Preliminary Engineering Report
for
Septage and Leachate Treatment Facility
at
Matanuska-Susitna (Mat-Su) Borough
Palmer, Alaska

Prepared for

Matanuska-Susitna Borough

January 17, 2018

CLARK ENGINEERING

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Date:	October 22, 2017(Revised January 17, 2018)
Project Number:	E17003
Wastewater Type:	Septage and Landfill Leachate

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Section 1: Executive Summary

1 Project Background

The Matanuska-Susitna Borough (MSB) is mainly a rural community with about 20 percent of the population living in areas with a centralized sewage collection and treatment system. The rest of the Borough is mainly un-sewered and relies on decentralized individual subsurface wastewater treatment systems (septic tanks). These systems collect the solids and other contaminants (septage), which are pumped and hauled to the Anchorage Wastewater Utility (AWWU) for treatment and disposal every two to three years. Residents of MSB have produced up to 15 million gallons of septage each year. In addition to septage, MSB also produces about 1.6 million gallons per year of leachate from its landfills in the area. This leachate is also transported to AWWU for disposal. Due to a lack of sufficient capacity at AWWU to absorb current and future septage and leachate from MSB, along with increasing economic and social pressures, this practice is becoming less and less sustainable.

The Borough has been searching for alternatives to this practice for the past three decades. They commissioned studies to evaluate strategic, financial, and technological options to address the septage and leachate treatment issues in the Mat-Su Valley.

2 Project Need

Population growth in the MSB region has been steady during the last two decades at a rate of approximately four percent. Using this trend, the estimated population of the region will be about 141,247 in 2030.

Table 1: Mat-Su Borough U.S. Census Data

1990	2000	2010	2016	2030
39,681	59,322	88,995	104,365	*141,247*

However, a closer look at the data indicates a much larger growth in the last two years. Using the last two years' trend, the estimated population for the year 2030 is about 184,000. For the purpose of this PER, and based on discussions with MSB staff, the long term trend will be used.

The need for this project is especially great due to the impact of current practices on health, sanitation, and security for the Borough's population. Last year, more than 15 million gallons of septage and about 1.6 million gallons of leachate were transported to the AWWU facility in Anchorage. Approximately 5,500 truckloads (roughly 20 trucks per day) of wastewater are transported to the AWWU treatment plant, which discharges the partially treated wastewater into the Cook Inlet. The Cook Inlet is home to five species of Pacific salmon, Pacific herring, and smelt, which may be impacted if this practice is continued. In addition, the AWWU treatment plant is aging, having been built in July 1972; in addition, it is only a primary treatment facility and is in need of renovation and upgrade to a secondary and/or tertiary treatment plant. The rapid population growth and the possibility of an imminent cessation of accepting waste by the AWWU also make the need for this project ever so important. The increasing cost of disposal at his facility imposes a significant financial burden on the residents by increasing their cost of solid and liquid disposal.

3 Alternatives

The following strategic alternatives were defined in past studies, as well as in our current study:

1. Install a septage consolidation facility and bulk haul to Anchorage
2. Construct co-treatment facility with the City of Palmer
3. Construct regional septage disposal facility
4. Construct individual septage and leachate treatment facilities
5. Construct septage and leachate co-treatment facility
6. Construct a joint (in the same building and location) but separate (separate treatment train) septage and leachate treatment facility

A thorough examination of these alternatives indicated option #6 above is the most suitable option for the Borough. This option utilizes the benefits of a joint facility such as shared building, utilities, and management, as well as the advantages of having a dedicated treatment train to avoid cross-contaminations, complete control over discharge characteristics of each treatment train, and the ability to accommodate the quality and quantity variation of each waste stream.

To finance this alternative, two funding instruments were examined:

- ADEC Clean Water Grant/Loan Program
- USDA Rural Development Grant/Loan Program

This preliminary engineering report (PER) examined both alternatives and provided capital, operational, and finance costs for each option. No particular recommendation is made on these options. These must be examined by the MSB management to select the most suitable alternative.

4 Summary Costs of Alternatives

The following table shows a summary of the costs of some of the alternatives considered by the MSB staff over the years for septage treatment. A separate table is provided below that summarizes the cost for a separate septage and leachate treatment system provided by Clark. Details of these costs are provided in Appendix 3.

Table 15 - Memorandum Cost Summary for Septage Treatment (Septage Volume 238,000 GPD by 2030)

Alternative	Order of Magnitude Capital Cost in 2013	Estimated Annual O&M Costs in 2013	Equivalent Annual Cost in 2013
Option 1 - Do Nothing - Maintaining Existing Haul Practices	$0	$0	$1,418,700
Option 4A - Aerated Lagoon	$15,992,200	$440,000	$1,371,500

(Secondary Treatment)			
Alternative	**Order of Magnitude Capital Cost in 2013**	**Estimated Annual O&M Costs in 2013**	**Equivalent Annual Cost in 2013**
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

Above costs updated using the local consumer price index (CPI) to reflect 2017 costs.

Alternative	Order of Magnitude Capital Cost in 2017	Estimated Annual O&M Costs in 2017	Equivalent Annual Cost in 2017
Option 1 - Do Nothing - Maintaining Existing Haul Practices	$0	$0	$1,506,984
Option 4A - Aerated Lagoon (Secondary Treatment)	$16,987,381	$467,381	$1,456,847
Option 4B - SBR (Secondary Treatment)	$18,117,911	$531,115	$1,586,439
Option 4C - SBR/Filtration/Disinfection (Tertiary Treatment)	$21,634,421	$690,449	$1,950,571

Proposed Septage Treatment System Costs (Septage Design Volume 100,000 GPD*)

Alternative	Order of Magnitude Capital Cost in 2013	Estimated Annual O&M Costs in 2013	Equivalent Annual Cost in 2013
Recommended/Option LB-10-100	$11,614,000	$248,000	$748,432

*Note: Please refer to Section 5, subsection 2.2 for additional information.

Proposed Leachate Treatment System Costs (Leachate Design Volume 20,000 GPD)

Alternative	Order of Magnitude Capital Cost in 2013	Estimated Annual O&M Costs in 2013	Equivalent Annual Cost in 2013
Recommended/Option LB-10-20	$5,480,000	$117,000	$348,760

5 Technologies Evaluated

This PER also evaluated numerous technologies available for treatment of septage and leachate:

- Lagoon-based biological process
- Lagoon-activated sludge (LAS)
- Sequencing batch reactors (SBR)
- Membrane bioreactor reactors (MBR)
- Solar aquatic system (SAS)
- Constructed wetlands
- Evaporation
- Electrocoagulation
- Chemical precipitation
- Media filtration
- Conventional filtration
- Graduated single pass filtration (LEACHBUSTER®)

All of the technologies outlined above present some challenges due to the nature of the contaminants, the associated bacteria, the flux in temperatures in the area, and technological costs associated. The LEACHBUSTER® system addresses most of the challenges that the above-mentioned technologies have with leachate and septage treatment issues at MSB. In addition, the selection of LEACHBUSTER®, as opposed to SBR and MBR proposed by other consultants' previous reports, substantially reduces the land requirement. Based on the information from the studies conducted by the Borough and the options available in the marketplace, we recommend the strategic option of constructing a joint but separate treatment plant (strategic alternative #6) using the graduated single pass membrane technology to treat leachate and septage. The septage and leachate treatment aspect of the proposed project is intended to serve the current and future Borough residents, as well as the liquids that drain from the Central Landfill Facility, which is the only landfill within the Borough. Regarding financial alternatives, as recommended in the latest study, the Borough should evaluate both options and select the most suitable one for this project.

The following parameters were used to evaluate the strategic and technological option selected here:

- Meeting the tightening and emerging effluent discharge requirement
- Coping with current and future demand fluctuations
- Weather and climate dependence
- Odor and noise nuisance
- Land requirement
- Environmental impact
- Aesthetics
- Disinfection
- Biota kill and washouts
- Control of rodents, birds, and other predators
- Catastrophic failure (seismic, hurricanes, storms)
- Operator skills and numbers
- Operator health and safety

The LEACHBUSTER® was selected as it satisfies the above selection criteria, responds to the future needs of MSB residents to overcome issues related to capacity demand, and addresses new and emerging discharge requirements. The system treats both septage and leachate without biological, chemical, or extensive mechanical pre-treatment in a single pass.

In addition to the above parameters, some technical criteria such as design effluent discharge limits and design flow also were established. Based on correspondence with the Alaska Department of Environmental Conservation (ADEC), more stringent requirements of the drinking water standards and water quality standards for both septage and leachate effluent discharge were recommended. They also proposed the point of compliance as groundwater monitoring wells down gradient from subsurface discharge and within the property boundary. ADEC has also conveyed the importance of designing a system that can respond to and tackle the emerging contaminants that may be applied to future discharge permits. Neither the discharge limits nor the point of compliance has been approved by ADEC, but requires finalization in the second phase of this study.

6 Recommended System for Septage and Leachate Treatment

In order to confirm the capability of the selected system in meeting the discharge limits, a limited treatability study was conducted using samples from septage and leachate from the MSB area. These samples were received in late August and treated using the LEACHBUSTER® test unit at Clark Engineering's laboratory in Minneapolis. In addition to measuring the physical parameters such as power requirement and membrane cleaning, samples from treated effluent were also taken and sent to an analytical commercial laboratory for testing and analysis. Results indicated that the selected system is fully capable of treating both septage and leachate to meet both of the above-mentioned standards.

The normal design practice using an average number with a peak factor and a future growth for estimating design flow often results in extensive overdesign by several fold to cover estimated peak flows and population growth over a very long period, which results in very expensive projects that most small communities cannot afford. To avoid shortcomings in fluctuations estimated in this PER, a Temporal Dynamics Analysis (TDA) is used to estimate the most suitable design flow.

The following is a summary of the results of the TDA analysis for leachate for a single open cell and a two or more open cell scenarios.

Table 2: Design Flow and Equalization Tank Capacity for Leachate

Number	Percentile	Flow	Equalization Tank Capacity (Gallons)
Single Open Cell			
1	25	2,200	400,000
2	50	4,200	380,982
3	75	6,600	250,000
4	95	10,000	149,247
5	99	15,000	50,000
Two or More Open Cells			
1	25	4,400	500,000
2	50	8,200	460,982
3	75	15,200	350,000
3	95	20,000	189,247
4	99	30,000	80,000
Final Design Flow with Expansion Capacity included			
	75	20,000	150,000

For the purpose of this PER, 75 percentile is selected as the design flow parameter. This will require a 15,200 gpd system to account for the planned additional new landfill cell. In order to accommodate future growth, potential expansion capacity of about 6% per year until the year 2025, is added to this design flow, which results in a design flow capacity of 20,000 gallons per day.

Table 3

Number	Percentile	Flow	Equalization Tank Capacity (Gallons)
1	25	145,884	1,800,000
2	50	197,230	1,500,000
3	75	215,000	900,000
4	95	242,282	400,000
5	99	258,396	100,000

For septage, the cost is estimated and presented to allow the comparison with previous options presented by CH2M HILL and HDR.

- Two separate treatment trains housed in one building will be designed for septage and leachate
- Two financial scenarios will be presented for funding the project
- One risk level will be used for leachate capacity estimation
- Three percentile (risk) levels of 25, 50, 75 and 99 are evaluated for estimating septage capacity, only 99% is presented for leachate

The following parameters comprise the design basis for the system. These parameters were developed using the information from the MSB, the regulatory agencies and the studies we conducted on the target waste stream:

Table 4: Leachate and Septage Design Parameters

Leachate		
Waste Stream	Parameter	Value
	Percentile	75
	Flow in (GPD)	20,000
	Clean Water Output (GPD)	17,500
	Concentrate (GPD)	2,500
	Influent Characteristics	See Section 5
	Effluent Characteristics	ADEC Clean Water Limits
Septage		
Scenario 1		
	Percentile	25
	Flow in (GPD)	150,000
	Clean Water Output (GPD)	72,000
	Concentrate (GPD)	8000
	Influent Characteristics	See Section 5
	Effluent Characteristics	ADEC Clean Water Limits
Scenario 2		
	Percentile	50
	Flow in (GPD)	200,000
	Clean Water Output (GPD)	180,000
	Concentrate (GPD)	20,000
	Influent Characteristics	See Section 5
	Effluent Characteristics	ADEC Clean Water Limits
Scenario 3		
	Percentile	75
	Flow in (GPD)	215,000
	Clean Water Output (GPD)	190,000
	Concentrate (GPD)	25,000
	Influent Characteristics	See Section 5
	Effluent Characteristics	ADEC Clean Water Limits
Scenario 4		
	Percentile	99
	Flow in (GPD)	250,000
	Clean Water Output (GPD)	225,000
	Concentrate (GPD)	25,000
	Influent Characteristics	See Section 5
	Effluent Characteristics	ADEC Clean Water Limits

Note: Numbers are rounded to nearest 100.

After the wastewater is processed, the concentrate is collected in a tank for disposal. The commercial laboratory testing indicated that the concentrate will pass the TCLP tests and is therefore non-hazardous. The concentrate will be returned to the landfill for permanent confinement. Also, the concentrated septage material is pathogen-free and can easily be composted or land applied. The final determination on this will be made during Phase II in consultation with ADEC and other regulatory agents.

Cost Comparisons

The following tables outline a comparison of costs of various treatment options (capacity), as well as probable financing offered (ADEC and USDA) of a local treatment facility within MSB and the "do nothing" option, which is to dispose septage to the facility in Anchorage at total cost of $230.45 per tanker (3,000 gallons). As stated previously, this comparison assumes the costs to collect septage within the MSB would be the same for each scenario, so those costs are excluded from both. This comparison focuses on the costs to haul and discharge a 3,000 gallon tanker at the AWWU facility to the disposal costs at an MSB facility under both funding scenarios.

Table 5: Total Cost (USDA)

Percentile	25	50	99
System Capacity GPD Septage + Leachate	**270,000**	**220,000**	**120,000**
Annual Debt Service/Ga	$0.015	$0.018	$0.016
	$0.012	$0.013	$0.011
Total Cost/Ga	$0.0262	$0.0301	$0.0267
	$0.0219	$0.0251	$0.0223
Cost/1000 Gallons	$26.23	$30.08	$26.69
	$78.68	$90.23	$80.07

Note: Salvage Value is excluded.

Table 6: Total Cost (ADEC)

Percentile	25	50	99
System Capacity GPD Septage + Leachate	**290,000**	**220,000**	**120,000**
Annual Debt Service/Ga	$0.028	$0.033	$0.030
	$0.012	$0.013	$0.011
Total Cost/Ga	$0.0392	$0.0456	$0.0409
	$0.0219	$0.0251	$0.0223
Cost/1000 Gallons	$39.17	$45.59	$40.86
	$117.52	$136.76	$122.58

Section 2: Project Planning, Needs, and Alternatives

1 Project Planning

1.1 Location

The Matanuska-Susitna Borough (MSB or Borough) encompasses 25,260 square miles in south-central Alaska, roughly bordered by Anchorage and the Chugach Mountains to the south, the Alaska Range to the north and west, and the Matanuska river watershed to the east. Although the Borough is approximately the size of the state of West Virginia, the vast majority of the land area is uninhabited, with approximately 90% of the Borough's roughly 104,000 total residents living in the southern portion of the Borough in a 60-mile corridor along the Parks and Glenn Highways between the communities of Willow and Sutton[1]. Figure 1 on the following page shows the boundaries of the entire MSB, as well as designated community council boundaries.

The septage treatment aspect of the proposed project is intended to serve all households within the Borough that utilize septic systems for sewage disposal. The purpose is to accommodate the present and future wastewater treatment needs of the Borough. Previous studies suggest that the majority of households within the Borough utilize septic tanks and leach fields for sewage; therefore, for project planning purposes, the service area must include all communities within the MSB.

The leachate treatment aspect of the proposed project treats the liquids that drain from the lined landfill into the leachate collection tanks and discharges the clean effluent. The Central Landfill Facility is the only landfill within the Borough and accepts waste from residential garbage collection services, as well as the five transfer sites located in Butte, Big Lake, Willow, Sutton, Lake Louise, and Talkeetna. For project planning purposes, as with the septage treatment portion of this project, the service area must include all communities within the Borough.

[1] HDR. April 25, 2007. *Septage Handling and Disposal Plan.*

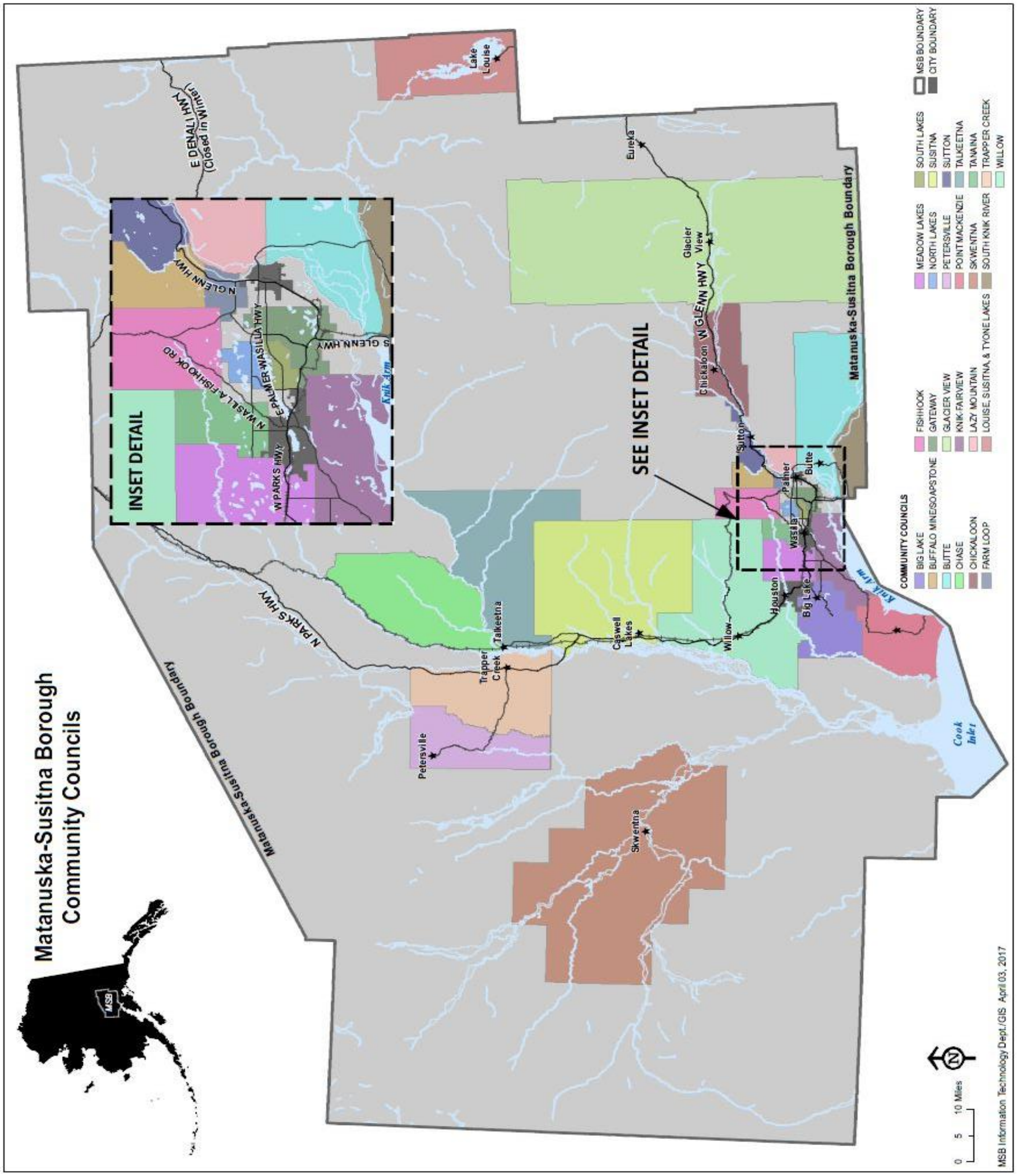

Figure 1: Project Service Area

In 2015, CH2M HILL completed the Septage and Leachate Treatment Facility Site Suitability and Engineering Analysis to evaluate and select a site for a septage and leachate treatment facility. That report identified the Borough Central Landfill, and specifically the southwest corner of the landfill tract, as the preferred facility site. The Central Landfill was designated as the site for a new septage and leachate facility by the Borough Assembly under Resolution 15-060 on June 6, 2016. The MSB Septage Treatment Advisory Board and the MSB Planning Commission previously accepted recommendations contained in the report under Resolution 15-02 on April 14, 2015, and Resolution 15-21 on May 18, 2015, respectively.

The Borough Central Landfill facility is a 620-acre tract of land located approximately 3 miles west of Palmer at the south end of North 49th State Street. The Central Landfill property is bordered by a residential subdivision to the north; mixed commercial-residential development to the west, northeast, and east; and undeveloped park land to the south[2]. The current landfill development is located on the northern portion of the property and includes the solid waste weigh station and several other maintenance buildings, the MSB Animal Shelter, the Crevasse-Moraine trail network, and the Valley Center for Recycling Solutions (VCRS) facility.

The Borough designated land for a treatment facility in the southwest corner of the landfill tract within Lot A3 of Section 11, Township 17 North, Range 1 East, Seward Meridian. The proposed project area is along a flat plateau between moraine ridges. Further, the 2015 Site Suitability and Engineering Analysis, referenced previously, indicated that there are no natural boundaries such as wetlands, water bodies, or bedrock expected to be encountered at this location.

Figure 2 on the following page shows the general location, existing infrastructure, and property boundaries for the Central Landfill, as well as the location for development of the new septage and leachate treatment facility, as identified in the Site Suitability and Engineering Analysis.

[2] CH2M HILL. June 2015. *Septage and Leachate Treatment Facility Site Suitability and Engineering Analysis.*

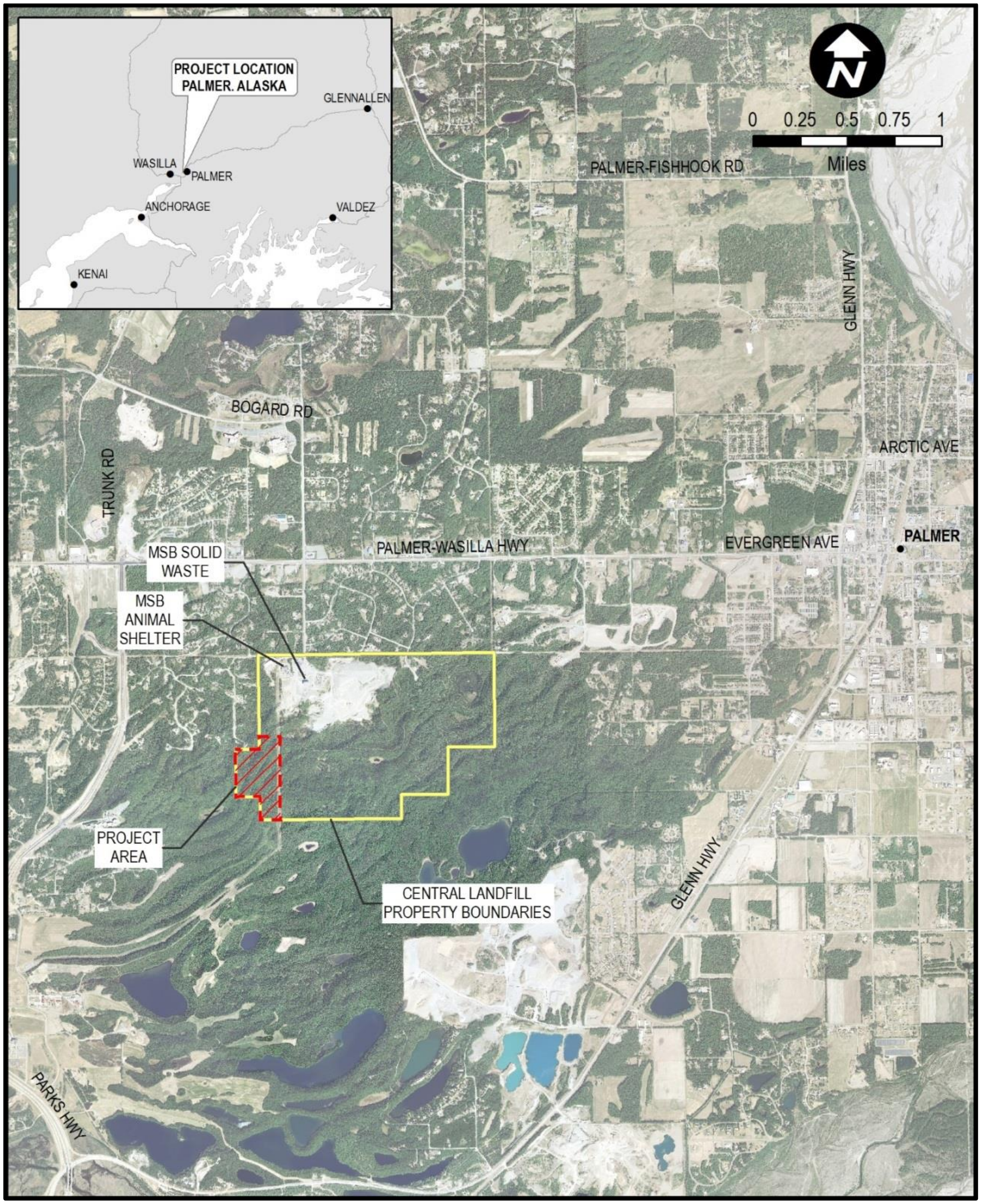

Figure 2: Project Location

1.2 Environmental Resources Present

This section presents the components of the environmental resources that may be affected by the proposed project. For the purpose of this overview of environmental resources present, the study area is defined as the MSB central landfill parcel boundary.

1.2.1 Farm Lands, Range Lands, and Forest Lands

According to the Farmland Protection Policy Act (FPPA), the USDA regulation implementing FPPA (7 CFR Part 658) and USDA Departmental Regulation No. 9500-3, "Land Use Policy," require consideration of the potential effects a USDA action may have on important farmland.

According to the Natural Resources Conservation Service Alaska (NRCS), there are no areas of important farmland, prime forestland, and/or prime rangeland that exist in the project area, as defined by FPPA and USDA Departmental Regulation No. 9500-3, "Land Use Policy"[3].

1.2.2 Wetlands

Executive Order 11990, "Protection of Wetlands," states that it is federal policy to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modifications of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. Wetlands that are determined to be jurisdictional under the U.S. Army Corps Engineers (USACE) will require consultation and permitting. A formal wetlands delineation will be required in order to determine whether wetlands within the study area are jurisdictional. A formal wetlands delineation was not conducted at the time of this assessment. For the purpose of this analysis, both wetland areas are assumed to be jurisdictional[4 5 6].

A review of the Cook Inlet Wetlands, MSB Wetlands View, and the USFWS National Wetlands inventory indicates:

- An approximately 0.52-acre freshwater forested/shrub wetland within the utility easement located along the western property line
- An approximately 1.37-acre freshwater emergent wetland located within the southeastern quadrant of the property that surrounds an approximately 0.32-acre freshwater pond

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[3] NRCS. 2017. Natural Resources Conservation Service Alaska. Last accessed on October 6, 2017. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ak/soils/surveys/?cid=nrcs142p2_035988.

[4] Gracz, Mike. 2017. Cook Inlet Wetlands. Accessed on October 6, 2017. http://www.cookinletwetlands.info/.

[5] MSB. 2017. Mat-Su Borough Wetlands Viewer. Accessed on October 6, 2017. http://msb.maps.arcgis.com/home/item.html?id=15658472427f459ab6d73b1d3ca5ab77.

[6] USFWS. 2017. Information for Planning and Consultation website. U.S. Department of the Interior, Fish and Wildlife Service. Accessed October 6, 2017. https://ecos.fws.gov/ipac/.

1.2.3 *Wildlife and Fisheries*

The Alaska Department of Fish and Game (ADF&G) Anadromous Waters Catalog and Fish Inventory, and the National Oceanic and Atmospheric Administration (NOAA) Essential Fish Habitat (EFH) Data Inventory Mapper were reviewed for the project. According to the information available, there are no known anadromous water bodies located within the project area[7].

Review of the USFWS IPaC planning tool identified migratory bird species that are protected under the Migratory Bird Treaty Act within the project area. In addition, the project area contains suitable habitat for Bald and Golden eagles, as well as other migratory bird species[8] [9].

1.2.4 *Endangered Species*

According to USFWS' Information for Planning and Consultation (IPaC) website and the National Marines Fisheries Service (NMFS) Endangered Species Act mapper, there are no listed threatened or endangered species or designated critical habitat in the vicinity of the project[10] [11].

1.2.5 *Historical and Archaeological Sites*

Review of the National Park Service's (NPS) Register of National Historic Places (NRHP) indicates that there are no known historic or archaeological resources located within the project area[12]. This overview did not include review of the Alaska Heritage Resource Survey cards at the State of Alaska Office of History and Archaeology. Research of the AHRS database requires a professionally qualified individual who meets the requirements outlined by the Secretary of the Interior. In addition, cultural resources assessment/evaluation was not completed in conjunction with the research conducted for this overview.

1.2.6 *Flood Hazards*

According to the Federal Emergency Management Agency (FEMA) Flood Hazard Mapper, Panel 8135E and 8155E, there are no mapped floodplains within the project area[13].

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[7] ADF&G. 2017a. ADF&G Atlas to the *Catalog of Waters Important to the Spawning, Rearing or Migration of Anadromous Fishes*. Accessed on January 12, 2017. https://www.adfg.alaska.gov/sf/SARR/AWC/index.cfm?ADFG=maps.interactive.

[8] ADF&G. 2017b. Bald Eagle (*Haliaeetus leucocephalus*) Species Profile. Accessed on October 6, 2017. http://www.adfg.alaska.gov/index.cfm?adfg=baldeagle.main.

[9] USFWS. 2017. Information for Planning and Consultation website. U.S. Department of the Interior, Fish and Wildlife Service. Accessed October 6, 2017. https://ecos.fws.gov/ipac/.

[10] USFWS. 2017. Information for Planning and Consultation website. U.S. Department of the Interior, Fish and Wildlife Service. Accessed October 6, 2017. https://ecos.fws.gov/ipac/.

[11] NMFS. 2017. Endangered Species Act/Marine Mammal Protection Act Mapper. National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Accessed October 6, 2017. https://alaskafisheries.noaa.gov/mapping/esa/.

[12] NPS. 2017. National Park Service: National Register of Historic Places public, non-restricted data depicting National Register spatial data processed by the Cultural Resources GIS facility. Last updated in April 2014. Accessed on October 6, 2017. https://www.nps.gov/.

[13] FEMA. 2017. FEMA Flood Map Service Center: Welcome. Accessed on October 6, 2017. https://msc.fema.gov/portal.

1.3 Population Trends

The MSB has been Alaska's fastest growing region for the last two decades. Table 7 below summarizes U.S. Census Bureau data from 1990 to 2010 and available population estimates for 2016. Population growth of the MSB region has been steady during the last two decade at a rate of approximately 4%. Using this trend the estimated population of the region will be about 141,247 in year 2030.

Table 7: Mat-Su Borough U.S. Census Data

Year	1990	2000	2010	2016	2030
Population	39,681	59,322	88,995	104,365	*141,247*

However, a closer look at the data indicates a much larger growth in the last two years. Using the last two years' trend, the estimated population for the year 2030 is about 184,000. Following a suggestion from the MSB management, the long term trend is used for the purpose of this PER.

The Alaska Department of Labor and Workforce Development (ADOL) has published population projections for estimated growth throughout Alaska for the years 2015 through 2045. ADOL estimates are based on historical Census population data, fertility and mortality rates, and migration. Projected populations for Alaska's main census areas are summarized in Table 8.

Using historic data from the Census Bureau indicates a steady population growth of about 2% per year until 2015. The population of MSB grew from 90,000 in 2010 to about 100,000 in 2015.

Table 8: Project Populations for Alaska's Main Census Areas

Area Name	July 1, 2015	July 1, 2020	July 1, 2025	July 1, 2030	July 1, 2035	July 1, 2040	July 1, 2045	Growth Rate*
Alaska (Statewide)	737,625	771,529	802,352	829,620	854,104	877,134	899,825	0.73%
Anchorage/Mat-Su Region	399,086	423,107	445,773	466,780	486,263	504,566	522,007	1.03%
Municipality of Anchorage	298,908	309,692	318,629	325,533	330,821	335,148	339,171	0.45%
Matanuska-Susitna Borough	*100,178*	*113,415*	*127,144*	*141,247*	*155,442*	*169,418*	*182,836*	*2.75%*
Gulf Coast Region	81,111	83,703	85,819	87,404	88,516	89,298	89,920	0.36%
Interior Region	112,818	116,478	119,402	121,504	123,063	124,417	125,893	0.39%
Northern Region	27,802	28,707	29,597	30,522	31,568	32,843	34,402	0.79%
Southeast Region	74,395	75,600	76,272	76,411	76,099	75,481	74,655	0.01%
Southwest Region	42,413	43,934	45,489	46,999	48,595	50,529	52,948	0.83%

**Averaged Annual*

Table 9: MSB Population Trends for the Period of 2010 to 2016 and Estimated Growth Through 2030

Year	Population
2010	88,995
2011	91,721
2012	93,685
2013	96,022
2014	98,377
2015	100,175
2016	104,365
2017	105,865
2018	108,283
2019	110,701
2020	113,119
2021	115,537
2022	117,956
2023	120,374
2024	122,792
2025	125,210
2026	127,628
2027	130,047
2028	132,465
2029	134,883
2030	137,301

1.4 Community Engagement

In 2008, the MSB commissioned a Regional Wastewater and Septage Treatment Study[14] to address alternatives for providing wastewater treatment and septage disposal services for the residents of Wasilla, Palmer, and septage haul contractors operating in the MSB. As part of this study, the project team held two public meetings in June and July of 2009 to present progress, answer questions, and ask for comments concerning the project.

Once the study was completed in 2010, the MSB Assembly formed a Wastewater and Septage Advisory Board (WSAB) to begin long-term wastewater and septage treatment planning. The board consists of seven voting members who are residents of the Borough. The board holds meetings on a quarterly basis, or more frequently if necessary. Meetings are listed on the public meetings schedule on the MSB website and community members are encouraged to attend. Agendas, informational packets, and supplements, as well as meeting minutes, are posted on the WSAB page on the MSB website for public viewing.

[14] HDL. 2010. *Regional Wastewater and Septage Treatment Study.*

As part of the 2015 Site Suitability and Engineering Analysis, the project team held a public meeting on April 1, 2015. Mailers, including a project fact sheet and public meeting announcement, were sent to over 1,000 residents living within the two areas included in the study area.

As additional community engagement, MSB gave a presentation to the Meadow Lakes Community Council on January 15, 2015, and the Gateway Community Council on January 21, 2015. The presentation included discussions on current septage disposal practices, project history, treatment alternatives, and progress with the Site Suitability and Engineering Analysis Project.

Once the Site Suitability and Engineering Analysis was complete, the MSB Wastewater and Septage Advisory Board, MSB Planning Commission, and Borough Assembly held separate meetings open to the public.

As the project moves forward, MSB will continue with community engagement. Future community engagement may include a combination of informational mailers, community surveys, public meetings, and a project-specific website.

2 Existing Facilities

Currently there are no functioning facilities in the MSB core area that can treat septage and leachate from this area. Local area wastewater treatment plants either do not have the capacity or are out of compliance with their discharge limit requirements, which do not allow them to accept any septage or leachate from the area pumpers.

The only dedicated facility which was taking septage was the Houston Septage Treatment Plant constructed in early 1980s, which was later shut down by the ADEC.

Currently all the leachate and septage from MSB area is transported to AWWU in Anchorage, Alaska.

2.1 Location Map

The map on the following page shows the Houston facility, which was the only dedicated septage treatment facility in the area for a period of time.

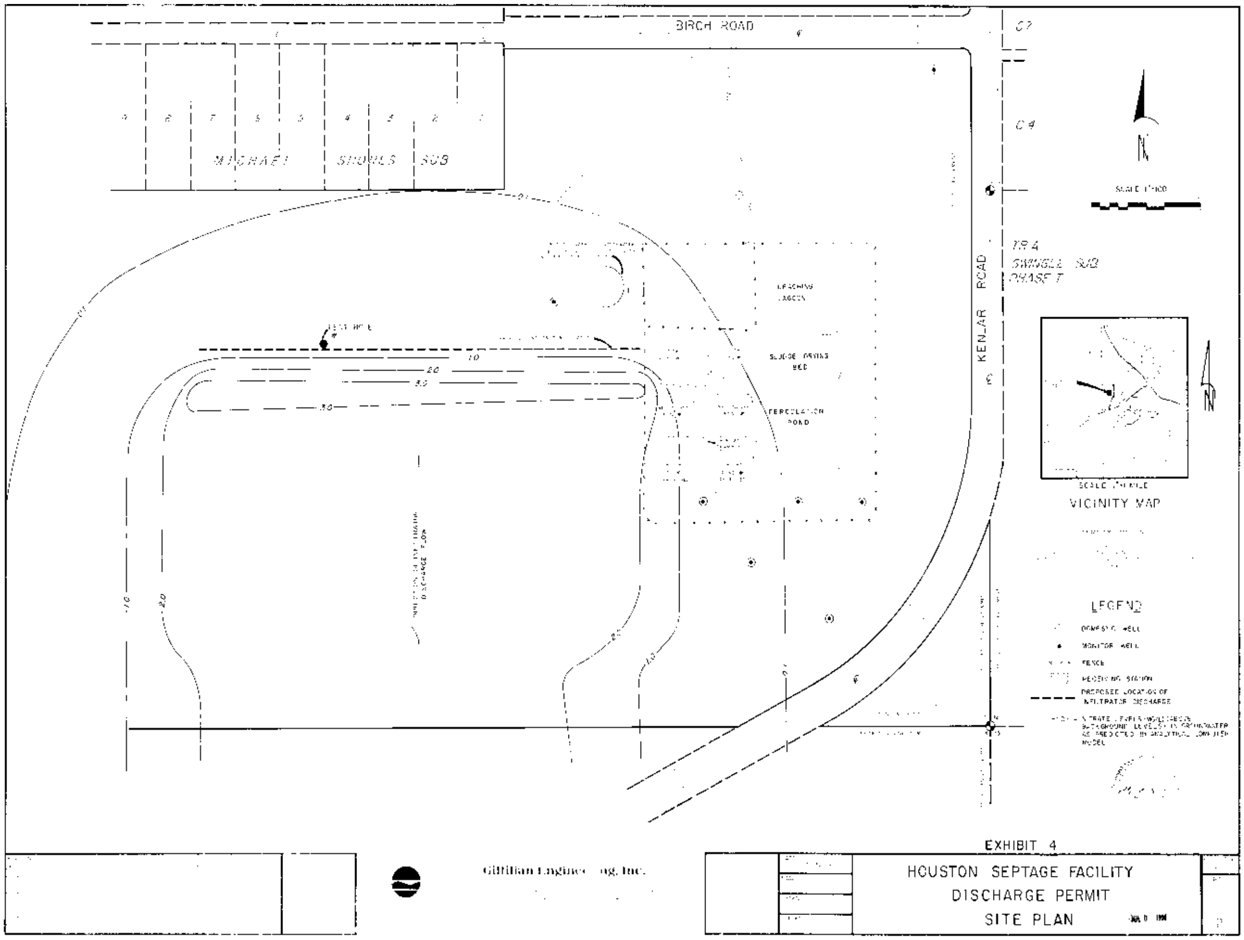


Figure 3: Houston Septage Facility Site Plan

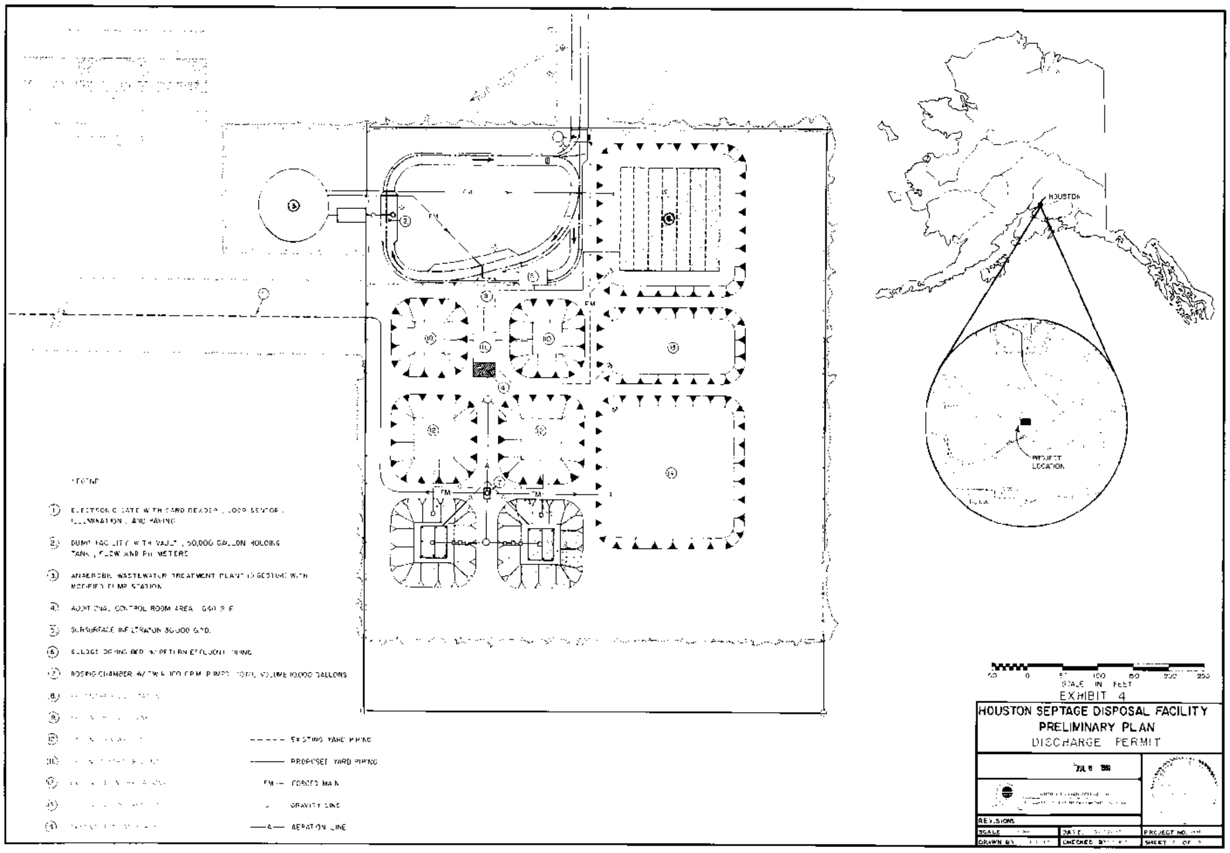


Figure 4: Houston Septage Disposal Facility Preliminary Plan

2.2 History of Facilities

Since the 1970s, the MSB has been exploring different alternatives to eliminate the need for transporting septage and leachate from its territory to the Anchorage Wastewater Treatment Plant in Anchorage.

Prior to 1980, the only septage retaining facility in the MSB was operated by the City of Palmer. In 1980, the City of Palmer closed its sewage treatment lagoons to septage disposal. This required valley septic tank pumpers to haul to the Turpin Street Sewage Dump Station in Anchorage. To provide a more convenient alternative for MSB residents, the City of Houston conducted a feasibility study to build a septage facility in 1981. The Houston Septage Facility was designed by CRW Engineering Group in 1982 with a capacity of 2.5 MG/year. The facility was constructed for $1.3 million and became operational in 1983.

As a result of the operation of this plant, in 1991 nearby groundwater wells around the plant reported unacceptable levels of pollutants. This contaminated the surrounding area and caused the closure of an adjacent fish hatchery. Over the lifespan of the project, revenue decreased as septage haulers chose to use the Anchorage facility because it was less expensive. Later, the Houston facility was closed by ADEC. Today, all septage is transported to Anchorage for disposal.

The Anchorage Water and Wastewater Utility (AWWU) had been accepting MSB wastewater over the years since there are no suitable facilities to take it to in the MSB. Following discussions with the MSB team and a review of publicly available documents and news articles, we understand that the Anchorage plant is aging and under compliance scrutiny and is moving forward with a plan to limit acceptance of wastewater generated outside the city of Anchorage. The cost to treat septage or leachate hauled to the AWWU treatment plant will be significantly higher to those outside the city and borough limits of Anchorage. Over the years the MSB commissioned and completed several studies to evaluate different alternatives and constructed wastewater treatment facilities to address the need to process wastewater and septage within the MSB. One treatment plant in particular closed due to adverse environmental impacts and economics. The following is a list of the some of the more significant studies that have been commissioned and completed by the MSB over the past ten years.

2007 Septage Study

In April 2007, HDR Alaska published the report of a comprehensive study evaluating the feasibility of establishing a new septage and leachate treatment facility vs. continuing existing practice of hauling to Anchorage. They reviewed the advantages and disadvantages of four alternatives to select and recommend the most practical and economical alternative for addressing the septage and leachate treatment issues in the MSB area.

2010 Regional Wastewater and Septage Treatment Plan

In 2010 HDL Engineering Consultants, in cooperation with the cities of Palmer and Wasilla, MSB extensively reviewed and evaluated combining wastewater treatment efforts into one large regional facility for wastewater from the three local governments of Matanuska-Susitna Borough, City of Palmer, and City of Wasilla. A comprehensive regional wastewater and septage treatment study was issued.

Progress was made and the WSAB, as mentioned previously was formed and MSB continued to explore opportunities for a septage and leachate treatment facility.

2013 Septage Study Update

In 2013, HDR Alaska revised and updated the data and calculations from the 2007 report for changes in fuel costs, population growth, and construction costs to further evaluate the feasibility of establishing a new septage and leachate treatment facility. The analysis indicated that the project is financially feasible. It also updated a conceptual level analysis of an advanced treatment system capable of achieving more stringent water quality requirements.

2014 Leachate Treatment Evaluation

In 2014, MSB contracted CH2M HILL to conduct an update to the landfill plan that included the evaluation of a new leachate treatment alternative. The study concluded that the co-treatment of septage and leachate is the most economical alternative.

2015 Site Suitability and Engineering Analysis

In 2015, CH2M HILL completed a comparative review and analysis for siting the septage and leachate treatment facility. Based on the engineering and cost analysis the report concluded that the treatment facility should be located at the MSB Central Landfill.

2.3 Condition of Existing Facilities

Currently there is no facility in the MSB core area that can accept septage and leachate from the MSB. The only dedicated facility in the city of Houston was shut down in early 1990s. Its condition does not allow its rehabilitation or use as a wastewater treatment plant.

Current Septage Production

MSB septage production has been estimated using records provided by AWWU's septage receiving facilities.

This data was used to calculate the annual septage production by MSB households, as well as flow characteristics for the proposed septage treatment plant. A summary of these findings is presented here.

Using this data, a production dynamic analysis was conducted to establish possible future growth/decline pattern in the septage production over the period of past six years, as well as possible growth/decline values.

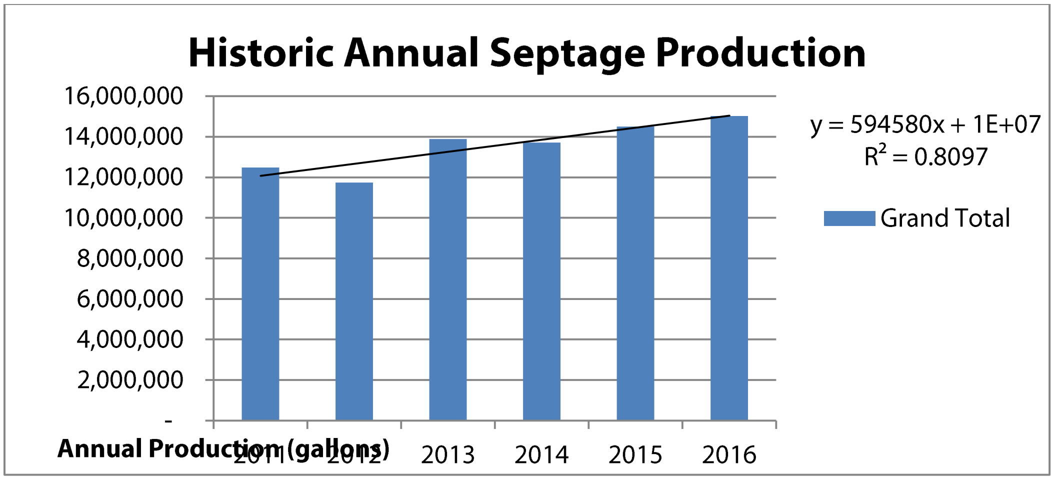
Table 10: Variation of Septage Production Over 6 Years

Year	Grand Total
2011	12,484,420
	11,736,177
2013	13,889,230
	13,710,008
2015	14,497,385
	15,025,597
2017 Until July	7,892,761

The annual production ranged from around 11.7 million gallons in 2012 to about 15 million gallons in 2016. A trend analysis was conducted and the predictive equation is as follows:

Annual Production = 594,580 x Year + 1.E+07 (R2 = 0.8097).

