geometry may be circular, square, rectangular or sloped with construction materials including concrete, steel or earthen.

- Rectangular or sloped basin construction with length to width ratios greater than 1.5:1 may require alterations in the equipment recommendation.

- Tanks are not included in the pricing and shall be provided by others.

- Influent is assumed to enter the reactor above the waterline, located appropriately to avoid proximity to the decanter, splashing or direct discharge in the immediate vicinity of other equipment.

- If the influent is to be located submerged below the waterline, adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- A minimum freeboard of 2.0 ft. is recommended for diffused aeration.

- Aqua-Aerobic Systems, Inc. (AASI) is familiar with the Buy American provision of the American Recovery and Reinvestment Act of 2009 as well as other Buy American provisions (i.e. FAR 52.225, EXIM Bank, USAid, etc.). AASI can provide a system that is in full compliance with Buy American provisions. As the project develops AASI can work with you to ensure full compliance with a Buy American provision, if required. Please contact the factory should compliance with a Buy American provision be required.

Pricing

- Scope of supply includes installation supervision and start-up services; however, freight is not included.

- If the equipment is installed indoors, please ensure that the minimum number of air exchanges are provided otherwise explosion proof materials of construction will be required.

AquaSBR - Sequencing Batch Reactor - Design Summary

DESIGN INFLUENT CONDITIONS

Avg. Design Flow = 0.238165 MGD = 900 m3/day
Max Design Flow = 0.238165 MGD = 900 m3/day

DESIGN PARAMETERS	Influent	mg/l	Effluent Required	<= mg/l	Effluent Anticipated	<= mg/l
Bio/Chem Oxygen Demand:	COD	1,250	BOD5	30	BOD5	30
Total Suspended Solids:	TSS	500	TSS	30	TSS	30
Inf. Ammonia Nitrogen:	NH3-N	50	–	–	–	–
Ammonia Nitrogen:	–	–	NH3-N	8.70	NH3-N	8.70

SITE CONDITIONS	Maximum		Minimum		Design		Elevation (MSL)
Ambient Air Temperatures:	70 F	21.1 C	20 F	-6.7 C	70 F	21.1 C	20 ft
Influent Waste Temperatures:	59 F	15.0 C	46 F	8.0 C	59 F	15.0 C	6.1 m

SBR BASIN DESIGN VALUES

			Water Depth			Basin Vol./Basin		
No./Basin Geometry:	= 2 Square Basin(s)		**Min**	= 15.5 ft	= (4.7 m)	**Min**	= 0.167 MG	= (633.3 m³)
Freeboard:	= 2.0 ft	= (0.6 m)	**Avg**	= 21.0 ft	= (6.4 m)	**Avg**	= 0.227 MG	= (858.7 m³)
Length of Basin:	= 38.0 ft	= (11.6 m)	**Max**	= 21.0 ft	= (6.4 m)	**Max**	= 0.227 MG	= (858.7 m³)
Width of Basin:	= 38.0 ft	= (11.6 m)						

Number of Cycles:	= 2 per Day/Basin (advances cycles beyond MDF)	
Cycle Duration:	= 12.0 Hours/Cycle	
Food/Mass (F/M) ratio:	= 0.198 lbs. COD/lb. MLSS-Day	
MLSS Concentration:	= 4500 mg/l @ Min. Water Depth	
Hydraulic Retention Time:	= 1.905 Days @ Avg. Water Depth	
Solids Retention Time:	= 8.4 Days	
Est. Net Sludge Yield:	= 0.581 lbs. WAS/lb. COD	
Est. Dry Solids Produced:	= 1443.7 lbs. WAS/Day	= (654.9 kg/Day)
Est. Solids Flow Rate:	= 300 GPM (17311 GAL/Day)	= (65.5 m³/Day)
Decant Flow Rate @ MDF:	= 992.0 GPM (as avg. from high to low water level)	= (62.6 l/sec)
LWL to CenterLine Discharge:	= 2.0 ft	= (0.6 m)
Lbs. O2/lb. COD	= 1.00	
Lbs. O2/lb. NH3-N	= 4.60	
Actual Oxygen Required:	= 2940 lbs./Day	= (1333.4 kg/Day)
Air Flowrate/Basin:	= 472 SCFM	= (13.4 Sm3/min)
Max. Discharge Pressure:	= 10.7 PSIG	= (74 KPA)
Avg. Power Required:	= 885.2 KW-Hrs/Day	