The line slope is indicating a value of approximately 600,000 gal/year or slope to intercept ratio (594,580 / 1.E+07 = 0.06) of 0.06, which translates to about 6% growth per year with a confidence level of about 80%. The graph on the following page is the visual analysis of this process.Figure 5: Historic Annual Septage Production



Although the annual flow rate so far has not exceeded 15 million gallons, the data indicated extreme temporal variations in the flow rate for different months, weeks, and even days. It is customary to use an average daily flow (ADF) for system sizing (often with a peak factor); wide temporal variations render this method ineffective. For example, the flow rate ranged from about 375,000 gallons for January 2012 to about 2.5 million in October of the same year. Due to these variations, a Temporal Dynamic Analysis (TDA) was developed and utilized to estimate the current production numbers. The complete TDA analysis is provided in Section 5 of this report.

2.4 Financial Evaluation

A financial analysis and cost study is provided in Section 7 of this report.

3 Need for Project

3.1 Health, Sanitation, and Security

The current practice of hauling and disposing septage and leachate from the MSB core area to AWWU has numerous health, sanitation and security implications.

Last year more than 15 million gallons of septage and approximately 1.6 million gallons of leachate were transported to AWWU facility in Anchorage. At approximately 3,000 gallons/truckload, it is estimated during the year that around 5,500 truckloads of wastewater are transported over the already crowded roadways between Anchorage and the MSB region. On average, approximately 20 trucks per day are hauling septage and leachate to the AWWU treatment plant. This number could be as high as 80 trucks per day based on October 2012 data provided by AWWU.

Having this many trucks hauling septage and leachate on public roads increases the chances of accidents and spillage, thus endangering the public, sanitation, and security.

In addition, the septage and the landfill leachate are trucked to AWWU's Turpin Street facility for treatment at the Asplundh facility prior to disposal into the Cook Inlet. The Cook Inlet is home to five species of Pacific salmon, Pacific herring, and smelt that are commercially harvested, among other fish and shellfish. The continued disposal or increase of disposal of untreated septage and leachate will increase the detrimental effects on the surrounding water quality and the fisheries of Alaska. The Asplundh facility is operating under a variance to the U.S. Clean Water Act. Considering the sensitivity of the fisheries, AWWU may close this facility in the near future.

3.2 Aging Infrastructure

All the wastewater treatment facilities within 100 miles of the MSB, including the cities of Palmer, Wasilla, Houston, and Anchorage, have been built in the early 1970s to 1980s and are either shut down (Houston), do not have the capacity and are non-compliant (Wasilla and Palmer), or are too far away (Anchorage) and do not meet with the future financial goals of treating septage and leachate by the constituents of the MSB. The Anchorage facility, which is the only treatment plant accepting septage and leachate from MSB, was built in July 1972. It is only a primary treatment facility and is in need of renovation and upgrading to a secondary and/or tertiary treatment plant.

3.3 Reasonable Growth

The analysis of population statistics of the MSB region indicates a rapid growth in most of the cities in the area, including Palmer, Wasilla, and Houston. This creates a high demand for treatment facilities in the region, which are already over-capacity. This also applies to AWWU, which is the only facility accepting septage and leachate from the Valley.

AWWU has communicated repeatedly that they will eventually close Turpin facility which will increase burden on the King Street facility. Considering the lack of any facility that can receive these wastes from the MSB, including pumpers and landfills in the area, coupled with uncertainty of continued service by AWWU, the pumpers and landfill operators in the MSB core area are placed in a very difficult position, creating the need for a dedicated septage and leachate treatment facility.

3.4 Management and Social Need

The purpose of this study is to address the short- and long-term treatment and disposal policies for both septage collected from household septic tanks and leachate generated at Central Landfill in the city of Palmer. It is also to address regulatory compliance and capacity needs of the Palmer and the city of Wasilla septage treatment plants and to address the long-term regional needs for a leachate and septage treatment system in the core area of the Borough between Palmer and Wasilla.

The existing municipal wastewater treatment systems for Palmer and Wasilla are limited in their capacity to meet the needs for present demand and future growth within the core area of the Borough, and have no facility for accepting or treating septage and leachate generated within the Borough and its landfills. Septage haulers within the MSB and the management at the MSB landfill are compelled to transport septage and leachate to AWWU, at an increasing cost and with numerous adverse environmental and social impacts. Although the cities of Palmer and Wasilla currently operate independent wastewater collection and treatment facilities, due to forecast growth within the service area and a changing regulatory environment, these cities are moving toward improving their respective treatment systems or they may face regulatory action. The city of Palmer has a regulatory notice to come into regulatory compliance with NPDES permit limits for ammonia and total suspended solids (TSS). The city of Wasilla struggles with ADEC regulatory limits for nitrates and cannot increase plant capacity because of its groundwater discharge. Septage haulers operating within the Borough face escalating costs because there is no way to treat and dispose of septage within the Borough.

Similarly, AWWU has limited capacity to accept these wastes from the MSB and has intimated the potential closure of the Turpin Street facility and continuation of this practice. This potential action creates both economical and practical uncertainty for the future of septage and leachate disposal from the Borough. The Borough continues to face substantial management challenges and significant public reaction for septage treatment throughout the Borough's population. This study and implementation of its findings will address these issues and attempt to alleviate the aforementioned challenges. Construction of a septage and leachate treatment facility within the Borough's core area could reduce traffic onto the heavily used arterial connection between the Borough and Anchorage area, as well as reduce the possibilities of accidents and spillage.

3.5 Economic and Financial Needs

According to further study by CH2M HILL in 2016, the estimated disposal cost (including fuel, labor, etc.) per 3,000 gallon truck is approximately is about $222.88. This translates to roughly 7.4 cents per gallon. According to the analysis of the data supplied by MSB, the Borough generated and disposed of approximately 1.6 million gallons of leachate at AWWU in 2016. Based on the information provided, the MSB spends about $112,000 per year on leachate disposal. Also, in the same report it is mentioned that AWWU is likely to increase its disposal rate, which is currently $75.58 per 3,000 gallon truck. This uncertainty, coupled with possible and continued increase in labor, fuel, and maintenance costs, imposes a significant burden on the MSB officials for future planning and budget estimation, as well as the Borough's residents. Constructing septage and leachate treatment facility within the Borough will provide possible cost savings, as well as certainty for future budgeting and operations planning.

Table 11: Estimated Disposal Costs

Cost Item	Estimated Cost/3,000 gal
Fuel	$48.00
	$62.50
Truck Maintenance and Insurance	$36.80
	$75.58
Total	$222.88

*Table 1*Source: CH2M Hill, 2015 Septage and Leachate Treatment Facility Site Suitability and Engineering and Analysis*

4 Alternatives Considered

During the past nearly four decades, numerous attempts have been made by MSB to determine a technically and financially feasible alternative for addressing the septage and leachate handling, treatment, and disposal issue in the MSB region.

Several alternatives have been reviewed and evaluated by the MSB and numerous studies have been prepared. As part of the scope of this phase of the PER, the various studies and their recommended options were reviewed. A list of alternatives generated from the previous studies, along with a brief overview of each one, is provided. Major shortcomings or disadvantages, if any are highlighted and discussed. A financial comparison of two options, previously identified as favored alternatives, will be covered in this document.

MSB was faced with three sets of decision points:

- **Logistical alternatives,** such as whether to continue the current practices or build dedicated septage treatment system, join with other regional partners and build a regional treatment plant, or build a co-treatment for leachate and septage together
- **Technology alternatives,** such as a lagoon system, Sequencing Batch Reactor or Membrane Bioreactor.
- **Financial alternatives** such as the type of funding sources they should use. Some alternatives include: USDA or ADEC grant and loan or General Obligation Bonds.

During this period, MSB commissioned several studies to look at these alternatives and select a viable and feasible strategy and technology to move forward and address the Borough's septage and leachate treatment issues. The following is a summary of these studies and their outcomes.

These alternatives have been fully reported in the documents listed above; therefore, only a summary of these alternatives is presented here. For each alternative, the description, Design Criteria, Map, Environmental Impacts, Land Requirements, Potential Construction Concerns, Sustainability Considerations, and Green Infrastructure have been fully described in each reported document. Only a listing of these alternatives together with a summary of each alternative will be presented here.

4.1 Logistical Alternatives

In 2007 in consultation with the MSB Department of Public Works, HDR Inc. evaluated four different alternatives for addressing the issue of septage handling and disposal. HDR provided an update to the 2007 report in 2013 at the request of MSB. In 2014, MSB requested CH2M HILL, to evaluate and suggest a treatment/disposal policy for the leachate generated at the Central Landfill. The logistical alternatives reviewed by these studies are:

For Septage:

1) Keep existing hauling practices
2) Install septage consolidation facility and bulk haul to Anchorage
3) Construct co-treatment facility with the City of Palmer
4) Construct regional septage disposal facility

For Leachate and Septage:

1) Keep existing hauling practices
2) Pre-treat the leachate to stabilize the zinc and haul it to the Anchorage wastewater treatment plant
3) Treat leachate only and produce an effluent suitable for surface or sub-surface discharge
4) Co-process and treat leachate and septage to produce an effluent suitable for surface or sub-surface discharge

Upon a comprehensive review of these alternatives, the consultants concluded that the MSB should pursue further exploration of the last two alternatives (3 and 4) since their costs and advantages were comparable and successful implementation of anyone of these alternatives will provide independence and possible future cost savings for the MSB.

In 2013, MSB revisited this study and concluded that alternative 4, Construct an Independent Regional Septage Facility, is the most logical way to move forward. The study suggested three technology alternatives, which are listed in the next section

In 2014, CH2M HILL, as part of the landfill sequencing plan, also favored an independent septage and leachate treatment facility and compared two different technologies for treatment of these two waste streams, which are provided in the next section.

4.2 Technology Alternatives Reviewed

During these studies, several technologies and procedures were examined. The following is a sample list of these technologies that were evaluated over the past decade:

4.2.1 Solar Aquatic System (SAS)

During the 2007 study, HDR also evaluated some technological alternatives namely, Solar Aquatic System (SAS) and conventional treatment. The process that employs mechanical, phytoremediation, and bioremediation principles to remove and destroy contaminants in the wastewater had not been proven to work in Alaska and was not recommended by the evaluators.

4.2.2 Lagoon Based Biological Process

In the same study, HDR also reviewed lagoon based conventional treatment process while citing some of the advantages and disadvantages of the process. They did not favor one system (SAS) to the other (lagoons) and recommended that one of these systems should be explored.

4.2.3 Lagoon Activated Sludge (LAS)

In 2013, in an updated report from the 2007 study, HDR suggested an aerated lagoon or Lagoon Activated Sludge System (LAS) as part of their recommendations for a more efficient system to process septage and leachate from MSB area septic tanks and landfills.

4.2.4 Sequencing Batch Reactors (SBR)

In 2013, HDR cited that 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. Among the number of available activated sludge process alternatives, including conventional activated sludge (CAS), lagoon activated sludge (LAS), sequencing batch reactor (SBR), and membrane bioreactor (MBR), HDR further discussed SBR and MBR. Since they had already reviewed LAS in their 2007, they presented a conceptual design cost estimate for SBR and MBR in that report.

4.2.5 Membrane Bioreactor Reactors, (MBR)

In the same study, HDR also reviewed an advanced form of SBR that includes a membrane system to enhance clarification and produce a much higher quality water to meet more stringent discharge limits or make the effluent suitable for possible reuse.

4.2.6 Leachate Evaporation and Recirculation of Concentrate Back to Landfill

A sequencing plan studies by CH2Mhill reviewed available evaporation technologies and provided sample vendor proposals. These technologies require removal of oils and other debris prior to evaporation process. They cited high operating costs and air emission control as some of the disadvantages of the technology.

4.2.7 Additional Alternatives Reviewed

In addition to the above mentioned technologies, Clark reviewed some other non-biological, non-common, and emerging technologies based on our experience with each technology. . The technologies include:

- **Electrocoagulation:** High operating cost, not effective in addressing the low discharge limits and high levels of safety.
- **Constructed Wetlands:** Require extremely large area, not suitable for cold climates and not effective meeting stringent discharge limits.
- **Media Filtration:** Frequent filter media replacement, frequent backwash, not effective meeting stringent discharge limits.
- **Conventional Filtration:** Require extensive pre-treatment, high operating costs and not effective meeting stringent discharge limits.
- **Chemical Precipitation:** High chemical costs, not effective meeting stringent discharge limits specially organics removal.

4.3 Financial Alternatives

Recently, CH2M HILL evaluated the funding alternatives available to MSB for financing any one of these alternatives. Among other alternatives, they evaluated the following three:

- MSB General Obligation (GO) Bond – requires assembly and voter approval.
- ADEC Clean Water Grant/Loan Program – loan application approved by DEC for first $5 million. Remaining funds to become available in subsequent years.
- USDA Rural Development Grant/Loan Program – requires preliminary engineering and environmental studies for application. This has been partially completed as part of site suitability in 2015.

4.4 Summary of Previously Proposed Alternatives

Amongst numerous options presented to MSB over the past decade, the following is a summary of main solutions that have been provided to MSB officials:

- **Strategic Alternative:** construct a co-treatment plant to treat both septage and leachate at a MSB facility.
- **Financial (Funding) Alternative:** No specific funding alternative was preferred. It was recommended that all three funding alternatives should be further studied once a clear path forward is established.
- **Technological Alternative:** Sequencing batch reactor (SBR) or its advanced form (i.e.,

membrane bioreactor or MBR) was recommended as viable technology for co-treatment of septage and leachate.

5 Selection of Alternatives

5.1 Life Cycle Costs Analysis

Life cycle analysis was conducted for leachate and septage treatment systems for different risk levels and funding options. The following is a summary of these analyses. Further analysis is provided in Section 7 of this document.

5.1.1 Operating Expenses

Table 12 presents the equivalent uniform annual cost for operating expenses.

Table 12: Annual Septage and Leachate Operations and Maintenance Costs

Percentile	25	50	75	99
System Capacity GPD Leachate + Septage	**120,000**	**220,000**	**235,000**	**270,000**
EUAC O&M ($)	$355,000	$535,000	$594,000	$657,000
	29,565,000	32,850,000	38,599,000	44,348,000
Cost/Gallon	$0.037	$0.045	$0.041	$0.037
	$36.52	$44.89	$40.70	$37.22
Cost/3000 Gallons	$110	$135	$122	$112

5.1.2 Capital

Tables 13.A and 13.B present the equivalent uniform annual debt service costs for each of the funding scenarios analyzed. It is assumed that USDA Loan will be augmented with 30% grant.

Table 13.A - Projected Annual Debt Service Costs (USDA)

USDA Loan

Percentile	25	50	75	99
System Capacity GPD Leachate + Septage	**120,000**	**220,000**	**235,000**	**270,000**
Capital Cost	$16,989,000	$21,641,000	$22,403,000	$22,619,000
	($5,097,000)	($6,492,000)	($6,721,000)	($6,786,000)
Debt Financed	$11,892,000	$15,149,000	$15,682,000	$15,833,000
	3.13%	3.13%	3.13%	3.13%
Term	40	40	40	40
	0%	0%	0%	0%
	29,565,000	32,850,000	38,599,000	44,348,000
Cost/Gallon	$0.038	$0.048	$0.044	$0.041
	$38.12	$48.20	$44.28	$41.18
Cost/3000 Gallons	$114	$145	$133	$124

Note: Salvage Value is excluded.

Table 13.B - Projected Annual Debt Service Costs (ADEC)

ADEC Loan

Percentile	25	50	75	99
System Capacity GPD Leachate +Septage	**120,000**	**220,000**	**235,000**	**270,000**
Capital Cost	$16,989,000	$20,640,000	$20,403,000	$22,619,000
	$0	$0	$0	$0
Debt Financed	$16,989,000	$20,640,000	$20,403,000	$22,619,000
	1.5%	1.5%	1.5%	1.5%
Term	20	20	20	20
	0%	0%	0%	0%
	29,565,000	32,850,000	38,599,000	44,348,000
Cost/Gallon	$0.037	$0.045	$0.041	$0.037
	$36.52	$44.89	$40.70	$37.22
Cost/3000 Gallons	$110	$135	$122	$112

5.1.3 Comparison

Table 14 presents a comparison of costs of various treatment options (capacity) as well as probable financing offered (ADEC and USDA) of a local treatment facility within MSB and the "do nothing" option which is to dispose of septage to the facility in Anchorage at total cost of $223 per tanker (3000 gallons). As stated previously, this comparison assumes the costs to collect septage within the MSB would be the same for each scenario, so those costs are excluded from both. This comparison focuses on the costs to haul and discharge a 3,000 gallon tanker at the AWWU facility to the disposal costs at an MSB facility under both funding scenarios.

Table 14A: Total Cost (USDA)

Total Cost with USDA Loan

Percentile	25	50	75	99
System Capacity GPD Leachate + Septage	**120,000**	**220,000**	**235,000**	**270,000**
	$0.012	$0.016	$0.015	$0.015
Total Cost/Ga	$0.038	$0.048	$0.044	$0.042
	$38.12	$48.20	$44.28	$41.18
Cost/3000 Gallons	$114	$145	$132.83	$123.54

Note: Salvage Value is excluded.

Table 14B: Total Cost (ADEC)

Total Cost with ADEC Loan

Percentile	25	50	75	99
System Capacity GPD Leachate + Septage	**120,000**	**220,000**	**235,000**	**270,000**
	$0.012	$0.016	$0.015	$0.015
Total Cost/Ga	$0.037	$0.045	$0.041	$0.037
Cost/1000 Gallons	$36.52	$44.89	$40.70	$37.22
	$110.00	$135.00	$122.09	$112.00

Note: Salvage Value is excluded.

5.2 Non-Monetary Factors

In order to select an alternative that can meet the technical objectives, as well as the needs of the residents of the MSB region and to provide a reliable, economical, and environmentally safe system to treat septage and leachate generated in the area, a series of criteria must be satisfied. Some of these criteria were specified by the client in their contract and some were identified by Clark. The following is a list of some of these criteria:

- Meeting the tightening and emerging effluent discharge requirements
- Coping with current and future demand fluctuations
- Weather and climate dependence
- Odor and noise nuisance
- Land requirement
- Environmental impact
- Aesthetics
- Disinfection
- Biota kill and washouts
- Control of rodents, birds, and other predators
- Catastrophic failure (seismic, hurricanes, storms)
- Operator skills and numbers
- Operator health and safety

6 Proposed Project

The proposed project is selected based on strategic, financial, and technological attributes to provide the best alternative for treatment of septage and leachate at MSB.

6.1 Strategic Alternative

The proposed strategic alternative of co-treatment plant to treat both leachate and septage together presents certain strategic and management challenges. Septage is relatively predicable and stable wastewater stream, while leachate quality is extremely variable. Its quality is dictated by population demographics, landfill type, landfill age, management practices, precipitation, and several other parameters. Mixing a landfill leachate waste stream with septage, especially in a relatively small biological wastewater treatment plant, can create unmanageable upsets in the biological activities. It can also cause adverse impacts on the quality of discharge effluent, which can create non-compliance on the discharge limits.

On the other hand, treating these two waste streams separately will provide a complete control over the quality and operation of each treatment system.

Upon careful review of all the alternatives examined by a comprehensive series of studies during the past decade, as well as all the treatment alternatives available in the market place, Clark recommends that each waste stream be treated in a separate treatment system inside a single facility. Conducting treatment together in a single facility will allow for substantial savings on utilities provisions, site work, and management costs including staff, laboratory, and maintenance, while avoiding the aforementioned shortcomings of co-treatment.

6.2 Financial (Funding) Alternatives

We reviewed available information on the proposed three funding alternatives provided by the MSB and detailed in the previous studies and compared their impact on the rates, as well as overall cost of the suggested treatment systems. No specific preference was given to any particular alternative. It was suggested that all alternatives should be explored and the most suitable one should be selected. For the purposes of this PER, we are in agreement with the conclusion provided in the previous studies, in that, all the available funding alternatives should be evaluated and a suitable one selected. This will be done during Phase II of this study.

6.3 Technology Alternative

In the latest study, CH2M HILL recommended aerated lagoon, sequencing batch reactor, or membrane bioreactor technology should be selected to treat septage and leachate from the MSB area. All these technologies are a variation of biological wastewater treatment technologies, which employ activated sludge treatment principles.

All of these alternatives create numerous technological, financial, and management challenges and have several negative attributes that make them not favorable for cold climate applications. These shortcomings, such as inability to meet current and emerging regulatory discharge limits, weather dependency, large footprint, sophisticated operation and maintenance requirements, and adverse environmental impact make these systems unfavorable for this application. Even the most advanced one of these technologies, namely membrane bioreactor (MBR) still relies on the biological process as pre-treatment to membranes; therefore it still will have the adverse environmental impacts of traditional activated sludge system. Also MBRs (submerged or side-stream) utilize ultrafiltration technology with a Molecular Cutoff Weight of 200,000 Daltons, which will not reject any dissolved material, thus will not impact monovalent elements or salts.

A different alternative, devoid of these negative attributes and meeting the client's objective, is needed.

Section 3: Selected Project

1 Overview

To achieve goals and objective listed in previous sections, as well as responding to the future needs of MSB residents to overcome capacity demand, as well as new and emerging discharge requirements, an emerging technology was evaluated that meets nearly all the aforementioned challenges. This technology which is a graduated single-pass membrane filtration system, with a trade name of LEACHBUSTER®, utilizes flow path velocity to constantly clean the systems membranes. The system treats both septage and leachate without biological, chemical, or extensive mechanical pre-treatment in a single pass. It can address both the septage and leachate treatment and disposal issues in the MSB region. No pre-treatment is required for leachate, however for septage, an industry standard coarse filtration will be required to remove large objects that could damage pumps and potentially clog pipes and the treatment system.

The selected technology, LEACHBUSTER®, was evaluated using monetary and non-monetary criteria as follows:

1.1 Meeting the Tightening and Emerging Effluent Discharge Requirement

Effluent discharge criteria are the most important parameters dictating the type and size of any of the proposed wastewater treatment plants. All the systems reviewed here, including biological treatment systems, have limited capabilities in treating and removing most of the inorganic contaminants such as chlorides, metals, sulfides, etc., as well as some organic compounds such as perfluorocarbons (PFCs), polychlorinated biphenyls (PCBs), or polycyclic aromatic hydrocarbons and halogenated (PAHs), etc. They are especially limited in treating dissolved and stable compounds.

Recent advances in the contaminants detection technologies, as well as enhanced research on the impact of these contaminants on human and marine health and the environment have identified and added numerous new compounds to the list of controlled or monitored contaminants discharged from wastewater treatment plants. These compounds are termed as Contaminants of Emerging Concern (CECs) and are often in dissolved form and very stable (non-degradable).

Federal and local authorities are increasingly adding these compounds to the list of parameters to be restricted in the treated effluent being discharged into the environment.

In addition, to the types and numbers of these contaminants, their discharge limits are also becoming more stringent. For example, the discharge limits for common contaminants such as phosphorus and nitrogenous compounds are being lowered nearly every year.

A recent correspondence from Lori Aldrich, Regional Program Manager, Alaska Department of Environmental Conservation Solid Waste Program, provided insight into this subject and its future from the standpoint of a regulatory agency.

Based on her statement and our experience; when selecting a wastewater treatment and disposal technology; all the present and future changes in the contaminant type and levels should be considered in the evaluation process.

As part of this study a treatability study with LEACHBUSTER® system was conducted utilizing samples from both the septage and leachate sources from the MSB residents and landfill. The treated samples were sent to an independent third-party commercial laboratory for analysis. The results from this analysis indicated that the system can remove all contaminants listed in the U.S. Drinking Water and Water Quality Standards to meet regulatory compliance levels.

1.2 Coping with Current and Future Demand Fluctuations

The volume of present and future wastewater flow to the treatment plant is also an important parameter dictating the size of any wastewater treatment facility. The proposed treatment plant must be designed to treat both leachate and septage, both of which have extreme temporal variability.

Leachate volume is impacted by precipitation, management practices such as runoff and drainage management, landfill operation such as number and surface area of the open and closed landfill, as well as the type of municipal solid waste (MSW) and its moisture content.

Similarly, septage volume is also impacted by weather such as snowfall or cold temperatures (impacting transportation and handling practices), management practices such as pumping frequency, as well as availability of haulers or capacity of the receiving station.

The normal design practice is to use an average number with a peak factor and a future growth estimate. Since most of these plants are difficult to upgrade and are designed for long-term use (up to 40 years), they are often overdesigned by several fold to cover estimated peak flows and population growth over a very long period, which often results in very expensive projects that many communities have difficulty incorporating into their budget. Also, most of these plants either exhaust their capacity due to rapid population growth or have idle capacity for prolonged periods of time due to slower community expansion than expected.

The proposed LEACHBUSTER® technology is a modular system that will allow the addition or deduction of treatment modules to meet the dynamics of flow demand. The system is designed in the form of individual and independent skids, the number of which can be increased or reduced to meet the increasing or decreasing demand. Should the demand fall below the current level, a given number of skids can be removed and transported elsewhere and installed in a matter of days to be used in a new location. Also, in the case of increased demand, additional skids can be added to increase the treatment capacity.

To accommodate short-term and seasonal fluctuations, certain sections of each skid can be shut down and preserved (membranes can be preserved and reused up to two years without the loss of performance) and restarted when the demand increases.

In addition, most of these systems are designed to be expandable (i.e., sufficient pump and flow capacity, as well as power is included in the system (up to 30% of the present capacity) without installing the membranes). Should the increase occur, by up to 30%, the additional membranes are added and system capacity is increased by up to 30%.

This flexibility and modularity will eliminate the need for designing the system for future capacities, thus avoiding the tying up of capital for years in expectation of increased demand, which in turn will reduce the present cost.

1.3 Organic and Mineral Shock Loads

Concentration of contaminants (load) in both septage and leachate varies dramatically for various reasons. The concentration of leachate is much higher in winter months, especially in colder climates, due to presence of frost, which slows down microbial activities, thus releasing less moisture as water infiltration into the leachate collection system. In contrast, the leachate is more dilute during warmer months with high precipitation and the existence of high microbial activities.

Septage consistency can vary substantially. For example, septage from a restaurant or a truck wash is substantially different from septage from a single-family home. Septage from a more frequently pumped septic system can be much more dilute than that of a less frequently pumped system. Biological and other technologies proposed in previous studies are not capable or have difficulty in responding and addressing sudden shock loads.

The proposed LEACHBUSTER® system can tolerate up to three times of the design contaminant and hydraulic load. In the absence of precipitation, the concentration of the contaminants in the leachate increases. The system automatically (high conductivity) senses this change and increases the operating pressure, thus compensating for the decreased membrane performance. Similarly, in the presence of higher precipitations and increased volume, more permeate will flow through the membranes, enhancing performance, thus compensating for decreased membrane performance.

1.4 Weather and Climate Dependence

The weather impacts the performance of biological wastewater treatment systems in many ways. The most important impact of the weather on the performance of these plants is low temperatures. Almost all of the bacteria employed in biological wastewater treatment plants, including BOD-consuming bacteria, as well as nitrifying and de-nitrifying microorganisms, stop functioning at temperatures of below 40°F. Anaerobic bacteria (even psychrophiles) require at least 50°F for minimal function. These systems are totally unsuitable for a temperature regime that exists for part of the year in the MSB region. The other impacts of the weather on performance of biological wastewater treatment are rainfall (Increasing the treatment volume), wind, and storms.

On the other hand, the proposed LEACHBUSTER® system is totally weather-independent for its functions. It is housed in an insulated enclosure and does not rely on high temperatures for its function. It only requires maintaining a temperature of above 40°F in an enclosure to avoid pipe and pumps from freezing.

1.5 Odor, Pathogens, and Noise Nuisance

In a typical biological wastewater treatment plant, the wastewater is passed through coarse and fine screens, grit removal chamber, primary clarifier, aeration tanks, return and waste activated sludge (RAS and WAS) handling system, secondary tank, and sometimes a tertiary treatment system such as sand or membrane systems. During all of these processes, wastewater is agitated and exposed to the air, which causes the release of volatile and often odorous (hydrogen sulfide, ammonia, and other gases into the atmosphere, that are potentially dangerous to human and animal health).

These actions also release a large amount of pathogens such as *E. coli* and fecal coliforms, as well as other dangerous viruses, bacteria, and fungi into the air, which are transported to nearby populated areas.

Also, most of these processes use large mechanical (motors, aerators, pumps, etc.) equipment that creates constant and often high decibel noises. This can be a nuisance if not dangerous to the workers' and nearby residents' health.

The proposed alternative in this report the LEACHBUSTER® is a system that is housed inside a building or enclosure in its entirety and is operated in a totally enclosed loop. There are no open aeration, clarification, or settling tanks; RAS and WAS pumps; or exposed grit removal equipment. The wastewater is exposed to the air only after it has completely been cleaned and is void of contaminants or pathogens to disperse to the air. This also eliminates the dispersal of odorous material into the atmosphere and creation of odor nuisance. Even the receiving station is totally enclosed with minimal or no odor emanating from it. Nevertheless, it will be housed in an enclosed area and if needed, an odor abatement system will be installed to filter the air.

As for noise, there are only a few pumps that operate in an insulated building which emits reduced noises to the surrounding community. There may be some noise from the pumps, in which case an acoustic enclosure may be provided to mitigate high noise levels.

1.6 Land Requirement

Most of the conventional wastewater treatment plants require several acres of land for lagoons, aeration and anaerobic tanks, clarifiers, as well as sludge stabilizers.

The proposed system has very small footprint of about 400 square feet, which is housed in a proposed 9,000 square foot building (for both the septage and leachate systems).

1.7 Environmental Impact

Systems proposed in earlier studies create substantial amounts of adverse environmental impact by requiring large amount of soil movement and excavations for numerous tanks, basins, access roads, buildings, etc. As mentioned earlier, they also impact the environment by creating air pollution by dispersing volatile compounds, as well as pathogens into the atmosphere. Again, by comparison, the proposed system requires minimal soil disturbance and, as mentioned earlier, causes minimal air pollution.

1.8 Aesthetics

The alternatives proposed in previous studies consist of large tanks and other structures full of untreated wastewater, which are regarded as an eyesore. The proposed system is housed in a single building that is aesthetically pleasing and could blend in with the nearby buildings without creating unpleasant infrastructure.

1.9 Disinfection

Treated effluent from almost all the wastewater treatment plants contains viable pathogens that have to be disinfected prior to discharge into the environment. This is normally achieved by using some kind of oxidizing chemicals such as chlorine gas or liquid. These materials are corrosive, hazardous to the environment and biota, as well as expensive to purchase.

In the case of chlorinated compounds, the residual chlorine in the effluent after discharge reacts with the organic matter in the receiving waters and forms a harmful product called trihalomethanes or THMs.

The maximum inward osmotic pressure that bacteria and virus cell walls can tolerate is about 250 psi. The proposed system LEACHBUSTER® exposes the bacteria and viruses in the waste stream to over high pressures, which implodes the bacteria and virus cell walls and renders them unviable.

Bacteria sizes range from 0.11µ to 10. The proposed system screens the dead and viable bacteria and most viruses from the treated water using membranes with 0.007µ mean diameter orifices.

The proposed technology produces a pathogen-free effluent without the use of disinfectants thus possible forming of THMs.

1.10 Washouts, Biota Kill, Infestation

The systems proposed earlier (SBR or MBR), like any other biological system, rely on bacteria to digest soluble BOD and nitrogenous compounds. Sometimes in the event of unexpectedly high flows and flooding, these bacteria can be discharged with the effluent (washout) upsetting the Food/Mass (F:M) ratio, which interrupts system performance. It can take up to several weeks to rejuvenate and restore the bacteria population.

Similarly, any chemical imbalance on the influent caused by, for example, spilling some toxic chemicals such as bleach or other material into the waste stream can cause a complete or partial killing of the bacteria population. It could also reduce or impede their performance, which can often take several weeks to restore.

Also, these systems rely on specific species of bacteria for their performance. Sometimes parasitic bacteria such as filamentous bacteria can infest the indigenous population and hinder or stop their performance, which may require complete repopulation of the aerobic or anaerobic basins.

The proposed system does not rely on bacteria for its performance; therefore it is immune to these problems.

1.11 Control of Rodents, Birds, and Other Predators

The presence of large amount of wastewater in basins and channels, etc., invites birds, rodents, and other predators in search of food or water to the plant. The presence of these animals causes both health and management problems. They can spread toxins and pathogens to other animals, humans, and the environment.

In the proposed system, the wastewater is treated in an enclosed loop and there is no open access to wastewater by these animals, therefore there no opportunity for dispersing pathogens or toxins to the environment.

1.12 Catastrophic Failure - Seismic Activities or Hurricanes, Etc.

The State of Alaska is situated on an active seismic area and the City of Palmer is in close proximity of both Denali and Susitna Glacial seismic faults with a history of several major earthquakes, some as high as 7.9 in Richter scale.

Also, the city is less than 100 miles from the ocean, which has the history of producing heavy storms with strong winds and heavy rainfalls.

Storing large quantities of wastewater and leachate in large basins such as grit chambers, primary and secondary clarifiers, as well as aeration or anaerobic tanks, which are required by the conventional systems, exposes these structures to flooding and catastrophic failures with dire consequences to the environment, animals, and the people in the vicinity of the plant.

The proposed system defined in this PER utilizes much smaller underground concrete or plastic tanks that are less prone to rupture, as well as being immune to flooding.

1.13 Operator Skills and Numbers

Due to the complexity of the operation of the biological systems to maintain healthy environment for bacterial life higher levels of training, education, and skills are needed by the operators to properly manage the plant. An example of the requirements includes maintaining proper levels and balance of the following parameters: dissolved oxygen (DO), alkalinity, F : M ratio, mixed liquor volatile suspended solids ML(V)SS, pH, control of parasitic biota such as filamentous bacteria. Maintaining many different types of equipment is another required skill with successful operation of biological systems.

Also due to the multiplicity and complexity of the tasks to be performed to operate and maintain the biological plants, several people with varied skill such as mechanical, biological, chemical, and electrical may be required by these plants.

The proposed system is a completely mechanical system and does not employ any biological processes; therefore, the operator does not need to possess these skills. Also, there is much less equipment, which requires much less maintenance, thus fewer people to operate the system.

1.14 Operator Health and Safety

Prevalence of parasitic pathogens in conventional wastewater treatment plants and continuous exposure of workers to these micro-organisms has adverse effect on the health and wellbeing of these workers.

In addition to pathogens, other hazardous material may enter the plant in soluble form or attached to suspended solids. Compounds reported from sludge analyses include chlorinated organic solvents and pesticides, PCBs, polycyclic aromatics, petroleum hydrocarbons, flame retardants, nitrosamines, heavy metals, asbestos, dioxins, and radioactive materials.

In conventional wastewater treatment plants, the plant workers could be exposed to these compounds and pathogens by direct contact with wastewater and sludge, or by inhalation of gases, particles, aerosols, vapors, or droplets.

In 1997, Nellie J. Brown of Cornell University in his book "Health Hazard Manual: Wastewater Treatment Plant and Sewer Workers" found that Anchorage wastewater workers showed a prevalence of antibodies to three respiratory viruses (adenovirus, parainfluenza type 1, and influenza type A), a sewage exposure-related effect. In the same study, they found that Bucharest wastewater workers also showed a prevalence of antibodies to three respiratory viruses (adenovirus, parainfluenza type 1, and influenza type A), a sewage exposure-related effect. Also, in Copenhagen sewer workers, hepatitis-A antibody was found more often than among other workers, limited risk of enteric infection due to municipal sewage exposure.

As mentioned earlier, the selected and proposed technology in this report is a totally enclosed treatment system where workers do not come in contact with nor are exposed to pathogens and emissions present in the septage and leachate.

2 System Design

2.1 Design Effluent Discharge Criteria

In order to establish a design effluent discharge criteria, in a recent enquiry CH2M HILL proposed some suggestions and requested some guidance from the Alaska Department of Environmental Conservation (ADEC or DEC) for the discharge strategy for the proposed treatment plant for MSB septage and leachate. The following is ADEC response and suggestions to that requests:

- The CH2M HILL-proposed design discharge limits appear to be similar to the domestic wastewater limits in Article 2 of the Wastewater Disposal regulations (18 AAC 72). These are not appropriate because **leachate is an industrial source**. Similarly, because septage will be from all over the MSB, the septage will be considered coming from **non-domestic sources**.
- The appropriate regulations are Articles 5 and 6 for Nondomestic Wastewater (18 AAC 72) which include a more engineering-centric approach.
- CH2M HILL's proposed approach for point of compliance in downgradient monitoring wells on MSB property appears reasonable and has been approved by ADEC previously. Up-gradient monitoring wells can be used for comparison.
- For planning purposes, CH2M HILL/MSB can use the more stringent of the drinking water standards (18 AAC 80) and water quality standards (18 AAC 70) for both septage and leachate

In the same report, CH2M HILL proposed the following design discharge limits:

- BOD_5 – 30 mg/L (monthly average)
- TSS – 30 mg/L (monthly average)
- NO_3-N – 10 mg/L (monthly average)
- Metals < Maximum Contaminant Limits

This was countered by ADEC as "For planning purposes, CH2M HILL/MSB can use the more stringent of the drinking water standards (18 AAC 80) and water quality standards (18 AAC 70) for both septage and leachate."

They also proposed the point of compliance as groundwater monitoring wells down gradient from subsurface discharge and within property boundary.

In a July 25, 2017 communique´, Lori Aldrich, the Regional Program Manager at Alaska Department of Environmental Conservation, Solid Waste Program, conveyed the importance of designing a system that can respond to and tackle the emerging contaminants that may be applied to future discharge permits. She mentioned radioactive material, as well as perfluorinated compounds. Although the former is not allowed to be disposed in any landfill without special legislation, the latter can be disposed in lined landfills. These materials are very stable, but at the same time they are very water soluble and thus highly mobile. They can easily leach out of the contaminated MSW and find their way into the landfill leachate, which has to be treated. The following is an excerpt from this communique´.

Perfluorinated Compounds

PFCs are emerging contaminants of concern. The compounds have been used in a number of household products such as nonstick pans, furniture, cosmetics, household cleaners, clothing, and packaged food, as well as used in fire-fighting foams. They are readily found as contaminants in the environment, and certainly in wastes disposed in a municipal solid waste landfill. These compounds are highly mobile and persistent.

Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) have become a significant concern in drinking water and the EPA has established a Drinking Water Health Advisory Level of 70 parts per trillion (.070 µg/L) combined PFOS & PFOA. In addition, ADEC has established cleanup standards (18 AAC 75): PFOS - .0030 mg/kg and PFOA - .0017 mg/kg in soil (migration to groundwater); and, PFOS & PFOA - .040 µg/L in groundwater.

Disposal of both PFC solidified product and contaminated soils are problematic. For Alaska, they will not be considered for disposal in anything but a fully lined landfill. For a solidified product, ADEC does not currently have specific regulations or a good mechanism for addressing disposal, and encourages shipping the material out of state. For even a lined landfill to accept the product, they would need to prepare a demonstration similar to one under 18 AAC 60.025(d) and (e) to show that the addition of the product to the current landfill concentration would not increase the likelihood of migration to groundwater or surface water.

For acceptance of polluted soil, each landfill must provide acceptance criteria for PFOS and PFOA to ADEC prior to accepting the contaminated soil. If the acceptance criteria exceed the migration to groundwater cleanup levels for soil in 18 AAC 75, ADEC will require the facility to add PFOS and PFOA to their water monitoring Analytes for all wells (and/or surface water locations). ADEC recommends discussing monitoring protocols with your consultant.

Neither the discharge limits nor the point of compliance has been approved by the ADEC at the moment and needs to be finalized in the second phase of this study.

For the purpose of this PER, **water quality standards (18 AAC 70)**, which is more stringent than drinking water standards (18 AAC 80) will be used in the design of the proposed wastewater treatment plant for treatment of leachate and septage at MSB.

Although the treatability study mentioned in the next section indicated that the selected system is fully capable of meeting these standards, efforts must be made in discussions with ADEC to accept less stringent discharge criteria by taking into account soil absorption, treatment by soil fauna and flora, and interception, as well as soil buffering, etc. Also, photo degradation by the sun's rays, as well as volatilization and oxidation process, should be taken into the account.

We agree with CH2M HILL's suggestion and the ADEC provisional acceptance of "CH2M HILL's proposed approach for point of compliance in downgradient monitoring wells on MSB property" appears reasonable and has been approved by ADEC previously. Up-gradient monitoring wells can be used for comparison as a point of compliance. If this is adopted, then a lower level of treatment can be implemented, which can be augmented by the above-mentioned processes. This could be verified during Phase II of this study where a degradation and attenuation dynamics analysis can be conducted to evaluate the value of the treatment augmentation by this auxiliary process.

2.2 Treatability Test

In order to confirm the capability of the selected system in meeting the discharge limits, a limited treatability study was conducted using samples from septage and leachate from the MSB area supplied by the MSB. These samples were received in late August and treated using the LEACHBUSTER® test unit at the vendor's laboratory in Minneapolis. In addition to measuring the physical parameters such as power requirement, membrane cleaning, samples from treated effluent were also taken and sent to the analytical commercial laboratory for testing and analysis. Samples were analyzed for all the Analytes listed in both **water quality standards (18 AAC 70)** and **drinking water standards (18 AAC 80)**. Some of these Analytes are indicator parameters such as BOD, COD, TSS, TDS etc.; metals, semi-metals, VOCs, PFCs, and TCLP values. Results indicated that the selected system is fully capable of treating both septage and leachate to meet both of the above-mentioned standards. Full description of the results is provided in Section 5 of this report.

2.3 Design Flow

The normal design practice is to use an average number with a peak factor and a future growth estimate. Since most of these plants are difficult to upgrade and are designed for long-term use (up to 40 years), they are often overdesigned by several fold to cover estimated peak flows and population growth over a very long period, which often results in very expensive projects that most small communities cannot afford. Also, most of these plants either exhaust their capacity due to rapid population growth or have idle capacity for prolonged periods of time due to slower community expansion.

To avoid shortcomings in fluctuations estimate, in this PER, a Temporal Dynamics Analysis (TDA) is used to estimate the most suitable design flow. TDA is a procedure where historic temporal dynamics (daily, weekly, monthly, or yearly) in the flow patterns are analyzed and design flows for varying risk levels are calculated. Statistical procedures such as percentile analysis are used to evaluate the impact of risk levels on the design flow. The full description of this procedure and the results of the analysis are given in Section 3 of this report.

2.3.1 Leachate

Leachate quality and quantity has extensive spatial and temporal variations. Spatially, different parts of the landfill produce different amount and quality of leachate, depending on the type of the material disposed in the landfill, status of the landfill (open and active or closed), and its management practices (compaction, daily or permanent cover type and thickness). Temporally, leachate quality and quantity are dictated by time of the year and age of the landfill among other parameters.

It is rather difficult to predict the impact of spatial variations on the quality and quantity of the leachate produced; therefore, pilot testing is used to test samples from various parts of the landfill to somewhat estimate this impact. However, effective techniques such as TDA available to predict temporal variation in the quantity of the leachate produced based on the probabilities of its occurrence fairly accurately. This analysis was conducted and the full description and results are presented in Section 4 of this study. The following is a summary of these results of the analysis.

The following is a summary of the results of TDA analysis for leachate for a single open cell and a two or more open cell scenarios.

Table 15: Design Flow and Equalization Tank Capacity for Leachate

Number	Percentile	Flow	Equalization Tank Capacity (Gallons)
Single Open Cell			
1	25	2,200	400,000
2	50	4,200	380,982
3	75	7,600	250,000
4	95	10,000	149,247
5	99	15,000	50,000
Two or More Open Cells			
1	25	4,400	500,000
2	50	8,200	460,982
3	75	15,200	350,000
3	95	20,000	189,247
4	99	30,000	80,000
Final Design Flow with Expansion Capacity included			
	75	20,000	150,000

For the purpose of this PER, 75 percentile is selected as the design flow parameter. This will require a 15,200 gpd system to account for the planned additional new landfill cell. In order to accommodate future growth, potential expansion capacity of about 6% per year until the year 2025, is added to this design flow, which results in a design flow capacity of 20,000 gallons per day.

For septage, four percentile (risk) levels of 25, 50,75, 95 and 99 are evaluated. The estimated flow and corresponding storage capacity requirement is given in the following table.

Table 16: Design Flow and Equalization Tank Capacity for Septage

Number	Percentile	Flow	Equalization Tank Capacity (Gallons)
1	25	145,884	1,800,000
2	50	197,230	1,500,000
3	75	215,000	900,000
4	95	242,282	400,000
5	99	258,396	100,000

The cost information (Capex and Opex) were estimated and presented to allow the comparison with previous options presented in CH2MHill and HDR.

Section 4: Selected System Specifications

1 Introduction

1.1 Project Overview

Based on the previous studies and discussion and, evaluation of current demand the following project was selected and is presented to the management of MSB by means of this PER.

- Two separate treatment systems will be designed for septage and leachate
- These systems will be housed in one building
- Three financial scenarios will be presented for funding the project
- One risk level will be used for leachate capacity estimation
- Three risk levels will be evaluated for estimating septage capacity, but only one type of design will be presented.

1.2 Project Objectives

The objective of this project is to design and install a septage and leachate treatment plant utilizing the LEACHBUSTER® system. This system can process the estimated design flow and produce effluent that will allow the client to:

- Minimize or eliminate the hauling of these wastewaters to AWWU or elsewhere
- Produce high-quality water to be discharged into the environment or used within the landfill
- Produce a waste solid that can be used as feedstock for a potential waste-to-energy (WTE) facility

1.3 System Design Parameters

The following parameters comprise the design basis for the system. These parameters were developed using the information from the MSB, the regulatory agencies and the studies we conducted on the target waste stream:

Table 17: Leachate and Septage Design Parameters

Leachate			
Waste Stream		Parameter	Value
		Percentile	75
		Flow in (GPD)	20,000
		Clean Water Output (GPD)	17,500
		Concentrate (GPD)	2,500
		Influent Characteristics	See Section 5
		Effluent Characteristics	ADEC Clean Water Limits
Septage			
	Scenario 1		
		Percentile	25
		Flow in (GPD)	100,000
		Clean Water Output (GPD)	90,000
		Concentrate (GPD)	9000
		Influent Characteristics	See Section 5
		Effluent Characteristics	ADEC Clean Water Limits
	Scenario 2		
		Percentile	50
		Flow in (GPD)	200,000
		Clean Water Output (GPD)	180,000
		Concentrate (GPD)	18000
		Influent Characteristics	See Section 5
		Effluent Characteristics	ADEC Clean Water Limits
	Scenario 3		
		Percentile	75
		Flow in (GPD)	215,000
		Clean Water Output (GPD)	190,000
		Concentrate (GPD)	25,000
		Influent Characteristics	See Section 5
		Effluent Characteristics	ADEC Clean Water Limits
	Scenario 4		
		Percentile	99
		Flow in (GPD)	250,000
		Clean Water Output (GPD)	225,000
		Concentrate (GPD)	25,000
		Influent Characteristics	See Section 5
		Effluent Characteristics	ADEC Clean Water Limits

2 System Components

2.1 Primary Screening

Fine screening will be done in two sections:

(a) Leachate

For leachate only, a series of Y strainers have proven to be effective. These are simple and practical in removing a minute amount of large solids which may exist in the leachate stream. There are two main reasons for the low screening requirement for leachate.

- Leachate is usually screened through the geo-membranes and the sand bed in the landfill and has low TSS; our recorded data from other landfills confirms this.
- LeachBuster membranes can accept relatively large (up to ½ ") solids, and thus, there is no need for over-screening the leachate

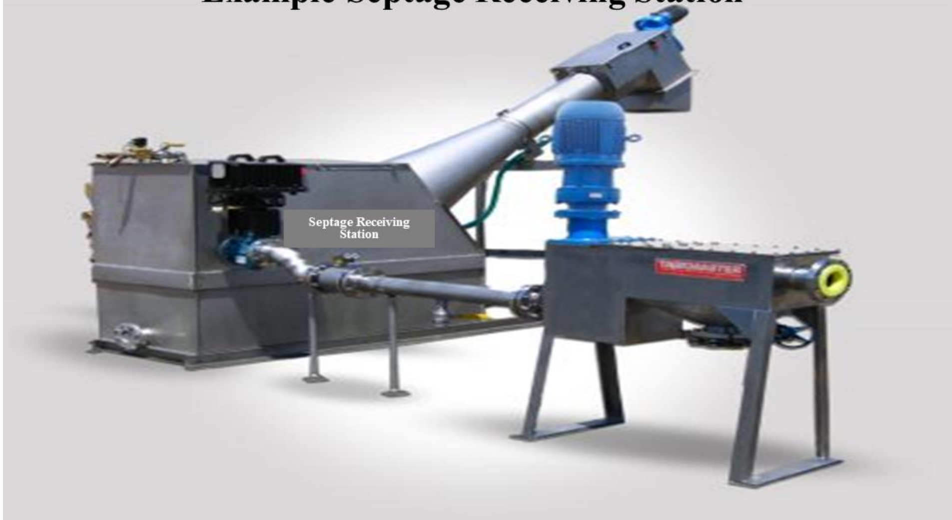
(b) Septage

Unlike leachate, Septage contains substantial amounts of large and fine solids which have to be removed from the wastewater stream prior to its entrance into the treatment system.

It is proposed that a Septage receiving station to be installed to screen solids of >5mm followed by a grinder pump which will grind the remaining solids and send it to the reception pit to be processed by the system. This process has been tried in Clark's other projects and it has proven to be very effective.

The following is an photograph of one of these receiving stations which we have used in the past.

Example Septage Receiving Station



The system proposed here is equipped with a PLC, card reader, data logger and report preparation computer which can be accessed remotely with a display screen. A toxicity monitoring system can be installed to detect and reject toxic material. We will provide complete detail, drawings, capacity and operation manual as well as design information in the Phase II of this PER.

The system is capable of logging information such as truck number, waste type, waste source, date and time, waste volume and several additional information that can be directed to a billing center's computer.

2.2 Tanks and Other Storage Equipment

The LEACHBUSTER® system includes the necessary four (4) empty day storage tanks (approximately 300 gallons each) required for a clean-in-place (CIP) system. These four tanks will hold sulfuric acid, sodium hydroxide, sodium metabisulfite, and detergent, respectively. In addition, four (4) tanks will also be required for equalization/settling, batch, effluent storage, and sludge holding. Clark recommends that these tanks be made of plastic or other suitable material, with capacities as specified in the PFD for each (this may be modified during the design phase).

2.3 Treatment System

The LEACHBUSTER® system is internally automated and operated with a Program Logic Controller (PLC) with digital human-machine-interface HMI featuring remote monitoring and operation capability. The LEACHBUSTER® PLC will be integrated into the overall PLC.

Based on the flow rates obtained from the tests, the system needs to process a varied amount of influent, depending on the system size selected, with an overall recovery rate of 90% (about 70% to 80% from the main system and additional 10% to 20% from the concentrate processing system). Based on these flow rates, the system will be manufactured in separate skid units. Each of these units will be fitted with a suitable number of modules.

The system is manufactured on skids so that they can be pre-assembled and tested at the factory to shorten the on-site installation time. Also skids provide flexibility in the operation and reduce the downtime. For example, by having 8 skids, if one fails to operate, we only lose 1/8th of the system capacity. This also will allow the cleaning process to be staggered to maintain the continuity of the operation (rather than shutting down the entire system for cleaning), only one skid will be down at a given time.

The system will be manufactured by Clark and its affiliates and transported to the site for installation.

2.4 System Footprint

It is difficult to estimate the exact dimensions or footprint of the complete system without final design; however, based on Clark's previous experience and the preliminary design (see PFD in the appendix), the approximate dimensions are as follows.

Each Skid Dimension is:	16 ft x 8 ft x 10 ft (H)
Numbers of Skids:	Please refer to the drawings in the Appendix
Receiving Station Units Dimension is:	16 ft x 14 ft x 7 ft (H)

The footprint estimated here includes space to allow for removal and replacement of the membranes. The PFD indicates the space required for tanks and other auxiliary equipment.

2.5 State Revolving Fund American Iron and Steel (AIS) Requirement

The provisions of The American Iron and Steel requirements will be observed during the sourcing of the material for construction of the proposed system.

The American Iron and Steel (AIS) provision requires Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States. This requirement applies to projects for the construction, alteration, maintenance, or repair of a public water system or treatment works.

The AIS provision is a permanent requirement for all CWSRF projects. The Consolidated and Further Continuing Appropriations Act of 2015 requires the use of AIS products in DWSRF projects through September 30, 2015. The appropriation language sets forth certain circumstances under which EPA may waive American Iron and Steel requirements.

2.6 Building Requirement

The building size required to house the septage and leachate treatment systems is approximately:

60 feet wide x 150 feet long and 16 feet high
Total area will be approximately 9,000 square feet.

The building size required housing the septage receiving station piping and equipment which will be connected into each of three receiving station pads is approximately:

42 feet wide x 60 feet long and 16 feet high
Total area will be approximately 2,500 square feet.

These sizes are estimated for 99 percentile scenario for both septage and leachate. For lower percentile scenarios less land may be needed.

2.7 Land Requirement

Additional site development land will be needed for parking lots, staging of septage hauling trucks, delivery traffic and some auxiliary use. The total land area required is defined in the attached civil site plans.

2.8 System Concentrate Processing System

The system parses the wastewater and leachate into two streams of clean effluent and concentrate. The clean effluent will be disposed of according the applicable rules of the State of Alaska. The concentrate, which is collected in a tank will be processed and disposed seperately for leachate and septage. For leachate, the commercial laboratory testing indicated that the concentrate will pass the TCLP tests and are therefore non-hazardous. The leachate concentrate will be returned to the landfill for permanent confinement.

As for the concentrated septage, it will be disposed of according to the rules of the State of Alaska. The laboratory tests indicated that material is pathogen free and can be composted or land applied. The final determination on this will be made during Phase II of the in consultation with the MSB and ADEC.

2.9 Concentrate volumes and recovery rates

Concentrate and volumes and recovery rates for both the leachate and the concentrate can vary depending on the quality of the raw wastewater and the treated effluent. The following is a brief description of the possible recovery rates for both leachate and the septage. More accurate levels will be determined during the second phase of this study.

2.9.1 Leachate

Concentration levels for leachate will vary throughout the year and is dependent on the volume and conductivity of the leachate. The LeachBuster® allows the operator to decide on the level of concentration based on the incoming leachate quality. For example, in high-flow times, the recovery rate can be set to be as low as 50% to catchup with the backlog while in low-flow times, the recovery rate can be increased to as high as 90%. This is evident in the following table which is provided from a similar project in Minnesota.

Month	Leachate to System	Permeate to Pond	Concentrate Reject	% of Reject to Total Flow to System
Jan	64,870	52,981	11,889	18.3
Feb	169,237	121,715	47,522	28.1
Mar	227,472	164,261	63,211	27.8
Apr	231,277	157,386	73,891	31.9
May	287,757	197,924	89,832	31.2
Jun	238,538	153,758	84,780	35.5
Jul	18,218	12,546	5,673	31.1
Aug	38,961	30,920	8,041	20.6
Sep	294,083	245,793	48,290	16.4
Oct	408,502	312,951	95,551	23.4
Nov	375,988	254,696	121,291	32.3
Dec	123,333	96,175	27,158	22.0
Avg	206,520			26.6
Total	2,478,236			

As it can be seen during the months of February to June and the month of November, the landfill received high levels of rainfall and the system was operated at a low recovery rate of around 70%. But for the rest of the year, the recovery rate was around 80% to 85% levels. The lower recovery rate observed is due to the installation of a second stage system to specifically decrease the Boron level to a threshold set by the state regulators.

When the LeachBuster® was designed for this site, the discharge limit for Boron was around 1000 ppb. Around July 2016, the requirement was reduced to 250 ppb. To meet this requirement, the system was modified to produce higher contaminant rejection rates. This resulted in the increase in the volume of the reject coming out of the system. One must understand that half the reject or concentrate leaving the system and returning to the landfill is clean drinking water mixed with boron. This water is often cleaner than the rain that falls on the landfill. This modification will be taken into the account for the MSB project. Based on the limited laboratory test which was conducted last year for MSB leachate, we anticipate the recovery rate would be >80% or around 85%. This will be determined during the Phase

II of this project when a long term field/onsite pilot testing will be conducted to obtain an optimum recovery rate.

Septage

For septage, we anticipate lower and a more constant recovery rate since:

a) Rain and other forms of precipitation are not expected to impact the daily volume and quality of the septage, thus, there would be no need for the capacity and recovery rate adjustment.
b) We do not anticipate the Boron level to be an issue (this will be determined during the next phase), therefore the recovery rate will be higher.

This is an excellent management tool which allows the operator to increase the system capacity during the high-flow times and decrease it during the low-flow periods.

2.10 Solids handling and disposal

Solids handling for leachate and septage will be carried out as follows:

2.10.1 Leachate

Due to filtration of the leachate through the geo-membrane in the landfill, it is anticipated that very few (if any) large solids will be present in the leachate. Only some suspended and mostly dissolved solids are anticipated to be present in the leachate, which will be concentrated and returned to the landfill.

2.10.2 Septage

For septage, the system will produce two types of solids, similar to any other wastewater treatment system, as follows:

a) Large solids

As it was mentioned in previous sections, the Septage Receiving Station will collect all solids larger than 5mm and after washing and compacting (drying) it will place them in a container to be disposed of in a landfill. We do not have exact numbers on the volume and the weight of these solids but we will determine these numbers during the pilot testing and study in Phase II of this project. These will be similar to solids that are normally collected by bar screens in conventional wastewater treatments plant.

b) Fine solids (sludge)

In addition to large solids, there will be some fine solids (<5mm) which will be collected by the membranes in the concentrate. These consist of suspended (organic) and dissolved solids as well as some grit.

Separated solids are fully oxidized and conditioned by the LeachBuster® therefore most of the volatiles such as ammonia, hydrogen sulfide, etc. are converted into salts which are more stable and less odorous. Septic tanks from where the septage is collected are reducing environments (anaerobic condition). This environment causes some elements such as nitrogen, sulfur and carbon, etc. to be reduced into ammonia, hydrogen sulfide, and methane. These are volatile gasses and are often odorous, thus land applying raw septage is often regarded as not environmentally friendly. This was determined by measuring the oxidation/reduction potential (ORP) for the raw septage and the concentrate collected after the treatment process. **Redox potential** or **oxidation / reduction potential**, **ORP**, **pE**, **ε**, are a measures of the tendency of a chemical species to acquire electrons, and thereby be reduced. Reduction potential is measured in volts (V), or millivolts (mV).

For the septage received at our laboratory from MSB, the ORP was around -160 mv. After processing for a few hours, the ORP increased to over +170mv indicating that sludge is fully oxidized and has high potential for receiving electrons.

This change in the environment results in reduced (volatile) compounds such ammonia, hydrogen sulfides, and methane into nitrous oxides, sulfur dioxides, as well as carbon dioxides, which react with water. This then forms mineral acids which bind with actions such as Ca, Mn, Na, etc. and form stable salts such as nitrates, sulfates and carbonates, etc. These salts have several beneficial characteristics such as being stable (less odorous and flammable) and soluble which makes them easy for plant uptake when land applied.

This concentrate is also pathogen free. The main reason for the lack of viable biota (bacteria, virus and fungi) in the concentrate is the vulnerability of the biota to external pressure. Since both the septage and leachate treatment systems operate at high pressures, most of the bacteria and viruses are inactivated and rendered unviable. This makes the concentrates (liquid or solid/cake) pathogen free.

These solids can either be land applied or further dewatered (with a screw or belt press) where the cake can be land applied, composted or disposed of in the landfill. The cost of the dewatering system is included in the scope of the project.

3 Regulations

The system will be designed and operated in accordance with the applicable State and National rules and regulation governing such installations.
These will be clearly identified and followed during the next phases (full design, engineering, construction, and operation) of this project. The following is a few examples of these regulations that will be followed during the full design, engineering, construction, and operation.

3.1 Alaska Wastewater Rules

Alaska Administrative Code establishes the procedures and requirements for planning, designing, and operating wastewater facilities that discharge to the waters of the state of Alaska. During the preliminary design leachate and septage samples from the site were processed by a scaled model LeachBuster® system and the following sample results indicate that the proposed system is capable of meeting the water quality standards (18 AAC 70) for both the leachate and septage treated effluent.

3.1.1 Leachate

Currently it is proposed that the treated leachate will disposed via an infiltration/evaporation pond which necessitates meeting the groundwater intervention limits. In a communication, ADEC suggested that the effluent should meet the Alaska Water Quality Standards (18 AAC 70).

As it is given in the results section of this document, the effluent from leachate treatment system meets the ground water discharge requirements including the groundwater intervention limits (ILs) for Boron as well as Alaska Water Quality Standards(AWQS) (18 AAC 70). It is proposed to dispose the treated leachate in an infiltration/evaporation basin (pond) or drain field. The monitoring will be done at the proper border downstream of the treatment system. The following tables are the comparison of treated leachate quality with the requirements of Alaska Water Quality Standards (18 AAC 70). As it can be seen the treatment system removes the pathogens, heavy metal, metals, organics, volatiles, PFCs etc. to meet the groundwater discharge requirements.

Treated Leachate Quality Compared with AWQS (18 AAC 70)

	Mat-Su Borough		
PARAMETER	**Leachate EEFLUENT**	**Water Quality Standards**	**Units**
Ammonia N	1.8	N/A	mg/L
Nitrate + Nitrite NO_2 plus NO_3		N/A	mg/L
TKN	18.4	N/A	mg/L
Phosphorus	ND	N/A	mg/L
TDS	71	1000	mg/L
TSS	ND	N/A	mg/L
BOD_5	29	N/A	mg/L
COD	ND	N/A	mg/L
E.coli	<1	N/A	MPN/100/ml
Total Coliform	3	N/A	MPN/100/ml

Treated Leachate Quality Compared with AWQS (18 AAC 70)- Metals

Mat-Su Borough						
PARAMETER	**Leachate EEFLUENT**	**Water Quality Standards**	**PARAMETER**	**Leachate EEFLUENT**	**Water Quality Standards**	**Units**
Arsenic	ND	36	**Manganese**	10.8	N/A	µg/L
Barium	ND	N/A	**Molybdenum**	ND	N/A	µg/L
Cyanide	ND	N/A	**Nickel**	ND	8.2	µg/L

Boron	231	N/A	**Selenium**	ND	71	µg/L
Cadmium	ND	9.3	**Silver**	ND	1.9	µg/L
Chromium	ND	50	**Zinc**	ND	81	µg/L
Cobalt	ND	N/A	**Calcium**	960	N/A	µg/L
Copper	ND	3.1	**Magnesium**	983	N/A	µg/L
Iron	ND	N/A	**Sodium**	11500	N/A	µg/L
Lead	ND	8.1	**Potassium**	2700	N/A	µg/L

Treated Leachate quality compared with AWQS (18 AAC 70)
– Volatile and Semi-volatile Compounds

Mat-Su Borough						
PARAMETER	**Leachate EEFLUENT**	**Water Quality Standards**	**PARAMETER**	**Leachate EEFLUENT**	**Water Quality Standards**	**Units**
Acetone	2160	N/A	**1,2-Dichloropropane**	ND	N/A	µg/L
Allyl chloride	ND	N/A	**1,3-Dichloropropane**	ND	N/A	µg/L
Benzene	ND	N/A	**2,2-Dichloropropane**	ND	N/A	µg/L
Bromobenzene	ND	N/A	**1,1-Dichloropropene**	ND	N/A	µg/L
Bromochloromethane	ND	N/A	**cis-1,3-Dichloropropene**	ND	N/A	µg/L
Bromodichloromethane	ND	N/A	**trans-1,3-Dichloropropene**	ND	N/A	µg/L
Bromoform	ND	N/A	**Diethyl ether (Ethyl ether)**	ND	N/A	µg/L
Bromomethane	ND	N/A	**Ethylbenzene**	ND	N/A	µg/L
2-Butanone (MEK)	615	N/A	**Hexachloro-1,3-butadiene**	ND	N/A	µg/L
n-Butylbenzene	ND	N/A	**Isopropylbenzene (Cumene)**	ND	N/A	µg/L
sec-Butylbenzene	ND	N/A	**p-Isopropyltoluene**	ND	N/A	µg/L
tert-Butylbenzene	ND	N/A	**Methylene Chloride**	ND	N/A	µg/L
Carbon tetrachloride	ND	N/A	**4-Methyl-2-pentanone (MIBK)**	ND	N/A	µg/L

Chlorobenzene	ND	N/A	**Methyl-tert-butyl ether**	ND	N/A	µg/L
Chloroethane	ND	N/A	**Naphthalene**	ND	N/A	µg/L
Chloroform	1.5	N/A	**n-Propylbenzene**	ND	N/A	µg/L
Chloromethane	ND	N/A	**Styrene**	ND	N/A	µg/L
2-Chlorotoluene	ND	N/A	**1,1,1,2-Tetrachloroethane**	ND	N/A	µg/L
4-Chlorotoluene	ND	N/A	**1,1,2,2-Tetrachloroethane**	ND	N/A	µg/L
1,2-Dibromo-3-chloropropane	ND	N/A	**Tetrachloroethene**	ND	N/A	µg/L
Dibromochloromethane	ND	N/A	**Tetrahydrofuran**	24.1	N/A	µg/L
1,2-Dibromoethane (EDB)	ND	N/A	**Toluene**	6.6	N/A	µg/L
Dibromomethane	ND	N/A	**1,2,3-Trichlorobenzene**	ND	N/A	µg/L
1,2-Dichlorobenzene	ND	N/A	**1,2,4-Trichlorobenzene**	ND	N/A	µg/L
1,3-Dichlorobenzene	ND	N/A	**1,1,1-Trichloroethane**	ND	N/A	µg/L
1,4-Dichlorobenzene	ND	N/A	**1,1,2-Trichloroethane**	ND	N/A	µg/L
Dichlorodifluoromethane	ND	N/A	**Trichloroethene**	ND	N/A	µg/L
1,1-Dichloroethane	ND	N/A	**Trichlorofluoromethane**	ND	N/A	µg/L
1,2-Dichloroethane	ND	N/A	**1,2,3-Trichloropropane**	ND	N/A	µg/L
1,1-Dichloroethene	ND	N/A	**1,1,2-Trichlorotrifluoroethane**	ND	N/A	µg/L
cis-1,2-Dichloroethene	ND	N/A	**1,2,4-Trimethylbenzene**	ND	N/A	µg/L
trans-1,2-Dichloroethene	ND	N/A	**1,3,5-Trimethylbenzene**	ND	N/A	µg/L
Dichlorofluoromethane	ND	N/A	**Vinyl chloride**	ND	N/A	µg/L
			Xylene (Total)	ND	N/A	µg/L

3.1.2 Septage

Unlike leachate, septage has much lower levels of heavy metals and other contaminants of emerging concern (CECs) such as Boron therefore there is less concern on the meeting of the groundwater discharge requirements. This has to be discussed with MSB since none of the previously proposed alternatives (biological process such as SBR, MBR etc.) will be able to produce effluent quality which can meet the groundwater discharge limits specially as far as CECs such as Boron is concerned. Clark's proposed system removes all the CECs and meets the groundwater discharge limits. The following tables are a comparison of the treated septage quality with the Alaska Water Quality Standards.

Treated Septage Quality Compared with Water Quality Standards

	Mat-Su Borough		
PARAMETER	Septage EEFLUENT	Water Quality Standards	Units
Ammonia N	1.9	N/A	mg/L
Nitrate + Nitrite NO_2 plus NO_3	ND	N/A	mg/L
TKN	2.6	N/A	mg/L
TDS	22	1000	mg/L
TSS	ND	N/A	mg/L
BOD_5	ND	N/A	mg/L
COD	ND	N/A	mg/L
Cyanide		N/A	ug/L
Phosphorus	ND	N/A	mg/L
E.coli		N/A	MPN/100/ml
Total Coliform		N/A	MPN/100/ml

As it can be seen, the proposed system, in addition to the parameters listed in the Water Quality Standards, removes numerous other pollutants such as Volatile Organic Compounds (VOCs), PFCs, and other contaminants of emerging concern.

3.2 U.S. Environmental Protection Agency 503 Rule

The U.S. Environmental Protection Agency's (EPA's) biosolids regulations (40 CFR 503, EPA503, or 503 Rules) govern biosolids generation and disposal from municipal wastewater facilities. The biosolids produced by the proposed system meets the requirements of US EPA's 503 Rule as it was discussed in previous section.

3.3 U.S. Environmental Protection Agency's Reliability and Redundancy Criteria

EPA has a guidance document for which lists "Design Criteria for Mechanical, Electrical, and Fluid System and Components Reliability" (document EPA-430-99-74-001), to help evaluate reliability and redundancy of new improvements to the treatment systems. The recommendations of this document were considered in the preliminary design and will follow during the next and subsequent phases. Here are a few areas which address the reliability and redundancy considerations.

This has been taken into account in several ways:

a) Equipment

Most of the essential equipment such as pumps will be supplied in duplicate (duty/standby) when needed and as applicable. Also, spare pumps and membranes will be housed at the plant to replace equipment which may fail; these redundancies will be discussed with MSB in Phase II of the project.

b) Capacity

Both systems will be designed to a given percentile to include extra capacity requirements during the unexpected demand increase. For example, if the system is designed for a 99 percentile criterion, it will run only in 1 percent of the time at 100% capacity. At 99% of the time, the system will have extra capacities of up to 60% of the full/design capacity. If a lower percentile is selected, this availability will decrease.

c) Modularity

Depending on the size of the final design, the system will be built in several skids (parallel train), each catering to a small portion of the total system capacity. For example with the current preliminary design, the system has 8 modules where each module will treat 1/8th of the total capacity. In the case of failure of one skid/module, only 1/8th of the total capacity will be lost. In addition, a spare module can be included (at the client's request) to be used as a standby skid in case of one skid's failure.

3.4 Ten States Standards.

A Report of the Wastewater Committee of the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers provide a series of guidance documents for designing water, wastewater and individual sewage system. These are commonly referred to as Ten State Standards. These standards together with all the other relevant rules will be taken into the account during the next phase of this project.

When relevant, some of these recommendation have been included in the preliminary design. A more detailed compatibility description will be provided upon completion of the onsite pilot testing during the phase II of this study.

4 Process Flow

We are enclosing a preliminary PFD in the appendix, together with a layout of the system components. A mezzanine is assumed in this layout to maximize space utilization; however, it may be altered to fit an existing space.

5 Floor Plan

A floor plan is enclosed in the appendix to show the approximate layout of the system. This is a preliminary plan that can be modified to include existing structures and overall plant equipment, such as tanks, pumps, and other significant items.

Section 5: Temporal Dynamics Analysis – Capacity Calculation for the Leachate and Septage Treatment System at Mat-Su Borough

1 Introduction

1.1 Overview

Following the biweekly teleconference and our request for septage and leachate volumes generated by Mat-Su Borough on July 27, we received a spreadsheet from Mr. Mario Croce, Industrial Pretreatment Coordinator, Anchorage Water & Wastewater Utility at Anchorage. This document contained detailed information for daily volumes of leachate and septage received by this center from each hauler.

By examining this dataset, Clark noticed huge temporal variations in the daily flows for varying years, months, and even days of the week.

In order to design a system that can process all the wastewater generated in an economical and practical manner, instead of using averages, minimums, and maximums, Clark employs advanced statistical techniques to arrive at a number that will satisfy these objectives.

The traditional use of average, minimum, and maximum values does not provide an accurate picture of the flow patterns in different years, months, or days. However, the use of percentile analysis will provide a clear picture of the flow pattern for a given percent of the time. From the results of these analyses, a design flow can be established with confidence for a given level of risk tolerance.

1.2 The Analysis

Clark was presented with a large and comprehensive dataset that had recoded the leachate and septage values such as number of trucks per day for each day of the week, for each company and from each location, as well as volume of each truck for every month for over seven years. Overall about 800,000 data points were recorded, which very clearly mapped the dynamics of the septage and leachate production in this period. Normally, averages together with an arbitrary peak factor are used to arrive at a design flow and storage requirement numbers. This procedure may work for a piped sewage system where a usage pattern (morning and evening rush and overnight lull) or a production pattern (infiltration and inflow, I&I in mixed flow systems) may exist. But for septage, these parameters do not have any impact on the production patterns of the septage tank evacuation. Another, more relevant, procedure is needed to determine a meaningful design flow and storage capacity values.

In these cases, historic data analysis (when available) would be a more suitable procedure to use to achieve these objectives.

Since there is a comprehensive historic dataset available, a combination of volume, trend, and percentile analysis was used to determine practical, economical, and technically feasible values for the design flow and storage requirement. These analyses were conducted for both septage and leachate for this location.

2 Septage

The septage is collected from septic tanks and delivered to the septage receiving station in Anchorage for treatment at the wastewater treatment plant. To establish a design capacity for the proposed septage treatment system at Mat-Su Borough the following, steps were taken.

2.1 Trend Analysis

Monthly values of the septage delivered to the receiving station were tabulated and are given below. Monthly volumes of septage varied from about 360,000 gallons in February 2013 to as high as about 2.4 million in October 2012.

Table18: Monthly Fluctuations of Septage Volumes Received by Receiving Station for the Period of 2011 to July 2017 (Year to Date)

Year	Jan	Feb	Mar	Apr	May	Jun
2011	493,546	460,434	728,329	1,010,003	1,121,990	1,264,645
	375,603	440,334	565,292	963,299	839,754	556,658
2013	678,114	363,327	554,719	810,735	1,590,319	1,446,167
	631,169	603,722	755,516	857,059	986,829	1,565,539
2015	526,532	460,846	804,808	959,469	1,406,344	1,494,497
	735,218	667,527	1,035,213	1,160,627	1,423,174	1,638,039
2017	697,978	416,734	667,148	1,276,008	1,710,885	1,719,309
Year	Jul	Aug	Sep	Oct	Nov	Dec
2011	983,621	1,367,743	1,664,137	1,934,284	856,435	599,253
	1,286,290	1,326,659	1,724,798	2,431,281	836,929	389,280
2013	1,562,125	1,443,158	1,719,280	2,106,284	970,960	644,042
	1,386,587	1,383,454	1,823,408	2,219,017	963,771	533,937
2015	1,477,197	1,446,445	1,924,408	2,248,888	920,333	827,618
	1,362,644	1,415,103	1,619,813	2,005,911	1,274,346	687,982
2017	1,404,699					

A production dynamic analysis was conducted to establish possible future growth/decline in the septage production over the period of past seven years, as well as possible growth/decline values.

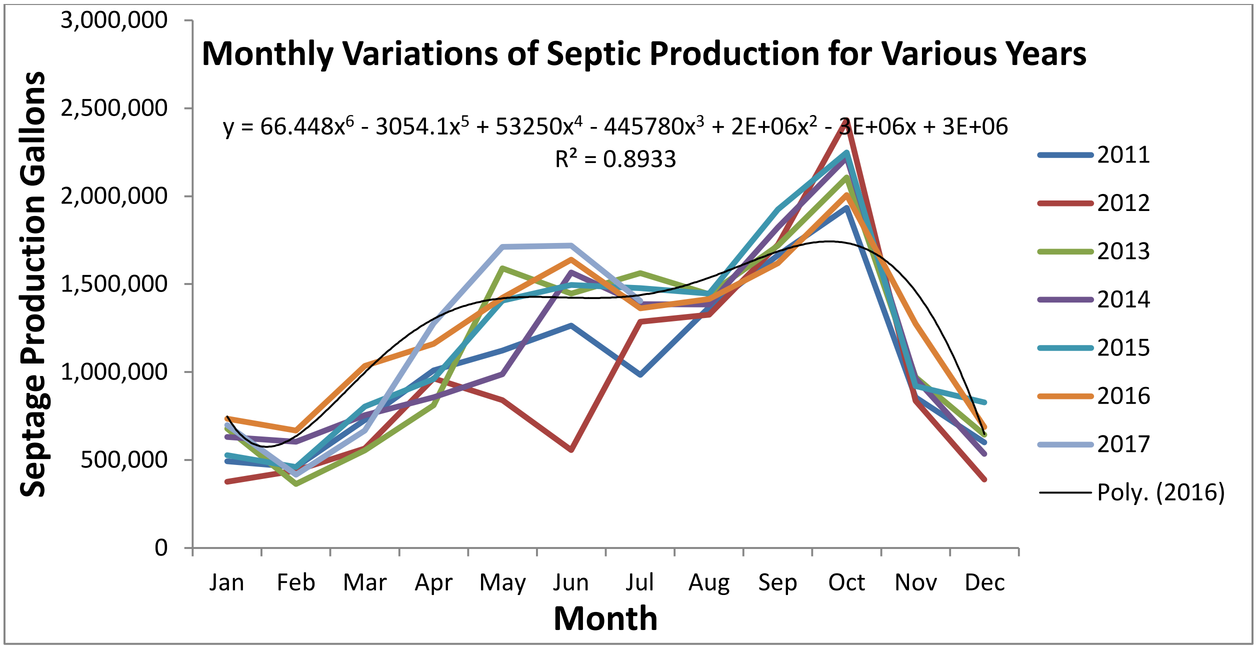


Figure 5-1 Graphical representation of the septage production for each month during the past 7 years.

As it was presented in the percentile analysis, the month of October shows a sharp increase in the septage pumping activities and volume.

Table 19: Variation of Septage Production Over 6 Years

Year	Grand Total
2011	12,484,420
	11,736,177
2013	13,889,230
	13,710,008
2015	14,497,385
	15,025,597
2017	7,892,761

The annual production ranged from around 11.7 million gallons in 2012 to about 15 million gallons in 2016. The production data for the remainder of 2017 was not available at the time this report was issued. A trend analysis was conducted and the predictive equation is as follows:

Annual Production = 594,580 x Year + 1.E+07 (R2 = 0.8097).

The line slope is indicating a value of about 600,000 gal/year or slope to intercept ratio (594,580 / 1.E+07 = 0.06) of 0.06. This translates to about 6% growth per year with a confidence level of about 80%. The following graph is the visual analysis of this process.

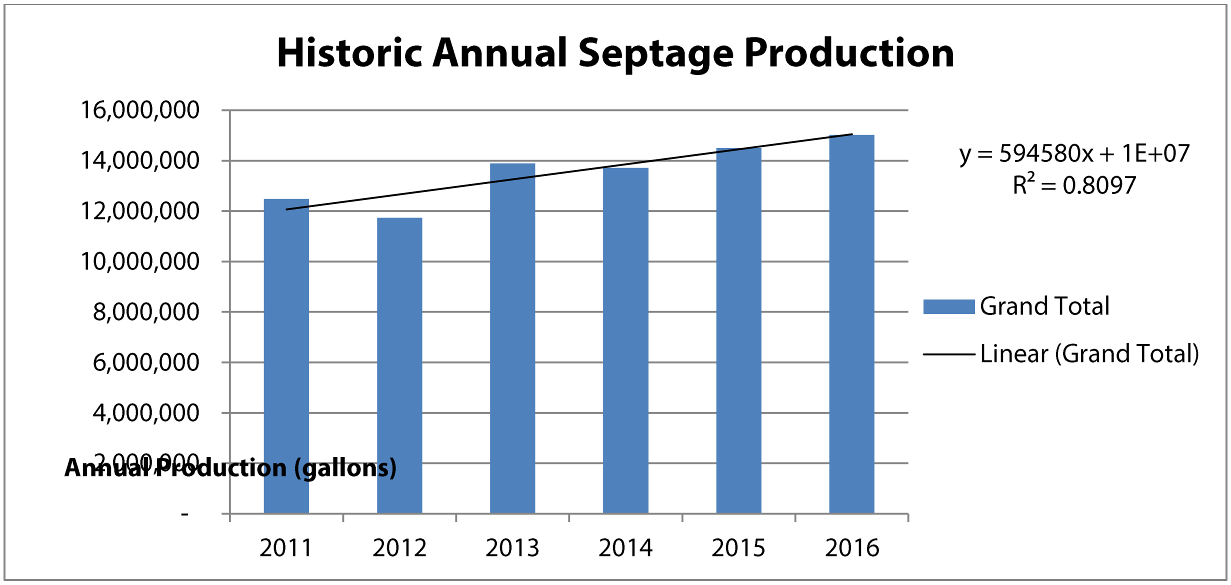


Figure 1: Historic Annual Septage Production

2.2 Percentile Analysis

In order to determine a most practical and economical design flow, a percentile analysis is conducted to achieve this objective. Percentile analysis is used to select a value from a dataset that will fall within a given percentile of the data set.

Annual Analysis

First, the annual totals are analyzed to obtain the annual percentile pattern. This was done by calculating the total annual production at different percentile levels. The table given below presents the annual percentile values for the four levels of confidence.

Table 20: Monthly Volume of Septage Received at a Given Percentile for the Period of 2011 to July 2017

Year	25 Percentile Gal/Month	50 Percentile Gal/Month	95 Percentile Gal/Month	99 Percentile Gal/Month
2011	669,633	996,812	1,785,703	1,904,568
	527,577	838,342	2,042,715	2,353,568
2013	647,265	1,207,059	1,893,432	2,063,714
	724,429	975,300	2,001,432	2,175,500
2015	735,239	1,182,907	2,070,424	2,213,195
	960,214	1,318,495	1,803,581	1,965,445
2017	604,545	986,993	1,716,361	1,718,719

As shown in the table above, designing the system to meet the requirements in 25% of the time will require a minimum storage area of about 1.8 million gallons (2,353,568 - 527,577 = 1,825,991). Increasing the design confidence to 50 percentile (average) will reduce the storage requirement to about 1.5 million (2,353,568 - 838,342 = 1,515,226). On the other hand, increasing the confidence level to 95% or 99% will reduce the storage requirement to about 400,000 gallons or zero (0) gallons, respectively.

Both 25 and 50 percentile scenarios require substantial amount of storage area for equalizing the flow and so that all the septage produced in high season, can be processed during slow production period. If an open lagoon is selected for storage, it will retain all the adverse characteristics of the lagoons such as odor, aesthetics, catastrophic failure, and bacteria and pathogen dispersion.

On the other hand, using 95 or 99 percentile will minimize or eliminate the need for large storage are therefore will not have the adverse characteristics of these storage basins.

However, a somewhat smaller storage area will still be required to equalize daily fluctuations, which can be built underground or as a covered tank to avoid the adverse characteristics associated with large open storage basins.

Based on the above discussion, 95 and 99 percentile scenarios are selected for further economic analysis and comparison.

To achieve a given percentile in a multi-parameter analysis, for example, where the data contains days, months, years etc. to achieve an overall percentile number, the percentile of the largest unit (in this case "YEAR") is calculated an followed by the percentile of the subsequent units such as "MONTH" or "DAY". For example, at 99 percentile number occurred in , "YEAR" of 2012 and "MONTH " of October. Based on this, the year 2012 was used to conduct a monthly percentile analysis to identify the corresponding volume for this value.

Monthly Analysis

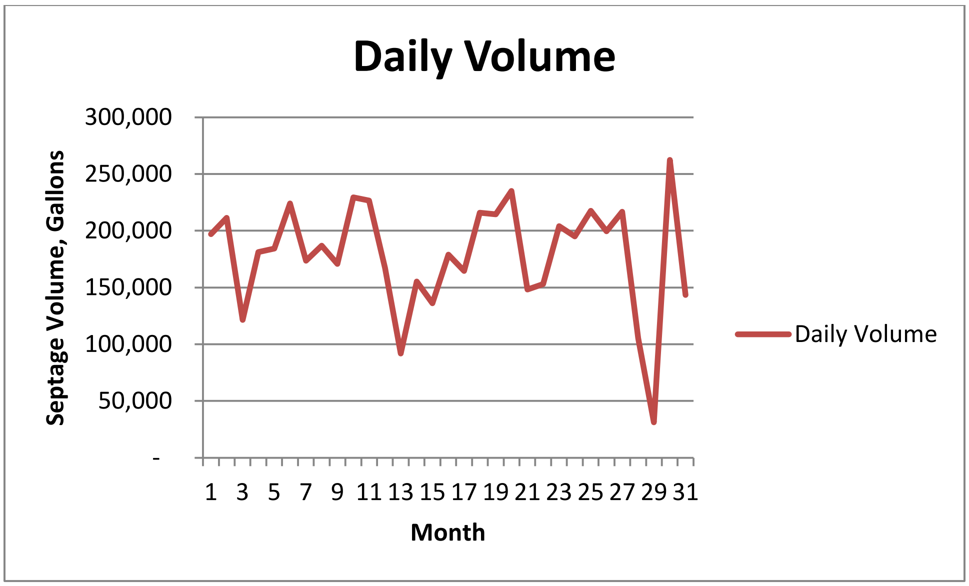
By examining the table 18 and 19, it is concluded that volumes for both 95 and 99 percentiles were dictated by the October volumes. The value of 2,431,281 gallons in October 2012 (Table 21) is within ±2% of the 95 percentile of 2,353,568 from Table 22. Based on this, the month of October 2012 was selected for daily percentile analysis.

Table 21 Daily Fluctuation of Septage Production for October 201

Day	Weekday	Daily Volume
1	Mon	196,876
2	Tue	211,405
3	Wed	121,481
4	Thu	181,149
5	Fri	184,290
6	Sat	223,906
7	Sun	173,435
8	Mon	186,683
9	Tue	170,613
10	Wed	229,494
11	Thu	226,685
12	Fri	166,968
13	Sat	91,883
14	Sun	155,129
15	Mon	136,043
16	Tue	178,950
17	Wed	164,518
18	Thu	215,955
19	Fri	214,364
20	Sat	234,996
21	Sun	148,053
22	Mon	152,921
23	Tue	203,925
24	Wed	194,999

25	Thu	217,664
26	Fri	199,461
27	Sat	216,711
28	Sun	105,431
29	Mon	31,101
30	Tue	262,424
31	Wed	143,538
Total		**5,541,051**
Average		**178,744**
Maximum		**262,424**
Minimum		**31,101**

Daily fluctuations of septage volume produced during October 2012



A percentile analysis was conducted for this month and the results are given in the following table.

Table 22: Daily Percentile Analysis Results

25 Percentile	50 Percentile	75 Percentile	95 Percentile	99 Percentile
	197,230	215,160	242,282	258,396

As shown in this table, the 95 and 99 percentile volumes are within ±5% and 2% of the daily maximum values.

Based on these analyses, it is concluded that a value between 95 and 99 percentile will provide the best design volume that will minimize or eliminate the storage requirement, provide sufficient capacity 95% to 99% of the time, and provide some safeguard for future expansion.

2.3 Summary and Conclusion

Based on the above analysis, we can conclude that depending on the level of confidence required, a combination of storage size/system size can be selected to develop a design flow for the system.

In order to simplify the selection process, only five levels of confidence i.e. percentiles are examined and presented here. These are 25, 50, 75. 95, and 99 percentiles.

2.3.1 Percentile 25

At this confidence level, the required storage capacity is about 1.8 million gallons and the system size is about 145,884 gpd.

2.3.2 Percentile 50

At this level, the required storage capacity is about 1.5 million gallons and the system size is about 200,000 gallons per day.

2.3.3 Percentile 75

At this level, the required storage capacity is about 900,000 gallons and the system size is about 215,000 gallons per day.

2.3.4 Percentile 95

At this level, the required storage capacity is about 400,000 gallons and the system size is about 242,282 gallons per day.

2.3.5 Percentile 99

At this level, the required storage capacity is minimal and can be as low as 100,000 gallons to even out morning rush and overnight lull in the production. The system size to provide this confidence level is 258,396 gallons per day.

2.3.6 Final Design Specifications

The final design specification for the septage treatment system at Mat-Su Borough that provides adequate capacity to meet the treatment requirements 95 to 99% of the time also provides sufficient storage volume to cope with daily fluctuations and short term system downtimes is given below. It is recommended that the system be operated in a manner such that this tank is always (when possible) at its lowest level so that it can provide buffering capacity for high flow events, as well as system shutdown periods.

- Design flow: 250,000 gallons per day
- Equalization tank capacity requirement: 250,000 gallons

This number is similar to the number that was presented by HDR in the Table 1 – Page 2 of the report, dated February 19, 2013, with the title of "Preliminary Engineering and Technical Memorandum – Update to the 2007 Septage Handling and Disposal Plan".

Following discussions and correspondence with the MSB management, it was conveyed to Clark and HDL that some other methods of risk mitigation can be practiced by the management to reduce the risk burden from the treatment plant. Some of these may be incentivizing the low-peak acceptance of leachate and penalizing the high-peak reception to even out the work load on the treatment plant. Based on this discussion a mitigated risk temporal dynamics analysis was conducted to examine this scenario.

2.3.7 Mitigated Risk TDA

As it can be seen from the figure 5-1 and the percentile analysis in almost all years, bulk of the septage production has occurred during the months of October and November. This put an undue burden on the treatment plant during these months. In order to alleviate some of this burden, another method of risk assessment call "Mitigated Risk Temporal Dynamics Analysis, MRTDA" can be employed to add another decision node to alleviate the burden from the treatment plant. This method uses alternative means to mitigate the risk thus reduce the contingency level and system capacity requirement. Some of these means can be construction of larger equalization basins or management techniques, such as providing incentive for low season and dis-incentive for high season demands. The level of risk mitigation by other means is totally objective and depends on the MSB Management's decision based on the availability of other means. A 50% risk mitigation coefficient is applied to demonstrate the concept. Using this method, the numbers will be decreased as given below:

25 Percentile	50 Percentile	75 Percentile	95 Percentile	99 Percentile
48,011	65,925	78,459	103,521	117,678

This means that at a given percent of the time (depending on the percentile selected) about 50% of the traffic has to be rejected or stored (to be treated later) in an equalization basin. For example, if 75 percentile is selected, during the 25% (100-75=25) of the time, 50% of the trucks have to be either turned away or their contents are stored to be treated later. In this case, 91 days in a year (in September and October as well as a few days in other months) about 50% of the trucks have to use alternative treatment options while for the remaining 365 days (273 days) the system can treat all the incoming leachate.

These numbers do not include the 6% growth per year until year 2015.

Based on the above discussion, the decision rests entirely on the management of the MSB and depends on the risk mitigation levels. However, if some management techniques such as incentivizing low peak time deliveries is applied, choosing the 50% risk mitigation with 75 percentiles design will meet the needs of the Borough and provide adequate capacity to treat the septage produced in the Borough.

Based on these assumptions, a LeachBuster LB-L10-100 capable of treating 100,000 gpd of Septage can be selected to cover the 6% growth until year 2025 after which, if the growth is continued, additional skids can be added to the system.

The average flow as derived from the data provided by the Borough management is about 40,000 gpd. There is a wide variation in the daily flow with a minimum flow of 12,000 gpd and maximum flow of 253,000 gpd.

Although we recommend the above option however, in order to allow the client to make a learned decision on selecting a risk level, four percentiles (with no mitigated risk) of 25, 50, 75, and 99 were selected and system capacity, storage requirement, Opex and Capex was estimated for these scenarios.

Table 23

Number	Percentile	Standard Risk Flow (Gal/s)	Mitigated Risk Flow (Gal/s)	Equalization Tank Capacity (Gallons)
1	25	145,884	48,011	1,800,000
2	50	197,230	65,925	1,500,000
3	75	215,160	78,459	900,000
4	95	242,282	103,521	400,000
5	99	258,396	117,678	100,000

For septage, the cost for is estimated for three percentile (risk) levels of 25, 50, 75,and 99 and presented to allow the comparison with previous options presented by CH2MHill and HDR.

2.3.8 Recommendations

Due to adverse weather conditions in the Mat-Su Borough region, the aforementioned adverse characteristics of large open storage basins, environmental considerations and the results of the risk and percentile analysis, it is recommends that a value of the 75 percentile, with 50% risk mitigation should be selected to a) minimize the storage requirements, b) provide sufficient capacity, and c) respond the potential annual growth.

Based on the discussions with MSB staff and the preceding mitigated risk analysis, Clark recommends a 100,000 gpd septage treatment system, along with a underground and covered equalization basin with a capacity of 400,000 gallons.

3 Leachate

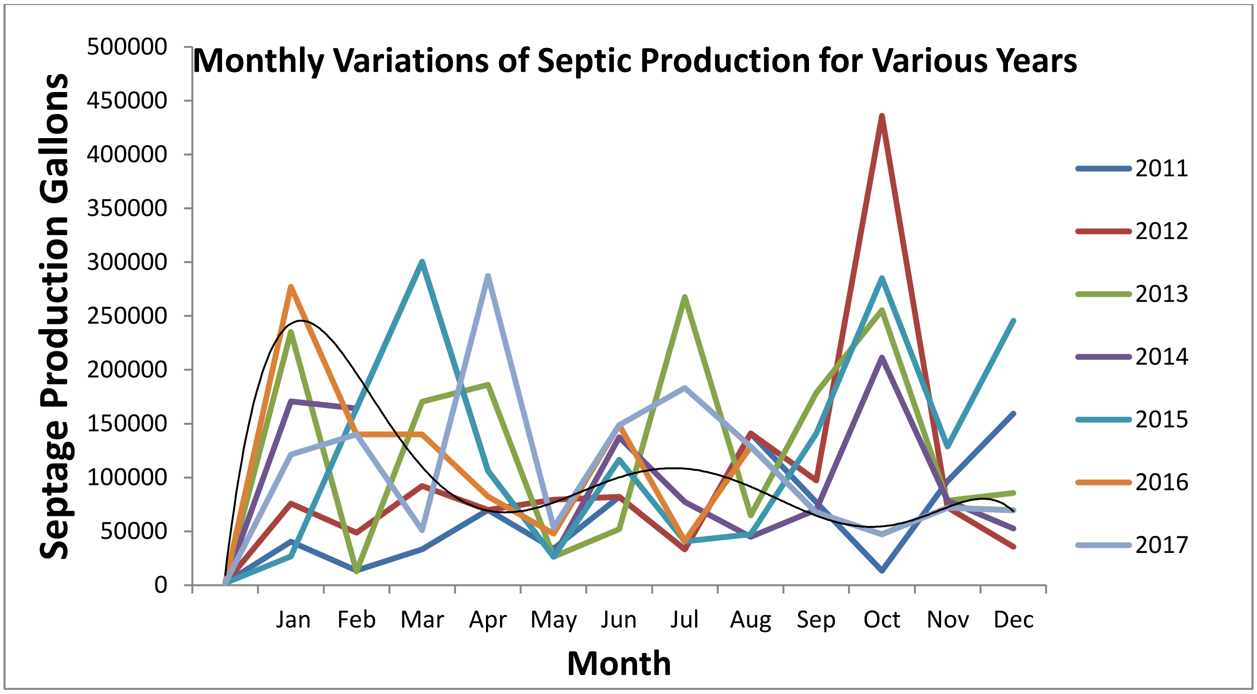
The leachate is collected from landfill and transported to the underground collection tank located in the landfill site. To establish a design capacity for the proposed leachate treatment system at Mat-Su Borough the following, steps are taken.

3.1 Total Volume

Monthly values of the leachate delivered to the receiving station were tabulated and are given below. Monthly volumes of leachate varied from about 13,562 gallons in February 2011 to as high as about 435,998 in October 2012.