AquaSBR

Influent Valves

2 Influent Valve(s) will be provided as follows:

- 4 inch electrically operated plug valve(s).

Mixers

2 AquaDDM Direct Drive Mixer(s) will be provided as follows:

- 7.5 HP Aqua-Aerobic Systems Endura Series Model FSS DDM Mixer(s).

Mixer Mooring

2 Mixer pivotal mooring assembly(ies) consisting of:

- 304 stainless steel pivotal mooring arm(s).
- #12 AWG-four conductor electrical service cable(s).
- Electrical cable strain relief grip(s), 2 eye, wire mesh.

2 Mixer De-Watering Support(s) will be provided as follows:

- Galvanized steel dewatering support post(s).
- Galvanized steel support angle(s).
- 304 stainless steel anchors.

Decanters

2 Decanter assembly(ies) consisting of:

- 6x4 Aqua-Aerobics decanter(s) with fiberglass float, 304 stainless steel weir, galvanized restrained mooring frame, and painted steel power section with #14-10 conductor power cable wired into a NEMA 4X stainless steel junction box with terminal strips for the single phase, 60 hertz actuator and limit switches.
- 8 inch diameter decant hose assembly.
- 4" schedule 40 galvanized steel mooring post.
- 8 inch electrically operated butterfly valve(s) with actuator.

Transfer Pumps/Valves

2 Submersible Pump Assembly(ies) consisting of the following items:

- 3 HP Submersible Pump(s) with painted cast iron pump housing, discharge elbow, and multi-conductor electrical cable.
- Manual plug valve(s).
- 3 inch Nibco check valve(s).
- Galvanized steel slide rail assembly(ies).
- 304 stainless steel intermediate support(s).

Retrievable Fine Bubble Diffusers

4 Retrievable Fine Bubble Diffuser Assembly(ies) consisting of:

- 20 diffuser tubes consisting of two flexible EPDM porous membrane sheaths mounted on a rigid support pipe with 304 stainless steel band clamps.
- 304 stainless steel manifold weldment.
- 304 stainless steel leveling angles.
- 304 stainless steel leveling studs.
- Galvanized vertical support beam.
- Galvanized vertical air column assembly.
- Galvanized upper vertical beam and pulley assembly.
- Galvanized top support bracket.
- 3" EPDM flexible air line with ny-glass quick disconnect end fittings.
- Galvanized threaded flange.

- 3" manual isolation butterfly valve with cast iron body, EPDM seat, aluminum bronze disk and one-piece steel shaft.
- Ny-glass quick disconnect cam lock adapter.
- 304 stainless steel adhesive anchors.
- Brace angles.

1 Diffuser Electric Winch(es) will be provided as follows:

- Portable electric winch.

Positive Displacement Blowers

3 Positive Displacement Blower Package(s), with each package consisting of:

- Sutorbilt 6M Positive Displacement Blower Package with common base, V-belt drive, enclosed drive guard, pressure gauge, pressure relief valve, and vibration pads.
- 304 stainless steel anchors.
- 40 HP motor with slide base.
- Inlet filter and inlet silencer.
- Discharge silencer, check valve, manual butterfly isolation valve, and flexible discharge connector.

Level Sensor Assemblies

2 Pressure Transducer Assembly(ies) each consisting of:

- Submersible pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting weldment(s).
- 304 stainless steel anchors.

2 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- 304 stainless steel anchors.