Table 24: Monthly Fluctuations of the Leachate Volumes Received by the Receiving Station for the Period of 2011 to July 2017 (Year to Date)

		Feb	Mar	Apr	May	Jun
2011	40,297	13,562	33,310	69,735	33,858	81,990
	75,870	48,736	92,048	69,742	79,205	81,990
2013	235,305	12,657	170,405	186,015	26,384	52,064
	170,782	164,014	300,477	106,016	26,384	137,502
2015	26,552	164,014	300,477	106,016	26,384	116,471
	277,144	139,963	139,963	82,413	47,876	148,811
2017	121,272	139,963	51,016	287,328	53,354	148,811
Year	Jul	Aug	Sep	Oct	Nov	Dec
2011	33,347	141,053	76,860	13,363	96,601	159,262
	33,347	141,053	97,162	435,998	72,072	35,735
2013	267,801	64,818	178,791	255,595	78,390	85,601
	77,240	44,898	70,174	211,480	78,378	52,711
2015	40,727	47,061	140,815	285,318	128,676	245,528
	41,079	128,730	67,422	47,207	71,898	69,583
2017	183,140	128,730	67,422	47,207	71,898	69,583



3.2 Trend Analysis

A production dynamic analysis was conducted to establish possible future growth/decline in the leachate production over the period of past seven years, as well as possible growth/decline values.

Table 25: Variation of Leachate Production over 6 Years

Year	Grand Total
2011	793,238
	1,262,958
2013	1,613,826
	1,440,056
2015	1,628,039
	1,262,089
2017	1,369,724

The annual production ranged from around 793,238 gallons in 2011 to about 1,628,039 gallons in 2015. A trend analysis was conducted and the predictive equation is as follows:

Annual Production =62212 x Year + 1.E+06 (R^2 = 0.2259).

The line slope is indicating a value of gal/year or slope to intercept ratio (62,212/ 1.E+06 = 0.06) of 0.06 which translates to about 6% growth per year with a confidence level of about 22%. Unlike the leachate data, the confidence level for this estimate is rather low at 22%. This is due to the substantial amount of missing data in the dataset. For some reason, there were several gaps in the data, which made the predictive equation less descriptive. The following graph is the visual analysis of this process.

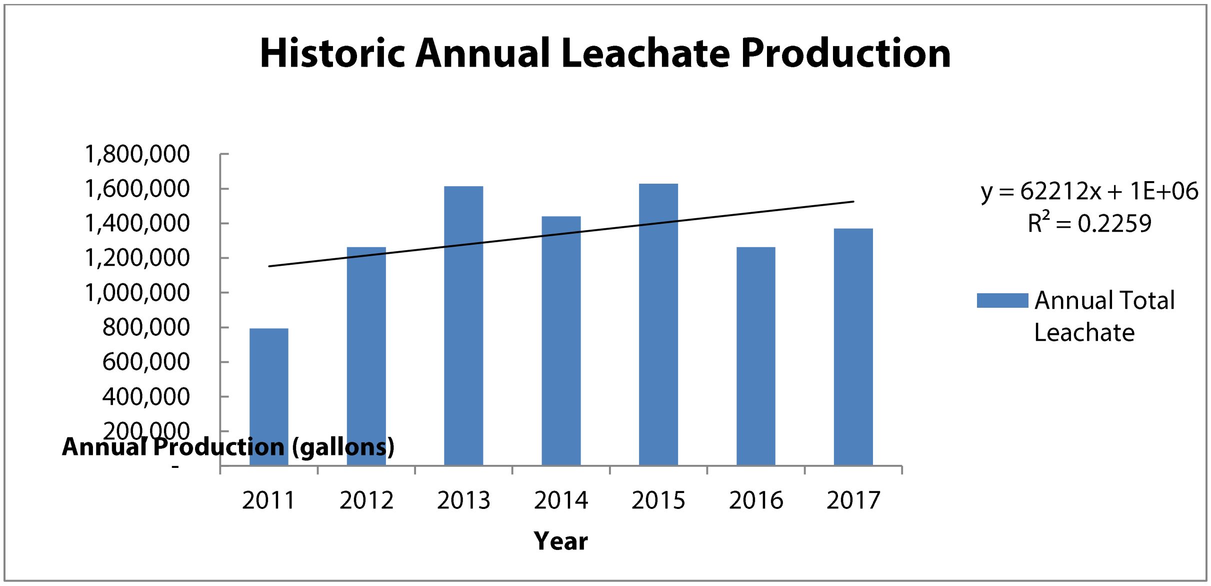


Figure 2: Historic Annual Leachate Production

3.3 Percentile Analysis

In order to determine a most practical and economical design flow, a percentile analysis was conducted to achieve this objective. Percentile analysis is used to select a value from a dataset that will fall within a given percentile of the data set.

Annual Analysis

First, the annual totals are analyzed to obtain the annual percentile pattern. This was done by calculating the total annual production at different percentile levels. The table given below presents the annual percentile values for the four levels of confidence.

Table 26. Percentile Analysis for the Leachate Received by the Receiving Station for the Period of 2011 to July 2017 (Year to Date)

Year	25 Percentile	50 Percentile	75 Percentile	95 Percentile	99 Percentile
2011	33,338	55,016	85,643	149,247	157,259
	64,491	77,538	86,516	273,778	403,554
2013	61,630	128,003	198,338	261,088	266,458
	65,808	92,197	165,612	251,529	290,687
2015	45,478	122,574	166,993	292,140	298,810
	62,536	77,156	142,175	206,561	263,027
2017	63,905	96,585	183,140	230,025	275,867

As shown in the table above, designing the system to meet the requirements in 25% of the time will require a minimum storage area of about 400,000 gallons (435,998- 33,347=402,660). Increasing the design confidence to 50 percentile (average) will reduce the storage requirement to about 380,982 gallons (435,998 - 55,016 = 380,982). On the other hand, increasing the confidence level to 95% or 99% will reduce the storage requirement to about 149,247 gallons or zero (0) gallons, respectively.

Both 25 and 50 percentile scenarios require substantial amount of storage area for equalizing the flow and so that all the leachate produced in high season, can be processed during slow production period. This will retain all the adverse characteristics of the lagoons such as odor, aesthetics, catastrophic failure, and bacteria and pathogen dispersion.

On the other hand, using 95 or 99 percentile will minimize or eliminate the need for large storage and therefore will not have the adverse characteristics of these storage basins. However, a somewhat smaller storage will still is required to equalize daily fluctuations which can be built underground or as a covered tank to avoid the adverse characteristics associated with large open storage basins.

Based on the above discussion, 95 and 99 percentile scenarios are selected for further economic analysis and comparison.

As a result of the above analysis, it is concluded that at 99 percentile, the highest volume occurred in 2012. Therefore, 2012 was used to conduct a monthly percentile analysis to identify the corresponding volume for this value.

Monthly Analysis

Tables 6 and 8 indicated that October 2012 dictated both 95 and 99 percentiles in the data set. The values for the 95 and 99 percentile are 435,998 and 403,554 gallons, respectively and it occurred in October 2012. Based on this, October 2012 was selected for daily percentile analysis.

Daily Analysis

In order to calculate the final design volume, the daily volumes were extracted from the dataset provided to Clark, which is presented below. Due to the existence of substantial data gaps in the dataset, a composite percentile analysis was conducted instead of a monthly percentile analysis. In this method, analysis is conducted on the entire data set as oppose to using the highest month. In this method, the large volume of data compensates for a few missing data points, thus providing a more accurate prediction of the values.

The following table is a summary of this analysis. The values for different percentiles vary from about 2,000 gallons per day to about 13,500 gallons per day.

Table 27: Daily Percentile Analysis Results

Year	25 Percentile	50 Percentile	75 Percentile	95 Percentile	99 Percentile
2011	1,111	1,834	2,855	4,975	5,242
	2,150	2,585	2,884	9,126	13,452
2013	2,054	4,267	6,611	8,703	8,882
	2,194	3,073	5,520	8,384	9,690
2015	1,516	4,086	5,566	9,738	9,960
	2,085	2,572	4,739	6,885	8,768
2017	2,130	3,220	6,105	7,667	9,196

Based on these analyses, it is concluded that a value between 95 and 99 percentile will provide the best design volume which will minimize or eliminate the storage requirement, provide sufficient capacity 99% of the times and provide some safeguard for future expansion.

3.4 Summary and Conclusion

Based on the above analysis, we can conclude that depending on the level of confidence required, a combination of storage size/system size can be selected to develop a design flow for the system.

In order to simplify the selection process, only 4 levels of confidence i.e. percentiles are examined and presented here. These are 25, 50, 95, and 99 percentiles.

As shown in the table above, designing the system to meet the requirements 25% of the time will require a minimum storage area of about 400,000 gallons (435,998- 33,347=402,660). Increasing the design confidence to 50 percentile (average) will reduce the storage requirement to about 380,982 gallons (435,998 - 55,016 = 380,982). On the other hand increasing the confidence level to 95% or 99% will reduce the storage requirement to about 149,247 gallons or zero (0) gallons, respectively.

3.4.1 Percentile 25

At this confidence level, the required storage capacity is about 400,000 gallons and the system size is about **3,000** gallons per day.

3.4.2 Percentile 50

At this level, the required storage capacity is about 380,982 gallons and the system size is about 5,000 gallons per day.

3.4.3 Percentile 95

At this level, the required storage capacity is about 149,247 gallons and the system size is about 10,000 gallons per day.

3.4.4 Percentile 99

At this level, the required storage capacity is minimal and can be as low as 50,000 gallons to even out the daily fluctuation. The system size to provide this confidence level is 15,000 to 20,000 gallons per day.

3.4.5 Recommendations

Due to adverse weather conditions in the Mat-Su Borough region, the aforementioned adverse characteristics of large open storage basins, environmental considerations, and the results of the risk and percentile analysis, it is recommends that a value between 95 to 99 percentile should be selected to a) minimize the storage requirements, b) provide sufficient capacity for rare occurring peaks, and c) respond to the potential annual growth.

Since the economic impact of moving from 95 to 99 percentile is marginal, it is recommended that the 99 percentile should be adopted with an underground and covered equalization basin with a capacity of around 100,000 gallons. This will accommodate the 6% annual growth for the next seven years when the risk level will drop from 1% to 5% (from 99 percentile to 95 percentile).

In summary, Clark recommends the following design parameters:

- Design flow: 20,000 gallons per day
- Equalization tank capacity requirement: 50,000 to 100,000 gallons

The client indicated that new cells will be opened in the near future which can double the leachate production. In order to accommodate the increased leachate production, the TDA was conducted for a single and two or more open cell scenarios.

The rational for choosing this number is as follows:
The average daily flow based on the data that was provided to us was around 7,500 gallons per day (gpd). But when temporal dynamic analysis is applied, the following picture emerges:

Percentile	25 Percentile	50 Percentile	75 Percentile	95 Percentile	99 Percentile
GPD	2,500	4,086	6,611	11,145	13,856

As it can be seen from the table, at 99 percentile, the flow is about 14,000 gpd. Since LeachBuster® modules are designed in 5000 gpd increments, 15,000 gpd was used for selection purposes. In a conference call the management of the MSB indicated that every few years a new cell is likely to open in the landfill in addition to an existing open cell; and thus, two open cells may exist simultaneously for a few years. As a result, it was suggested that the leachate during this period may be doubled. It was requested that this condition should be included in our design. Based on this request, the 15,000 gpd is doubled to 30,000 gpd. As it can be seen from the table, at 99 percentile, the flow is about 14,000 gpd. Since LeachBuster® modules are designed in 5000 gpd increments, 15,000 gpd was used for selection purposes. In a conference call the management of the MSB indicated that every few years a new cell is likely to open in the landfill in addition to an existing open cell; and thus, two open cells may exist simultaneously for a few years. As a result, it was suggested that the leachate during this period may be doubled. It was requested that this condition should be included in our design. Based on this request, the 15,000 gpd is doubled to 30,000 gpd.

Based on the historic population growth analysis presented in the PER, it was established that a 6% annual growth in the leachate production had occurred during the past 7 years. Since the LeachBuster® system is modular and can be expanded as needed, the system is designed for up to the year 2025 rather than 2030; considering the 6% growth rate this will result in the required capacity of 40,000 gpd.

In recent communications with the management of the MSB, it was conveyed that as part of another project at the landfill, a 500,000 gallon leachate lagoon will be built as an equalization basin. It was also determined byClark that the MSB management would prefer a leachate treatment system to be designed at the 75 Percentile.

Based on this discussion and various communications, the capacity can be reduced to reflect the existence of the lagoon which can safely reduce the risk level to the 75 Percentile.

Based on these developments, the current daily volume at the 75 Percentile is about 6,500 gpd, which can be doubled to represent the probable second open cell or 13,000 gpd. With the application of the 6% annual growth till the year 2025, the design volume will be approximately 18,000 gpd.

Based on these assumptions, a LeachBuster® LB-L10-20, which is capable of treating 20,000 gpd of landfill leachate, is recommended.

The following is a summary of the results of TDA analysis for leachate for a single open cell and a two or more open cell scenarios.

Table 28: Design Flow and Equalization Tank Capacity for Leachate

Number	Percentile	Flow	Equalization Tank Capacity (Gallons)
Single Open Cell			
1	25	2,200	400,000
2	50	4,200	380,982
3	75	6,600	250,000
4	95	10,000	149,247
5	99	15,000	50,000
Two or More Open Cells			
1	25	4,400	500,000
2	50	8,200	460,982
3	75	15,200	350,000
3	95	20,000	189,247
4	99	30,000	80,000
Final Design Flow with Expansion Capacity included			
	75	20,000	150,000

For the purpose of this PER, the 75 percentile is selected as the design flow parameter. In order to accommodate future growth potential expansion capacity of about 30% is added to this design flow, which results in a design flow capacity of 20,000 gallons per day.

Section 6: Treatability Test and Results

1 Introduction

1.1 Overview

In order to design a system for treatment of septage and leachate from MSB area the characteristics of these waste streams were required. Although some analytical data were made available by the client but they were limited in scope and had only information on a limited number of parameters. This information was sufficient for meeting National Pollution Discharge Elimination System (NDPES) limits. Since there is a possibility that the Borough has to meet Drinking Water or Clean Water Standards, both of which have far more parameters than NPDES permit requirements, a new test was needed to evaluate the abilities of the selected technology in meeting these new discharge limits.

1.2 Objectives

The objectives of the study were as follows:

- Evaluate the ability of LeachBuster® to address the high-strength septage and leachate disposal needs of MSB.
- Identify and select suitable technologies and procedures to effectively and economically treat these waste streams and assist MSB to achieve their operational and financial goals.
- Generate samples of concentrate and permeate for quantitative and qualitative analysis.
- Establish optimum operating conditions (flow, pressure) for a full-scale LEACHBUSTER® system treatment solution. This step will be finalized during design of the full-scale system.
- Establish a suitable cleaning regiment for the full-scale system to achieve a stable water flux. This step will be finalized during design of the full-scale system.
- Collect sufficient information during the study to estimate membrane life and frequency of replacement.
- Collect sufficient information to establish approximate full-scale system capital costs and annual operating expenses (including: annual energy use, filter replacement frequency, and cleaning costs).
- In cooperation with Apex, provide a financial pro forma that will evaluate the cost effectiveness of the proposed full-scale system.

2 The Technology

The LEACHBUSTER® is a single-stage membrane system that removes fine particulates and dissolved components from a waste stream. The system is capable of removing organics, water, and minerals using a single stage membrane system. The wastewater is screened through a fine screen (opening of approximately 2000 um) for easy separation of large solids, as well as to protect pumps, membranes, and other process equipment from damage. The screened influent is effectively filtered at a temperature of 50ºF or higher. The LEACHBUSTER® System achieves up to 90% recovery of the liquid, leaving the solids and minerals in the remaining approximately 10% concentrate. During the test, a 20 Volumetric Concentration Factor (VCF), which translates to a recovery rate of approximately 95%, was achieved but a more definitive number will be established during the Phase II of this study. A scale model of the full-sized LEACHBUSTER® system, capable of running up to 3 GPM in all modes, was used during the study. This system utilized four-foot modules using the same membranes as will be used for the full-scale system.

The system can be fitted with membranes with nominal orifice sizes (Molecular Cutoff Weights) ranging from 200,000 (Ultrafiltration), 200 (Ultrapure) Daltons representing levels 1to 13. This means that about 13 different levels of purity can be achieved in the treated effluent by selecting any one of these membranes. The levels from 1 to 13 are decreased in about 2000 Dalton increments providing the user a large flexibility in selecting

3 Definitions

The following is a brief description of the some of the terminologies used in this report.

3.1 Treatment Levels

The Clark LEACHBUSTER® system provides fourteen (14) different levels of treated water quality ranging from level 1 to level 13. For this project, Levels 2, 6 and 9 and 10 were used.

3.2 VCF

Volumetric Concentration Factor, or VCF, is a measure of the clean water recovery rate. For example, a VCF of 10 represents 90% recovery rate; similarly, VCF of 20 represents a 95% recovery rate.

3.3 TNTC

Too Numerous to Count, or TNTC, occurs when the bacteria levels exceed 10^7, the testing laboratory will report them as TNTC. For calculation purposes, we will use 10^7.

3.4 ND – Non-Detect

Each laboratory test has a detection limit below which the analyses cannot be detected using current technologies. These are often very close to 0 (zero). For calculation purposes, we will use 0 (zero).

3.5 NR – Not Reported

Often due to some event such as a spill, spoil, or some damage to the samples, a meaningful analysis cannot be performed. We normally collect extra samples to cover these events; however, on rare occasions no results can be obtained for a given sample. These samples are not used in our calculations.

3.6 Operating Modes

LEACHBUSTER® can operate in three different modes.

Full Batch Mode

In this mode the waste production is intermittent and produced in batches. For example, wastewater is produced during the day, but not through the night. In this case, the waste stream is stored in a vessel through the day and treated during the night. This mode was not used for this application.

Topped Batch Mode

In this mode, the feed tank is continuously topped by fresh wastewater while the liquid upstream is continually concentrated until reaching the target concentration of 10% solids or an unacceptable membrane performance (low flow).

Continuous Mode
This option does not employ any tanks for concentration of the solids; instead, they are concentrated within the system and continuously discharged in the sludge storage tank. An up to 3 gpm membrane pilot plant was utilized to achieve these objectives. This mode was used for the duration and engineering study. The LEACHBUSTER® unit was fitted with LB-L2, L6, L9 and L10 membranes using stainless steel modules in high-pressure mode. The pilot plant was run in continuous mode. The temperature of the screened wastewater was over 50°F; therefore, no heating of the wastewater was necessary before starting the pilot system. The wastewater was delivered through a pressurized feed line into to the recirculation line for the continuous mode. The flow was measured continuously to monitor the flux rate.

4 Description of Testing Phases

Prior to design and implementation of a full-sized LEACHBUSTER® system, it is necessary to conduct several preliminary bench tests, as well as an extended on-site duration and engineering study utilizing standard protocol, comprising the following steps:

- Exploratory and or treatability study (includes bench testing)
- Is conducted in the laboratory
- Problem identification and wastewater characterization
- Will be done during Phase II
- Process definition/development and engineering study
- Will be done during Phase II
- Repeatability and durability study
- Will be conducted during design and engineering Phase.

4.1 Exploratory and/or Treatability Study

The first step, as discussed and agreed to with MSB, was conducted at Clark's laboratory in Minneapolis after receiving wastewater samples from the client. The samples were tested using a bench scale unit. This brief test allowed Clark to evaluate the treatability of the client's wastewater prior to conducting the full-scale duration and engineering study.

In mid-September 2017, some samples of raw septage and leachate were collected and sent to laboratory in Minneapolis. On late September, the test was conducted using a Level 1, 6, 9 and 10 membranes to examine the membrane's performance in relation to the waste steam at the MSP. Samples were collected and sent to the analytical laboratory for analysis.

The following membranes were used to conduct these tests.

- Level 2
- Level 6
- Level 9
- Level 10

The objective of this test was to identify the best membrane which can provide an optimum water quality which balances economical and technical parameters. Treated samples were collected and sent to the EPA certified laboratory for testing and analysis.

The following laboratory tests were conducted on the samples:

- Biological Oxygen Demand (BOD)
- Total Suspended Solids (TSS)
- Chemical Oxygen Demand (COD)
- ICP Metals
- Semi Metals and their salts such as Phosphorus, Nitrogen, Nitrates, Nitrites, Ammonia etc.
- Volatile Organic Compounds (VOCs)
- Semi-Volatile Organic Compounds (SVOCs)
- Chlorides,
- Sulfides
- Perfluorocarbons (PFCs),
- Polychlorinated Biphenyls (Pcbs)
- Polycyclic Aromatic Hydrocarbons and Halogenated (Pahs)
- E-Coli
- Fecal Coliforms

5 Test Result

5.1 Leachate

About 30 gallons of leachate was processed using LB-L9 and LB-L10 membranes. The results indicated that to satisfy the Drinking Water Standards, LB-L9 can be used. To achieve the Water Quality Standards, LB-L10 had to be utilized.

5.1.1 Indicator Parameters

These are measures of a combination of parameters which collectively indicate the level of contaminants in the waste and wastewater. These are:

- Biological Oxygen Demand (BOD)
- Total Dissolved Solids (TDS)
- Chemical Oxygen Demand (COD)

Table 29: Levels of BOD, TDS, and COD Using LB Models 2, 6, 9, and 10

PARAMETER	LEACHATE BOD_5, COD, TDS (mg/L)					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
BOD_5	3820	3110	398	80	29	4050
COD	6040	4640	2700	143	ND	15600
TDS	5900	3700	3580	186	71	12000

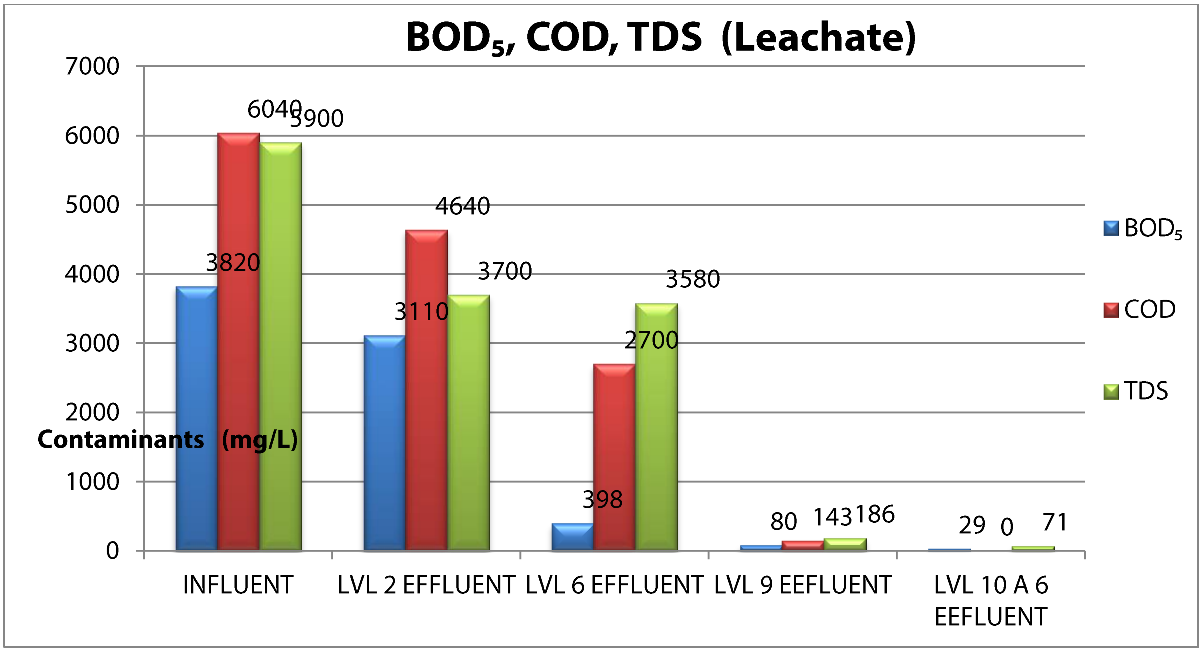


Figure 8: Levels of BOD, TDS, and COD Using LB Models 2, 6, 9, and 10

Model L9 and L10 produced effluents which can meet both standards mentioned earlier.

5.1.2 Semi Metals

The following is the results of Semi metals and their salts tested during this study

- Cyanide
- Phosphorus
- TKN (Total Kjeldahl Nitrogen)
- Ammonia
- TSS

Table 30: Levels of Cyanide and Phosphorus LB models 2, 6, 9 and 10

	LEACHATE Cyanide & Phosphorus (µg/L)					
PARAMETER	**INFLUENT**	**LVL 2 EFFLUENT**	**LVL 6 EFFLUENT**	**LVL 9 EEFLUENT**	**LVL 10 A 6 EEFLUENT**	**LVL 9 CONCENTRATE**
Cyanide	10.7	4.6	ND	ND	ND	58
Phosphorus	ND	ND	ND	ND	ND	0.89

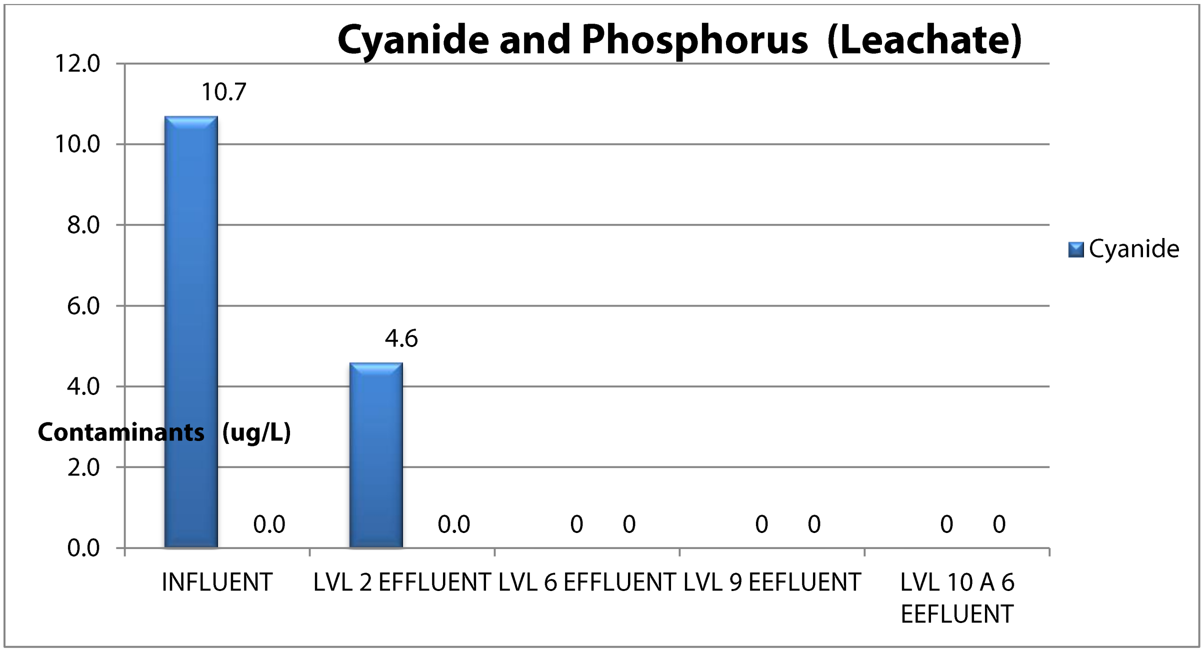


Figure 9: Levels of Cyanide and Phosphorus LB Models 2, 6, 9, and 10

All the levels L2, L6, L9 and L10 met the discharge requirement for both standards

Table 31: Levels of TSS, TKN and Ammonia using LB models 2, 6, 9 and 10

	LEACHATE TSS, TKN, & Ammonia Nitrogen (mg/L)					
PARAMETER	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
TSS	340	97.5	40	ND	ND	860
TKN	605	539	349	38.7	18.4	1540
Ammonia N	225	208	175	33.6	10.8	470

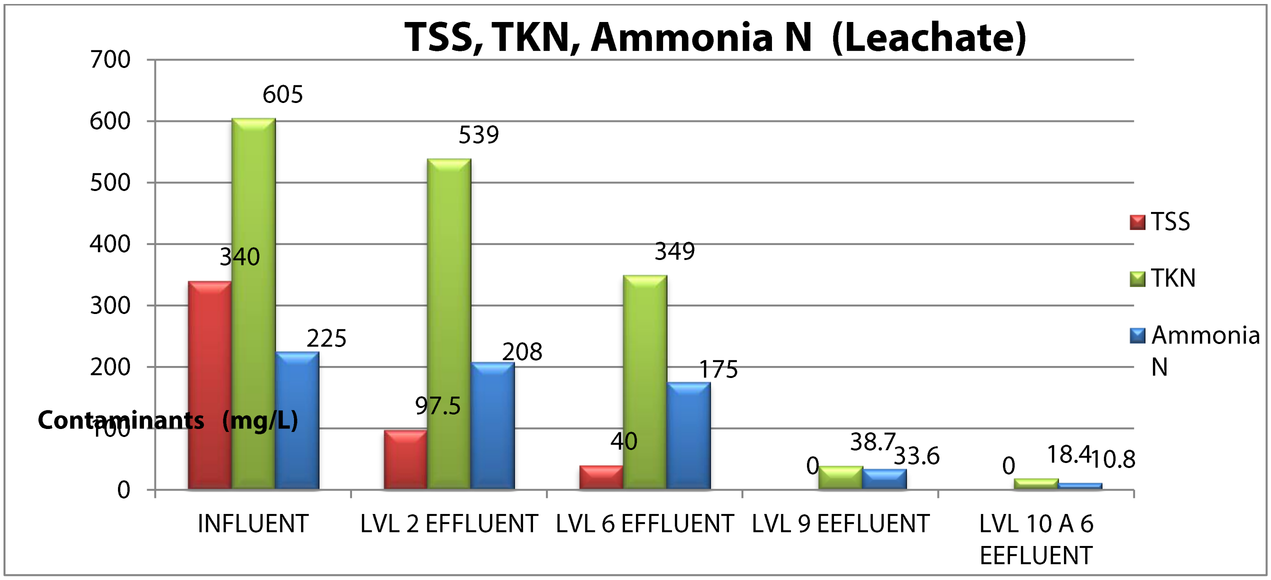


Figure 10. Levels of TSS, TKN and Ammonia using LB models 2, 6, 9 and 10

Table 32: Levels of Pathogen and Ammonia using LB models 6 and 10

	LEACHATE Total E.coli (MPN/100/mL)		
PARAMETER	**INFLUENT**	**LVL 6 EEFLUENT**	**LVL 10 A 6 EEFLUENT**
E.coli	23100	<1	<1
Total Coliform	2420	<1	3

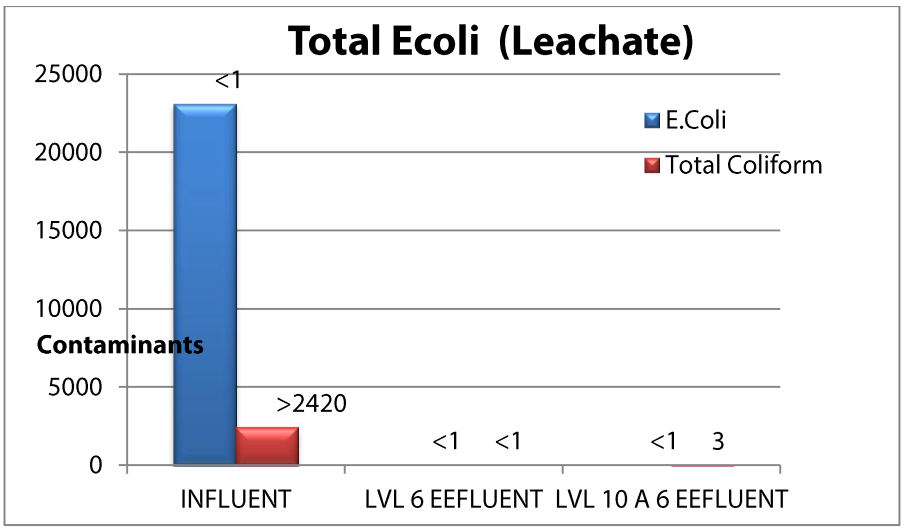


Figure 11. Levels of Pathogen and Ammonia using LB models 6 and 10

Both Fecal Coliform and E-Coli levels were well below the levels required by both standards which are 100 and 10 CFU/100 ml.

5.1.3 Metals

Samples were analyzed for all the following metals and the results are given below.

- Arsenic
- Barium
- Chromium
- Cobalt
- Copper
- Lead
- Nickel
- Manganese
- Zink
- Iron
- Calcium

Table 33: Levels of ICP metals using LB models 2, 6, 9 and 10

	LEACHATE METALS ICP (µg/L)					
PARAMETER	**INFLUENT**	**LVL 2 EFFLUENT**	**LVL 6 EFFLUENT**	**LVL 9 EEFLUENT**	**LVL 10 A 6 EEFLUENT**	**LVL 9 CONCENTRATE**
Arsenic	31.6	ND	ND	ND	ND	ND
Barium	264	138	61.8	ND	ND	430
Chromium	134	55.7	11	ND	ND	286
Cobalt	49.4	27.4	ND	ND	ND	117
Copper	21.1	11.3	ND	ND	ND	159
Lead	18.1	ND	ND	ND	ND	ND
Nickel	536	325	71.7	ND	ND	1370

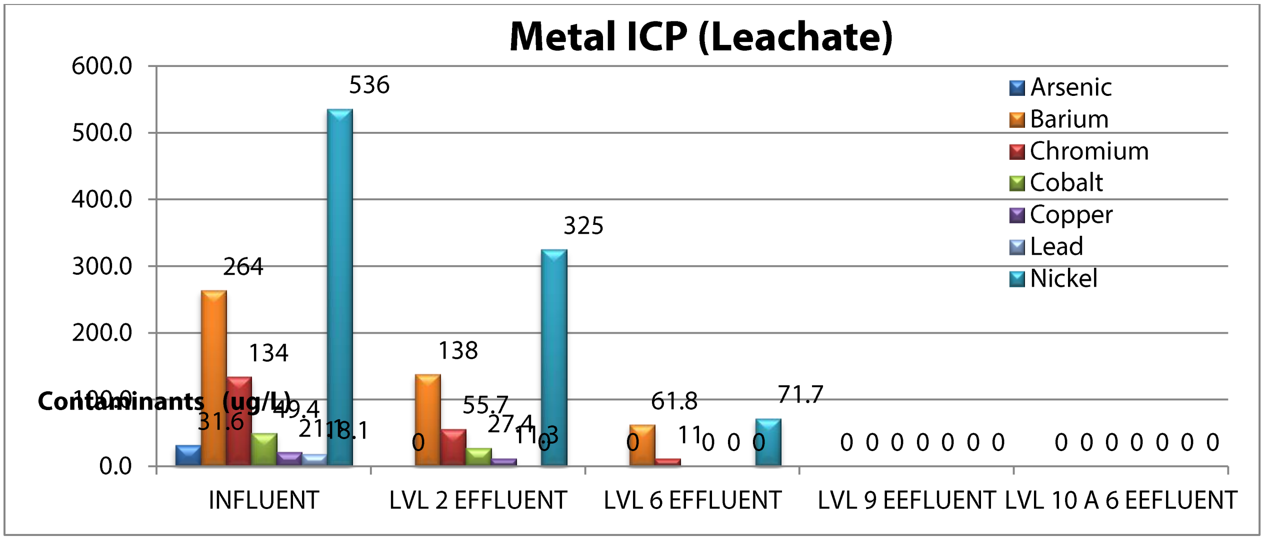


Figure 12: Levels of ICP metals using LB models 2, 6, 9 and 10

Table 34: Levels of ICP metals using LB models 2, 6, 9 and 10

PARAMETER	LEACHATE METALS ICP Removal %					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Arsenic	31.6	100.00%	100.00%	100.00%	100.00%	N/A
Barium	264	47.73%	76.59%	100.00%	100.00%	
Chromium	134	58.43%	91.79%	100.00%	100.00%	
Cobalt	49.4	44.53%	100.00%	100.00%	100.00%	
Copper	21.1	46.45%	100.00%	100.00%	100.00%	
Lead	18.1	100.00%	100.00%	100.00%	100.00%	N/A
Nickel	536	39.37%	86.62%	100.00%	100.00%	

Table 35: Levels of ICP metals using LB models 2, 6, 9 and 10

PARAMETER	LEACHATE METALS ICP (µg/L)					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Manganese	3820	2020	427	34.4	10.8	3980
Zinc	2180	44.2	ND	ND	ND	3210

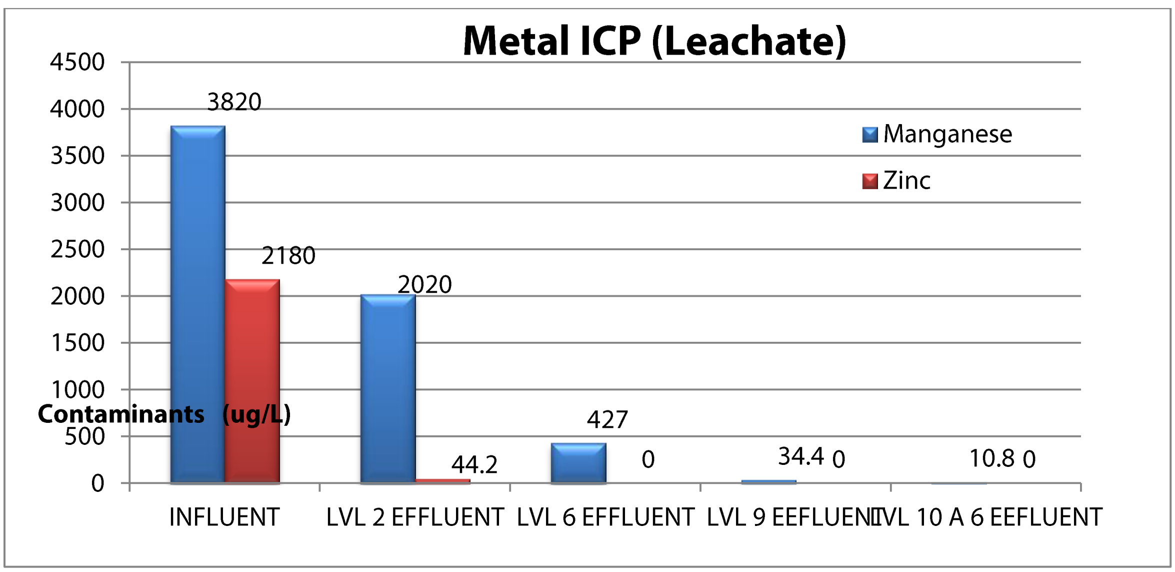


Figure 13: Levels of ICP metals using LB models 2, 6, 9 and 10

Table 36: Percent Removal of ICP metals using LB models 2, 6, 9 and 10

	LEACHATE METALS ICP Removal %					
PARAMETER	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Manganese	3820	47.12%	88.82%	99.10%	99.72%	
Zinc	2180	97.97%	100.00%	100.00%	100.00%	

Table 37: Levels of ICP metals using LB models 2, 6, 9 and 10

	LEACHATE METALS ICP (µg/L)					
PARAMETER	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Iron	131000	58400	22500	945	ND	198000
Calcium	363000	277000	122000	4840	960	691000
Magnesium	198000	169000	122000	2900	983	481000
Potassium	280000	238000	178000	11200	2700	673000

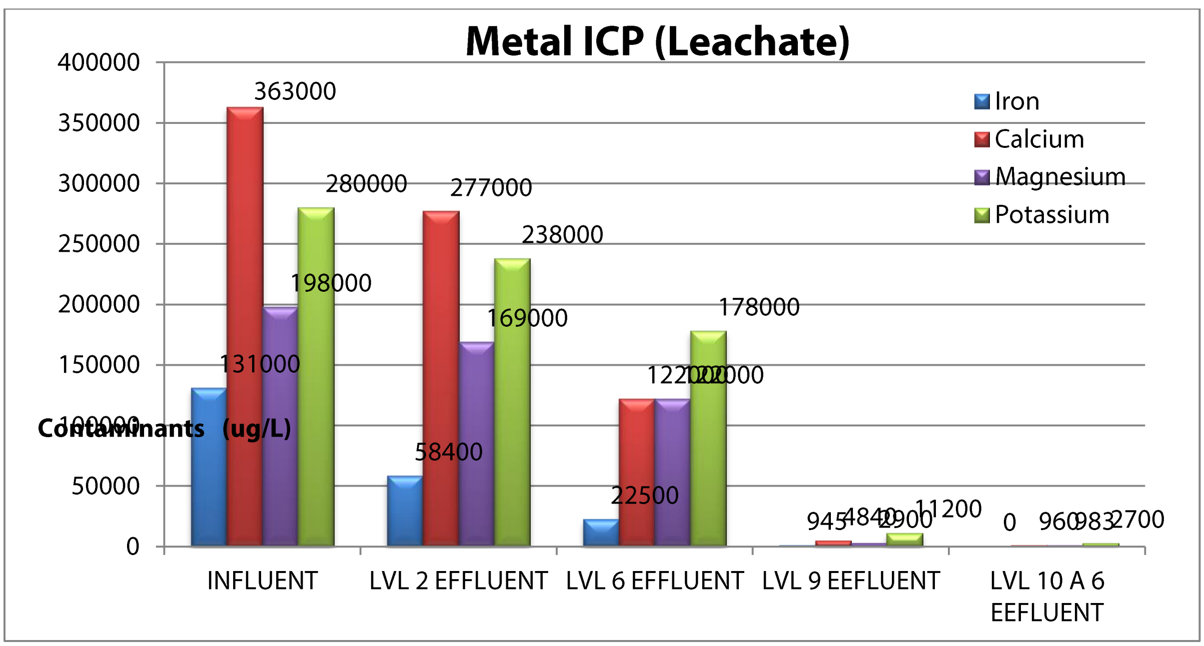


Figure 14: Levels of ICP metals using LB models 2, 6, 9 and 10

Table 38: Percent removal of ICP metals using LB models 2, 6, 9 and 10

PARAMETER	LEACHATE METALS ICP Removal %					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Iron	131000	55.42%	82.82%	99.28%	100.00%	
Calcium	363000	23.69%	66.39%	98.67%	99.74%	
Magnesium	198000	14.65%	38.38%	98.54%	99.50%	
Potassium	280000	15.00%	36.43%	96.00%	99.04%	

Table 39: Levels of ICP metals using LB models 2, 6, 9 and 10

PARAMETER	LEACHATE METALS ICP (µg/L)					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Boron	7270	6470	6070	2270	231	13500

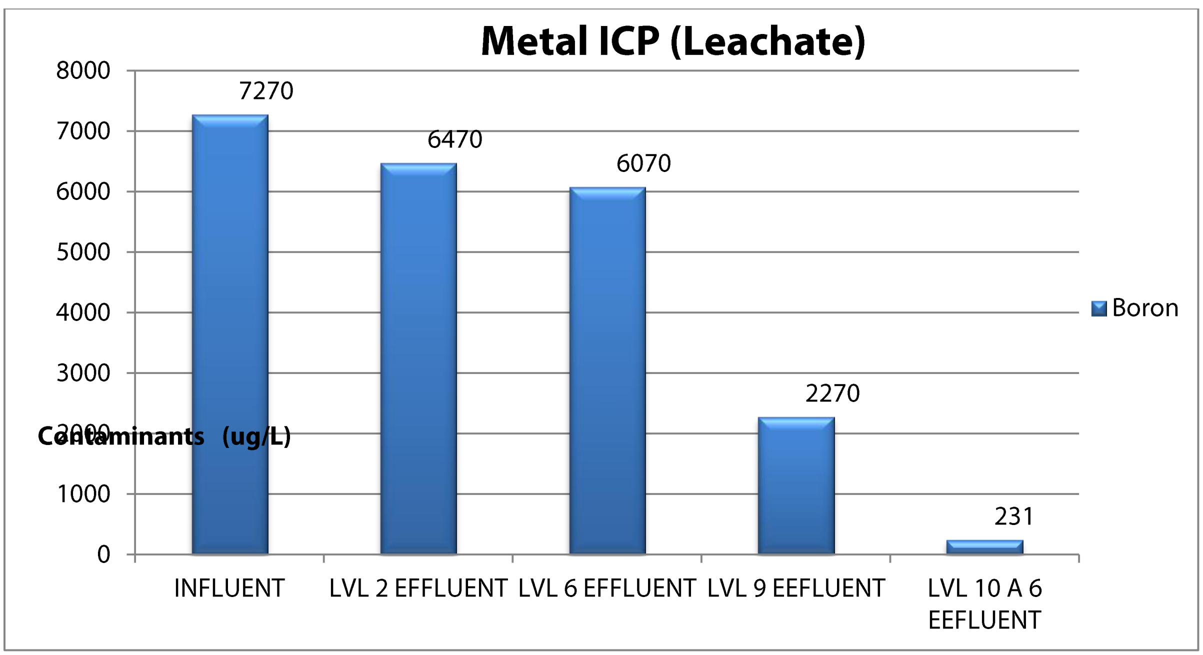


Figure 15: Levels of ICP metals using LB models 2, 6, 9 and 10

Table 40: Levels of ICP metals using LB models 2, 6, 9 and 10

PARAMETER	LEACHATE METALS ICP (µg/L)					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Sodium	1010000	862000	692000	39800	11500	2470000

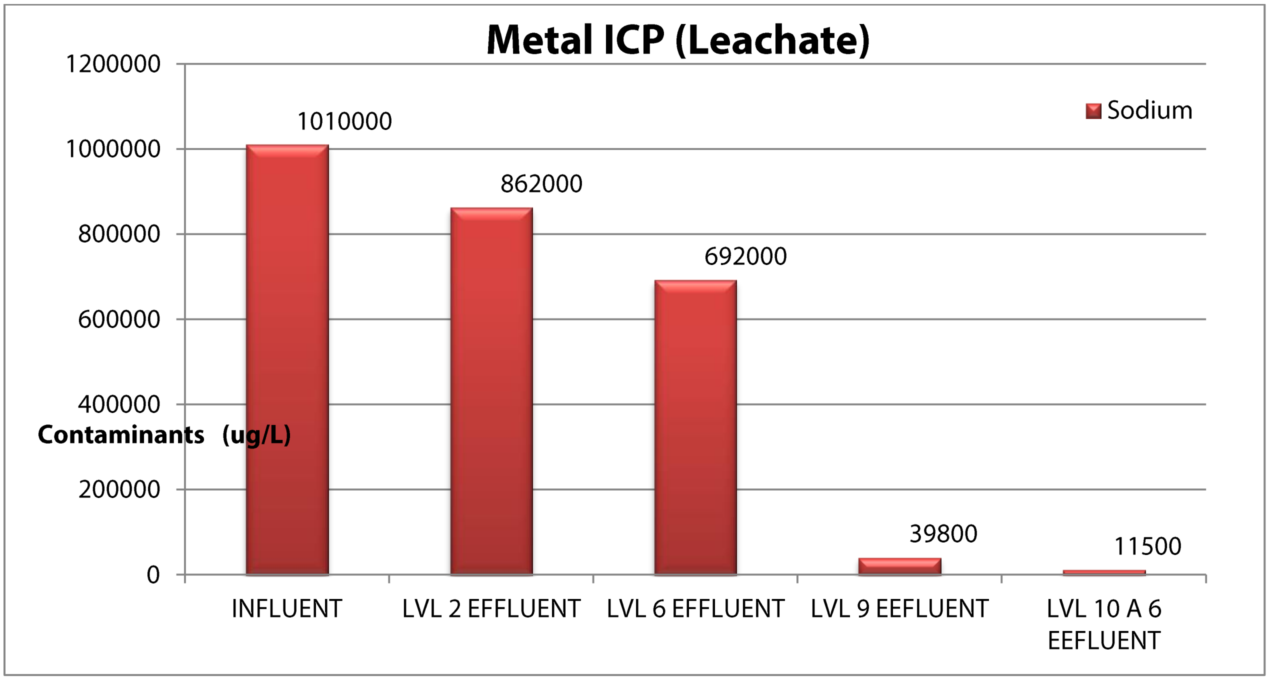


Figure 16: Levels of ICP Metals Using LB Models 2, 6, 9, and 10

5.1.4 Toxicity Characteristic Leaching Procedure (TCLP) Metals

In order to be able to return the concentrates back to the landfill, it has to be confirmed that these are not hazardous. To achieve this objective, Toxicity Characteristic Leaching Procedure (TCLP) has to be conducted. This test was conducted and the results indicated that the concentrate generated by this process is not hazardous. Following is the results of this test.