Instrumentation

2 Dissolved Oxygen Assembly(ies) consisting of:

- Hach LDO dissolved oxygen probe with replaceable sensor cap and electric cable. Probe includes stainless steel stationary bracket and retrievable pole probe mounting assembly. One (1) probe per basin.
- Hach SC200 controller and display module(s).

Controls

Controls wo/Starters

1 Controls Package(s) will be provided as follows:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Fuse(s) and fuse block(s).
- Allen Bradley SLC5/05 central processing unit with 32K memory and Ethernet connection.
- Operator interface(s).
- Remote Access Ethernet Modem.

PROCESS DESIGN REPORT

AQUA-AEROBIC SYSTEMS, INC.

MATSU BOROUGH AK

Design#: 132905

Option: AquaSBR and AquaDisk Preliminary Design

Designed By: Eric Roundy on Friday, December 14, 2012

Design Notes

Pre-SBR

- Pre-SBR treatment includes a Dissolved Air Floatation System or other system to remove the influent COD and TSS to the design influent parameters shown on the design summary.

- Neutralization is recommended/required ahead of the SBR if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Coarse solids removal/reduction is recommended prior to the SBR.

SBR

- The flow pattern is assumed to occur 24 hours/day over 7 days/week.

- The Maximum flow, as shown on the design, has been assumed as a hydraulic maximum and does not represent an additional organic load.

- The decanter performance is based upon a free-air discharge following the valve and immediately adjacent to the basin. Actual decanter performance depends upon the complete installation including specific liquid and piping elevations and any associated field piping losses to the final point of discharge. Modification of the high water level, low water level, centerline of discharge, and / or cycle structure may be required to achieve discharge of full batch volume based on actual site installation specifics.

Aeration

- The aeration system has been designed to provide 1.0 lbs O_2/lb COD applied and 4.6 lbs O_2/lb NH_3-N applied at the design average loading conditions.

Process/Site

- An elevation of 20 ft. has been assumed as displayed on the design.

- The anticipated effluent NH_3-N requirement is predicated upon an influent waste temperature of 8°C or greater. While lower temperatures may be acceptable for a short-term duration, nitrification below 10°C can be unpredictable, requiring special operator attention.

- Based on the information provided, the waste may be nutrient deficient. Nutrient addition is recommended to achieve a ratio of 100:5:1 (BOD:N:P).

- Sufficient alkalinity is required for nitrification, as approximately 7.1 mg alkalinity (as $CaCO_3$) is required for every mg of NH_3-N nitrified. If the raw water alkalinity cannot support this consumption, while maintaining a residual concentration of 50 mg/l, supplemental alkalinity shall be provided (by others).

- It is assumed that there are no substances in the influent stream that would be inhibitory for a biological system.

Anticipated

- It is assumed the influent COD is either directly, or biologically oxidizeable to the required discharge limits.

- Treatability study recommended to assure required effluent quality is achievable.

- Maximum fats, oils, and grease to the AquaSBR is 100 mg/l. Depending upon the nature of the FOG, reduction in activated sludge treatment is unpredictable. If an effluent FOG requirement exists, FOG should be reduced to the effluent limit required prior to biological treatment. High FOG levels may also cause poor settling and excessive foaming which can damage equipment and lead to effluent quality degradation.

Filtration

- Effluent flow equalization follows the AquaSBR process. The anticipated filtered effluent quality is based on the filter influent conditions as shown under "Design Parameters" of this Process Design Report. In addition, the filter influent should be free of algae and other colloidal solids that are not filterable through a nominal 10 micron pore size media. Provisions to treat algae and condition the solids to be filterable are the responsibility of others.

- The anticipated effluent quality is based upon filterable influent solids.

- For this application, pile filter cloth is recommended.

Equipment

- The basin dimensions reported on the design have been assumed based upon the required volumes and assumed basin geometry. Actual basin geometry may be circular, square, rectangular or sloped with construction materials including concrete, steel or earthen.

- Rectangular or sloped basin construction with length to width ratios greater than 1.5:1 may require alterations in the equipment recommendation.