Table 41: Levels of ICP Metals Using LB Models 2, 6, 9, and 10

	LEACHATE METALS TCLP (mg/L)	
PARAMETER	**TCLP Regulatory Level**	**LVL (Concentrate Level)**
Arsenic	5.0	ND
Barium	100.0	ND
Cadmium	1.0	ND
Chromium	5.0	0.19
Lead	5.0	ND
Mercury	0.2	ND
Selenium	1.0	ND
Silver	5.0	ND

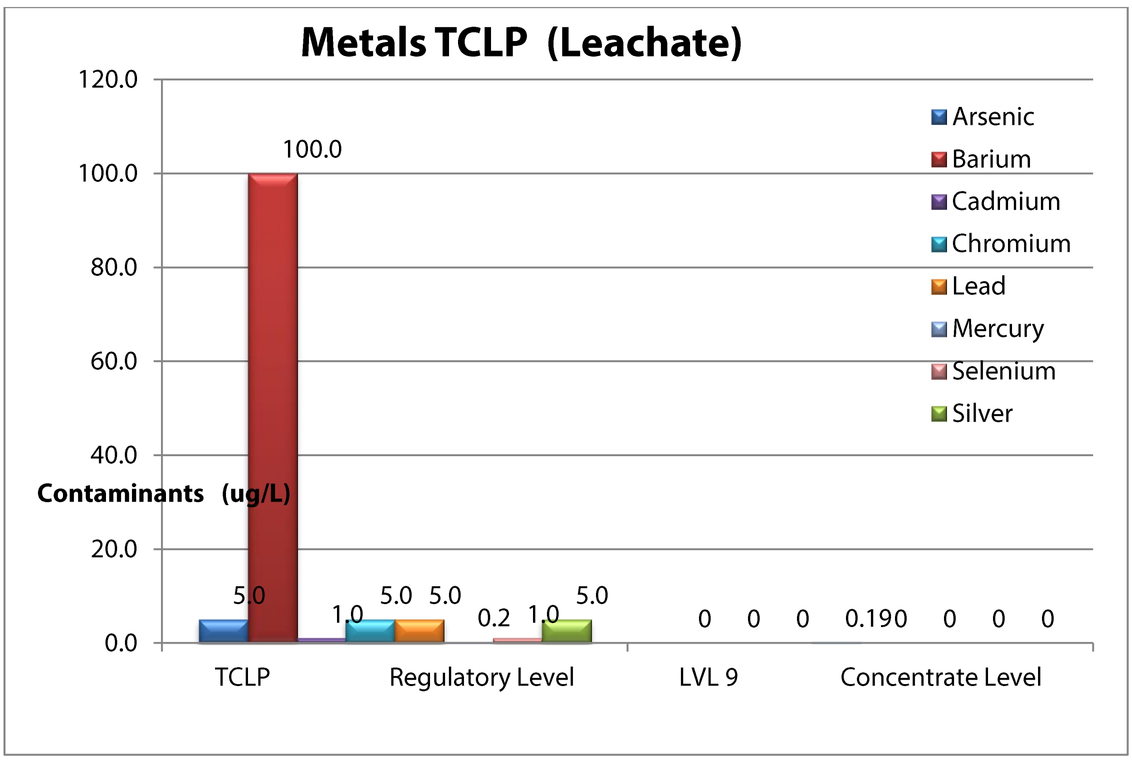


Figure 17: Levels of ICP metals using LB models 2, 6, 9 and 10

5.1.5 Volatile Organic Compounds (VOCs)

This system oxidizes most of the VOCs into less harmful material such as CO^2 and water etc. as well as removing them from the waste stream. The results in the following tables indicate that almost all the VOCs are removed by all the LB models. Even LB2 removed majority of VOCs from the waste stream.

Following tables and graphs show the results of the test with different LB models. Lack of VOCs in the concentrate indicates that the VOCs were oxidized and destroyed.

Table 42

	LEACHATE VOC By 8260 (µg/L)					
PARAMETER	**INFLUENT**	**LVL 2 EFFLUENT**	**LVL 6 EFFLUENT**	**LVL 9 EEFLUENT**	**LVL 10 A 6 EEFLUENT**	**LVL 9 CONCENTRATE**
Benzene	7.5	5.8	ND	ND	ND	ND
1,2-Dichloroethane	5.5	ND	ND	ND	ND	ND
Methyl-tert-butyl ether	5.8	ND	ND	ND	ND	12.6
1,2,4-Trimethylbenzene	8.9	ND	ND	ND	ND	ND
Xylene (Total)	25.5	ND	ND	ND	ND	ND

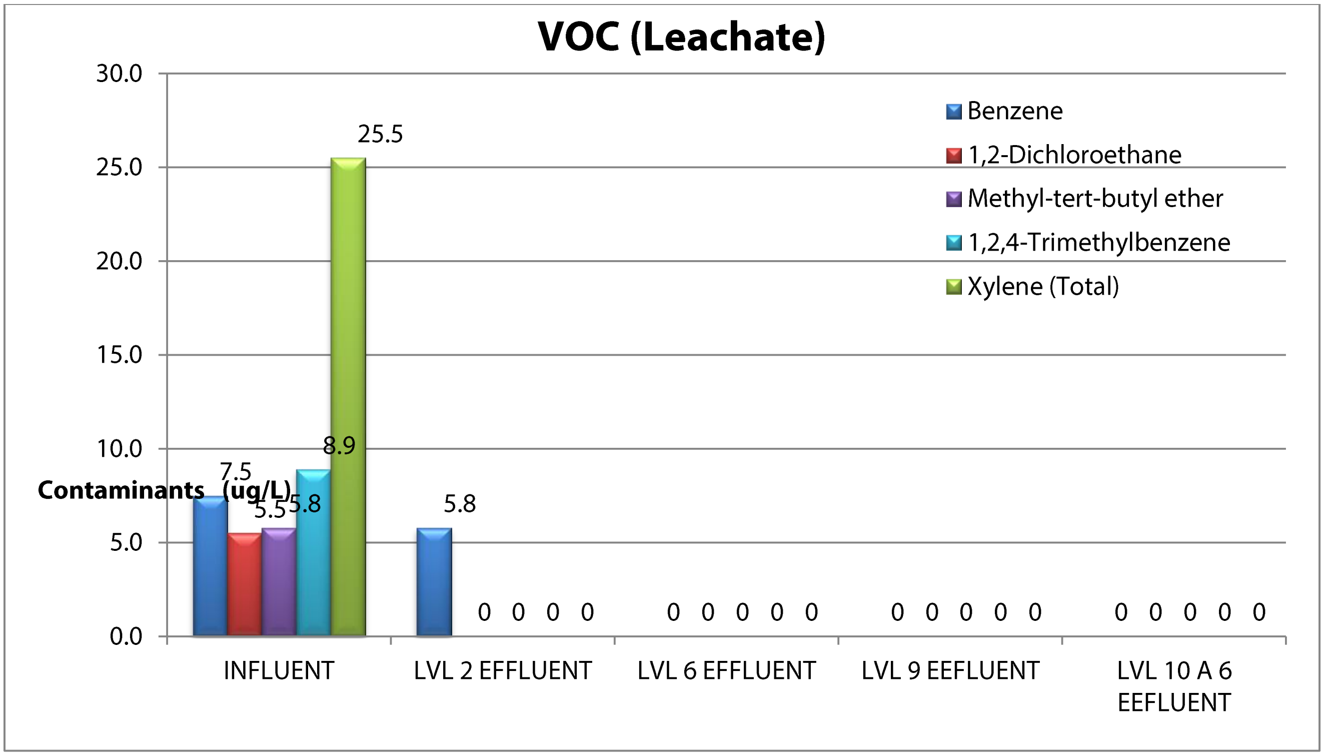


Figure 18: XXXXXXXXXXXXXXXXXXXXXXXXXXX

Table 43

PARAMETER	LEACHATE VOC By 8260 Removal %					
	INFLUENT	**LVL 2 EFFLUENT**	**LVL 6 EFFLUENT**	**LVL 9 EEFLUENT**	**LVL 10 A 6 EEFLUENT**	**LVL 9 CONCENTRATE**
Benzene	7.5	22.67%	100.00%	100.00%	100.00%	N/A
1,2-Dichloroethane	5.5	100.00%	100.00%	100.00%	100.00%	N/A
Methyl-tert-butyl ether	5.8	100.00%	100.00%	100.00%	100.00%	
1,2,4-Trimethylbenzene	8.9	100.00%	100.00%	100.00%	100.00%	N/A
Xylene (Total)	25.5	100.00%	100.00%	100.00%	100.00%	N/A

Table 44

PARAMETER	LEACHATE VOC By 8260 (µg/L)					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Diethyl ether (Ethyl ether)	142	114	54.9	20.9	ND	232
4-Methyl-2-pentanone (MIBK)	149	119	93.9	ND	ND	367

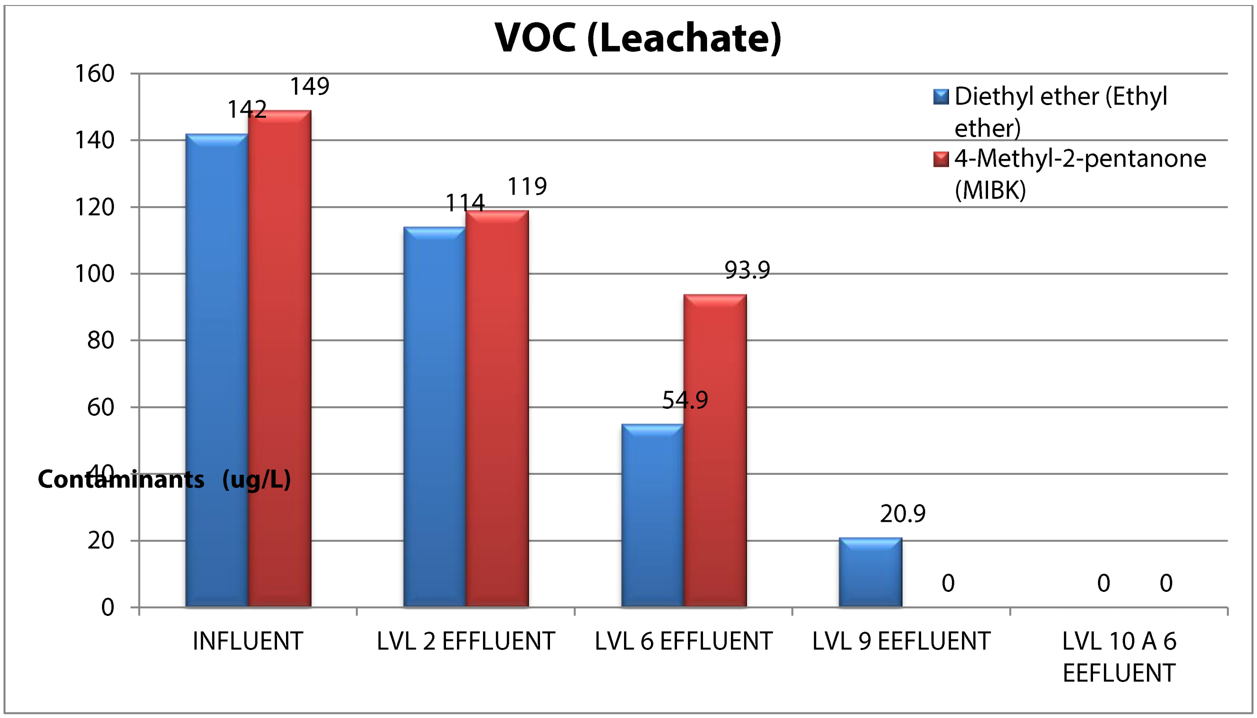


Figure 19

Table 45

PARAMETER	LEACHATE VOC By 8260 Removal %					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Diethyl ether (Ethyl ether)	142	19.72%	61.34%	85.28%	100.00%	63.38%
4-Methyl-2-pentanone (MIBK)	149	20.13%	36.98%	100.00%	100.00%	146.31%

Table 46

PARAMETER	LEACHATE VOC By 8260 (µg/L)					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Acetone	14300	11900	11400	7310	2160	21100
2-Butanone (MEK)	9150	7260	5990	2940	615	18300

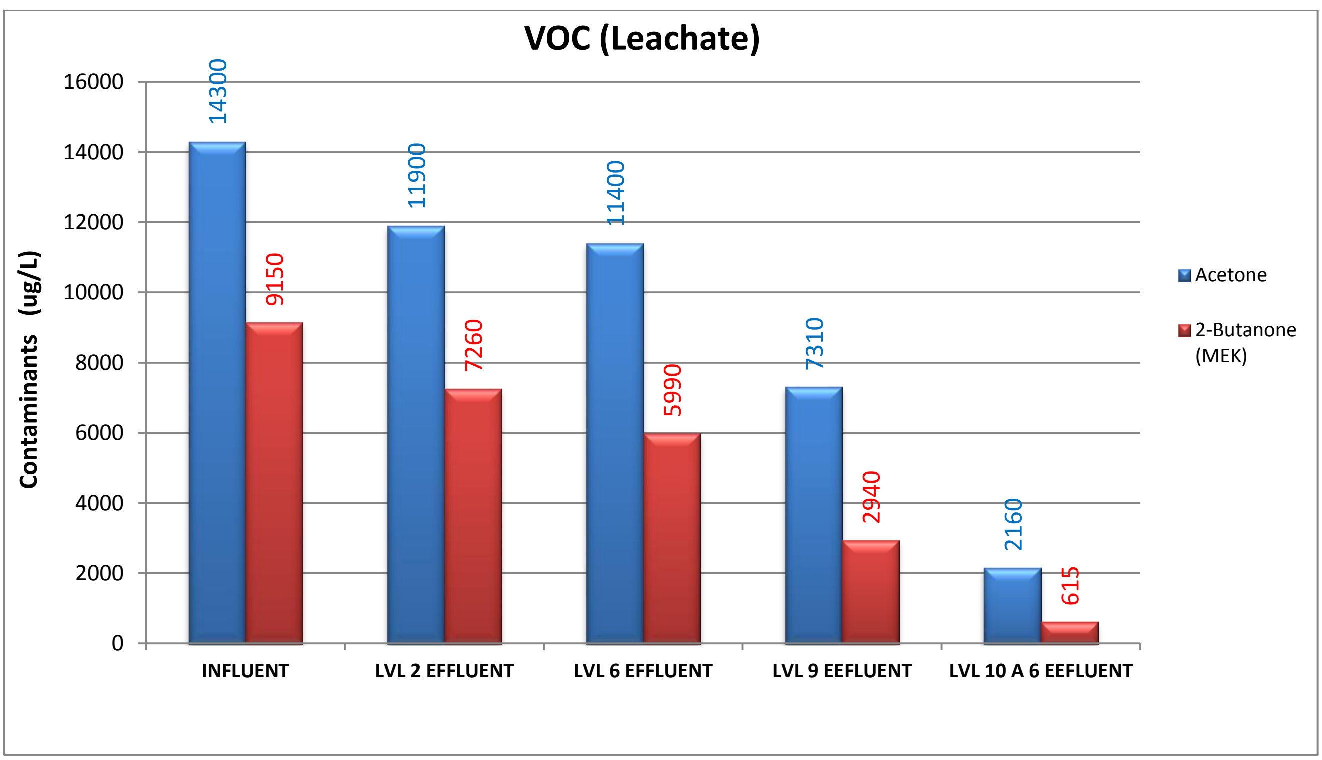


Figure 20

Table 47

PARAMETER	LEACHATE VOC By 8260 Removal %					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Acetone	14300	16.78%	20.28%	48.88%	84.90%	47.55%
2-Butanone (MEK)	9150	20.66%	34.54%	67.87%	93.28%	100.00%

Table 48

PARAMETER	LEACHATE VOC By 8260 (µg/L)					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Tetrahydrofuran	1210	1010	681	198	24.1	1850
Toluene	981	493	223	22.5	6.6	980

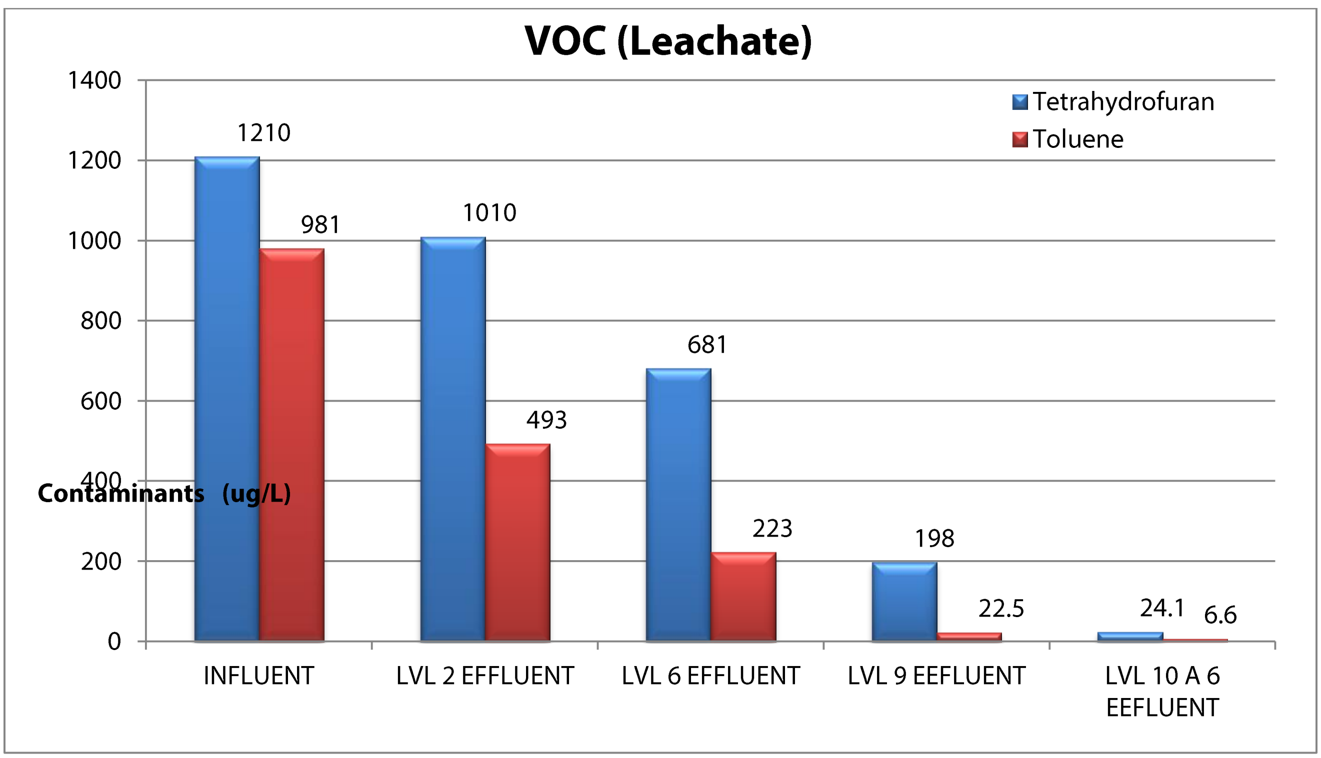


Figure 21

Table 49

PARAMETER	LEACHATE VOC By 8260 Removal %					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Tetrahydrofuran	1210	16.53%	43.72%	83.64%	98.01%	
Toluene	981	49.75%	77.27%	97.71%	99.33%	

5.1.6 Perfluorocarbons (PFCs)

Perfluorocarbons are emerging contaminants that are increasingly showing up in landfills and gathering importance. They are durable and non-biodegradable. In fact they are used for their non-degradability as fire retardant as well as fire suppressants.

Although in this particular leachate sample only trace PFOA was detected but in several other landfill leachate samples which we have tested there has been substantial levels of PFCs especially high carbon >8 species present. The system successfully has removed them to non-detect levels.

Following tables and graph show these results for this test.

Table 50

PARAMETER	LEACHATE PFC (µg/L)					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Perfluorobutanesulfonic acid	ND	ND	ND	ND	ND	ND
Perfluoroheptanoic acid	ND	ND	ND	ND	ND	ND
Perfluorohexanesulfonic acid	ND	ND	ND	ND	ND	ND
Perfluorononanoic acid	ND	ND	ND	ND	ND	ND
Perfluorooctanesulfonic acid	ND	ND	ND	ND	ND	ND
Perfluorooctanoic acid	0.35	0.23	0.11	ND	ND	0.94

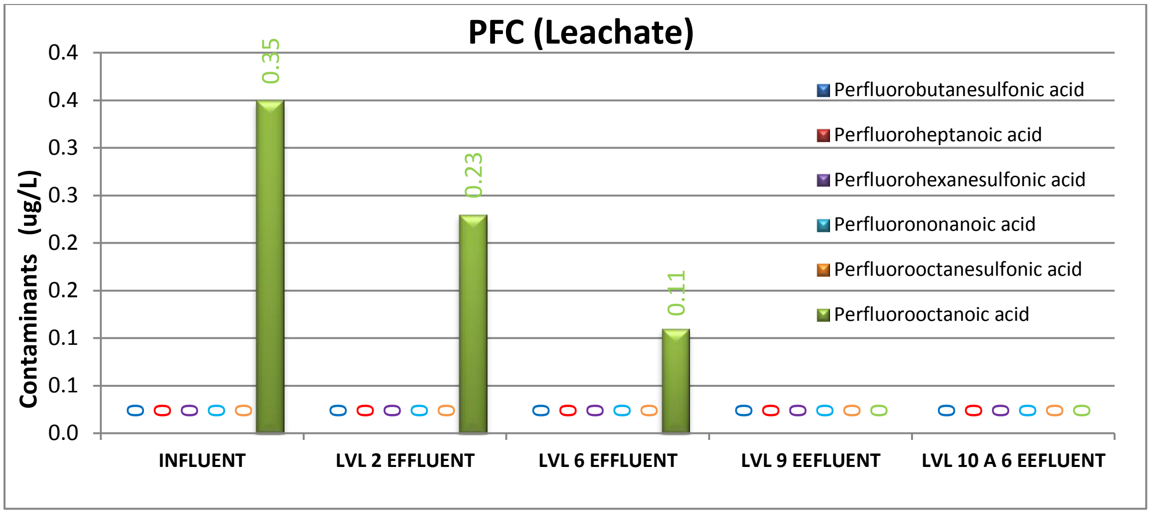


Figure 22

Table 51

PARAMETER	LEACHATE PFC Removal %					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
Perfluorobutanesulfonic acid	N/A	N/A	N/A	N/A	N/A	N/A
Perfluoroheptanoic acid	N/A	N/A	N/A	N/A	N/A	N/A
Perfluorohexanesulfonic acid	N/A	N/A	N/A	N/A	N/A	N/A
Perfluorononanoic acid	N/A	N/A	N/A	N/A	N/A	N/A
Perfluorooctanesulfonic acid	N/A	N/A	N/A	N/A	N/A	N/A
Perfluorooctanoic acid	0.35	34.29%	68.57%	100.00%	100.00%	

5.2 Septage

Similarly septage samples were treated using LB L2 and LBL10 and results indicated that LB L10 removed all the contaminant to levels below the Drinking Water and Clean Water Standards.

The graphs and table presented here show these results for indicator parameters such as BOD, COD, TSS, TDS; metals such as ferrous and non-ferrous as well as heavy metal; semi-metals such as Phosphorus, Nitrogen, Sulfur, Chlorine etc.; VOCs and SVOCs.

Table 52

PARAMETER	SEPTAGE BOD_5, COD, TDS, & TSS (mg/L)					
	INFLUENT	LVL 2 EFFLUENT	LVL 6 EFFLUENT	LVL 9 EEFLUENT	LVL 10 A 6 EEFLUENT	LVL 9 CONCENTRATE
BOD_5	1850	289	ND	6.9	ND	7760
COD	3490	543	193	ND	ND	24800
TDS	1300	1360	947	41	22	1430
TSS	2380	117	74	ND	ND	9500

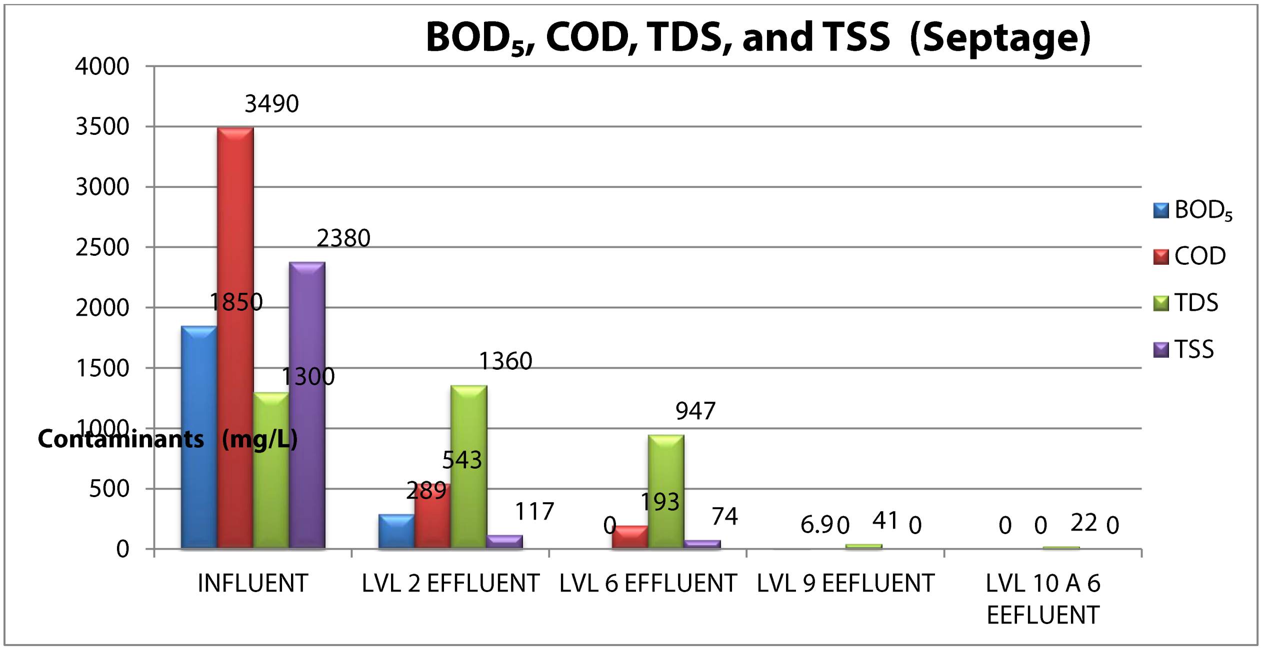


Figure 23

Table 53

	SEPTAGE BOD_5, COD, TDS, & TSS Removal %					
PARAMETER	**INFLUENT**	**LVL 2 EFFLUENT**	**LVL 6 EFFLUENT**	**LVL 9 EEFLUENT**	**LVL 10 A 6 EEFLUENT**	**LVL 9 CONCENTRATE**
BOD_5	1850	84.38%	100.00%	99.63%	100.00%	
COD	3490	84.44%	94.47%	100.00%	100.00%	
TDS	1300	0.00%	27.15%	96.85%	98.31%	
TSS	2380	95.08%	96.89%	100.00%	100.00%	

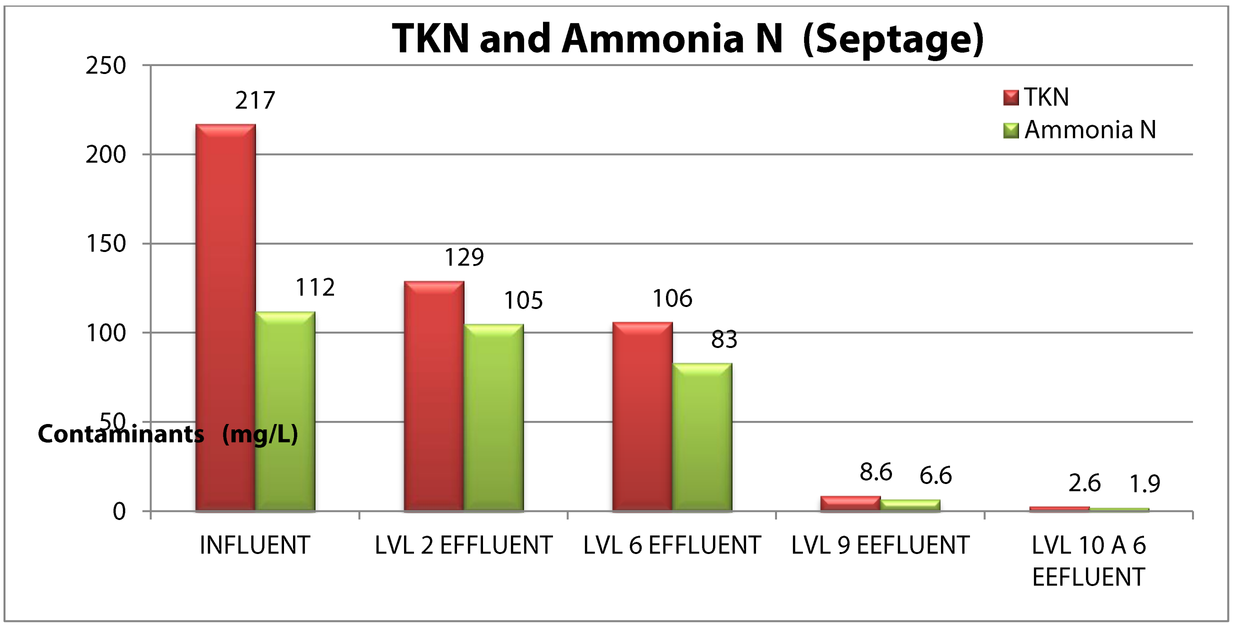


Figure 24

Table 54

	SEPTAGE TKN & Ammonia Nitrogen Removal %					
PARAMETER	**INFLUENT**	**LVL 2 EFFLUENT**	**LVL 6 EFFLUENT**	**LVL 9 EEFLUENT**	**LVL 10 A 6 EEFLUENT**	**LVL 9 CONCENTRATE**
TKN	217	40.55%	51.15%	96.04%	98.80%	
Ammonia N	112	6.25%	25.89%	94.11%	98.30%	

Table 55

	SEPTAGE TKN & Ammonia Nitrogen (mg/L)					
PARAMETER	**INFLUENT**	**LVL 2 EFFLUENT**	**LVL 6 EFFLUENT**	**LVL 9 EEFLUENT**	**LVL 10 A 6 EEFLUENT**	**LVL 9 CONCENTRATE**
TKN	217	129	106	8.6	2.6	673
Ammonia N	112	105	83	6.6	1.9	140

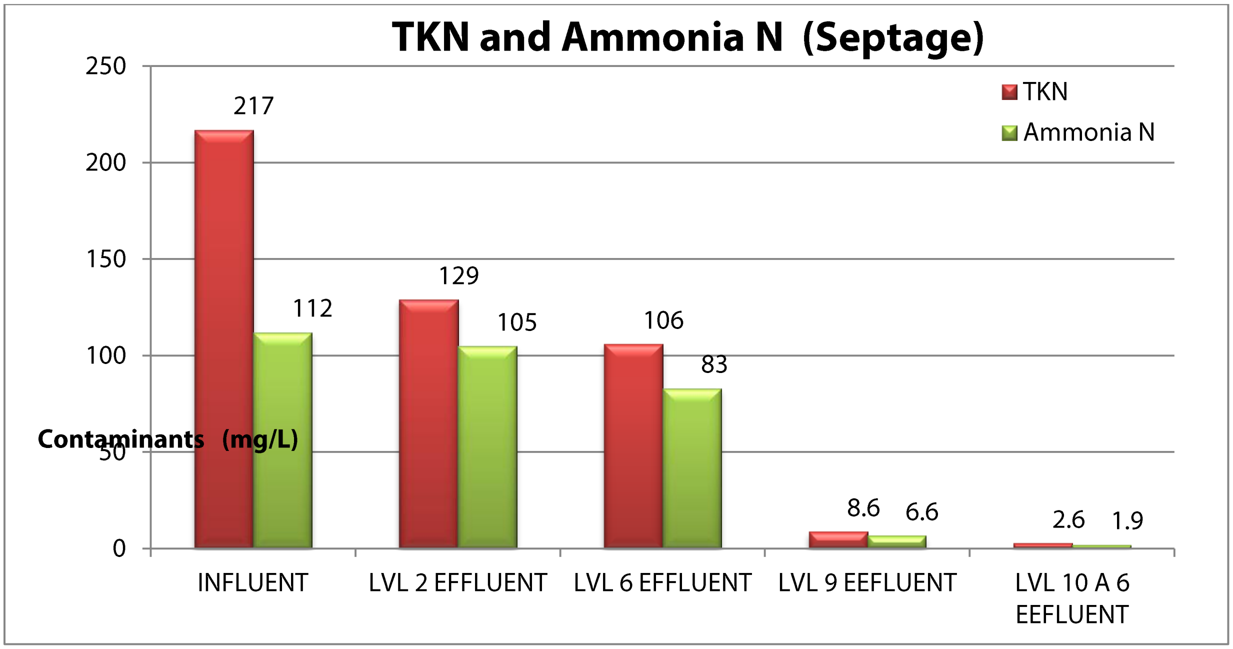


Figure 25

Table 56

	SEPTAGE TKN & Ammonia Nitrogen Removal %					
PARAMETER	**INFLUENT**	**LVL 2 EFFLUENT**	**LVL 6 EFFLUENT**	**LVL 9 EEFLUENT**	**LVL 10 A 6 EEFLUENT**	**LVL 9 CONCENTRATE**
TKN	217	40.55%	51.15%	96.04%	98.80%	

6 Challenges

The Septage at the MSB has proven to be relatively unique and challenging in that it had substantial variations in contaminant concentrations. It has rather complex chemistry with high levels of salts (TDS > 6,000), which can contribute to membrane clogging in traditional membrane treatment systems. High levels of suspended, dissolved and total solids require the use of specialized membranes to avoid clogging and frequent cleaning.

This wastewater stream has relatively high conductivity of up to 6000 µS/cm (almost 10 times higher than normal sewage), which can pose some limitations on the recovery rate. The final complete process and full-sized system solution required some considerations to overcome this challenge and achieve desirable recovery rates.

7 Conclusions

After careful analysis and review of the treatability study date the following conclusions were reached:

- The system will be designed to meet the performance requirements at varying temperatures. Design parameters will be obtained during the long term pilot study.
- Preliminary data indicated that no pH or temperature adjustment is required to obtain optimum performance from the membranes. This may change after the long term pilot study and necessary adjustment will be made to meet any possible deviations from the results of the preliminary tests.
- Trans-membrane pressure, Δp, was within the anticipated range for these samples. However, spatial or temporal variability may exist in the actual waste streams. A longer term (4 to 6 weeks) study may be needed to evaluate this possible variability and include them in the system design.
- The LEACHBUSTER® system can successfully remove up to 99% of the contaminants from the tested waste stream from MSB septage and leachate samples.
- The LEACHBUSTER® system can handle varying levels of conductivity and contaminant concentrations and produce varying qualities of treated water for discharge to the environment or put for beneficial reuse in and around the treatment plant.
- LB L10 membranes yielded the highest quality effluent which meets Water Quality Standards. Also the LB L6 and LB L9 membranes produced high quality effluents which can meet NPDES, if needed, and other similar discharge limits should the proposed disposal method change.
- Membrane life based on the test results and data collected during the treatability study is estimated to be at least 18 months, for the Level 2 membranes, and at least 48 months, for the Level 10 membranes.
- Based on the this study data and results, a rough order of magnitude (ROM) capex and annual operating expenses can be provided as part of Phase I PER.

8 Recommendations

Based on the results of these tests, Clark recommends that MSB should install a LEACHBUSTER® system utilizing LB L10 where high-quality water is produced that can meet the both the Drinking Water and Clean Water Standards or, be partially or totally reused in and around the landfill and treatment plant. This option, followed by a concentrate processing system to further reduce the volume of the disposable waste, presents the most economical and practical system for this application.

Section 7: Financial Analysis and Cost Estimates

1 Introduction

This section will provide an opinion of probable capital, O&M, and uniform annual cost (equivalent uniform annual cost) of various options explored in this report. We will not go through all the options suggested by other consultants (CH2M, HDR, and HDL); however, their reports are available if more information is required.

The design and analysis provided are based on assumptions provided throughout this report including the physical location of the receiving station, the septage and leachate treatment building, and storage tanks as well as road and site work required for truck and other vehicles access to the treatment facility. If the location of the building is changed, substantial savings may be realized as the need for the required access road may be diminished.

In addition, previous reports (CH2M report and PPT) have focused on data received from AWWU with an estimated 13,000,000 gallons of leachate and septage delivered for treatment by haulers. That amounts to a uniform daily volume of approximately 26,000 gallons (GPD). Clark utilized and performed a statistical analysis and suggested design options based on several confidence levels. As outlined in previous sections, Clark suggests one option for leachate treatment, namely a 20,000 GPD system to cover 75% of the spectrum including having two landfill cells open simultaneously. For septage treatment, Clark provides several options since the Borough has the option of not accepting the total volume delivered by the septage haulers in a single day.

Based on the cost analysis and calculation of the equivalent annual cost (uniform annual cost), we calculated the average probable treatment cost/fee per gallon, 1000 gallons, and 3,000 gallons (capacity of an average septage tanker truck) of wastewater (septage and leachate). For capital cost comparison, we used two financing options: ADEC Loan and USTDA Loan. It is our understanding that MSB wishes not to go through bonding, but to operate the septage treatment facility as an enterprise with tipping fees covering the loan repayment and annual operating costs. These two funding strategies will be compared to the AWWU hauling and disposal costs.

2 Assumptions

Based on Clark's review of previous reports developed by various consultants over the past ten years on behalf of MSB and our understanding of the funding availability for this project, we have made the following assumptions:

2.1 Hauling and Disposal Cost to AWWU

The hauling and disposal from MSB to ANC was calculated by CH2M in 2015 as listed in the following tables.

Hauling costs from MSB to ANC was estimated by CH2M based on the following:

- 80 miles of round trip travel with 2 hours of travel time
- 5 miles per gallon
- $3.00 per gallon for fuel
- Labor rate of $25.00 per hour plus 25% for benefits
- Other vehicle costs (excluding labor and fuel): $0.46 per mile
- AWWU discharge rate per $1,000 gallons: $22.60
- Average size of tanker: 3,000
- Hauling costs within MSB were assumed to be the same whether haulers deliver the discharge to Anchorage or to a facility located within the MSB. The following table was developed by CH2M in their 2015 report to MSB.

Table 57

Estimated Breakdown of current disposal cost for Mat-Su Haulers

Cost Item	Estimated Cost/3,000 gal
Fuel	$48.00
Labor	$62.50
Truck maintenance & Insurance	$36.80
AWWU discharge cost*	$75.58
Total	$222.88

*AWWU is currently conducting a rate study for a proposed rate increase in 2017, to be approved by the RCA.

If we add a CPI of 2.5% per year, the above cost escalates to approximately $230.45 per tanker truck, assuming the discharge/disposal fee remains the same.

2.2 Funding

The following assumptions were used to develop the comparison of funding alternatives:

- Annual operating expenses: Reference attached tables
- Capital Costs: Reference attached tables
- Annual septage and leachate received at the treatment facility
  - Leachate: 20,000 GPD; reference attached tables
  - Septage: Reference attached tables

Note that CH2M reported that in 2015, close to 13,000,000 gallons of septage were received by AWWU, which included 1 million gallons of leachate. All CH2M derivations were based on this volume. Clark's proposed treatment plant will treat a much higher volume to cover daily and monthly variations, as well as accommodate future growth within the Borough.

Clark prepared two different funding scenarios based on our understanding of the funding options available to the Borough.

- Option 1: Loan from Alaska Department of Environmental Conservation (ADEC) Clean Water program
  - ADEC: 1.5% interest rate, 20 year term, no issuance costs
- Option 2: Loan form USTDA Rural Development Grant/Loan Program
  - USDA: 3.125% interest rate, 40 year term, no issuance costs, up to 30% grant

Interest rates used in this analysis are estimated interest rates. Actual interest rates on loans at the time of issuance may be different. This will be analyzed in more details in Phase II of the project.

3 Results

3.1 Operating Expenses

Table 58 presents the equivalent uniform annual cost for operating expenses.

Table 58: Annual O&M

System Capacity GPD	120,000	220,000	235,000	270,000
EUAC O&M ($)	$355,000	$535,000	$594,000	$657,000
	29,565,000	32,850,000	38,599,000	44,348,000
Cost/Gallon	$0.037	$0.045	$0.041	$0.037
	$36.52	$44.89	$40.70	$37.22
Cost/3000 Gallons	$110	$135	$122	$112

3.2 Capital

Tables 59.A and 59.B present the equivalent uniform annual debt service costs for each of the funding scenarios analyzed. It is assumed that USDA Loan will be augmented with 30% grant.

Table 59.A - Projected Annual Debt Service Costs (USDA)

USDA Loan

System Capacity GPD Septage + Leachate	120,000	220,000	235,000	270,000
Capital Cost	$16,989,000	$21,641,000	$22,403,000	$22,619,000
	($5,097,000)	($6,492,000)	($6,721,000)	($6,786,000)
Debt Financed	$11,892,000	$15,149,000	$15,682,000	$15,833,000
	3.13%	3.13%	3.13%	3.13%
Term	40	40	40	40
	0%	0%	0%	0%
Annual Debt Serv	$749,917	$955,238	$749,917	$998,438
	29,565,000	32,850,000	38,599,000	44,348,000
Cost/Gallon	$0.038	$0.048	$0.044	$0.041
	$38.12	$48.20	$44.28	$41.18

Cost/3000 Gallons	$114	$145	$133	$124

Note: Salvage Value is excluded.

Table 59.B - Projected Annual Debt Service Costs (ADEC)

ADEC Loan

System Capacity GPD Septage and Leachate	120,000	220,000	235,000	270,000
Capital Cost	$16,989,000	$20,640,000	$20,403,000	$22,619,000
	$0	$0	$0	$0
Debt Financed	$16,989,000	$20,640,000	$20,403,000	$22,619,000
	1.5%	1.5%	1.5%	1.5%
Term	20	20	20	20
	0%	0%	0%	0%
Annual Debt Serv	$989,548	$1,260,477	$1,304,888	$1,317,480
	29,565,000	32,850,000	38,599,000	44,348,000
Cost/Gallon	$0.037	$0.045	$0.041	$0.037
	$36.52	$44.89	$40.70	$37.22
Cost/3000 Gallons	$110	$135	$122	$112

Note: Salvage Value is excluded.

3.2.1 Comparison

Table 60 presents a comparison of costs of various treatment options (capacity) as well as probable financing offered (ADEC and USDA) of a local treatment facility within MSB and the “do nothing” option which is to dispose septage to the facility in Anchorage at total cost of $230.45 per tanker (3000 gallons). As stated previously, this comparison assumes the costs to collect septage within the MSB would be the same for each scenario, so those costs are excluded from both. This comparison focuses on the costs to haul and discharge a 3,000 gallon tanker at the AWWU facility to the disposal costs at an MSB facility under both funding scenarios.

Table 60A: Total Cost (USDA)

Total Cost with USDA Loan

System Capacity GPD Septage + Leachate	120,000	220,000	235,000	270,000
	$0.025	$0.029	$0.026	$0.023
	$0.012	$0.016	$0.015	$0.015
Probable Ga Treated	29,565,000	32,850,000	38,599,000	44,348,000
Total Cost/Ga	$0.038	$0.048	$0.044	$0.042
	$38.12	$48.20	$44.28	$41.18
Cost/3000 Gallons	$114	$145	$132.83	$123.54

Note: Salvage Value is excluded.

Table 60B: Total Cost (ADEC)

Total Cost with ADEC Loan

Percentile	25	50	75	99
System Capacity GPD Leachate + Septage	**120,000**	**220,000**	**235,000**	**270,000**
	$0.033	$0.038	$0.034	$0.030
	$0.012	$0.016	$0.015	$0.015
Probable Ga Treated	29,565,000	32,850,000	38,599,000	44,348,000
Total Cost/Ga	$0.037	$0.045	$0.041	$0.037
Cost/1000 Gallons	$36.52	$44.89	$40.70	$37.22
	$110.00	$135.00	$122.09	$112.00

Note: Salvage Value is excluded.

Capital and O&M costs in this analysis assume that leachate is treated separately from septage. During Phase II of the project, we may consider co-treatment of leachate and septage once the Borough decides on the final desired septage treatment capacity. The effluent from the both leachate and septage treatment systems will be sent to subsurface drain fields. The concentrate from the leachate treatment system will be sent back to the landfill. The concentrate from the septage treatment system will be pressed into sludge and land applied or disposed into the landfill. The liquid from the screw press will be sent back into the septage or leachate treatment system. The large solids recovered at the receiving station systems will be collected into dumpsters and sent into the landfill. While CH2M considered a leachate evaporation system ($3 million capital and $1.4 million/year for O&M; CLF Development Plan, CH2M HILL, 2014), we do not see a need for such system.

Section 8: Integrated Waste Management, Resource Recovery, and Renewable Energy System

1 Project Description

1.1 Growth Problems

The Mat-Su Central Landfill is the Borough's main receiving station for the municipal solid waste (MSW) generated in the Borough. The county is home to approximately 104,000 people and is growing at the rate higher than other parts of Alaska. This growth raises several critical environmental concerns including life span of the entire landfill, constructing new cells for accepting the growing tonnage of MSA, health and safety issues related to organic wastes exposed to air, storage of unfriendly material such as plastics and other oil-based, non-degradable material, dust, odor, wile-life exposure, etc.

In addition, Alaska's current total energy cost is one of the two highest in the USA (number 2 after Connecticut). Its current electricity and motor fuel prices are among the highest with ranking of 4 in both categories. Alaska ranks last in renewable energy production in the United States; only 0.77% of its energy generated is through renewable means (source: energy.gov).

At the same time, Mat-Su Borough's residents experience one of the highest tipping fees for garbage disposal in the United Sates. This is due to the fact that per unit cost of landfill construction in Alaska is much higher than the lower 48 states.

Residents in the surrounding neighborhoods, as well as those who live and work within the landfill may be exposed to air that is contaminated with high levels of noxious gases. Plans are underway to add additional cells to the landfill, but the growing Borough will continue to generate waste, which must be disposed of into additional future cells.

Waste production surpasses the Borough's storage and treatment capacity every 5 years; thus, additional cells must be constructed at an already high cost that increases higher than yearly inflation. The Central Landfills accepts more than 180 tons of garbage per day. The landfill plan for on-site leachate collection and treatment system is the first step toward a positive solution as the tipping fee in Anchorage wastewater treatment facility increases over time.

Human/municipal wastewater is also a problem; while there are collection services that will empty private septic systems, capacity for solid and liquid waste treatment is insufficient and much untreated sewage ends up in Anchorage. The Borough's plan for construction of a septage collection and treatment system at the central landfill is a positive step towards solving this issue.

1.2 A Solution

Anaerobic digestion and biogas capture have been used to provide energy since the 1870s and were extensively researched and developed in the 1970s. However, most of this research focused on single-source, single-stage biogas production. The Clark/Evergreen team has improved the traditional anaerobic digestion process by incorporating more than one waste stream as well as multi-stage process with addition of bio-catalyst to aide in high volatile solid conversion into biogas. This results in both increased biogas production and more efficient wastewater treatment. As noted by Dr. Charles Clanton of the University of Minnesota, the Evergreen Energy digester in Mercer, Wisconsin, "exceeds a well performing digester at greater than 2.4 times to total digester volume."

Clark has developed an integrated waste management and waste-to-energy conversion system that integrates the above process into its total waste solution plant. In addition to more than doubling the energy output, the process provides several additional useful products, including clean water for irrigation, fertilizer, sandblasting glass, renewable diesel fuel, and usable metals that are reclaimed from the waste input. The system starts with a sorting system as depicted on the following page.

The outcome of this project will be a clean, reliable source of energy, clean water, organic fertilizer, and a dramatic improvement in health and sanitation resulting from the processing of 90% of the Borough's waste. Mat-Su Borough's already in-place system for collecting both human waste and municipal solid waste can be used to route waste to a waste-to-energy facility (right at the landfill property), where it will be separated into components and processed to produce green gas (biogas) or electricity, as well as the byproducts mentioned above.

The biogas generated through the AD process could be cleaned into grid-quality natural gas and sold to Enstar Natural Gas. Or, the gas could be converted into electricity and send to the grid; the primary customer for the power generated at the facility will be Matanuska Electric Association Alaska Utility, the Borough's electric producer. As stated previously, State of Alaska ranks at the very bottom in renewable energy production. This and other facilities could improve this ranking while producing energy at very reasonable and sustainable rates.

In addition, the hardly degradable plastics could be converted into green diesel or heating fuel through pyrolysis. It must be noted that Alaska has one of highest motor fuel costs in the nation. The capex and opex of the proposed pyrolysis system for production of green diesel is economically very attractive.

Local off-takers will be determined for the additional useful production products, including fertilizer, sandblasting glass, and salvaged metals. Proceeds from the sale of the increased energy output and the byproducts of the process make the Clark Evergreen process more financially feasible than traditional anaerobic digesters, while at the same time providing greater benefits in reliable energy and waste disposal for the Borough. The ultimate beneficiaries will be the resident of the Borough who will see cleaner conditions, lower fees and renewable energy. The addition of this total waste management will also lead to an increase in industries in the city, thus increasing the number of available jobs.

1.3 Anticipated Benefits

The plant would process approximately 200 tons of MSW per day and will generate much needed renewable energy at a very affordable cost. It is anticipated that the organics could be converted into 4.5 MW of power. At per capita consumption of close 13,000 kWh in USA of power, the plant could provide electricity to thousands of household in the Borough.

While the Borough's garbage and human waste collection services are very good, they still do not meet current needs. We estimate that individuals living in and near the Borough would directly benefit from a cleaner environment, while the rest of the Borough's population will indirectly benefit from improved garbage processing practices.

Additionally, the Borough will be able to process only a portion of the liquid human waste collected from individual septic tanks after a new septage treatment facility is constructed. The additional waste could be directed to this future total waste management system.

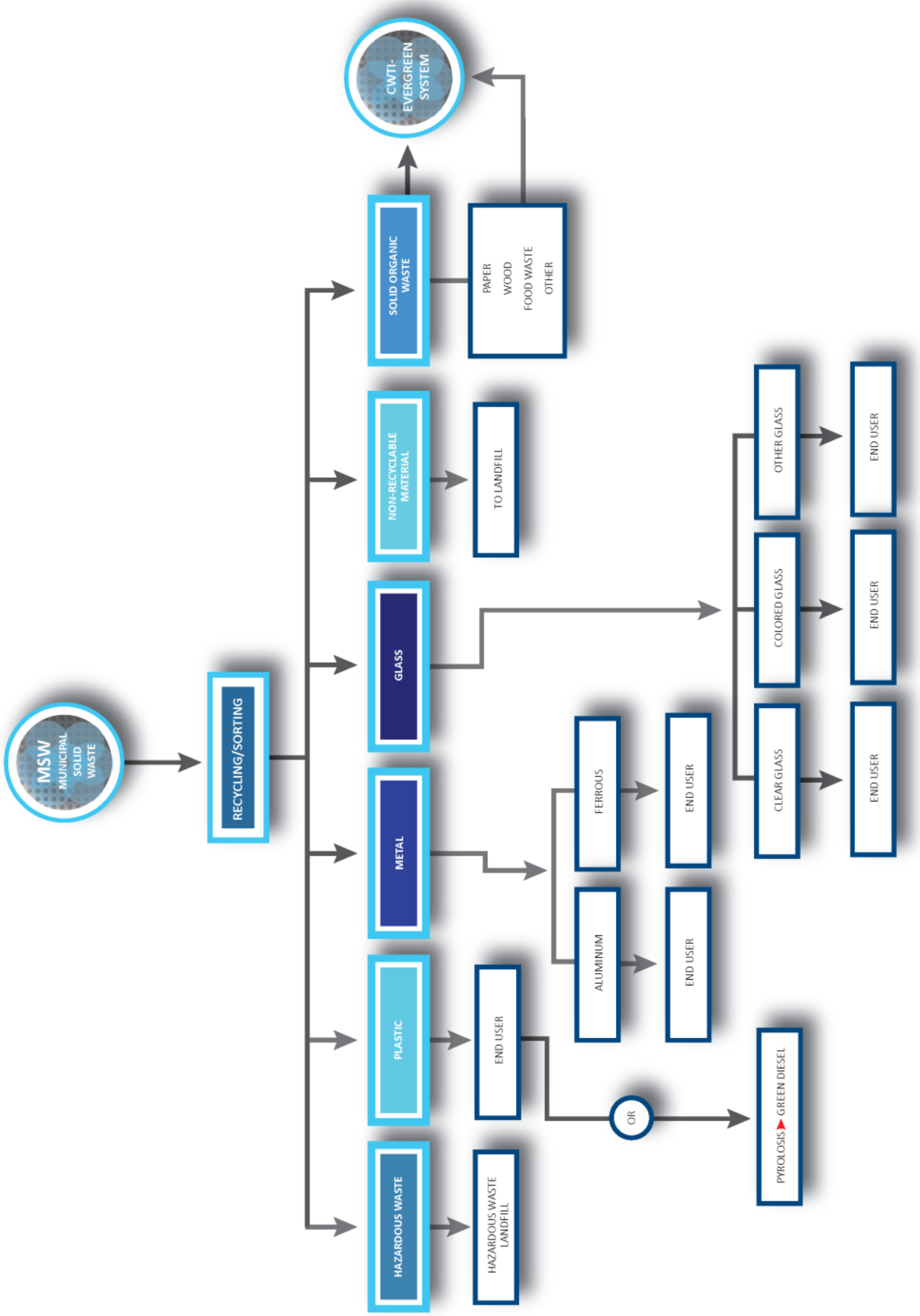
The initial facility will employ approximately 20 individuals to operate the anaerobic digester and an additional 10 individuals to operate the other parts of the treatment facility. It is also estimated that indirect employment in industries associated with the facility will increase considerably. Construction of a second plant could be planned after the first facility goes on line.

Finally, the agricultural sector in and around the Borough will directly benefit from the production of clean water for irrigation, as well as organic fertilizer. It is estimated that the first facility will produce water and fertilizer sufficient to supply several hundreds of acres of water-intensive crops.

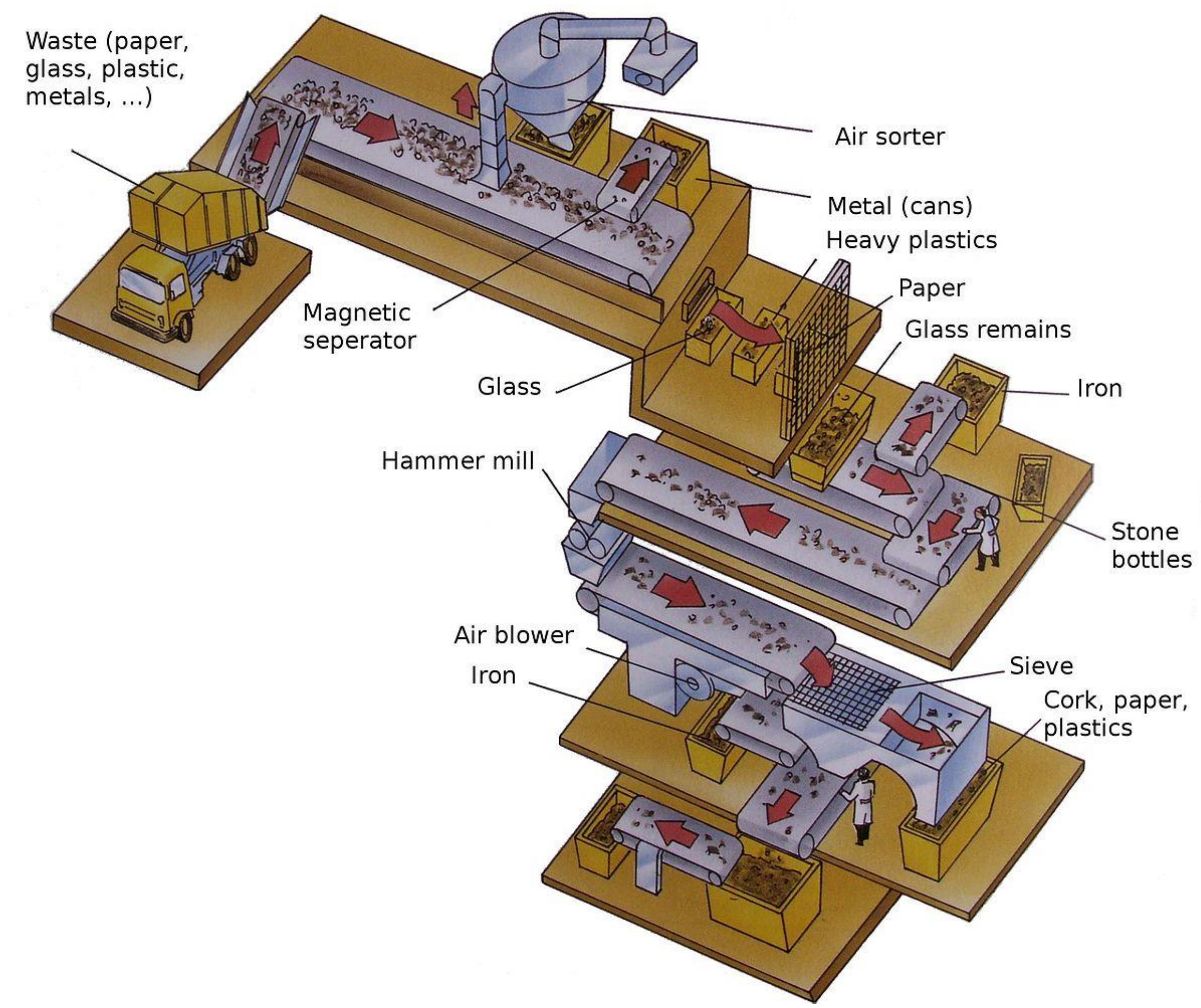
2 Project Components

2.1 Materials Recovery Facility (MRF)

The materials recovery facility will be a state-of-the-art system sorting the solid wastes into recoverable materials such as plastics, aluminum, other metals, glass, and organic material. These materials will be sold to the end users or used as fuels in our suggested processes. The plastics will be sent into the pyrolysis system, while the organics will be converted into biogas through anaerobic digestion. There are markets for all these materials, fuels generated, and the by-products such as clean water and fertilizer. MRF systems have been around for decades. They range from labor intensive to fully automatic systems that need very few operators.


MSW
MUNICIPAL SOLID WASTE
RECYCLING/SORTING
HAZARDOUS WASTE
PLASTIC
METAL
GLASS
NON-RECYCLABLE MATERIAL
SOLID ORGANIC WASTE
HAZARDOUS WASTE LANDFILL
END USER
TO LANDFILL
PAPER
WOOD
FOOD WASTE
OTHER
CWTI-EVERGREEN SYSTEM
ALUMINUM
FERROUS
END USER
END USER
CLEAR GLASS
COLORED GLASS
OTHER GLASS
END USER
END USER
END USER
OR
PYROLOSIS GREEN DIESEL

Following is an example a sophisticated MRF/Sorting System:



2.2 Pyrolysis (Gasification)

Many of the plastics, tires, and carpets that are sorted by the MRF can be converted back into a valuable green fuel. This fuel can be used to run diesel engines, furnaces, boilers, or vehicles used for public transportation. Pyrolysis processes have been around for many years; however, they are more sophisticated and can be constructed faster with lower CAPEX and OPEX. Depending on the usage, the fuel oil from this process could be configured to the most useable and specifications by back-end further processing such as distillation.

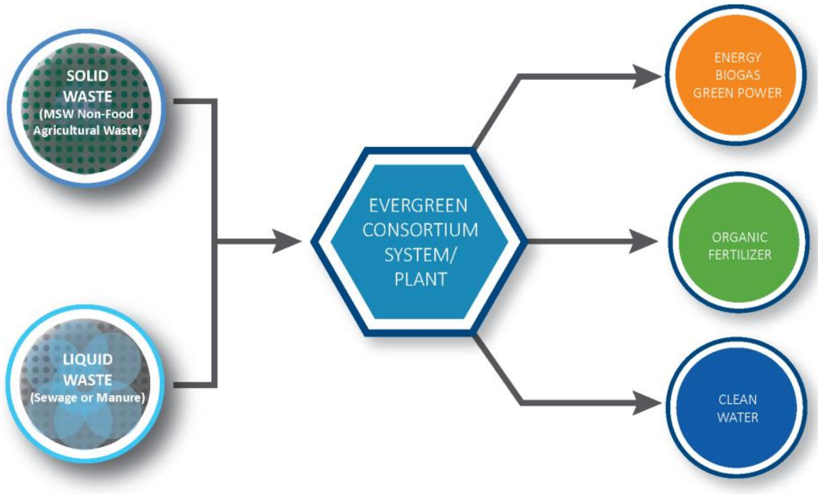
Following is an example of a pyrolysis system built and in operation by our partners:

2.3 Anaerobic Digestion

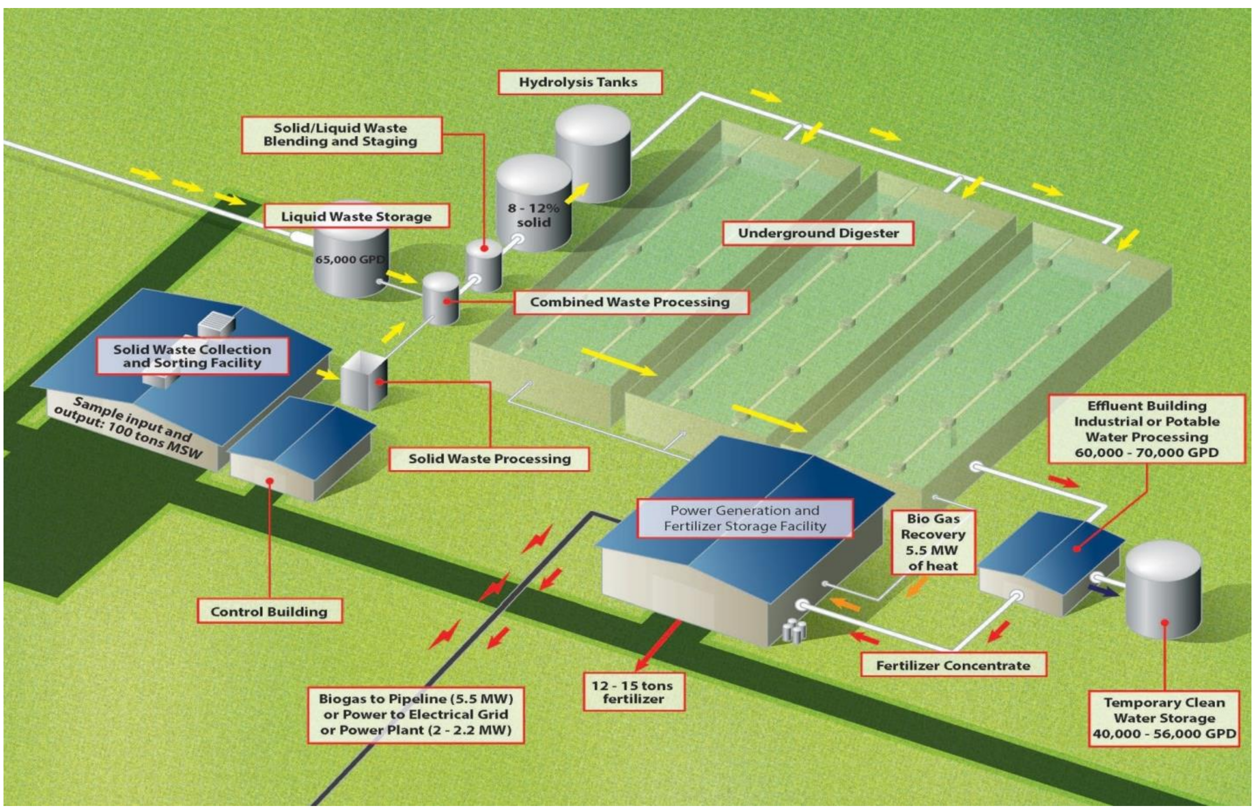
The organics part of the sorted MSW along with a portion of the septage will be diverted into a Clark-Evergreen AD system, where it will be treated using one of the most robust AD processes and converted into biogas (methane), fertilizer, and clean water. There are markets for both water and fertilizer, if they are not intended to be used right at the landfill or around the plant if another location is chosen. The biogas could be used in vehicles within the Borough or sent to end users through the nearby pipeline. It could also be compressed into CNG and shipped for sales to end users.

If desired, much of that biogas could be converted into green electricity utilizing Gensets or turbines. We anticipate Gensets will suffice in this particular application. With an electric power facility, green power can be provided to many more thousands of residences and businesses nearby.

The organics are then introduced into Evergreen waste-to-energy conversion plant as shown below.



Following is a Schematic View of a Clark-Evergreen Integrated Waste to Energy Plant:



2.4 Public Education

The WTE facility could be an integral component of the public education process to be incorporated into a curriculum for local and regional districts and university and colleges. The intent is to educate the public on the possibilities of sustainability and green energy, and how waste products can be put to beneficial use.

2.5 Technical Experience

As a multi-discipline engineering firm, Clark Engineering has naturally gravitated toward renewable energy, waste management, and resource recovery. Our team works with clients and the challenges they face to develop innovative technologies and solutions for recovering resources and converting liabilities into valuable assets. The expertise in this area encompasses recovering and reusing water from polluted effluents to converting organic material into energy, clean water, and fertilizer to heat recycling and energy savings.

3 Business Experience and Track Record

Selected project experience is provided on the following pages.

LOCATION

New London, Kandiyohi County, Minnesota, USA

COMPLETION

October 2015

CURRENT SYSTEM CAPACITY

Expandable to 80,000 GPD

While membrane technology is not new, the solution Clark Technology and Clark Engineering delivered to Kandiyohi County is unique to its membrane technology predecessors. The LEACHBUSTER® is a membrane-based system capable of processing in excess of the 20,000 gallons per day of leachate flow the landfill currently produces in a single pass.

The system was engineered to interface with the leachate pumping and storage system previously operating at the landfill. Four 20,000 gallon underground storage tanks hold leachate that is pumped into a 2,000 gallon leachate pre-filtration and concentration tank. The leachate is pumped through the system and, in a single pass, is cleaned below the NPDES regulatory discharge limits. Clean water, which meets the U.S. National Drinking Water Standard, is stored on site for use in irrigation and discharge to an adjacent infiltration basin.

Features of the new system include a Programmable Logic Controller (PLC) that allows for easy system control and monitoring, as well as a patented cleaning and maintenance system.

The system at Kandiyohi County went through a rigorous vetting process by the Minnesota Pollution Control Agency (MPCA). Proceedings and a snapshot of data from these studies are provided on the next page.

Before the Minnesota Pollution Control Agency (MPCA) would issue a permit to operate, a multi-stage inspection and verification process consisting of numerous analytical tests was performed. The MPCA was interested in contaminants of emerging concern such as PFAs and PCBs, as well as more typical measures of water quality, such as TSS, COD, and the like. An advantage of the LEACHBUSTER® noted by the MPCA was that because the system relies on a physical separation process rather than a chemical transformation process, there is a lack of harmful chlorinated byproducts or chemically recalcitrant contaminants.

	Concentrations of PFAs in raw leachate, treated effluent, and concentrate			
Analyte	Raw Leachate	Treated Leachate	Removal (%)	Units
Perfluorobutane sulfonate (PFBS)	680	ND	100.00	ng/l
Perfluorohexanoic Acid	8300	ND	100.00	ng/l
Perfluoroheptanoic Acid	3200	ND	100.00	ng/l
Perfluorohexane sulfonate (PFHxS)	2600	ND	100.00	ng/l
Perfluorooctanoic Acid (PFOA) and Salts	4500	ND	100.00	ng/l
Perfluorooctane Sulfonate (PFOS) and Salts	1100	ND	100.00	ng/l

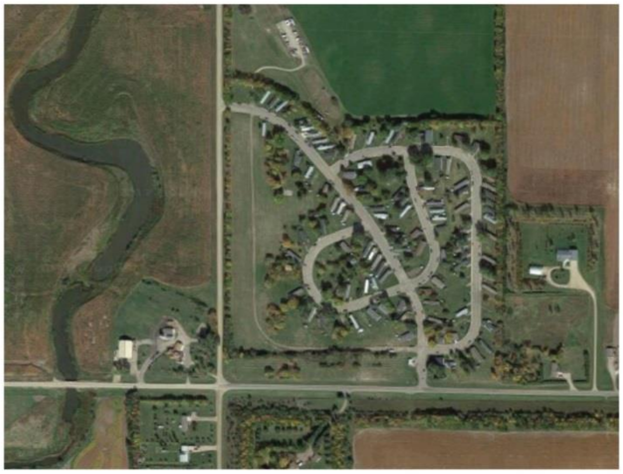
	Concentrations of common contaminants in raw leachate, treated effluent, and concentrate			
Analyte	Raw Leachate	Treated Leachate	Removal (%)	Units
Biological Oxygen Demand, 5 day	4020	18.4	99.54	mg/L
Chemical Oxygen Demand	5960	91.9	98.46	mg/L
Alkalinity, Total as $CaCO_3$	3570	110	96.92	mg/L
Total Dissolved Solids	7600	82	98.92	mg/L
Total Suspended Solids	170	ND	100.00	mg/L
Nitrogen, Ammonia	580	10.3	98.2	mg/L
Nitrogen, Kjeldahl, Total	644	10.6	98.35	mg/L

Alibayramli – Landfill Leachate Treatment Plant	
Location	City of Alibayramli, Azerbaijan
Capacity	52,000 GPD
In operation since	2013
Input materials	Landfill leachate
Special features	Provided for a 1,000,000 person city, continues to meet BOD < 30 mg/l and TSS levels < 10 mg/l
Delivered product	LEACHBUSTER® Technology, including screening, tanks, and pumps

MUNICIPAL WASTEWATER TREATMENT

Maragheh – Municipal Sewage Treatment Plant	
Location	City of Maragheh, East Azerbaijan
Capacity	10.6 MGD
In operation since	2005
Input materials	Sewage
Special features	Provided for a 100,000 person city, continues to meet BOD, TSS levels < 10 mg/l
Delivered product	ABJ sequencing batch reactor, including screening, SBR tanks, chlorination

Country Village Wastewater Treatment Plant Project
Aberdeen, SD



Location

Aberdeen, Brown County, South Dakota, USA

Completion

September 2017

Current System Capacity

20,000 GPD

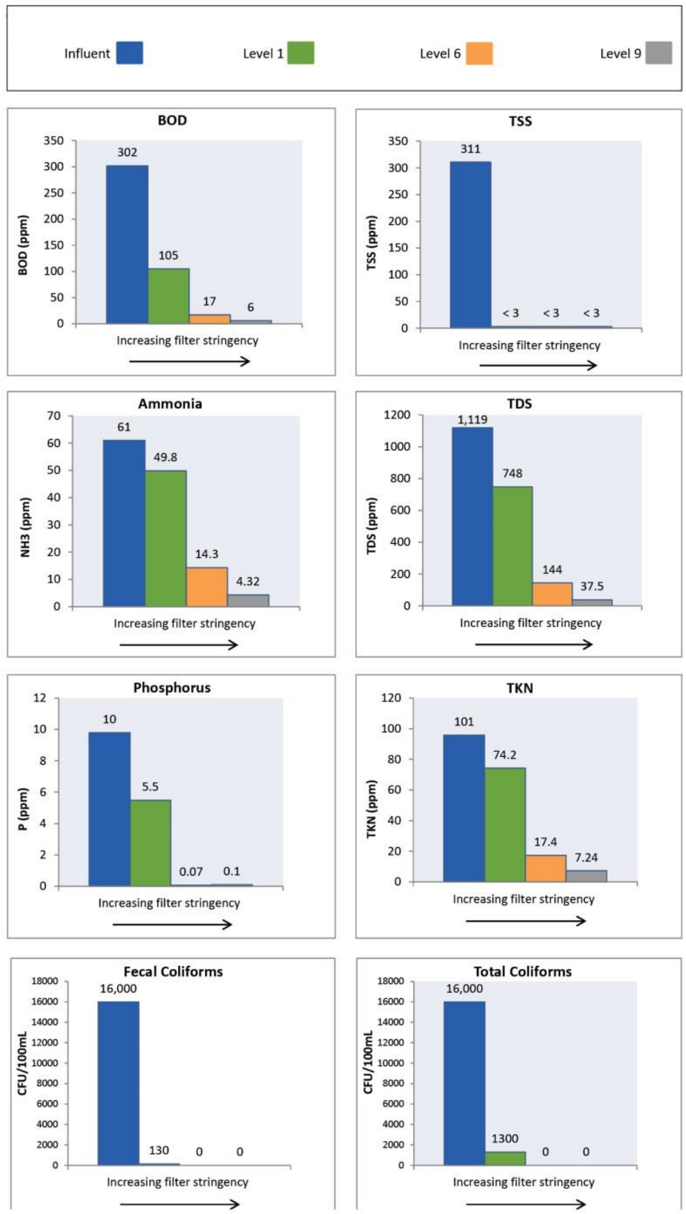
Features

Pre-manufactured treatment skid
Remote monitoring

The Country Village residential development outside Aberdeen, South Dakota, selected Clark to design and build a LEACHBUSTER® wastewater treatment plant to treat incoming sewage. The development's single-cell stabilization lagoon was leaking and posed a threat to water quality in nearby Foot Creek, which is classified as a warm water fishery. Clark evaluated several options, including installing piping to the city's wastewater system, identifying nearby land to add a lagoon, and construction of a total retention facility. None of these options was feasible in the end. The owner of the development decided to move forward with the LEACHBUSTER®.

Data from samples collected and tested by the South Dakota Department of Health Laboratory demonstrate the capabilities of the different membrane stringency levels in the context of treating municipal wastewater. Representative results are shown in the charts on the following page. If required, the system is capable of removing contaminants beyond what is shown in the charts by using higher level membranes.

LEACHBUSTER® technology is compact and robust enough to handle a wide range of water and wastewater treatment applications from landfill leachate to septage to municipal sewage to industrial wastewater and beyond.


Influent
Level 1
Level 6
Level 9
BOD
BOD (ppm)
302
105
17
6
Increasing filter stringency
TSS
TSS (ppm)
311
< 3
< 3
< 3
Increasing filter stringency
Ammonia
NH3 (ppm)
61
49.8
14.3
4.32
Increasing filter stringency
TDS
TDS (ppm)
1,119
748
144
37.5
Increasing filter stringency
Phosphorus
P (ppm)
10
5.5
0.07
0.1
Increasing filter stringency
TKN
TKN (ppm)
101
74.2
17.4
7.24
Increasing filter stringency
Fecal Coliforms
CFU/100mL
16,000
130
0
0
Increasing filter stringency
Total Coliforms
CFU/100mL
16,000
1300
0
0
Increasing filter stringency

Monticello - Sequencing Batch Reactor Facility

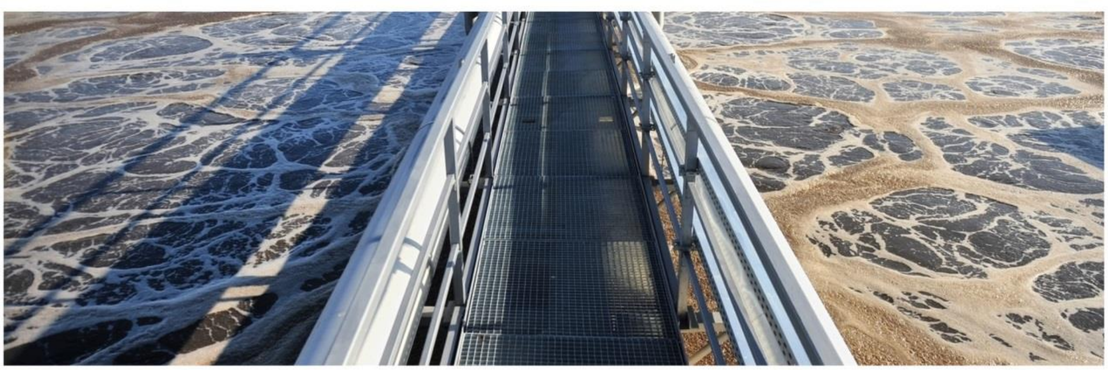
Location	Monticello, Minnesota, USA
Capacity	2.1 MGD
In operation since	2005
Input materials	Sewage
Special features	Three-tank SBR facility for the city, including headworks equipment, two-stage anaerobic digesters, biogas collection, sludge thickening, sludge storage, and odor control facilities

North Branch – Wastewater Treatment Plant Expansion

Location	North Branch, Minnesota, USA
Capacity	0.8 MGD
In operation since	2006
Input materials	Sewage
Special features	Biological nutrient removal oxidation ditch wastewater treatment plant expansion
Delivered product	Engineering report and package, including construction documents, construction administration, project management, and operation and maintenance manual

Azerbaijan Armed Forces – Municipal Sewage Treatment Plant

Location	Country of Azerbaijan
Capacity	2 units at 105,000 GPD, 1 unit at 66,000 GPD
In operation since	2011
Input materials	Sewage
Special features	Provided 5,000 person brigade, effluent used for irrigation during growing season and discharged into river during winter
Delivered product	Continuous Flow Cyclic Activated Sludge System (CFCAS) Reactor



LIVESTOCK WASTEWATER TREATMENT

Afton Farms, Partner in Pork, Farmland Industries – Hog Waste Treatment

Location	Creston, Iowa, USA
Capacity	200,000 GPD
Population	5,200 pigs
In operation since	1998
Input materials	Livestock waste from hogs
Special features	Treated effluent was returned to the barns for flushing and washing the floors
Delivered product	Single Basin Extended Aeration Cyclic Reactor (SBEACR) modified, screening/ press, SBEACR tanks, chlorination

Taatjes Farm – Hog Waste Treatment

Location	Raymond, Minnesota, USA
Capacity	40,000 GPD
Population	500 pigs
In operation since	1998
Input materials	Livestock waste from hogs
Special features	Grant applied for through the Agricultural Utilization Research Institute of Minnesota to test the technology through a pilot plant for treatment of livestock wastewater
Delivered product	Single Basin Extended Aeration Cyclic Reactor (SBEACR) modified, screening/press, SBEACR tanks, chlorination

Little Pine Dairy Farms – Dairy Cow Waste Treatment

Location	Perham, Minnesota, USA
Capacity	200,000 GPD
Population	1,800 head of dairy cows
In operation since	2001
Input materials	Livestock waste from dairy cows
Special features	Treated effluent was returned to the land for irrigation; the dried and sterilized solids were reused as bedding
Delivered product	Single Basin Extended Aeration Cyclic Reactor (SBEACR) modified, screening press, liquid/solid separation, SBEACR tanks, solid drying and bagging

Gilger Slaughter House and Minnesota Beef Industries – Anaerobic Biodigester and Wastewater Treatment

Location	Buffalo Lake, Minnesota, USA
Capacity	150,000 GPD
Population	400 cows/day slaughter capacity
In operation since	2001
Input materials	Livestock waste from slaughtered cows
Special features	Fluidized bed high-rate anaerobic biodigester to process high COD waste; treated effluent was returned as wash water
Delivered product	Anaerobic biodigester, Single Basin Extended Aeration Cyclic Reactor (SBEACR) modified, screening press, liquid/solid separation, SBEACR tanks, solid drying and bagging

Gold'n Plump Poultry – Biological Nutrient Removal/Membrane Wastewater Treatment Plant

Location	Cold Spring, Minnesota, USA
Capacity	2.4 MGD
In operation since	2006
Input materials	Poultry processing waste and wastewater
Special features	Conversion of conventional activated sludge wastewater system to a biological nutrient removal and nitrification/denitrification membrane treatment facility
Delivered product	Engineering report and package, including construction documents and operation, and maintenance manual

Finzen Farms and Farmland Industries – Hog Waste Treatment	
Location	Atkins, Iowa, USA
Capacity	100,000 GPD
Population	2,500 pigs
In operation since	2001
Input materials	Livestock waste from hogs
Special features	Treated effluent was returned to the barns for flushing and washing the floors
Delivered product	Single Basin Extended Aeration Cyclic Reactor (SBEACR) modified, screening/press, SBEACR tanks, chlorination

WATER TREATMENT

Azerbaijan Potable Water Treatment	
Location	67 villages across Azerbaijan
Capacity	Varies from 5,000 GPD to 80,000 GPD
Population	250 to 3,000 people per village
In operation since	2008
Input materials	Kur and Aras Rivers
Special features	Rivers contained high turbidity and bacterial and chemical contamination; projects all completed within nine months of contract execution
Delivered product	Micro filtration, ultra filtration, nano filtration, and reverse osmosis systems

Spencer – Water Treatment Plant

Location	Spencer, Iowa, USA
Capacity	1.0 MGD
In operation since	2000
Input materials	River water
Special features	Lime softening plant for the Spencer Municipal Utility
Delivered product	Facility plan, engineering report, and package, including construction documents, construction administration, project management, and operation and maintenance manual

St. Cloud – Water Treatment Expansion

Location	Monticello, Minnesota, USA
Capacity	24 MGD
In operation since	2002
Input materials	River water
Special features	Lime softening water treatment plant expansion
Delivered product	Facility plan, engineering report, and package, including construction documents, construction administration, project management, and operation and maintenance manual

Brooklyn Park – Water Treatment Expansion

Location	Brooklyn Park, Minnesota, USA
Capacity	10.0 MGD
In operation since	2004
Input materials	River water
Special features	Iron and manganese removal
Delivered product	Facility plan, engineering report, and package, including construction documents, construction administration, project management, and operation and maintenance manual

Building Large Scale Waste to Energy Plant in Leeuwarden, the Netherlands

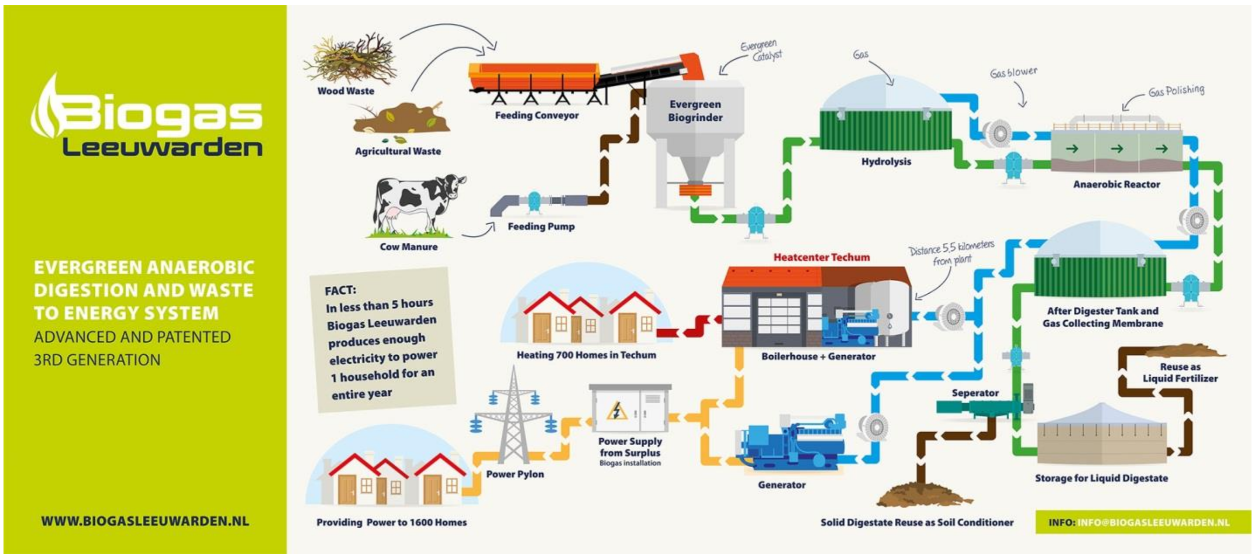
As shown in our YouTube video at https://www.youtube.com/watch?v=bAcJtF7SKSg, development of the Leeuwarden Biogas project started in 2013 and finally was commissioned and went into operation on October of 2015.

The Dairy Campus of Wageningen University and Research Center (WUR) is the top-ranked agricultural research university in the world by U.S. News & World Report. Originally, a waste-to-energy plant on campus converted cow manure into biogas (methane) using traditional anaerobic digesters. The biogas production was originally designed to fuel two 340 kW generators and heat nearby residences on campus.

The traditional system failed to yield the necessary biogas production and operationally became obsolete. A new Minnesota based bio-catalytic conversion system protected by several patents and a patent-pending technology developed by Clark Engineering, Clark Technology, Evergreen Energy, Adverio Engineering, and Clear Water Technologies were used to retrofit the plant. The retrofit involved applying the patent-pending technology by adding process equipment and structurally modifying the digesters into multi-stage digesters, as well as adding gas sparging and polishing.

Readily available organic waste materials (cow manure, wood waste, and agricultural waste) are transported to the plant for a tipping fee or at no cost. High-quality organic fertilizer, a by-product of the plant, is then returned to the feedstock providers, which will benefit agriculture in the region, while consumers receive sustainably produced energy.

This advanced third generation anaerobic digester (AD) of the future allows high-efficiency conversion of organics into clean energy at volatile solid reduction of more than 90%. The revived facility produces 60% more biogas at a lower cost compared to the original system. The plant uses 50,000 tons of manure and 36,000 tons of agricultural waste per year to produce electricity for 1,700 residences and heat for an additional 700 residences. In five hours, Biogas Leeuwarden produces enough electricity to meet the needs of one family for an entire year.



Aberdeen – Power and Gas to Client (Biomass ADA)

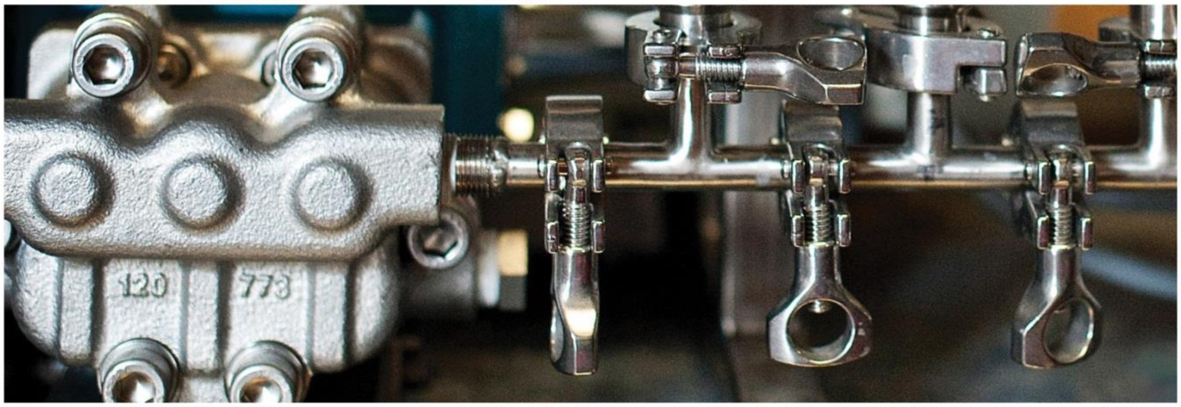
Location	Aberdeen, Scotland
Capacity	1.920 kWe
In operation since	1998
Input materials	Hog waste
Special features	Gas and electrical use "off grid" for farm
Delivered product	Engineering package, procurement, construction

Clear Water Technologies Laboratory

Location	Fridley, Minnesota, USA
Capacity	Bench top lab testing
In operation since	2000
Input materials	Sugar beet pulp, potato waste, woody cellulose, MSW, grass, human waste, cow manure, and fruits and vegetable waste
Special features	Lab testing to determine basic parameters of anaerobic digestion
Delivered product	Total implementation of bench top anaerobic digestion reactors

Morris – CAFO Manure Digester/Gasifier Analysis Project – Agricultural Utilization Resources Institute (AURI)

Location	Morris County, Minnesota, USA
Capacity	9.1 MW with annual generation of about 65,000 MWH
In operation since	Concept development and feasibility reports completed 2005
Input materials	Animal manure and municipal solid waste
Special features	15 CAFOs in the region produce 50,000 tons of dry manure, conversion of the biogas to electrical MWH
Delivered product	Based on this information to date, both a gasification and anaerobic digestion project has been constructed



Evergreen Energy Mercer Plant

Location	Mercer, Wisconsin, USA
Capacity	5,000 cubic feet per day of biogas through anaerobic digestion
In operation since	2008
Input materials	Human waste
Special features	Produced natural gas to determine output and financial data
Delivered product	Total engineering, procurement, and construction

Evergreen Energy Mercer Plant

Location	Mercer, Wisconsin, USA
Capacity	8,000 cubic feet per day of biogas through anaerobic digestion
In operation since	Trials from 2008-2010
Input materials	Aspen wood and human waste
Special features	Natural gas production from hard cellulose
Delivered product	Design of the process in a lab then total engineering, procurement, and construction

Power to Grid/Heat to Customer (Biomass AD) Jointly with OHbE

Location	Stadskanaal, Netherlands
Capacity	2.000 kWe
In operation since	2012
Input materials	Cattle manure and agro residues
Special features	Ammonia elimination; heat utilization for local hospital
Delivered product	Engineering package

Evergreen Energy Mercer Plant

Location	Mercer, Wisconsin, USA
Capacity	12,000 cubic feet per day of biogas through anaerobic digestion
In operation since	Trials from 2011-2013
Input materials	Municipal solid waste and human waste
Special features	Produced natural gas to determine output and financial data
Delivered product	Total engineering, procurement, and construction

OTF – Plant Power (AD) Joint Project with Nivoba

Location	Kislang, Hungary
Capacity	4.000 kW and biogas for steam production
In operation since	2012
Input materials	Cattle manure, straw and agro residues
Special features	Steam production
Delivered product	Conceptual engineering; further implementation is waiting financing

Nasonville Dairy – Energy Plant

Location	Nasonville, Wisconsin, USA
Capacity	2 MW
In operation since	Engineering completed in 2013; permitting underway with start-up anticipated in 2018
Input materials	Cheese production waste materials
Special features	Two-state anaerobic digester with full scale production 750 wet tons/day used to produce biogas to generate power in addition to the thermal recovery
Delivered product	Design-build documents delivered with guaranteed maximum price

ABC Board Company (biomass for board)

Location	Wijster, Netherlands
Capacity	50,000 tons per year
In operation since	N/A
Input materials	Raw biomass fibers
Special features	Cradle-to-cradle end product
Delivered product	Feasibility, business plan, preparation for permits, engineering in progress – expected start-up Q2 2018

Astarta - Plant Power (Biomass AD)

Location	Globino, Ukraine
Capacity	15,000 kWe equivalent/production of 7,000m^3 biogas/hour
In operation since	1st phase, Dec. 2013/ 2nd phase March 2014
Input materials	Beet pulp and maize silage
Special features	Biogas upgrading and water treatment facility
Delivered product	Engineering package; construction and commissioning support

Nij Bosma Zathe – Retrofit – Power to Grid, Heat to Grid & Gas to Grid (Biomass AD)

Location	Leeuwarden-Goutum, Netherlands
Capacity	700 kWe; 5,000,000 nM^3/year – 36,000 tons biomass/year
In operation since	2016, Engineering design completed, permits are in place, start construction Q1, 2018
Input materials	Cattle manure, grass and wood chips
Special features	Retrofit of existing AD facility; proposed AD technology according US patented Hogen® process
Delivered product	Engineering package for retrofit and financing

Biogas Kootstertille – Gas to Grid (Biomass AD)

Location	Kootstertille, Netherlands
Capacity	SDE 1.25mM^3/hour/8,000,000nM^3/year; 75,000 ton biomass/year
In operation since	2016, Engineering design completed, permits are in place, start construction Q1, 2018
Input materials	Cattle manure, grass, and wood chips
Special features	Proposed AD technology according US patented Hogen® process
Delivered product	Engineering package for retrofit and financing

Phoenix – CAFO Manure Digester/Gasifier Analysis Project

Location	Pinal County, Phoenix, Arizona, USA
Capacity	20 MW with annual generation of about 155.2 GWh (with packed manure)
Capacity	1.3 million MMBTU/year, 167 MMBTU/hour (with slurry manure)
In operation since	Concept development and feasibility reports completed 2013
Input materials	Animal manure and municipal solid waste
Special features	36 CAFOs in the region produce 4.6 million tons of both packed and slurry manure, Integrated Waste Management approach together with County's municipal solid waste; conversion of the biogas to electrical MWH
Delivered product	Arizona Public Service Commission formulating an Environmental Portfolio Standard for their overall Megawatt-hour sales

ABC Board Company (Board and Biogas) with Dabar Ingenieros Valencia, Spain

Location	El Ejido, Andalusia, Spain
Capacity	50,000-ton board and 3 MW for electricity and heat
In operation since	Q2, 2017
Input materials	Biomass fibers from tomato and pepper
Special features	Own energy production; cradle-to-cradle end product
Delivered product	Feasibility, business plan, permits documents; waiting for financial close; engineering in progress; expected start-up Q2 2017

Palestine – Power to Grid (Biomass AD)

Location	Hebron, Palestine Territory; farm lined AD facility
Capacity	340 kWe
In operation since	Scheduled for Q1 2018
Input materials	Cattle manure and agro residues
Special features	Project partly funded by EVD/NL foreign affairs
Delivered product	Feasibility and engineering package completed; waiting for permit approval; detailed engineering in progress; tasks: project management, supply of key equipment and (local) construction

South Korea – Power (Biomass from Sewage / AD)

Location	Incheon/Seoul, South Korea; AD facility linked to sewage plant
Capacity	1,800 kWe
In operation since	Scheduled for Q4 2018
Input materials	Sewage sludge and food residues
Special features	A digestate dryer and wastewater treatment system included
Delivered product	Feasibility study and conceptual engineering completed; scheduled in 2014, complete EPCM contract; waiting for financial close

Biogas Wijster – Gas to Grid (Biomass AD)

Location	Wijster - ETP, Netherlands
Capacity	1.250nM^3/hour - 10,000,000nM^3/year; 90,000 ton biomass/year
In operation since	Scheduled start Q2 2018
Input materials	Cattle manure, grass, and wood chips
Special features	Proposed AD technology according US patented Hogen® Process
Delivered product	Engineering package for permit and SDE application; permits & SDE awarded; project owner is waiting for financing

ESP Plant Power & Fertilizer (Biomass AD) with Dabar Ingenieros Valencia, Spain

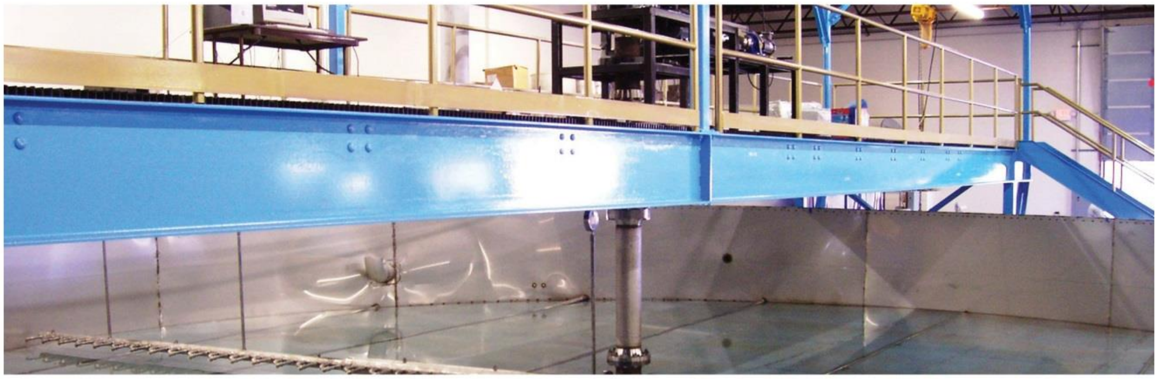
Location	Torre Pacheco I, Murcia, Spain
Capacity	1.000 kWe
In operation since	N/A
Input materials	Cattle manure and agro residues
Special features	Evaporator and dryer for biofertilizer
Delivered product	Full permit and engineering package; construction on hold for financing

ESP Plant Power & Fertilizer (Biomass AD) with Dabar Ingenieros Valencia, Spain

Location	Torre Pacheco II, Murcia, Spain
Capacity	1.000 kWe
In operation since	N/A
Input materials	Cattle manure and agro residues
Special features	Dryer for biofertilizer
Delivered product	Full permit and engineering package; construction on hold for financing

ESP Plant Power & Fertilizer (Biomass AD) with Dabar Ingenieros Valencia, Spain

Location	Guadassuar, Murcia, Spain
Capacity	1.000 kWe
In operation since	N/A
Input materials	Cattle manure and agro residues
Special features	Dryer for biofertilizer
Delivered product	Full permit and engineering package; construction on hold for financing



ESP Plant Power & Fertilizer (Biomass AD) with Dabar Ingenieros Valencia, Spain

Location	Sarrion, Teruel, Spain
Capacity	1.000 kWe
In operation since	N/A
Input materials	Cattle manure and agro residues
Special features	Dryer for biofertilizer
Delivered product	Full permit and engineering package; construction on hold for financing

UK – Power to Grid (Biomass AD)

Location	Methwold, East Anglia, United Kingdom
Capacity	1.600 kWe
In operation since	N/A
Input materials	Pig and broiler manure and agro residues
Special features	Feedstock supply and digestate offset completely within the same estate
Delivered product	Full permit and complete engineering package; construction on hold for financing

POWER PLANTS

Jamaica Public Services – Retrofit – Combined Cycle Power Station with General Electrics	
Location	Bouge Power Station – Jamaica
Capacity	80 MW Combined Cycle Gas Fired
In operation since	2001 plant expansion, 2008 retrofit
Special features	Packaged centralized chiller system with 5,200-ton refrigeration capacity
Delivered product	Engineering package, including structural, civil, piping, land surveying, and project management

Nigeria NEMA – Retrofit – Combined Cycle Power Station with General Electric	
Location	Nigeria
Capacity	Confidential
In operation since	2009 retrofit
Special features	Retrofit gas turbine inlet filter house structure for implosion
Delivered product	Structural engineering design and analysis, including FEA model and report

Secunda – Combined Cycle Power Station Heat Recovery System with Deltak	
Location	Secunda – Republic of South Africa
Capacity	Confidential
In operation since	2010 retrofit
Special features	Heat recovery steam generation retrofit
Delivered product	Structural engineering design and analysis, including FEA model and report

Manzanillo – Combined Cycle Power Station with General Electric	
Location	Manzanillo, Mexico
Capacity	900 MW
In operation since	2012
Special features	GE gas turbine inlet filter system
Delivered product	Structural engineering design and analysis, including FEA model and report

Az Zour – Combined Cycle Power Station with General Electric	
Location	Az Zour, Kuwait
Capacity	Currently 800 MW
In operation since	2013 retrofit
Special features	GE gas turbine inlet filter system
Delivered product	Structural engineering design and analysis, including FEA model and report

4 Additional Information

We strongly believe the Clark Evergreen System is the most robust and state-of-the art solution for this project. It offers the most efficient conversion of municipal biomass into biogas energy, organic fertilizer, and clean water using the Clark Evergreen System. This section presents the Clark Evergreen System Detailed Process Report.