- Tanks (except the package filter tank) are not included in the pricing and shall be provided by others.

- Influent is assumed to enter the reactor above the waterline, located appropriately to avoid proximity to the decanter, splashing or direct discharge in the immediate vicinity of other equipment.

- If the influent is to be located submerged below the waterline, adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- A minimum freeboard of 2.0 ft. is recommended for diffused aeration.

- Aqua-Aerobic Systems, Inc. (AASI) is familiar with the Buy American provision of the American Recovery and Reinvestment Act of 2009 as well as other Buy American provisions (i.e. FAR 52.225, EXIM Bank, USAid, etc.). AASI can provide a system that is in full compliance with Buy American provisions. As the project develops AASI can work with you to ensure full compliance with a Buy American provision, if required. Please contact the factory should compliance with a Buy American provision be required.

Pricing

- Scope of supply includes installation supervision and start-up services; however, freight is not included.

- If the equipment is installed indoors, please ensure that the minimum number of air exchanges are provided otherwise explosion proof materials of construction will be required.

AquaSBR - Sequencing Batch Reactor - Design Summary

DESIGN INFLUENT CONDITIONS

Avg. Design Flow	= 0.238165 MGD	= 900 m3/day
Max Design Flow	= 0.238165 MGD	= 900 m3/day

DESIGN PARAMETERS	Influent	mg/l	Effluent (After Filtration) Required	<= mg/l	Anticipated	<= mg/l
Bio/Chem Oxygen Demand:	COD	1,250	BOD5	15	BOD5	15
Total Suspended Solids:	TSS	500	TSS	15	TSS	15
Inf. Ammonia Nitrogen:	NH3-N	50	–	–	–	–
Ammonia Nitrogen:	–	–	NH3-N	1.70	NH3-N	1.70

SITE CONDITIONS	Maximum		Minimum		Design		Elevation (MSL)
Ambient Air Temperatures:	70 F	21.1 C	20 F	-6.7 C	70 F	21.1 C	20 ft
Influent Waste Temperatures:	59 F	15.0 C	46 F	8.0 C	59 F	15.0 C	6.1 m

SBR BASIN DESIGN VALUES

			Water Depth			Basin Vol/Basin		
No./Basin Geometry:	= 2 Square Basin(s)		**Min**	= 15.5 ft	= (4.7 m)	**Min**	= 0.167 MG	= (633.3 m³)
Freeboard:	= 2.0 ft	= (0.6 m)	**Avg**	= 21.0 ft	= (6.4 m)	**Avg**	= 0.227 MG	= (858.7 m³)
Length of Basin:	= 38.0 ft	= (11.6 m)	**Max**	= 21.0 ft	= (6.4 m)	**Max**	= 0.227 MG	= (858.7 m³)
Width of Basin:	= 38.0 ft	= (11.6 m)						

Number of Cycles:	= 2 per Day/Basin (advances cycles beyond MDF)	
Cycle Duration:	= 12.0 Hours/Cycle	
Food/Mass (F/M) ratio:	= 0.198 lbs. COD/lb. MLSS-Day	
MLSS Concentration:	= 4500 mg/l @ Min. Water Depth	
Hydraulic Retention Time:	= 1.905 Days @ Avg. Water Depth	
Solids Retention Time:	= 8.4 Days	
Est. Net Sludge Yield:	= 0.581 lbs. WAS/lb. COD	
Est. Dry Solids Produced:	= 1443.7 lbs. WAS/Day	= (654.9 kg/Day)
Est. Solids Flow Rate:	= 300 GPM (17311 GAL/Day)	= (65.5 m³/Day)
Decant Flow Rate @ MDF:	= 992.0 GPM (as avg. from high to low water level)	= (62.6 l/sec)
LWL to CenterLine Discharge:	= 2.0 ft	= (0.6 m)
Lbs. O2/lb. COD	= 1.00	
Lbs. O2/lb. NH3-N	= 4.60	
Actual Oxygen Required:	= 2940 lbs./Day	= (1333.4 kg/Day)
Air Flowrate/Basin:	= 472 SCFM	= (13.4 Sm3/min)
Max. Discharge Pressure:	= 10.7 PSIG	= (74 KPA)
Avg. Power Required:	= 885.2 KW-Hrs/Day	

Post-Equalization - Design Summary

POST-SBR EQUALIZATION DESIGN PARAMETERS

Avg. Daily Flow (ADF):	= 0.238165 MGD	= (900 m^3/day)
Max. Daily Flow (MDF):	= 0.238165 MGD	= (900 m^3/day)
Decant Flow Rate from (Qd):	= 992 gpm	= (3.8 m^3M)
Decant Duration (Td):	= 60 min	
Number Decants/Day:	= 4	
Time Between Start of Decants:	= 360 min	

POST-SBR EQUALIZATION VOLUME DETERMINATION

The volume required for equalization/storage shall be provided between the high and the low water levels of the basin(s). This Storage Volume (Vs) has been determined by the following:

Vs = [(Qd -(MDF x 694.4)] x Td = 49,597 gal = (6,630.5 ft^3) = (187.8 m^3)

The volumes determined in this summary reflect the minimum volumes necessary to achieve the desired results based upon the input provided to Aqua. If other hydraulic conditions exist that are not mentioned in this design summary or associated design notes, additional volume may be warranted.

Based upon liquid level inputs from each SBR reactor prior to decant, the rate of discharge from the Post-SBR Equalization basin shall be pre-determined to establish the proper number of pumps to be operated (or the correct valve position in the case of gravity flow). Level indication in the Post-SBR Equalization basin(s) shall override equipment operation.

POST-SBR EQUALIZATION BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)				
Length of Basin:	= 38.0 ft	= (11.6 m)			
Width of Basin:	= 15.0 ft	= (4.6 m)			
Min. Water Depth:	= 1.5 ft	= (0.5 m)	**Min. Basin Vol. Basin:**	= 6,395.4 gal	= (24.2 m^3)
Max. Water Depth:	= 13.1 ft	= (4.0 m)	**Max. Basin Vol. Basin:**	= 55,991.9 gal	= (212.0 m^3)

POST-SBR EQUALIZATION EQUIPMENT CRITERIA

Mixing Energy with Diffusers:	= 15 SCFM/1000 ft^3	
SCFM Required to Mix:	= 112 SCFM/basin	= (191 Nm^3/hr/basin)
Max. Discharge Pressure:	= 6.3 PSIG	= (43.17 KPA)
Max. Flow Rate Required Basin:	= 165 gpm	= (0.626 m^3/min)
Avg. Power Required:	= 62.8 kW-hr/day	

AquaDISK Tertiary Filtration - Design Summary

DESIGN INFLUENT CONDITIONS

Pre-Filter Treatment: SBR

Avg. Design Flow	= 0.238165 MGD	= 165.4 gpm	= 900 m^3/day
Max Design Flow	= 0.238165 MGD	= 165.4 gpm	= 900 m^3/day

AquaDISK FILTER RECOMMENDATION

Qty Of Filter Units Recommended	= 1
Number Of Disks Per Unit	= 4
Total Number Of Disks Recommended	= 4
Total Filter Area Provided	= 43.2 ft^2 = (4.01 m^2)
Filter Model Recommended	= AquaDisk Package: Model ADFSP-11-4E-PC
Filter Media Cloth Type	= OptiFiber PA2-13

AquaDISK FILTER CALCULATIONS

Filter Type:

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

Average Flow Conditions:

Average Hydraulic Loading = Avg. Design Flow (gpm) / Recommended Filter Area (ft^2)
= 165.4 / 43.2 ft^2
= 3.83 gpm/ft^2 (2.60 l/s/m^2) at Avg. Flow

Maximum Flow Conditions:

Maximum Hydraulic Loading = Max. Design Flow (gpm) / Recommended Filter Area (ft^2)
= 165.4 / 43.2 ft^2
= 3.83 gpm/ft^2 (2.60 l/s/m^2) at Max. Flow

AquaSBR

Influent Valves

2 Influent Valve(s) will be provided as follows:

- 4 inch electrically operated plug valve(s).