4.1 Introduction: Efficient Biomass Conversion Using the Patented Clark Evergreen Process

The process of efficiently and rapidly converting complex biomass substrates – substrates with substantial fractions of hard-to-digest cellulose and lignin - into useable forms of energy began more than 20 years ago in the laboratory of Clear Water Technologies, Inc. (CWTI, Minneapolis, Minnesota, USA, one of Clark's standing partners.) This accelerated digestion process – the CWTI Process - developed and patented by CWTI founder, Del Hogen, was refined through a series of bench-top, batch reactor tests, so that 90% or more of the digestible carbon (volatile solids) in these complex organic materials can now be converted to biogas – converted more rapidly and more completely than simpler organic materials in traditional anaerobic digestion systems. The Hogen Process derives its digesting power from specific acetogenic bacteria, which use the CWTI solid catalyst to create one of the most energy-rich anaerobic fermentation pathways to be found in nature.

4.1.1 Proven Performance

More than two decades of experience developing the CWTI Process has consistently demonstrated its applicability to the bio-conversion of a wide variety of organic wastes and other biomass providing the following benefits:

- **Sequestration of sulfur in the bio-solid**s and the virtual removal of hydrogen sulfide (H_2S) from the gas phase of the digestion system. With H_2S levels below 7 ppm, corrosion in downstream power generation equipment – Gensets, turbines, and boilers – is eliminated, and gas scrubbing costs minimized.

- **Sequestration of phosphoru**s in the bio-solids, and its significant reduction in the liquid phase of the digestion system and discharge water.
- **Reduction in residual carbon** (volatile solids not converted to biogas) to less than 10% of the carbon present in the feedstock at the beginning of the CWTI Process.
- **Recovery of 80% or more of the NPK-rich bio-solids** – as organic fertilizer. Organic fertilizer, as opposed to commercial fertilizer, retains all of the macro and micronutrients present in original plant biomass.

4.1.2 The Biological Process

Complex organic material in anaerobic aqueous environments is catalyzed and converted to biogas and bio-solids as a result of naturally occurring microorganisms. All conventional wastewater treatment systems depend, in part, on this process. The uniqueness and power of the CWTI Process is derived from both specific acetogenic (acid forming) bacteria and specific hydrogenic (hydrogen-forming) bacteria thereby: (1) powering the conversion of more carbon to biogas than bacteria in conventional anaerobic systems – typically, 50% more and (2) increasing the energy content of the biogas (more methane and methane-equivalent gases, less carbon dioxide) by 25% or more than conventional digesters. In addition, the CWTI Process provides the additional benefit of sequestering sulfur and phosphorous in the bio-solids – not in the biogas or discharge water.

4.1.3 Nutrient Sequestering

Nutrients such as phosphorous, sulfur, and ammonia (nitrogen) are commonly referred to as macro nutrients because they are required in large amounts to support cell growth. The CWTI Process is designed to sequester and remove these macro nutrients from the water column- Nitrogen, which is reduced to ammonia (NH_4) under the anaerobic conditions in the digester, can be precipitated out of the aqueous phase as ammonium carbonate, ammonium sulfate or other nutrient salts valuable as organic fertilizer. These ammonia digestion salts are more bio-available than nitrogen in the nitrate or nitrite form.

The combination of proper feedstock (fiber) preparation and conditioning coupled with the CWTI Process offers our partners the most efficient MSW-to-energy biomass conversion system in the world – whether the conversion is through anaerobic digestion or through gasification The conversion of potentially polluting organic wastes to valuable byproducts with virtually no unwanted byproducts left over, makes the CWTI Process the "greenest" of all green technologies. Green benefits include waste mitigation, the displacement of fossil fuel (coal, natural gas and petroleum) with a renewable fuel (biogas), the displacement of fossil fuel-generated, resource-limited commercial fertilizer by renewable organic fertilizer, and recovery of clean water suitable for re-use. In addition, the CWTI Process makes sound financial sense – profit margins, typically are above 70% without government subsidy.

4.1.4 Implementation -From Laboratory to Commercial Scale Plant (The CWTI – Evergreen System)

With the completion of the laboratory testing phase in 2008, a field facility/pilot project was designed and constructed at a 1/100th scale of a large commercial scale facility. The pilot plant was designed and developed by CWTI and Evergreen Technology, LLC of Mercer, Wisconsin, USA to confirm that the CWTI Process can operate at or above the efficiencies demonstrated in the laboratory testing phase;

specifically, the pilot was designed to confirm: (1) the 90%+ carbon-to-biogas conversion rates in a continuous-flow process (lab testing is a “batch” process), (2) the high methane/methane-equivalent composition and energy/heat value of the biogas, (3) the high nutrient composition of the bio-solids (organic fertilizer) by-product, (4) the quality of the discharge water, suitable for irrigation and/or industrial process use, and (5) the production of sulfur-free biogas, thereby reducing corrosive sulfuric acid contamination in biogas by 100-fold or more (Evergreen biogas is typically below 5 ppm H_2S).

Section 9: Drawings (Provided Separately)

Section 10: Appendices

Appendix 1

Regulators' Correspondence

ADEC Email

From: "Aldrich, Lori (DEC)" <lori.aldrich@alaska.gov>
Date: July 25, 2017 at 4:36:25 PM AKDT
To: "Madden, Mark G." <MaddenMA@ci.anchorage.ak.us>, Spafford Mark <spaffordmw@muni.org>, "christiansensb@muni.org" <christiansensb@muni.org>, "Maryott, Jack" <JMaryott@kpb.us>, "Clore, Marie" <mclore@kpb.us>, "Butch Shapiro" <Macey.Shapiro@matsugov.us>, "Terry Berger (Terry.Berger@matsugov.us)" <Terry.Berger@matsugov.us>, "brett.olson@matsugov.us" <brett.olson@matsugov.us>, "bjordan@co.fairbanks.ak.us" <bjordan@co.fairbanks.ak.us>, "evance@wm.com" <evance@wm.com>, "btucker@kodiakak.us" <btucker@kodiakak.us>, "atorres@kodiakak.us" <atorres@kodiakak.us>, "dconrad@kodiakak.us" <dconrad@kodiakak.us>, "mike.monnin@north-slope.org" <mike.monnin@north-slope.org>, Rich Helinski <rhelinski@iceservices.net>, "landfill@iceservices.net" <landfill@iceservices.net>, "jrpearson@ci.unalaska.ak.us" <jrpearson@ci.unalaska.ak.us>, "bj@ci.unalaska.ak.us" <bj@ci.unalaska.ak.us>, "brian.adams3@us.army.mil" <brian.adams3@us.army.mil>, "Chris Nowlin (CNowlin@aimmtechnologies.com)" <CNowlin@aimmtechnologies.com>
Cc: "Maclure, Devynn J (DEC)" <devynn.maclure@alaska.gov>, "Schlichting, Sally G (DEC)" <sally.schlichting@alaska.gov>, "Roberts, Jennifer L (DEC)" <jennifer.roberts@alaska.gov>, "Halverson, John E (DEC)" <john.halverson@alaska.gov>, "Carpenter, Christina E (DEC)" <christina.carpenter@alaska.gov>, "Blankenburg, Robert J (DEC)" <bob.blankenburg@alaska.gov>, "Brewer, Marlena M (DEC)" <marlena.brewer@alaska.gov>, "Colvin, Rebecca A (DEC)" <rebecca.colvin@alaska.gov>, "Holland, Kaylie A (DEC)" <kaylie.holland@alaska.gov>, "Jordan, Kim (DEC)" <kim.jordan@alaska.gov>, "Price, Stephen V (DEC)" <stephen.price@alaska.gov>, "Thieme, Reese (DEC)" <reese.thieme@alaska.gov>, "Bower, Trisha M (DEC)" <trisha.bower@alaska.gov>, "Buteyn, Douglas J (DEC)" <doug.buteyn@alaska.gov>, "Durand, Sarah J (DEC)" <sarah.durand@alaska.gov>, "Lehner, Neil S (DEC)" <neil.lehner@alaska.gov>, "Woods, Sandra M (DEC)" <sandra.woods@alaska.gov>
Subject: PFA & TENORM disposal

At the SWANA meeting last Friday I discussed a couple of landfill hot topics that I want to share again, especially with those facilities that were not represented at the meeting:

1. **Technically Enhanced Naturally Occurring Radiological Material (TENORM)**
   Any radiological material that has been processed or removed from a site and brought to your landfill for disposal.
   Alaska Regulations:
   18 AAC 85.300. Disposal by burial in soil. A person may not dispose of radioactive material by burial in soil. (Eff. 9/16/71, Register 39; am 4/9/2009, Register 190; am 7/1/2015, Register 214)
   It would require a regulatory change to allow acceptance of any radiological material.

2. **Perfluorinated Compounds**

PFCs are emerging contaminants of concern. The compounds have been used in a number of household products, such as non-stick pans, furniture, cosmetics, household cleaners, clothing, and packaged food, as well as used in fire-fighting foams. They are readily found as contaminants in the environment, and certainly in wastes disposed in a municipal solid waste landfill. These compounds are highly mobile and persistent.

Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA) have become a significant concern in drinking water and EPA has established a Drinking Water Health Advisory Level of 70 parts per trillion (.070 µg/L) combined PFOS & PFOA. In addition, ADEC has established cleanup standards (18 AAC 75): PFOS - .0030 mg/kg & PFOA - .0017 mg/kg in soil (migration to groundwater); and, PFOS & PFOA - .040 µg/L in groundwater.

Disposal of both PFC solidified product and contaminated soils are problematic. For Alaska, they will not be considered for disposal in anything but a fully lined landfill. For solidified product, ADEC does not currently have specific regulations or a good mechanism for addressing disposal, and encourages shipping the material out of state. For even a lined landfill to accept the product, they would need to prepare a demonstration similar to one under 18 AAC 60.025(d)&(e) to show that the addition of product to the current landfill concentration would not increase the likelihood of migration to groundwater or surface water.

For acceptance of polluted soil, each landfill must provide acceptance criteria for PFOS & PFOA to ADEC prior to accepting the contaminated soil. If the acceptance criteria exceed the migration to groundwater cleanup levels for soil in 18 AAC 75, ADEC will require the facility to add PFOS & PFOA to their water monitoring analytes for all wells (and/or surface water locations). ADEC recommends discussing monitoring protocols with your consultant.

Please contact your ADEC project manager if you have any questions.

Regards,
Lori

Lori Aldrich
Regional Program Manager
Alaska Department of
Environmental Conservation
Solid Waste Program
555 Cordova Street
Anchorage, AK 99501
Ph: (907) 269-7622

ADEC Meeting Notes

MSB Central Landfill Planning for Treated Leachate and Septage

ATTENDEES:
Mike Campfield/MSB Cap.Proj.
A. Kantardjieff/CH2MHILL
Katie Winter/CH2M HILL Cory Hinds/CH2M HILL
Oran Woolley/ADEC ES&PR Melinda Smodey/ADEC WW Project file

PREPARED BY: Cory Hinds/CH2M HILL

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PROJECT NUMBER: 496410

The following is a summary of discussion:

1. Introductions
    a. Clint is the chief technical engineer for ADEC Engineering Support & Plan Review (ES&PR) and supports Oran and others with technical reviews
    b. Gene is the manager of the ES&PR department which issues wastewater discharge authorizations
    c. Mike is the MSB project manager and a member of the MSB Wastewater & Septage Advisory Board
    d. Cory is the CH2M HILL project manager
    e. Katie is working for Cory determine numerical discharge limits
    f. Alexandra is a CH2M HILL wastewater treatment expert

2. Background (see also Attachment A, sent prior to the meeting)
    a. This is a planning study to evaluate long-term development of landfill cells and leachate treatment at the Central Landfill in Palmer.
    b. Both leachate and septage are currently hauled to Anchorage. There is pressure to keep and manage both of these waste streams in Mat-Su. MSB is considering treatment of leachate on site at the Central Landfill. MSB is also considering co-treatment of leachate and pre-treated septage at the Central Landfill. The decision on leachate treatment and co- treatment of leachate and septage has not yet been made. Depending on the outcome of this study, other possible studies, and funding, MSB may pursue design and construction of a leachate or leachate and septage treatment plant starting in the next couple years.
    c. CH2M HILL needs a reasonable understanding of expected discharge limits in order to price various treatment options.
3. Proposed Solution
    a. CH2M HILL is evaluating two possible treatments for leachate only:
        i. Biological treatment (MBR or SBR package treatment) with subsurface discharge
        ii. Leachate evaporation and recirculation of concentrate back to landfill
    b. CH2M HILL is also evaluating biological co-treatment of pre-treated septage and leachate by activated sludge, aeration and clarifier and subsurface discharge
    c. CH2M HILL presented proposed design discharge limits and point of compliance as described in Attachment A

4. ADEC Response to suggestions

a. The CH2M HILL-proposed design discharge limits appear to be similar to the domestic wastewater limits in Article 2 of the Wastewater Disposal regulations (18 AAC 72). These are not appropriate because leachate is an industrial source. Similarly, because septage will be from all over the MSB, the septage will be considered coming from non-domestic sources.

b. The appropriate regulations are Articles 5 and 6 for Nondomestic Wastewater (18 AAC 72) which include a more engineering-centric approach.

c. CH2M HILL's proposed approach for point of compliance in downgradient monitoring wells on MSB property appears reasonable and has been approved by ADEC before up-gradient monitoring wells can be used for comparison.

d. For planning purposes, CH2M HILL/MSB can use the more stringent of the drinking water standards (18 AAC 80) and water quality standards (18 AAC 70) for both septage and leachate.

Appendix 2 – Treatability Test Protocol:

Following are the protocols describing the duration and engineering study protocols. Please note that during the test period, some departure from these protocols may be needed to accommodate variations in the quality or quantity of the waste stream.

Preparation for the Test:

Initial membrane cleaning procedure

1. Clean the membranes with dilute caustic soda solution with a pH of 9-9.5 to remove preservatives from the membranes prior to actual use, at ambient temperature.
2. Recirculate the caustic solution for 10 minutes at a set pressure with the control valve fully open. Drain the caustic solution.
3. Fill the unit with clean water by adding clean water to batch tank.
4. Rinse and flush the pilot plant with clean tap water at ambient temperature for 5 minutes at a set pressure.
5. Increase the module inlet pressure to a set pressure. Record the permeate flow and temperature. This is the initial water flux check for this set of membranes.

Initial Test - Run Batch Mode:

1. The initial test procedure establishes the pressure scan and flux versus concentration behavior of the system in a batch mode.
2. Run this test within 12 hours of cleaning and testing the membranes for water flux. Preserve membranes by filling the system with a 0.1% sodium metabisulfite solution if the plant is idled for more than 12 hours.
3. Fill feed tank; note volume of material used to charge feed tank. Set up the system with both concentrate and permeate returning to the feed tank.
4. Run pressure scan test by setting feed flow rate at 3 gpm. Start up the system and run at a set inlet pressure. Allow system to stabilize for 10 minutes, then record feed/recirculation flow, pressures, temperature, and permeate flow. Continue with pressure scan increasing pressure in set psi increments to maximum operating pressure.
5. Set up the system with concentrate returning to the feed tank and permeate going to a storage tank (or drain). Take initial sample of feed and permeate for analysis. Continue the test by setting the feed and recirculation flow at 3 gpm. Monitor and record the following every 30 minutes:
   - Volume of concentrate in the feed tank
   - Transmembrane pressures upstream and downstream of membrane
   - Temperatures
   - pH of concentrate
   - Conductivity of feed and permeate
   - Visual signs of precipitation of minerals in the concentrate
   - Flow rate through the system
6. Operate the pilot plant until the target volumetric concentration factor (VCF) is reached. Record volumes and take samples of concentrate and permeate. Analyze the samples for the parameters listed in Table 1 below.

7. Rinse and flush the pilot plant with clean tap water at ambient temperature for 5 minutes at minimum set pressure.
8. Check water flux on the membranes at the same conditions as used for the initial water flux check. Clean the membranes if a greater than a set drop in water flux is observed. We normally design the system with a 10% to 20% higher flux than the daily flow rate. This allows us to run the system up to 30% lower than of the daily flow for an extended period and still achieve the average daily flow. Therefore, the cleaning process is usually set to start when the flux is at or around 70% of the daily flow. Prior to membrane cleaning water samples will be collected to measure parameters listed in Table 1 below.

Table 1 Test Parameters

Parameter	Feed	Concentrate	Permeate
COD	x	x	x
TSS	x	x	x
TP	x	x	x
Total Plate Count	x	x	x
TDS	x	x	x
% Solids	x	x	X
pH	x	x	x
Conductivity	x	x	x
Alkalinity	x	x	x
Metals	x	x	x
Semi Metals	x	x	x
VOCs	x	x	x
SVOCs	x	x	x
PFCs	x	x	x
TCLP	x	x	x

Topped Batch Mode:

The system is operated while continuously topping off the batch tank. This will allow simulation of the system during a topped batch operation.

Continuous Flow Mode

Switch the system to continuous flow mode by directing the concentrate line to a separate container or to the sewer, instead of the batch tank.

Duration and Endurance Test

The system is subjected to multiple runs over the two-week period to determine the following:

1. Ability of the system to maintain the filtration flux, permeate recovery, and concentrate recovery over repeated operations.
2. Variation in permeate and concentrate quality with variations in influent quality and repeated membrane cleaning cycles.
3. The effectiveness of cleaning procedures in maintaining performance.

4. Physical durability of the membranes, membrane housings and equipment with repeated use.

Membrane Cleaning and Preservation Procedures:

Membrane cleaning and preservation can be done with a variety of chemicals. The cleaning procedure is similar in each case. The various steps are as follows:

Tank Fill

Drain and rinse cleaning tank. Partially fill the tank with hot water with sufficient volume to flush the membranes and leave enough water to effect a recirculation loop without creating a vortex in the feed tank.

Initial Flush

Open the back pressure control valve. Start the system and drain the concentrate and permeate to drain. As soon as the concentrate runs clear either stop the plant and then direct the concentrate back to the cleaning tank or, if it can be safely done, direct the concentrate and permeate hoses back to the feed tank without stopping the pump.

Chemical Addition

With the water recirculating, slowly add the cleaning chemical to the cleaning tank, giving enough time for mixing of the chemicals while the water is recirculating to avoid any pH shocks to the membrane. Chemicals should be added over sufficient time to complete at least one turnover of the cleaning tank.

Cleaning

Heat the cleaning solution to a set temperature. Recirculate the cleaning solution for at least 20 to 30 minutes to be effective.

Post Clean Flush

Drain the tank, rinse and refill with sufficient clean water to complete a flush and then recirculate the water. If a second clean is being done, this should be warm water so it can be used for the clean itself. Direct the concentrate and permeate hoses to drain. Start the pump and run until the chemicals are flushed from the concentrate side (approx. 1 minute). When the flush is complete, return the concentrate hose to the cleaning tank (stopping the plant if this cannot be otherwise safely done) and continue to flush the permeate lines directing permeate to drain until the pH of the permeate returns close to the natural pH of the water used to flush. When the permeate pH is normal stop the pump.

Cleaning Chemicals

1. Dilute caustic at pH 9-9.5 at a temperature of 120-130° F.
2. Enzyme detergent (maximum pH 9.5) – concentration typically 0.25% w/w dry solution or 0.5% w/w liquid solution or as otherwise recommended. Please consult MSLLC for guidance on this issue if use of a cleaning solution with some detergency is needed.
3. Acid – Phosphoric or Nitric Acid. Concentration sufficient to give a pH of 2.0 (0.2% w/w) at 120-130° F. Alternative acids may be used to target specific materials that foul membranes.

4. Preservation with sodium metabisulfite: depending on preservation duration - 0.1% (up to 3 days) to 0.25% (one month) w/w. Complete a membrane clean and flush first and then leave the preservative in the membranes.

Appendix 3 – Alternative Cost tables

The following tables present the summary of the cost of some of the options presented by HDR in their February 19, 2013 update of their previous study in 2017.

These are presented as they have been prepared by HDR and reviewed by MSB. No attempt was made to verify or alter these costs (it is not in the scope of this project). They are presented as a reference to the previous studies conducted by the MSB.

They selected two options out of four options they reviewed as follows:

Option 1 - Maintain Existing Hauling Practices

Option 4 - Construct an Independent Regional Septage Facility

Option 1. Maintain Existing Hauling Practices

Transport and Disposal Costs – AWWU Turpin Street	Year 2005	Year 2013	Year 2030
Estimated Annual Septage Production (Gal/Year)	13,596,389	17,761,301	38,101,158
No of Average Hauler Loads	4,742	6,195	13,290
Annual Mileage for Septage Delivery	379,390	495,607	1,306,193
Annual Fuel Consumption (Gal/Year)	75,878	99,121	212,699
Cost per trip	$179	$229	$348
Annual Disposal Cost	$825,200	$1,418,700	4,624,900

Option 4 - Construct an Independent Regional Septage Facility

For this option they considered three sub-options. These options were variations of Biological treatment system all of which required some kind of pre-treatment prior to secondary or tertiary treatment.

1.0 Cost of Pre-treatment or Septage Receiving Station

These costs include equalization, septage conditioning and solid/liquid separation. The following table is a summary of these costs.

Table 1 – 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.

The sub-options for the Option 4 are, Options 4-A, 4B and 4C.

Option 4A - Secondary Treatment by Aerated Lagoons

The following table is a summary cost for this option.

Table 2 – 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	$10.20	$257,800
	Backfill with Selective Material	12,692	CY	$3.70	$47,500
	Structural Fill	6,346	CY	$25.70	$162,800
	Membrane Liner and Geotextile Fabric	198,632	SF	$5.60	$1,115,500
	Insulated Lagoon Covers (4-inch, installed)	165,527	SF	$5.60	$929,600
	Gravel Drain Bed	10,153	CY	$18.00	$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	$10.20	$128,900
	Backfill with Selective Material	6,346	CY	$3.70	$23,700
	Structural Fill	3,173	CY	$25.70	$81,400
	Membrane liner and Geotextile Fabric	43,560	SF	$5.60	$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**

These lagoons require pre-treatments. The following tables the combined cost of the aerated lagoon and the pre-treatment.

Table 3 – 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 48 and 4C - Secondary Treatment by Sequencing Batch Reactor (SBR)

The following tables are some cost estimates for these options.

Table 4– 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	1000 SF	$400	$34,800
	Excavation	25,384	CY	$5.00	$126,900
	Load and Haul Excavated Material	12,692	CY	$10.20	$128,900
	Backfill with Selective Material	6,346	CY	$3.70	$23,700
	Structural Fill	3,173	CY	$25.70	$81,400
	Membrane liner and Geotextile Fabric	43,560	SF	$5.60	$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 5 – 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.

MAT-SU BOROUGH

LeachBuster® Leachate Treatment Plant

Single-pass Membrane Type Treatment and Pumping to Pond 2018 Opinion of Probable Construction Cost

20,000 GPD Leachate Treatment (Shared Work with Septage Treatment Development)

Item No.	Item Description	Est Quantity	Unit Cost	Item Total
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	6% LS	$2,367,000.00	$142,020.00
2	DEMOLITION (Shared with Septage Treatment Development 80/20)	4 ACRES	$6,000.00	$22,800.00
3	SITE WORK (SEE DETAILS IN APPENDIX) (Shared 80/20)	20% LS	$381,500.00	$76,300.00
4	ROAD WORK (SEE DETAILS IN APPENDIX) (Shared 80/20)	20% LS	$1,217,500.00	$243,500.00
5	SUBSURFACE DRAINFIELD (Shared 80/20)	2,000.0 SY	$50.00	$100,000.00
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	180 LS	$197.26	$35,506.80
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	4,100 LF	$175.00	$717,500.00
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	4,200 LF	$197.26	$828,500.02
9	SLUDGE BUNKER (Part of Septage Treatment Only)	0 LS	$50,000.00	$0.00
10	Sludge Management System (PART OF LB)(Part of Septage Treatment Only)	0 LS	$380,000.00	$0.00
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	0 LS	$4,100,000.00	$0.00
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	1 LS	$1,920,000.00	$1,920,000.00
13	LEACHBUSTER INTERCONNECTION (PART OF LB) (Shared 80/20)	20% LS	$45,000.00	$9,000.00
14	OVERALL PROCESS SENSORS, METERS, PLC (Shared 80/20)	20% LS	$205,000.00	$41,000.00
15	INTERIOR TANKS AND SUPPORT STRUCTURES	1 LS	$100,000.00	$100,000.00
16	MEP - POWER AND WATER TO THE BUILDING (Shared 80/20)	20% LS	$100,000.00	$20,000.00
17	WASTEWATER TREATMENT BUILDING	1,000 SQFT	$225.00	$225,000.00
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	0 LS	$300,000.00	$0.00
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	0 LS	$450,000.00	$0.00
20	OTHER (POWER, ETC.) (Shared 80/20)	20% LS	$100,000.00	$20,000.00
21				
22				

Subtotal:	**$4,501,200.00**
Contingencies (15%) On Balance of Plant Minus LeachBuster ®:	**$386,000.00**
Total Estimated Construction Cost:	**$4,887,200.00**
Engineering (12%) On Balance of Plant Minus LeachBuster®:	**$355,000.00**
Contract Administration (5%):	**$148,000.00**
Commissioning, Training, Trouble Shooting, etc.:	**$90,024.00**
Bonding, Insurance:	**$0.00**
Total Estimated Project Cost:	**$5,480,224.00**

(Basis of opinion, schematic layout)

MAT-SU BOROUGH

LeachBuster® Septage Treatment Plant

Single-pass Membrane Type Treatment and Pumping to Pond 2018 Opinion of Probable Construction Cost

100,000 GPD Septage Treatment (Shared Work with Leachate Treatment Development)

Item No.	Item Description	Est Quantity	Unit Cost	Item Total
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	6% LS	$4,600,000.00	$276,000.00
2	DEMOLITION (Shared with Septage Treatment Development 80/20	15 S	$6,000.00	$91,200.00
3	SITE WORK (SEE DETAILS IN APPENDIX) (Shared 80/20)	80% LS	$381,500.00	$305,200.00
4	ROAD WORK (SEE DETAILS IN APPENDIX) (Shared 80/20)	80% LS	$1,217,500.00	$974,000.00
5	SUBSURFACE DRAINFIELD (Shared 80/20)	8,000.0 SY	$50.00	$400,000.00
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS	180 LS	$197.26	$35,506.80
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS	0 LF	$175.00	$0.00
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS	0 LF	$197.26	$0.00
9	SLUDGE BUNKER (Part of Septage Treatment Only)	1 LS	$50,000.00	$50,000.00
10	Sludge Management System (PART OF LB)(Part of Septage Treatment Only)	1 LS	$380,000.00	$380,000.00
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	1 LS	$4,100,000.00	$4,100,000.00
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	0 LS	$1,920,000.00	$0.00
13	LEACHBUSTER INTERCONNECTION (PART OF LB) (Shared 80/20)	80% LS	$45,000.00	$36,000.00
14	OVERALL PROCESS SENSORS, METERS, PLC (Shared 80/20)	80% LS	$205,000.00	$164,000.00
15	INTERIOR TANKS AND SUPPORT STRUCTURES	2 LS	$100,000.00	$200,000.00
16	MEP - POWER AND WATER TO THE BUILDING (Shared 80/20)	80% LS	$100,000.00	$80,000.00
17	WASTEWATER TREATMENT BUILDING	3,000 SQFT	$225.00	$675,000.00
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	3 LS	$300,000.00	$900,000.00
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	2 LS	$450,000.00	$900,000.00
20	OTHER (POWER, ETC.) (Shared 80/20)	80% LS	$100,000.00	$80,000.00
21				
22				

Subtotal:	**$9,647,000.00**
Contingencies (15%) On Balance of Plant Minus LeachBuster ®:	**$770,000.00**
Total Estimated Construction Cost:	**$10,417,000.00**
Engineering (12%) On Balance of Plant Minus LeachBuster®:	**$709,000.00**
Contract Administration (5%):	**$296,000.00**
Commissioning, Training, Trouble Shooting, etc.:	**$192,940.00**
Bonding, Insurance:	**$0.00**
Total Estimated Project Cost:	**$11,614,940.00**

(Basis of opinion, schematic layout)

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant

Single-pass Membrane Type Treatment and Pumping to Pond 2018 Opinion of Probable Construction Cost

20,000 GPD Leachate + 100,000 GPD Septage Treatment

Item No.	Item Description	Est Quantity	Unit Cost	Item Total
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	6% LS	$6,957,000.00	$417,420.00
2	DEMOLITION	19 ACRES	$6,000.00	$114,000.00
3	SITE WORK (SEE DETAILS IN APPENDIX)	1 LS	$381,500.00	$381,500.00
4	ROAD WORK (SEE DETAILS IN APPENDIX)	1 LS	$1,217,500.00	$1,217,500.00
5	SUBSURFACE DRAINFIELD	10,000.0 SY	$50.00	$500,000.00
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	360 LS	$197.26	$71,013.60
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	4,100 LF	$175.00	$717,500.00
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	4,200 LF	$197.26	$828,500.02
9	SLUDGE BUNKER	1 LS	$50,000.00	$50,000.00
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	1 LS	$380,000.00	$380,000.00
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	1 LS	$4,100,000.00	$4,100,000.00
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	1 LS	$1,920,000.00	$1,920,000.00
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	1 LS	$45,000.00	$45,000.00
14	OVERALL PROCESS SENSORS, METERS, PLC	1 LS	$205,000.00	$205,000.00
15	INTERIOR TANKS AND SUPPORT STRUCTURES	3 LS	$100,000.00	$300,000.00
16	MEP - POWER AND WATER TO THE BUILDING	1 LS	$90,000.00	$90,000.00
17	WASTEWATER TREATMENT BUILDING	4,000 SQFT	$225.00	$900,000.00
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	3 LS	$300,000.00	$900,000.00
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	2 LS	$450,000.00	$900,000.00
20	OTHER (POWER, ETC.)	1 LS	$100,000.00	$100,000.00
21				
22				

Subtotal:	**$14,137,500.00**
Contingencies (144%) On Balance of Plant Minus LeachBuster®:	**$1,077,000.00**
Total Estimated Construction Cost:	**$15,214,500.00**
Engineering (12%) On Balance of Plant Minus LeachBuster®:	**$1,053,000.00**
Contract Administration (5%):	**$439,000.00**
Commissioning, Training, Trouble Shooting, etc.:	**$282,750.00**
Bonding, Insurance:	**$0.00**
Total Estimated Project Cost:	**$16,989,250.00**

(Basis of opinion, schematic layout)

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant

Single-pass Membrane Type Treatment and Pumping to Pond 2018 Opinion of Probable Construction Cost

20,000 GPD Leachate + 200,000 GPD Septage Treatment

Item No.	Item Description	Est Quantity	Unit Cost	Item Total
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	6% LS	$8,554,000.00	$513,240.00
2	DEMOLITION	19 ACRES	$6,000.00	$114,000.00
3	SITE WORK (SEE DETAILS IN APPENDIX)	1 LS	$381,500.00	$381,500.00
4	ROAD WORK (SEE DETAILS IN APPENDIX)	1 LS	$1,217,500.00	$1,217,500.00
5	SUBSURFACE DRAINFIELD	13,500.0 SY	$50.00	$675,000.00
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	360 LS	$197.26	$71,013.60
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	4,100 LF	$175.00	$717,500.00
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	4,200 LF	$197.26	$828,500.02
9	SLUDGE BUNKER	1 LS	$100,000.00	$100,000.00
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	1 LS	$800,000.00	$800,000.00
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	1 LS	$5,700,000.00	$5,700,000.00
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	1 LS	$1,920,000.00	$1,920,000.00
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	1 LS	$75,000.00	$75,000.00
14	OVERALL PROCESS SENSORS, METERS, PLC	1 LS	$320,000.00	$320,000.00
15	INTERIOR TANKS AND SUPPORT STRUCTURES	3 LS	$200,000.00	$600,000.00
16	MEP - POWER AND WATER TO THE BUILDING	1 LS	$100,000.00	$100,000.00
17	WASTEWATER TREATMENT BUILDING	6,500 SQFT	$225.00	$1,462,500.00
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	3 LS	$300,000.00	$900,000.00
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	3 LS	$450,000.00	$1,350,000.00
20	OTHER (POWER, ETC.)	1 LS	$150,000.00	$150,000.00
21				
22				

Subtotal:	**$17,995,800.00**
Contingencies (15%) On Balance of Plant Minus LeachBuster®:	**$1,426,000.00**
Total Estimated Construction Cost:	**$19,421,800.00**
Engineering (12%) On Balance of Plant Minus LeachBuster®:	**$1,312,000.00**
Contract Administration (5%):	**$547,000.00**
Commissioning, Training, Trouble Shooting, etc.:	**$359,916.00**
Bonding, Insurance:	**$0.00**
Total Estimated Project Cost:	**$21,640,716.00**

(Basis of opinion, schematic layout)

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant

Single-pass Membrane Type Treatment and Pumping to Pond 2017 Opinion of Probable Construction Cost

20,000 GPD Leachate + 215,000 GPD Septage Treatment

Item No.	Item Description	Est Quantity	Unit Cost	Item Total
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	6% LS	$8,597,000.00	$515,820.00
2	DEMOLITION	19 ACRES	$6,000.00	$114,000.00
3	SITE WORK (SEE DETAILS IN APPENDIX)	1 LS	$381,500.00	$381,500.00
4	ROAD WORK (SEE DETAILS IN APPENDIX)	1 LS	$1,217,500.00	$1,217,500.00
5	SUBSURFACE DRAINFIELD	14,000.0 SY	$50.00	$700,000.00
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS	360 LS	$197.26	$71,013.60
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS	4,100 LF	$175.00	$717,500.00
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS	4,200 LF	$197.26	$828,500.02
9	SLUDGE BUNKER	1 LS	$100,000.00	$100,000.00
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	1 LS	$800,000.00	$800,000.00
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	1 LS	$6,310,000.00	$6,310,000.00
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	1 LS	$1,920,000.00	$1,920,000.00
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	1 LS	$100,000.00	$100,000.00
14	OVERALL PROCESS SENSORS, METERS, PLC	1 LS	$360,000.00	$360,000.00
15	INTERIOR TANKS AND SUPPORT STRUCTURES	3 LS	$200,000.00	$600,000.00
16	MEP - POWER AND WATER TO THE BUILDING	1 LS	$100,000.00	$100,000.00
17	WASTEWATER TREATMENT BUILDING	7,800 SQFT	$225.00	$1,755,000.00
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	2 LS	$300,000.00	$600,000.00
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	3 LS	$450,000.00	$1,350,000.00
20	OTHER (POWER, ETC.)	1 LS	$175,000.00	$175,000.00
21				
22				

Subtotal:	**$18,715,900.00**
Contingencies (15%) On Balance of Plant Minus LeachBuster ®:	**$1,438,000.00**
Total Estimated Construction Cost:	**$20,153,900.00**
Engineering (12%) On Balance of Plant Minus LeachBuster®:	**$1,323,000.00**
Contract Administration (5%):	**$552,000.00**
Commissioning, Training, Trouble Shooting, etc.:	**$374,318.00**
Bonding, Insurance:	**$0.00**
Total Estimated Project Cost:	**$22,403,218.00**

(Basis of opinion, schematic layout)

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant

Single-pass Membrane Type Treatment and Pumping to Pond 2018 Opinion of Probable Construction Cost

20,000 GPD Leachate + 250,000 GPD Septage Treatment

Item No.	Item Description	Est Quantity	Unit Cost	Item Total
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	6% LS	$8,425,000.00	$505,500.00
2	DEMOLITION	19 ACRES	$6,000.00	$114,000.00
3	SITE WORK (SEE DETAILS IN APPENDIX)	1 LS	$381,500.00	$381,500.00
4	ROAD WORK (SEE DETAILS IN APPENDIX)	1 LS	$1,217,500.00	$1,217,500.00
5	SUBSURFACE DRAINFIELD	14,666.7 SY	$50.00	$733,333.35
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	360 LS	$197.26	$71,013.60
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	4,100 LF	$175.00	$717,500.00
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	4,200 LF	$197.26	$828,500.02
9	SLUDGE BUNKER	1 LS	$100,000.00	$100,000.00
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	1 LS	$800,000.00	$800,000.00
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	1 LS	$6,711,000.00	$6,711,000.00
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	1 LS	$1,920,000.00	$1,920,000.00
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	1 LS	$100,000.00	$100,000.00
14	OVERALL PROCESS SENSORS, METERS, PLC	1 LS	$400,000.00	$400,000.00
15	INTERIOR TANKS AND SUPPORT STRUCTURES	2 LS	$200,000.00	$400,000.00
16	MEP - POWER AND WATER TO THE BUILDING	1 LS	$100,000.00	$100,000.00
17	WASTEWATER TREATMENT BUILDING	9,000 SQFT	$225.00	$2,025,000.00
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	1 LS	$300,000.00	$300,000.00
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	3 LS	$450,000.00	$1,350,000.00
20	OTHER (POWER, ETC.)	1 LS	$200,000.00	$200,000.00
21				
22				

Subtotal:	**$18,974,900.00**
Contingencies (15%) On Balance of Plant Minus LeachBuster®:	**$1,417,000.00**
Total Estimated Construction Cost:	**$20,391,900.00**
Engineering (12%) On Balance of Plant Minus LeachBuster®:	**$1,304,000.00**
Contract Administration (5%):	**$544,000.00**
Commissioning, Training, Trouble Shooting, etc.:	**$379,498.00**
Bonding, Insurance:	**$0.00**
Total Estimated Project Cost:	**$22,619,398.00**

(Basis of opinion, schematic layout)

DESCRIPTION	QUANT	UNIT	UNIT COST	$/UNIT	TOTAL COST
2. SITE CIVIL WORK					
MISCELLANEOUS SITE DEVELOPMENT COSTS					$445,000
Mobilization and Demobilization (5% of Civil Cost)	5%		$4,049,333	202,467	
Construcftion Surveying (3% of Civil Cost)	3%		$4,049,333	121,480	
Stormwater Controls (3% of Civil Cost)	3%		$4,049,333	121,480	
DEMOLITION					$114,000
Clearing and Grubbing	19	ACRE	$6,000	114,000	
SITE WORK					$381,500
Excavation/Embankment	1,500	CY	$5.50	8,250	
Load/Haul Excavated Material	500	CY	$8.00	4,000	
Structural Fill	2,500	CY	$10.00	25,000	
Parking/Turnaround Area Surfacing	70,000	SF	$2.50	$175,000	
Curb and Gutter	250	LF	$30	$7,500	
Sidewalks	250	LF	$25	$6,250	
Outdoor Lighting	5	EA	$15,000	$75,000	
Perimeter Security Fencing	2350	LF	$30	$70,500	
Topsoil and Seed	4	ACRE	$10,000	$10,000	
ROAD WORK					$1,217,500
Excavation/Embankment	95,000	CY	$5.50	522,500	
Load/Haul Excavated Material	20,000	CY	$8.00	160,000	
Structural Fill	16,500	CY	$10.00	165,000	
Access Roadways, 24 Foot Wide, Paved	4,800	LF	$75	$360,000	
Topsoil and Seed	11	ACRE	$10,000	$10,000	
EFFLUENT DRAINFIELD					$733,333
Drainfield (DF)	14666.67	SY	$50	$733,333	
EFFLUENT PIPE AND MANHOLES TO DRAINFIELD					$57,000
Final Effluent (FE)	180	LF	$175	$31,500	
Manholes	3	EA	$8,500	$25,500	
LEACHATE PIPE FROM LEACHATE TANKS TO BUILDING					$717,500
Leachate Conveyance (LC)	4100	LF	$175	$717,500	
CONCENTRATE PIPE AND MANHOLES TO LANDFILL					$828,500
Concentrate (CONC)	4200	LF	$175	$735,000	
Manholes	11	EA	$8,500	$93,500	
SUBTOTAL - 2. SITE CIVIL WORK					$4,049,333
OH&P	0.00%				0
TOTAL - 2. SITE CIVIL WORK					**$4,494,333**

MAT-SU BOROUGH

LeachBuster® Leachate Treatment Plant - 20,000 GPD Leachate

Single-pass Membrane Type Treatment and Pumping to Pond Equivalent Uniform Annual Cost (ADEC Loan)

No.	Capital Cost Item Description	Price	Salvage Rate (20 yr)	Salvage Value	Present Worth of Salvage Value	Net Present Worth
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	$142,020	60%	$85,212	$63,267	$78,753
2	DEMOLITION (Shared with Septage Treatment Development 80/20)	$22,800	0%	$0	$0	$22,800
3	SITE WORK (SEE DETAILS IN APPENDIX) (Shared 80/20)	$76,300	60%	$45,780	$33,990	$42,310
4	ROAD WORK (SEE DETAILS IN APPENDIX) (Shared 80/20)	$243,500	60%	$146,100	$108,475	$135,025
5	SUBSURFACE DRAINFIELD (Shared 80/20)	$100,000	60%	$60,000	$44,548	$55,452
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	$35,507	60%	$21,304	$15,818	$19,689
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	$717,500	60%	$430,500	$319,634	$397,866
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	$828,500	60%	$497,100	$369,082	$459,418
9	SLUDGE BUNKER (Part of Septage Treatment Only)	$0	60%	$0	$0	$0
10	Sludge Management System (PART OF LB)(Pt of Septage Treatment Only)	$0	50%	$0	$0	$0
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	$0	50%	$0	$0	$0
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	$1,920,000	50%	$960,000	$712,772	$1,207,228
13	LEACHBUSTER INTERCONNECTION (PART OF LB) (Shared 80/20)	$9,000	50%	$4,500	$3,341	$5,659
14	OVERALL PROCESS SENSORS, METERS, PLC (Shared 80/20)	$41,000	50%	$20,500	$15,221	$25,779
15	INTERIOR TANKS AND SUPPORT STRUCTURES	$100,000	50%	$50,000	$37,124	$62,876
16	MEP - POWER AND WATER TO THE BUILDING (Shared 80/20)	$20,000	60%	$12,000	$8,910	$11,090
17	WASTEWATER TREATMENT BUILDING	$225,000	60%	$135,000	$100,234	$124,766
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	$0	50%	$0	$0	$0
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	$0	50%	$0	$0	$0
20	OTHER (POWER, ETC.) (Shared 80/20)	$20,000	0%	$0	$0	$20,000
21		$0	0%	$0	$0	$0
22		$0	0%	$0	$0	$0
23	Contingencies (15%) On Balance of Plant Minus LeachBuster®:	$386,000	0%	$0	$0	$386,000
24	Engineering (12%) On Balance of Plant Minus LeachBuster®:	$355,000	0%	$0	$0	$355,000
25	Contract Administration (5%):	$148,000	0%	$0	$0	$148,000
26	Commissioning, Training, Trouble Shooting, etc.:	$90,024	0%	$0	$0	$90,024
27	Bonding, Insurance:	$0	0%	$0	$0	$0
28						
	TOTAL ESTIMATED CONSTRUCTION COST	**$5,480,151**		**$2,467,996**	**$1,832,414**	**$3,647,737**
	ANNUAL OPERATION & MAINTENANCE COST DESCRIPTION	**EUAC**			**NET PRESENT WORTH**	
	EQUIPMENT	$1,000				$20,000
	SUPPLIES (Acid, Base, Detergent, Preservative for Clean-in-Place Cycle)	$11,000				$220,000
	UTILITIES	$20,000				$400,000
	LABOR	$40,000				$800,000
	LEACHBUSTER® SKID (Membranes, Supplies)	$45,000				$900,000
	PUMPING FEES	$0				$0
	TOTAL ESTIMATED ANNUAL COST (20 Years)	**$117,000**				**$2,340,000**
	GRANT					**$0**
	TOTAL NET PRESENT WORTH					**$5,987,737**
	EUAC					**$348,760**
	Total Volume Treated = (20,000 x 365 x 0.9 x 0.80)	**5,256,000**	**Gallons**		**Fee/Gallon=**	**$0.066**
	(Assumed Plant Operating at 90% of time and at 80% Capacity)				**Fee/1000 Ga=**	**$66.35**
					Fee/3000 Ga=	**$199**

MAT-SU BOROUGH

LeachBuster® Septage Treatment Plant - 100,000 GPD Septage

Single-pass Membrane Type Treatment and Pumping to Pond Equivalent Uniform Annual Cost (ADEC Loan)