Mixers

2 AquaDDM Direct Drive Mixer(s) will be provided as follows:

- 7.5 HP Aqua-Aerobic Systems Endura Series Model FSS DDM Mixer(s).

Mixer Mooring

2 Mixer pivotal mooring assembly(ies) consisting of:

- 304 stainless steel pivotal mooring arm(s).
- #12 AWG-four conductor electrical service cable(s).
- Electrical cable strain relief grip(s), 2 eye, wire mesh.

2 Mixer De-Watering Support(s) will be provided as follows:

- Galvanized steel dewatering support post(s).
- Galvanized steel support angle(s).
- 304 stainless steel anchors.

Decanters

2 Decanter assembly(ies) consisting of:

- 6x4 Aqua-Aerobics decanter(s) with fiberglass float, 304 stainless steel weir, galvanized restrained mooring frame, and painted steel power section with #14-10 conductor power cable wired into a NEMA 4X stainless steel junction box with terminal strips for the single phase, 60 hertz actuator and limit switches.
- 8 inch diameter decant hose assembly.
- 4" schedule 40 galvanized steel mooring post.
- 8 inch electrically operated butterfly valve(s) with actuator.

Transfer Pumps/Valves

2 Submersible Pump Assembly(ies) consisting of the following items:

- 3 HP Submersible Pump(s) with painted cast iron pump housing, discharge elbow, and multi-conductor electrical cable.
- Manual plug valve(s).
- 3 inch Nibco check valve(s).
- Galvanized steel slide rail assembly(ies).
- 304 stainless steel intermediate support(s).

Retrievable Fine Bubble Diffusers

4 Retrievable Fine Bubble Diffuser Assembly(ies) consisting of:

- 20 diffuser tubes consisting of two flexible EPDM porous membrane sheaths mounted on a rigid support pipe with 304 stainless steel band clamps.
- 304 stainless steel manifold weldment.
- 304 stainless steel leveling angles.
- 304 stainless steel leveling studs.
- Galvanized vertical support beam.
- Galvanized vertical air column assembly.
- Galvanized upper vertical beam and pulley assembly.
- Galvanized top support bracket.
- 3" EPDM flexible air line with ny-glass quick disconnect end fittings.
- Galvanized threaded flange.

- 3" manual isolation butterfly valve with cast iron body, EPDM seat, aluminum bronze disk and one-piece steel shaft.
- Ny-glass quick disconnect cam lock adapter.
- 304 stainless steel adhesive anchors.
- Brace angles.

1 Diffuser Electric Winch(es) will be provided as follows:

- Portable electric winch.

Positive Displacement Blowers

3 Positive Displacement Blower Package(s), with each package consisting of:

- Sutorbilt 6M Positive Displacement Blower Package with common base, V-belt drive, enclosed drive guard, pressure gauge, pressure relief valve, and vibration pads.
- 304 stainless steel anchors.
- 40 HP motor with slide base.
- Inlet filter and inlet silencer.
- Discharge silencer, check valve, manual butterfly isolation valve, and flexible discharge connector.

Level Sensor Assemblies

2 Pressure Transducer Assembly(ies) each consisting of:

- Submersible pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting weldment(s).
- 304 stainless steel anchors.

2 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- 304 stainless steel anchors.

Instrumentation

2 Dissolved Oxygen Assembly(ies) consisting of:

- Hach LDO dissolved oxygen probe with replaceable sensor cap and electric cable. Probe includes stainless steel stationary bracket and retrievable pole probe mounting assembly. One (1) probe per basin.
- Hach SC200 controller and display module(s).

AquaSBR: Post-Equalization

Transfer Pumps/Valves

2 Submersible Pump Assembly(ies) consisting of the following items:

- 3 HP Submersible Pump(s) with painted cast iron pump housing, discharge elbow, and multi-conductor electrical cable.
- Manual plug valve(s).
- 3 inch Nibco check valve(s).
- Galvanized steel slide rail assembly(ies).

Fixed Coarse Bubble Diffusers

1 Aqua-Aerobic's Fixed Coarse Bubble Diffuser System(s) consisting of the following components:

- PVC diffuser(s).
- Schedule 40 galvanized steel riser pipe(s).
- Schedule 40 PVC manifold piping.
- 304 stainless steel anchors.

Positive Displacement Blowers

1 Positive Displacement Blower Package(s), with each package consisting of:

- Sutorbilt 3M Positive Displacement Blower Package with common base, V-belt drive, enclosed drive guard, pressure gauge, pressure relief valve, and vibration pads.

- 304 stainless steel anchors.
- 7.5 HP motor with slide base.
- Inlet filter and inlet silencer.
- Discharge silencer, check valve, manual butterfly isolation valve, and flexible discharge connector.

Level Sensor Assemblies

1 Pressure Transducer Assembly(ies) each consisting of:

- Submersible pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting weldment(s).
- 304 stainless steel anchors.

1 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- 304 stainless steel anchors.

Controls

Controls wo/Starters

1 Controls Package(s) will be provided as follows:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Fuse(s) and fuse block(s).
- Allen Bradley SLC5/05 central processing unit with 32K memory and Ethernet connection.
- Operator interface(s).
- Remote Access Ethernet Modem.

Cloth Media Filters

AquaDisk Tanks/Basins

1 AquaDisk Model # ADFSP-11x4E-PC Package Filter Painted Steel Tank(s) consisting of:

- 4 disk tank(s) will be painted steel, estimated dry weight is 3,825 lbs., and estimated operating weight is 9,500 lbs.
Each tank will include an integral solids waste collection manifold.
The tank finish will be:
Interior: near white sandblast (SSPC-SP10), painted with Tnemec N69 polyamide epoxy (color "safety blue") 2 coats 4-6 mils each for 8-12 mils DFT.
Exterior: commercial sandblast (SSPC-SP6), painted with Tnemec N69 polyamide epoxy (color "safety blue") 2 coats 3-4 mils each, 1 coat Tnemec 175 endurashield 2-3 mils for 8-11 mils DFT.
- 2" ball valve(s).

AquaDisk Centertube Assemblies

1 Centertube(s) consisting of:

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

AquaDisk Drive Assemblies

1 Drive System(s) consisting of:

- Gearbox with motor.
- Drive sprocket(s).

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

AquaDisk Backwash/Sludge Assemblies

1 Backwash System(s) consisting of:

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

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

- Backwash/waste pump(s).
- 0 to 15 psi pressure gauge(s).
- 0 to 30 inches mercury vacuum gauge(s).
- Throttling gate valve(s).
- 2" bronze 3 way ball valve(s).

AquaDisk Instrumentation

1 Pressure Transmitter(s) consisting of:

- Level transmitter(s).

1 Vacuum Transmitter(s) consisting of:

- Vacuum transmitter(s).

1 Float Switch(es) consisting of:

- Float switch(es).
- Float switch support bracket(s).

AquaDisk Valves

1 Solids Waste Valve(s) consisting of:

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

1 Set(s) of Backwash Valves consisting of:

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

AquaDisk Controls w/Starters

1 Control Panel(s) consisting of:

- NEMA 4X fiberglass enclosure(s).
- Circuit breaker with handle.
- Transformer(s).
- Fuses and fuse blocks.
- Line filter(s).
- GFI convenience outlet(s).
- Control relay(s).
- Selector switch(es).
- Indicating pilot light(s).
- MicroLogix 1400 PLC(s).
- Ethernet switch(es).

- Operator interface(s).
- Power supply(ies).
- Motor starter(s).
- Terminal blocks.
- UL label(s).

1 Conduit installation(s) consisting of:

- PVC conduit and fittings.