No.	Capital Cost Item Description	Price	Salvage Rate (20 yr)	Salvage Value	Present Worth of Salvage Value	Net Present Worth
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	$276,000	60%	$165,600	$122,953	$153,047
2	DEMOLITION (Shared with Septage Treatment Development 80/20)	$91,200	0%	$0	$0	$91,200
3	SITE WORK (SEE DETAILS IN APPENDIX) (Shared 80/20)	$305,200	60%	$183,120	$135,961	$169,239
4	ROAD WORK (SEE DETAILS IN APPENDIX) (Shared 80/20)	$974,000	60%	$584,400	$433,900	$540,100
5	SUBSURFACE DRAINFIELD (Shared 80/20)	$400,000	60%	$240,000	$178,193	$221,807
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	$35,507	60%	$21,304	$15,818	$19,689
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	$0	60%	$0	$0	$0
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	$0	60%	$0	$0	$0
9	SLUDGE BUNKER (Part of Septage Treatment Only)	$50,000	60%	$30,000	$22,274	$27,726
10	Sludge Management System (PART OF LB)(Pt of Septage Treatment Only)	$380,000	50%	$190,000	$141,069	$238,931
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	$4,100,000	50%	$2,050,000	$1,522,064	$2,577,936
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	$0	50%	$0	$0	$0
13	LEACHBUSTER INTERCONNECTION (PART OF LB) (Shared 80/20)	$36,000	50%	$18,000	$13,364	$22,636
14	OVERALL PROCESS SENSORS, METERS, PLC (Shared 80/20)	$164,000	50%	$82,000	$60,883	$103,117
15	INTERIOR TANKS AND SUPPORT STRUCTURES	$200,000	50%	$100,000	$74,247	$125,753
16	MEP - POWER AND WATER TO THE BUILDING (Shared 80/20)	$80,000	60%	$48,000	$35,639	$44,361
17	WASTEWATER TREATMENT BUILDING	$675,000	60%	$405,000	$300,701	$374,299
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	$900,000	50%	$450,000	$334,112	$565,888
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	$900,000	50%	$450,000	$334,112	$565,888
20	OTHER (POWER, ETC.) (Shared 80/20)	$80,000	0%	$0	$0	$80,000
21		$0	0%	$0	$0	$0
22		$0	0%	$0	$0	$0
23	Contingencies (15%) On Balance of Plant Minus LeachBuster®:	$770,000	0%	$0	$0	$770,000
24	Engineering (12%) On Balance of Plant Minus LeachBuster®:	$709,000	0%	$0	$0	$709,000
25	Contract Administration (5%):	$296,000	0%	$0	$0	$296,000
26	Commissioning, Training, Trouble Shooting, etc.:	$192,940	0%	$0	$0	$192,940
27	Bonding, Insurance:	$0	0%	$0	$0	$0
28						
	TOTAL ESTIMATED CONSTRUCTION COST	**$11,614,847**		**$5,017,424**	**$3,725,289**	**$7,889,558**
	ANNUAL OPERATION & MAINTENANCE COST DESCRIPTION	**EUAC**			**NET PRESENT WORTH**	
	EQUIPMENT	$4,000				$80,000
	SUPPLIES (Acid, Base, Detergent, Preservative for Clean-in-Place Cycle)	$13,000				$260,000
	UTILITIES	$31,000				$620,000
	LABOR	$60,000				$1,200,000
	LEACHBUSTER® SKID (Membranes, Supplies)	$140,000				$2,800,000
	PUMPING FEES	$0				$0
	TOTAL ESTIMATED ANNUAL COST (20 Years)	**$248,000**				**$4,960,000**
	GRANT					**$0**
	TOTAL NET PRESENT WORTH					**$12,849,558**
	EUAC					**$748,432**
	Total Volume Treated = (100,000 x 365 x 0.9 x 0.75)	**24,637,500**	**Gallons**		**Fee/Gallon=**	**$0.030**
	(Assumed Plant Operating at 90% of time and at 75% Capacity)				**Fee/1000 Ga=**	**$30.38**
					Fee/3000 Ga=	**$91**

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant - 20,000 GPD Leachate + 100,000 GPD Septage

Single-pass Membrane Type Treatment and Pumping to Pond Equivalent Uniform Annual Cost (ADEC Loan)

No.	Capital Cost Item Description	Price	Salvage Rate (20 yr)	Salvage Value	Present Worth of Salvage Value	Net Present Worth
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	$417,420	60%	$250,452	$185,953	$231,467
2	DEMOLITION	$114,000	0%	$0	$0	$114,000
3	SITE WORK (SEE DETAILS IN APPENDIX)	$381,500	60%	$228,900	$169,951	$211,549
4	ROAD WORK (SEE DETAILS IN APPENDIX)	$1,217,500	60%	$730,500	$542,375	$675,125
5	SUBSURFACE DRAINFIELD	$500,000	60%	$300,000	$222,741	$277,259
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	$71,014	60%	$42,608	$31,635	$39,378
7	DETAILS)	$717,500	60%	$430,500	$319,634	$397,866
8	DETAILS)	$828,500	60%	$497,100	$369,082	$459,418
9	SLUDGE BUNKER	$50,000	60%	$30,000	$22,274	$27,726
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	$380,000	50%	$190,000	$141,069	$238,931
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	$4,100,000	50%	$2,050,000	$1,522,064	$2,577,936
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	$1,920,000	50%	$960,000	$712,772	$1,207,228
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	$45,000	50%	$22,500	$16,706	$28,294
14	OVERALL PROCESS SENSORS, METERS, PLC	$205,000	50%	$102,500	$76,103	$128,897
15	INTERIOR TANKS AND SUPPORT STRUCTURES	$300,000	50%	$150,000	$111,371	$188,629
16	MEP - POWER AND WATER TO THE BUILDING	$90,000	60%	$54,000	$40,093	$49,907
17	WASTEWATER TREATMENT BUILDING	$900,000	60%	$540,000	$400,934	$499,066
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	$900,000	50%	$450,000	$334,112	$565,888
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	$900,000	50%	$450,000	$334,112	$565,888
20	OTHER (POWER, ETC.)	$100,000	0%	$0	$0	$100,000
21		$0	0%	$0	$0	$0
22		$0	0%	$0	$0	$0
23	Contingencies (15%) On Balance of Plant Minus LeachBuster®:	$1,077,000	0%	$0	$0	$1,077,000
24	Engineering (12%) On Balance of Plant Minus LeachBuster®:	$1,053,000	0%	$0	$0	$1,053,000
25	Contract Administration (5%):	$439,000	0%	$0	$0	$439,000
26	Commissioning, Training, Trouble Shooting, etc.:	$282,750	0%	$0	$0	$282,750
27	Bonding, Insurance:	$0	0%	$0	$0	$0
28						
	TOTAL ESTIMATED CONSTRUCTION COST	**$16,989,184**		**$7,479,060**	**$5,552,981**	**$11,436,203**
	ANNUAL OPERATION & MAINTENANCE COST DESCRIPTION	**EUAC**			**NET PRESENT WORTH**	
	EQUIPMENT	$5,000				$100,000
	SUPPLIES (Acid, Base, Detergent, Preservative for Clean-in-Place Cycle)	$14,000				$280,000
	UTILITIES	$51,000				$1,020,000
	LABOR	$100,000				$2,000,000
	LEACHBUSTER® SKID (Membranes, Supplies)	$185,000				$3,700,000
	PUMPING FEES	$0				$0
	TOTAL ESTIMATED ANNUAL COST (20 Years)	**$355,000**				**$7,100,000**
	GRANT					**$0**
	TOTAL NET PRESENT WORTH					**$18,536,203**
	EUAC					**$1,079,655**
	Total Volume Treated = (120,000 x 365 x 0.9 x 0.75)	**29,565,000**	**Gallons**		**Fee/Gallon=**	**$0.037**
	(Assumed Plant Operating at 90% of time and at 75% Capacity)				**Fee/1000 Ga=**	**$36.52**
					Fee/3000 Ga=	**$110**

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant - 20,000 GPD Leachate + 200,000 GPD Septage

Single-pass Membrane Type Treatment and Pumping to Pond Equivalent Uniform Annual Cost (ADEC Loan)

No.	Capital Cost Item Description	Price	Salvage Rate (20 yr)	Salvage Value	Present Worth of Salvage Value	Net Present Worth
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	$513,240	60%	$307,944	$228,639	$284,601
2	DEMOLITION	$114,000	0%	$0	$0	$114,000
3	SITE WORK (SEE DETAILS IN APPENDIX)	$381,500	60%	$228,900	$169,951	$211,549
4	ROAD WORK (SEE DETAILS IN APPENDIX)	$1,217,500	60%	$730,500	$542,375	$675,125
5	SUBSURFACE DRAINFIELD	$675,000	60%	$405,000	$300,701	$374,299
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	$71,014	60%	$42,608	$31,635	$39,378
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	$717,500	60%	$430,500	$319,634	$397,866
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	$828,500	60%	$497,100	$369,082	$459,418
9	SLUDGE BUNKER	$100,000	60%	$60,000	$44,548	$55,452
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	$800,000	50%	$400,000	$296,988	$503,012
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	$5,700,000	50%	$2,850,000	$2,116,041	$3,583,959
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	$1,920,000	50%	$960,000	$712,772	$1,207,228
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	$75,000	50%	$37,500	$27,843	$47,157
14	OVERALL PROCESS SENSORS, METERS, PLC	$320,000	50%	$160,000	$118,795	$201,205
15	INTERIOR TANKS AND SUPPORT STRUCTURES	$600,000	50%	$300,000	$222,741	$377,259
16	MEP - POWER AND WATER TO THE BUILDING	$100,000	60%	$60,000	$44,548	$55,452
17	WASTEWATER TREATMENT BUILDING	$1,462,500	60%	$877,500	$651,518	$810,982
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	$900,000	50%	$450,000	$334,112	$565,888
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	$1,350,000	50%	$675,000	$501,168	$848,832
20	OTHER (POWER, ETC.)	$150,000	0%	$0	$0	$150,000
21		$0	0%	$0	$0	$0
22		$0	0%	$0	$0	$0
23	Contingencies (15%) On Balance of Plant Minus LeachBuster®:	$1,426,000	0%	$0	$0	$1,426,000
24	Engineering (12%) On Balance of Plant Minus LeachBuster®:	$1,312,000	0%	$0	$0	$1,312,000
25	Contract Administration (5%):	$547,000	0%	$0	$0	$547,000
26	Commissioning, Training, Trouble Shooting, etc.:	$359,916	0%	$0	$0	$359,916
27	Bonding, Insurance:	$0	0%	$0	$0	$0
28						
	TOTAL ESTIMATED CONSTRUCTION COST	**$21,640,670**		**$9,472,552**	**$7,033,090**	**$14,607,580**
	ANNUAL OPERATION & MAINTENANCE COST DESCRIPTION	**EUAC**				**NET PRESENT WORTH**
	EQUIPMENT	$8,000				$160,000
	SUPPLIES (Acid, Base, Detergent, Preservative for Clean-in-Place Cycle)	$42,520				$850,400
	UTILITIES	$90,000				$1,800,000
	LABOR	$100,000				$2,000,000
	LEACHBUSTER® SKID (Membranes, Supplies)	$295,000				$5,900,000
	PUMPING FEES	$0				$0
	TOTAL ESTIMATED ANNUAL COST (20 Years) GRANT	**$535,520**				**$10,710,400**
	TOTAL NET PRESENT WORTH					**$0**
						$25,317,980
	EUAC					**$1,474,664**
	Total Volume Treated = (200,000 x 365 x 0.9 x 0.5)	**32,850,000**	**Gallons**		**Fee/Gallon=**	**$0.045**
	(Assumed Plant Operating at 90% of time and at 50% Capacity)				**Fee/1000 Ga=**	**$44.89**
					Fee/3000 Ga=	**$135**

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant - 20,000 GPD Leachate + 215,000 GPD Septage

Single-pass Membrane Type Treatment and Pumping to Pond Equivalent Uniform Annual Cost (ADEC Loan)

No.	Capital Cost Item Description	Price	Salvage Rate (20 yr)	Salvage Value	Present Worth of Salvage Value	Net Present Worth
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	$515,820	60%	$309,492	$229,789	$286,031
2	DEMOLITION	$114,000	0%	$0	$0	$114,000
3	SITE WORK (SEE DETAILS IN APPENDIX)	$381,500	60%	$228,900	$169,951	$211,549
4	ROAD WORK (SEE DETAILS IN APPENDIX)	$1,217,500	60%	$730,500	$542,375	$675,125
5	SUBSURFACE DRAINFIELD	$700,000	60%	$420,000	$311,838	$388,162
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	$71,014	60%	$42,608	$31,635	$39,378
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	$717,500	60%	$430,500	$319,634	$397,866
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	$828,500	60%	$497,100	$369,082	$459,418
9	SLUDGE BUNKER	$100,000	60%	$60,000	$44,548	$55,452
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	$800,000	50%	$400,000	$296,988	$503,012
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	$6,310,000	50%	$3,155,000	$2,342,494	$3,967,506
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	$1,920,000	50%	$960,000	$712,772	$1,207,228
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	$100,000	50%	$50,000	$37,124	$62,876
14	OVERALL PROCESS SENSORS, METERS, PLC	$360,000	50%	$180,000	$133,645	$226,355
15	INTERIOR TANKS AND SUPPORT STRUCTURES	$600,000	50%	$300,000	$222,741	$377,259
16	MEP - POWER AND WATER TO THE BUILDING	$100,000	60%	$60,000	$44,548	$55,452
17	WASTEWATER TREATMENT BUILDING	$1,755,000	60%	$1,053,000	$781,821	$973,179
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	$600,000	50%	$300,000	$222,741	$377,259
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	$1,350,000	50%	$675,000	$501,168	$848,832
20	OTHER (POWER, ETC.)	$175,000	0%	$0	$0	$175,000
21		$0	0%	$0	$0	$0
22		$0	0%	$0	$0	$0
23	Contingencies (15%) On Balance of Plant Minus LeachBuster®:	$1,438,000	0%	$0	$0	$1,438,000
24	Engineering (12%) On Balance of Plant Minus LeachBuster®:	$1,323,000	0%	$0	$0	$1,323,000
25	Contract Administration (5%):	$552,000	0%	$0	$0	$552,000
26	Commissioning, Training, Trouble Shooting, etc.:	$374,318	0%	$0	$0	$374,318
27	Bonding, Insurance:	$0	0%	$0	$0	$0
28						
	TOTAL ESTIMATED CONSTRUCTION COST	**$22,403,152**		**$9,852,100**	**$7,314,893**	**$15,088,259**
	ANNUAL OPERATION & MAINTENANCE COST DESCRIPTION	**EUAC**			**NET PRESENT WORTH**	
	EQUIPMENT	$10,000				$200,000
	SUPPLIES (Acid, Base, Detergent, Preservative for Clean-in-Place Cycle)	$45,000				$900,000
	UTILITIES	$97,000				$1,940,000
	LABOR	$120,000				$2,400,000
	LEACHBUSTER® SKID (Membranes, Supplies)	$322,000				$6,440,000
	PUMPING FEES	$0				$0
	TOTAL ESTIMATED ANNUAL COST (40 Years)	**$594,000**				**$11,880,000**
	GRANT					**$0**
	TOTAL NET PRESENT WORTH					**$26,968,259**
	EUAC					**$1,570,786**
	Total Volume Treated = (235,000 x 365 x 0.9 x 0.5)	**38,598,750**	**Gallons**		**Fee/Gallon=**	**$0.041**
	(Assumed Plant Operating at 90% of time and at 50% Capacity)				**Fee/1000 Ga=**	**$40.70**
					Fee/3000 Ga=	**$122.09**

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant - 20,000 GPD Leachate + 250,000 GPD Septage

Single-pass Membrane Type Treatment and Pumping to Pond Equivalent Uniform Annual Cost (ADEC Loan)

No.	Capital Cost Item Description	Price	Salvage Rate (20 yr)	Salvage Value	Present Worth of Salvage Value	Net Present Worth
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	$505,500	60%	$303,300	$225,191	$280,309
2	DEMOLITION	$114,000	0%	$0	$0	$114,000
3	SITE WORK (SEE DETAILS IN APPENDIX)	$381,500	60%	$228,900	$169,951	$211,549
4	ROAD WORK (SEE DETAILS IN APPENDIX)	$1,217,500	60%	$730,500	$542,375	$675,125
5	SUBSURFACE DRAINFIELD	$733,333	60%	$440,000	$326,687	$406,646
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	$71,014	60%	$42,608	$31,635	$39,378
7	DETAILS)	$717,500	60%	$430,500	$319,634	$397,866
8	DETAILS)	$828,500	60%	$497,100	$369,082	$459,418
9	SLUDGE BUNKER	$100,000	60%	$60,000	$44,548	$55,452
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	$800,000	50%	$400,000	$296,988	$503,012
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	$6,711,000	50%	$3,355,500	$2,491,359	$4,219,641
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	$1,920,000	50%	$960,000	$712,772	$1,207,228
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	$100,000	50%	$50,000	$37,124	$62,876
14	OVERALL PROCESS SENSORS, METERS, PLC	$400,000	50%	$200,000	$148,494	$251,506
15	INTERIOR TANKS AND SUPPORT STRUCTURES	$400,000	50%	$200,000	$148,494	$251,506
16	MEP - POWER AND WATER TO THE BUILDING	$100,000	60%	$60,000	$44,548	$55,452
17	WASTEWATER TREATMENT BUILDING	$2,025,000	60%	$1,215,000	$902,102	$1,122,898
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	$300,000	50%	$150,000	$111,371	$188,629
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	$1,350,000	50%	$675,000	$501,168	$848,832
20	OTHER (POWER, ETC.)	$200,000	0%	$0	$0	$200,000
21		$0	0%	$0	$0	$0
22		$0	0%	$0	$0	$0
23	Contingencies (15%) On Balance of Plant Minus LeachBuster®:	$1,417,000	0%	$0	$0	$1,417,000
24	Engineering (12%) On Balance of Plant Minus LeachBuster®:	$1,304,000	0%	$0	$0	$1,304,000
25	Contract Administration (5%):	$544,000	0%	$0	$0	$544,000
26	Commissioning, Training, Trouble Shooting, etc.:	$379,498	0%	$0	$0	$379,498
27	Bonding, Insurance:	$0	0%	$0	$0	$0
28						
	TOTAL ESTIMATED CONSTRUCTION COST	**$22,619,345**		**$9,998,408**	**$7,423,522**	**$15,195,823**
	ANNUAL OPERATION & MAINTENANCE COST DESCRIPTION	**EUAC**			**NET PRESENT WORTH**	
	EQUIPMENT	$10,000				$200,000
	SUPPLIES (Acid, Base, Detergent, Preservative for Clean-in-Place Cycle)	$51,000				$1,020,000
	UTILITIES	$118,000				$2,360,000
	LABOR	$120,000				$2,400,000
	LEACHBUSTER® SKID (Membranes, Supplies)	$358,000				$7,160,000
	PUMPING FEES	$0				$0
	TOTAL ESTIMATED ANNUAL COST (20 Years) GRANT	**$657,000**				**$13,140,000**
	TOTAL NET PRESENT WORTH					**$0**
						$28,335,823
	EUAC					**$1,650,441**
	Total Volume Treated = (270,000 x 365 x 0.9 x 0.5)	**44,347,500**	**Gallons**		**Fee/Gallon=**	**$0.037**
	(Assumed Plant Operating at 90% of time and at 50% Capacity)				**Fee/1000 Ga=**	**$37.22**
					Fee/3000 Ga=	**$112**

MAT-SU BOROUGH

LeachBuster® Leachate Treatment Plant

Single-pass Membrane Type Treatment and Pumping to Pond 2018 Opinion of Probable Construction Cost

20,000 GPD Leachate Treatment (Shared Work with Septage Treatment Development)

Item No.	Item Description	Est Quantity	Unit Cost	Item Total
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	6% LS	$2,367,000.00	$142,020.00
2	DEMOLITION (Shared with Septage Treatment Development 80/20)	4 ACRES	$6,000.00	$22,800.00
3	SITE WORK (SEE DETAILS IN APPENDIX) (Shared 80/20	20% LS	$381,500.00	$76,300.00
4	ROAD WORK (SEE DETAILS IN APPENDIX) (Shared 80/20	20% LS	$1,217,500.00	$243,500.00
5	SUBSURFACE DRAINFIELD (Shared 80/20)	2,000.0 SY	$50.00	$100,000.00
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS	180 LS	$197.26	$35,506.80
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS	4,100 LF	$175.00	$717,500.00
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS	4,200 LF	$197.26	$828,500.02
9	SLUDGE BUNKER (Part of Septage Treatment Only)	0 LS	$50,000.00	$0.00
10	Sludge Management System (PART OF LB)(Part of Septage Treatment Only)	0 LS	$380,000.00	$0.00
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB	0 LS	$4,100,000.00	$0.00
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB	1 LS	$1,920,000.00	$1,920,000.00
13	LEACHBUSTER INTERCONNECTION (PART OF LB) (Shared 80/20	20% LS	$45,000.00	$9,000.00
14	OVERALL PROCESS SENSORS, METERS, PLC (Shared 80/20)	20% LS	$205,000.00	$41,000.00
15	INTERIOR TANKS AND SUPPORT STRUCTURES	1 LS	$100,000.00	$100,000.00
16	MEP - POWER AND WATER TO THE BUILDING (Shared 80/20	20% LS	$100,000.00	$20,000.00
17	WASTEWATER TREATMENT BUILDING	1,000 SQFT	$225.00	$225,000.00
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	0 LS	$300,000.00	$0.00
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	0 LS	$450,000.00	$0.00
20	OTHER (POWER, ETC.) (Shared 80/20)	20% LS	$100,000.00	$20,000.00
21				
22				

Subtotal:	**$4,501,200.00**
Contingencies (15%) On Balance of Plant Minus LeachBuster®:	**$386,000.00**
Total Estimated Construction Cost:	**$4,887,200.00**
Engineering (12%) On Balance of Plant Minus LeachBuster®:	**$355,000.00**
Contract Administration (5%):	**$148,000.00**
Commissioning, Training, Trouble Shooting, etc.:	**$90,024.00**
Bonding, Insurance:	**$0.00**
Total Estimated Project Cost:	**$5,480,224.00**

(Basis of opinion, schematic layout)

MAT-SU BOROUGH

LeachBuster® Septage Treatment Plant

Single-pass Membrane Type Treatment and Pumping to Pond 2018 Opinion of Probable Construction Cost

100,000 GPD Septage Treatment (Shared Work with Leachate Treatment Development)

Item No.	Item Description	Est Quantity	Unit Cost	Item Total
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	6% LS	$4,600,000.00	$276,000.00
2	DEMOLITION (Shared with Septage Treatment Development 80/20)	15 ACRES	$6,000.00	$91,200.00
3	SITE WORK (SEE DETAILS IN APPENDIX) (Shared 80/20	80% LS	$381,500.00	$305,200.00
4	ROAD WORK (SEE DETAILS IN APPENDIX) (Shared 80/20	80% LS	$1,217,500.00	$974,000.00
5	SUBSURFACE DRAINFIELD (Shared 80/20)	8,000.0 SY	$50.00	$400,000.00
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS	180 LS	$197.26	$35,506.80
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS	0 LF	$175.00	$0.00
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS	0 LF	$197.26	$0.00
9	SLUDGE BUNKER (Part of Septage Treatment Only	1 LS	$50,000.00	$50,000.00
10	Sludge Management System (PART OF LB)(Part of Septage Treatment Only)	1 LS	$380,000.00	$380,000.00
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB	1 LS	$4,100,000.00	$4,100,000.00
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB	0 LS	$1,920,000.00	$0.00
13	LEACHBUSTER INTERCONNECTION (PART OF LB) (Shared 80/20	80% LS	$45,000.00	$36,000.00
14	OVERALL PROCESS SENSORS, METERS, PLC (Shared 80/20)	80% LS	$205,000.00	$164,000.00
15	INTERIOR TANKS AND SUPPORT STRUCTURES	2 LS	$100,000.00	$200,000.00
16	MEP - POWER AND WATER TO THE BUILDING (Shared 80/20	80% LS	$100,000.00	$80,000.00
17	WASTEWATER TREATMENT BUILDING	3,000 SQFT	$225.00	$675,000.00
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	3 LS	$300,000.00	$900,000.00
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	2 LS	$450,000.00	$900,000.00
20	OTHER (POWER, ETC.) (Shared 80/20)	80% LS	$100,000.00	$80,000.00
21				
22				

Subtotal:	**$9,647,000.00**
Contingencies (15%) On Balance of Plant Minus LeachBuster®:	**$770,000.00**
Total Estimated Construction Cost:	**$10,417,000.00**
Engineering (12%) On Balance of Plant Minus LeachBuster®:	**$709,000.00**
Contract Administration (5%):	**$296,000.00**
Commissioning, Training, Trouble Shooting, etc.:	**$192,940.00**
Bonding, Insurance:	**$0.00**
Total Estimated Project Cost:	**$11,614,940.00**

(Basis of opinion, schematic layout)

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant

Single-pass Membrane Type Treatment and Pumping to Pond 2018 Opinion of Probable Construction Cost

20,000 GPD Leachate + 100,000 GPD Septage Treatment

Item No.	Item Description	Est Quantity	Unit Cost	Item Total
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	6% LS	$6,957,000.00	$417,420.00
2	DEMOLITION	19 ACRES	$6,000.00	$114,000.00
3	SITE WORK (SEE DETAILS IN APPENDIX)	1 LS	$381,500.00	$381,500.00
4	ROAD WORK (SEE DETAILS IN APPENDIX)	1 LS	$1,217,500.00	$1,217,500.00
5	SUBSURFACE DRAINFIELD	10,000.0 SY	$50.00	$500,000.00
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	360 LS	$197.26	$71,013.60
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	4,100 LF	$175.00	$717,500.00
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	4,200 LF	$197.26	$828,500.02
9	SLUDGE BUNKER	1 LS	$50,000.00	$50,000.00
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	1 LS	$380,000.00	$380,000.00
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	1 LS	$4,100,000.00	$4,100,000.00
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	1 LS	$1,920,000.00	$1,920,000.00
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	1 LS	$45,000.00	$45,000.00
14	OVERALL PROCESS SENSORS, METERS, PLC	1 LS	$205,000.00	$205,000.00
15	INTERIOR TANKS AND SUPPORT STRUCTURES	3 LS	$100,000.00	$300,000.00
16	MEP - POWER AND WATER TO THE BUILDING	1 LS	$90,000.00	$90,000.00
17	WASTEWATER TREATMENT BUILDING	4,000 SQFT	$225.00	$900,000.00
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	3 LS	$300,000.00	$900,000.00
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	2 LS	$450,000.00	$900,000.00
20	OTHER (POWER, ETC.)	1 LS	$100,000.00	$100,000.00
21				
22				

Subtotal:	**$14,137,500.00**
Contingencies (14%) On Balance of Plant Minus LeachBuster®:	**$1,077,000.00**
Total Estimated Construction Cost:	**$15,214,500.00**
Engineering (12%) On Balance of Plant Minus LeachBuster®:	**$1,053,000.00**
Contract Administration (5%):	**$439,000.00**
Commissioning, Training, Trouble Shooting, etc.:	**$282,750.00**
Bonding, Insurance:	**$0.00**
Total Estimated Project Cost:	**$16,989,250.00**

(Basis of opinion, schematic layout)

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant

Single-pass Membrane Type Treatment and Pumping to Pond 2018 Opinion of Probable Construction Cost

20,000 GPD Leachate + 200,000 GPD Septage Treatment

Item No.	Item Description	Est Quantity	Unit Cost	Item Total
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	6% LS	$8,554,000.00	$513,240.00
2	DEMOLITION	19 ACRES	$6,000.00	$114,000.00
3	SITE WORK (SEE DETAILS IN APPENDIX)	1 LS	$381,500.00	$381,500.00
4	ROAD WORK (SEE DETAILS IN APPENDIX)	1 LS	$1,217,500.00	$1,217,500.00
5	SUBSURFACE DRAINFIELD	13,500.0 SY	$50.00	$675,000.00
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	360 LS	$197.26	$71,013.60
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	4,100 LF	$175.00	$717,500.00
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	4,200 LF	$197.26	$828,500.02
9	SLUDGE BUNKER	1 LS	$100,000.00	$100,000.00
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	1 LS	$800,000.00	$800,000.00
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	1 LS	$5,700,000.00	$5,700,000.00
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	1 LS	$1,920,000.00	$1,920,000.00
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	1 LS	$75,000.00	$75,000.00
14	OVERALL PROCESS SENSORS, METERS, PLC	1 LS	$320,000.00	$320,000.00
15	INTERIOR TANKS AND SUPPORT STRUCTURES	3 LS	$200,000.00	$600,000.00
16	MEP - POWER AND WATER TO THE BUILDING	1 LS	$100,000.00	$100,000.00
17	WASTEWATER TREATMENT BUILDING	6,500 SQFT	$225.00	$1,462,500.00
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	3 LS	$300,000.00	$900,000.00
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	3 LS	$450,000.00	$1,350,000.00
20	OTHER (POWER, ETC.)	1 LS	$150,000.00	$150,000.00
21				
22				

Subtotal:	**$17,995,800.00**
Contingencies (15%) On Balance of Plant Minus LeachBuster®:	**$1,426,000.00**
Total Estimated Construction Cost:	**$19,421,800.00**
Engineering (12%) On Balance of Plant Minus LeachBuster®:	**$1,312,000.00**
Contract Administration (5%):	**$547,000.00**
Commissioning, Training, Trouble Shooting, etc.:	**$359,916.00**
Bonding, Insurance:	**$0.00**
Total Estimated Project Cost:	**$21,640,716.00**

(Basis of opinion, schematic layout)

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant

Single-pass Membrane Type Treatment and Pumping to Pond 2018 Opinion of Probable Construction Cost

20,000 GPD Leachate + 215,000 GPD Septage Treatment

Item No.	Item Description	Est Quantity	Unit Cost	Item Total
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	6% LS	$8,597,000.00	$515,820.00
2	DEMOLITION	19 ACRES	$6,000.00	$114,000.00
3	SITE WORK (SEE DETAILS IN APPENDIX)	1 LS	$381,500.00	$381,500.00
4	ROAD WORK (SEE DETAILS IN APPENDIX)	1 LS	$1,217,500.00	$1,217,500.00
5	SUBSURFACE DRAINFIELD	14,000.0 SY	$50.00	$700,000.00
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS	360 LS	$197.26	$71,013.60
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS	4,100 LF	$175.00	$717,500.00
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS	4,200 LF	$197.26	$828,500.02
9	SLUDGE BUNKER	1 LS	$100,000.00	$100,000.00
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB	1 LS	$800,000.00	$800,000.00
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB	1 LS	$6,310,000.00	$6,310,000.00
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB	1 LS	$1,920,000.00	$1,920,000.00
13	LEACHBUSTER INTERCONNECTION (PART OF LB	1 LS	$100,000.00	$100,000.00
14	OVERALL PROCESS SENSORS, METERS, PLC	1 LS	$360,000.00	$360,000.00
15	INTERIOR TANKS AND SUPPORT STRUCTURES	3 LS	$200,000.00	$600,000.00
16	MEP - POWER AND WATER TO THE BUILDING	1 LS	$100,000.00	$100,000.00
17	WASTEWATER TREATMENT BUILDING	7,800 SQFT	$225.00	$1,755,000.00
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	2 LS	$300,000.00	$600,000.00
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	3 LS	$450,000.00	$1,350,000.00
20	OTHER (POWER, ETC.)	1 LS	$175,000.00	$175,000.00
21				
22				

Subtotal:	**$18,715,900.00**
Contingencies (15%) On Balance of Plant Minus LeachBuster®:	**$1,438,000.00**
Total Estimated Construction Cost:	**$20,153,900.00**
Engineering (12%) On Balance of Plant Minus LeachBuster®:	**$1,323,000.00**
Contract Administration (5%):	**$552,000.00**
Commissioning, Training, Trouble Shooting, etc.:	**$374,318.00**
Bonding, Insurance:	**$0.00**
Total Estimated Project Cost:	**$22,403,218.00**

(Basis of opinion, schematic layout)

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant

Single-pass Membrane Type Treatment and Pumping to Pond 2018 Opinion of Probable Construction Cost

20,000 GPD Leachate + 250,000 GPD Septage Treatment

Item No.	Item Description	Est Quantity	Unit Cost	Item Total
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	6% LS	$8,425,000.00	$505,500.00
2	DEMOLITION	19 ACRES	$6,000.00	$114,000.00
3	SITE WORK (SEE DETAILS IN APPENDIX)	1 LS	$381,500.00	$381,500.00
4	ROAD WORK (SEE DETAILS IN APPENDIX)	1 LS	$1,217,500.00	$1,217,500.00
5	SUBSURFACE DRAINFIELD	14,666.7 SY	$50.00	$733,333.35
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	360 LS	$197.26	$71,013.60
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	4,100 LF	$175.00	$717,500.00
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	4,200 LF	$197.26	$828,500.02
9	SLUDGE BUNKER	1 LS	$100,000.00	$100,000.00
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	1 LS	$800,000.00	$800,000.00
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	1 LS	$6,711,000.00	$6,711,000.00
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	1 LS	$1,920,000.00	$1,920,000.00
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	1 LS	$100,000.00	$100,000.00
14	OVERALL PROCESS SENSORS, METERS, PLC	1 LS	$400,000.00	$400,000.00
15	INTERIOR TANKS AND SUPPORT STRUCTURES	2 LS	$200,000.00	$400,000.00
16	MEP - POWER AND WATER TO THE BUILDING	1 LS	$100,000.00	$100,000.00
17	WASTEWATER TREATMENT BUILDING	9,000 SQFT	$225.00	$2,025,000.00
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	1 LS	$300,000.00	$300,000.00
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	3 LS	$450,000.00	$1,350,000.00
20	OTHER (POWER, ETC.)	1 LS	$200,000.00	$200,000.00
21				
22				

Subtotal:	**$18,974,900.00**
Contingencies (15%) On Balance of Plant Minus LeachBuster®:	**$1,417,000.00**
Total Estimated Construction Cost:	**$20,391,900.00**
Engineering (12%) On Balance of Plant Minus LeachBuster®:	**$1,304,000.00**
Contract Administration (5%):	**$544,000.00**
Commissioning, Training, Trouble Shooting, etc.:	**$379,498.00**
Bonding, Insurance:	**$0.00**
Total Estimated Project Cost:	**$22,619,398.00**

(Basis of opinion, schematic layout)

MAT-SU BOROUGH

LeachBuster® Leachate Treatment Plant - <u>20,000 GPD Leachate</u>

Single-pass Membrane Type Treatment and Pumping to Pond Equivalent Uniform Annual Cost (USDA Loan)

No.	Capital Cost Item Description	Price	Salvage Rate (40 yr)	Salvage Value	Present Worth of Salvage Value	Net Present Worth
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	$142,020	20%	$28,404	$8,295	$133,725
2	DEMOLITION (Shared with Septage Treatment Development 80/20)	$22,800	0%	$0	$0	$22,800
3	SITE WORK (SEE DETAILS IN APPENDIX) (Shared 80/20)	$76,300	20%	$15,260	$4,457	$71,843
4	ROAD WORK (SEE DETAILS IN APPENDIX) (Shared 80/20)	$243,500	20%	$48,700	$14,222	$229,278
5	SUBSURFACE DRAINFIELD (Shared 80/20)	$100,000	20%	$20,000	$5,841	$94,159
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	$35,507	20%	$7,101	$2,074	$33,433
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	$717,500	20%	$143,500	$41,908	$675,592
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS	) $828,500	20%	$165,700	$48,391	$780,109
9	SLUDGE BUNKER (Part of Septage Treatment Only)	$0	20%	$0	$0	$0
10	Sludge Management System (PART OF LB)(Pt of Septage Treatment Only)	$0	10%	$0	$0	$0
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	$0	10%	$0	$0	$0
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	$1,920,000	10%	$192,000	$56,072	$1,863,928
13	LEACHBUSTER INTERCONNECTION (PART OF LB) (Shared 80/20)	$9,000	10%	$900	$263	$8,737
14	OVERALL PROCESS SENSORS, METERS, PLC (Shared 80/20)	$41,000	10%	$4,100	$1,197	$39,803
15	INTERIOR TANKS AND SUPPORT STRUCTURES	$100,000	10%	$10,000	$2,920	$97,080
16	MEP - POWER AND WATER TO THE BUILDING (Shared 80/20)	$20,000	20%	$4,000	$1,168	$18,832
17	WASTEWATER TREATMENT BUILDING	$225,000	20%	$45,000	$13,142	$211,858
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	$0	10%	$0	$0	$0
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	$0	10%	$0	$0	$0
20	OTHER (POWER, ETC.) (Shared 80/20)	$20,000	0%	$0	$0	$20,000
21		$0	0%	$0	$0	$0
22		$0	0%	$0	$0	$0
23	Contingencies (15%) On Balance of Plant Minus LeachBuster®:	$386,000	0%	$0	$0	$386,000
24	Engineering (12%) On Balance of Plant Minus LeachBuster®:	$355,000	0%	$0	$0	$355,000
25	Contract Administration (5%):	$148,000	0%	$0	$0	$148,000
26	Commissioning, Training, Trouble Shooting, etc.:	$90,024	0%	$0	$0	$90,024
27	Bonding, Insurance:	$0	0%	$0	$0	$0
28						
	TOTAL ESTIMATED CONSTRUCTION COST	**$5,480,151**		**$684,665**	**$199,949**	**$5,280,202**
	ANNUAL OPERATION & MAINTENANCE COST DESCRIPTION	**EUAC**			**NET PRESENT WORTH**	
	EQUIPMENT	$1,000				$40,000
	SUPPLIES (Acid, Base, Detergent, Preservative for Clean-in-Place Cycle)	$11,000				$440,000
	UTILITIES	$20,000				$800,000
	LABOR	$40,000				$1,600,000
	LEACHBUSTER® SKID (Membranes, Supplies)	$45,000				$1,800,000
	PUMPING FEES	$0				$0
	TOTAL ESTIMATED ANNUAL COST (40 Years) USDA GRANT	**$117,000**		**GRANT**		**$4,680,000**
	TOTAL NET PRESENT WORTH					**30%** **-$1,644,045**
						$8,316,156
	EUAC					**$367,082**
	Total Volume Treated = (20,000 x 365 x 0.9 x 0.80)	**5,256,000**	**Gallons**		**Fee/Gallon=**	**$0.070**
	(Assumed Plant Operating at 90% of time and at 80% Capacity)				**Fee/1000 Ga=**	**$69.84**
					Fee/3000 Ga=	**$210**

MAT-SU BOROUGH

LeachBuster® Septage Treatment Plant - 100,000 GPD Septage

Single-pass Membrane Type Treatment and Pumping to Pond Equivalent Uniform Annual Cost (USDA Loan)

No.	Capital Cost Item Description	Price	Salvage Rate (40 yr)	Salvage Value	Present Worth of Salvage Value	Net Present Worth
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	$276,000	20%	$55,200	$16,121	$259,879
2	DEMOLITION (Shared with Septage Treatment Development 80/20)	$91,200	0%	$0	$0	$91,200
3	SITE WORK (SEE DETAILS IN APPENDIX) (Shared 80/20)	$305,200	20%	$61,040	$17,826	$287,374
4	ROAD WORK (SEE DETAILS IN APPENDIX) (Shared 80/20)	$974,000	20%	$194,800	$56,889	$917,111
5	SUBSURFACE DRAINFIELD (Shared 80/20)	$400,000	20%	$80,000	$23,363	$376,637
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	$35,507	20%	$7,101	$2,074	$33,433
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	$0	20%	$0	$0	$0
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	$0	20%	$0	$0	$0
9	SLUDGE BUNKER (Part of Septage Treatment Only)	$50,000	20%	$10,000	$2,920	$47,080
10	Sludge Management System (PART OF LB)(Pt of Septage Treatment Only)	$380,000	10%	$38,000	$11,097	$368,903
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	$4,100,000	10%	$410,000	$119,736	$3,980,264
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	$0	10%	$0	$0	$0
13	LEACHBUSTER INTERCONNECTION (PART OF LB) (Shared 80/20)	$36,000	10%	$3,600	$1,051	$34,949
14	OVERALL PROCESS SENSORS, METERS, PLC (Shared 80/20)	$164,000	10%	$16,400	$4,789	$159,211
15	INTERIOR TANKS AND SUPPORT STRUCTURES	$200,000	10%	$20,000	$5,841	$194,159
16	MEP - POWER AND WATER TO THE BUILDING (Shared 80/20)	$80,000	20%	$16,000	$4,673	$75,327
17	WASTEWATER TREATMENT BUILDING	$675,000	20%	$135,000	$39,425	$635,575
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	$900,000	10%	$90,000	$26,284	$873,716
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	$900,000	10%	$90,000	$26,284	$873,716
20	OTHER (POWER, ETC.) (Shared 80/20)	$80,000	0%	$0	$0	$80,000
21		$0	0%	$0	$0	$0
22		$0	0%	$0	$0	$0
23	Contingencies (15%) On Balance of Plant Minus LeachBuster®:	$770,000	0%	$0	$0	$770,000
24	Engineering (12%) On Balance of Plant Minus LeachBuster®:	$709,000	0%	$0	$0	$709,000
25	Contract Administration (5%):	$296,000	0%	$0	$0	$296,000
26	Commissioning, Training, Trouble Shooting, etc.:	$192,940	0%	$0	$0	$192,940
27	Bonding, Insurance:	$0	0%	$0	$0	$0
28						
	TOTAL ESTIMATED CONSTRUCTION COST	**$11,614,847**		**$1,227,141**	**$358,374**	**$11,256,473**
	ANNUAL OPERATION & MAINTENANCE COST DESCRIPTION	**EUAC**			**NET PRESENT WORTH**	
	EQUIPMENT	$4,000				$160,000
	SUPPLIES (Acid, Base, Detergent, Preservative for Clean-in-Place Cycle)	$13,000				$520,000
	UTILITIES	$31,000				$1,240,000
	LABOR	$60,000				$2,400,000
	LEACHBUSTER® SKID (Membranes, Supplies)	$140,000				$5,600,000
	PUMPING FEES	$0				$0
	TOTAL ESTIMATED ANNUAL COST (40 Years)	**$248,000**				**$9,920,000**
	USDA GRANT			**GRANT**	**30%**	**-$3,484,454**
	TOTAL NET PRESENT WORTH					**$17,692,019**
	EUAC					**$780,941**
	Total Volume Treated = (100,000 x 365 x 0.9 x 0.75)	**24,637,500**	**Gallons**		**Fee/Gallon=**	**$0.032**
	(Assumed Plant Operating at 90% of time and at 75% Capacity)				**Fee/1000 Ga=**	**$31.70**
					Fee/3000 Ga=	**$95**

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant - 20,000 GPD Leachate + 100,000 GPD Septage

Single-pass Membrane Type Treatment and Pumping to Pond Equivalent Uniform Annual Cost (USDA Loan)

No.	Capital Cost Item Description	Price	Salvage Rate (40 yr)	Salvage Value	Present Worth of Salvage Value	Net Present Worth
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	$417,420	20%	$83,484	$24,381	$393,039
2	DEMOLITION	$114,000	0%	$0	$0	$114,000
3	SITE WORK (SEE DETAILS IN APPENDIX)	$381,500	20%	$76,300	$22,283	$359,217
4	ROAD WORK (SEE DETAILS IN APPENDIX)	$1,217,500	20%	$243,500	$71,112	$1,146,388
5	SUBSURFACE DRAINFIELD	$500,000	20%	$100,000	$29,204	$470,796
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	$71,014	20%	$14,203	$4,148	$66,866
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	$717,500	20%	$143,500	$41,908	$675,592
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	$828,500	20%	$165,700	$48,391	$780,109
9	SLUDGE BUNKER	$50,000	20%	$10,000	$2,920	$47,080
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	$380,000	10%	$38,000	$11,097	$368,903
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	$4,100,000	10%	$410,000	$119,736	$3,980,264
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	$1,920,000	10%	$192,000	$56,072	$1,863,928
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	$45,000	10%	$4,500	$1,314	$43,686
14	OVERALL PROCESS SENSORS, METERS, PLC	$205,000	10%	$20,500	$5,987	$199,013
15	INTERIOR TANKS AND SUPPORT STRUCTURES	$300,000	10%	$30,000	$8,761	$291,239
16	MEP - POWER AND WATER TO THE BUILDING	$90,000	20%	$18,000	$5,257	$84,743
17	WASTEWATER TREATMENT BUILDING	$900,000	20%	$180,000	$52,567	$847,433
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	$900,000	10%	$90,000	$26,284	$873,716
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	$900,000	10%	$90,000	$26,284	$873,716
20	OTHER (POWER, ETC.)	$100,000	0%	$0	$0	$100,000
21		$0	0%	$0	$0	$0
22		$0	0%	$0	$0	$0
23	Contingencies (15%) On Balance of Plant Minus LeachBuster®:	$1,077,000	0%	$0	$0	$1,077,000
24	Engineering (12%) On Balance of Plant Minus LeachBuster®:	$1,053,000	0%	$0	$0	$1,053,000
25	Contract Administration (5%):	$439,000	0%	$0	$0	$439,000
26	Commissioning, Training, Trouble Shooting, etc.:	$282,750	0%	$0	$0	$282,750
27	Bonding, Insurance:	$0	0%	$0	$0	$0
28						
	TOTAL ESTIMATED CONSTRUCTION COST	**$16,989,184**		**$1,909,687**	**$557,704**	**$16,431,480**
	ANNUAL OPERATION & MAINTENANCE COST DESCRIPTION	**EUAC**			**NET PRESENT WORTH**	
	EQUIPMENT	$5,000				$200,000
	SUPPLIES (Acid, Base, Detergent, Preservative for Clean-in-Place Cycle)	$14,000				$560,000
	UTILITIES	$51,000				$2,040,000
	LABOR	$100,000				$4,000,000
	LEACHBUSTER® SKID (Membranes, Supplies)	$185,000				$7,400,000
	PUMPING FEES	$0				$0
	TOTAL ESTIMATED ANNUAL COST (40 Years)	**$355,000**				**$14,200,000**
	USDA GRANT			**GRANT**	**30%**	**-$5,096,755**
	TOTAL NET PRESENT WORTH					**$25,534,725**
	EUAC					**$1,127,125**
	Total Volume Treated = (120,000 x 365 x 0.9 x 0.75)	**29,565,000**	**Gallons**		**Fee/Gallon=**	**$0.038**
	(Assumed Plant Operating at 90% of time and at 75% Capacity)				**Fee/1000 Ga=**	**$38.12**
					Fee/3000 Ga=	**$114**

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant - <u>20,000 GPD Leachate + 200,000 GPD Septage</u>

Single-pass Membrane Type Treatment and Pumping to Pond Equivalent Uniform Annual Cost (USDA Loan)

No.	Capital Cost Item Description	Price	Salvage Rate (40 yr)	Salvage Value	Present Worth of Salvage Value	Net Present Worth
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	$513,240	20%	$102,648	$29,977	$483,263
2	DEMOLITION	$114,000	0%	$0	$0	$114,000
3	SITE WORK (SEE DETAILS IN APPENDIX)	$381,500	20%	$76,300	$22,283	$359,217
4	ROAD WORK (SEE DETAILS IN APPENDIX)	$1,217,500	20%	$243,500	$71,112	$1,146,388
5	SUBSURFACE DRAINFIELD	$675,000	20%	$135,000	$39,425	$635,575
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	$71,014	20%	$14,203	$4,148	$66,866
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	$717,500	20%	$143,500	$41,908	$675,592
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	$828,500	20%	$165,700	$48,391	$780,109
9	SLUDGE BUNKER	$100,000	20%	$20,000	$5,841	$94,159
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	$800,000	10%	$80,000	$23,363	$776,637
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	$5,700,000	10%	$570,000	$166,462	$5,533,538
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	$1,920,000	10%	$192,000	$56,072	$1,863,928
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	$75,000	10%	$7,500	$2,190	$72,810
14	OVERALL PROCESS SENSORS, METERS, PLC	$320,000	10%	$32,000	$9,345	$310,655
15	INTERIOR TANKS AND SUPPORT STRUCTURES	$600,000	10%	$60,000	$17,522	$582,478
16	MEP - POWER AND WATER TO THE BUILDING	$100,000	20%	$20,000	$5,841	$94,159
17	WASTEWATER TREATMENT BUILDING	$1,462,500	20%	$292,500	$85,422	$1,377,078
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	$900,000	10%	$90,000	$26,284	$873,716
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	$1,350,000	10%	$135,000	$39,425	$1,310,575
20	OTHER (POWER, ETC.)	$150,000	0%	$0	$0	$150,000
21		$0	0%	$0	$0	$0
22		$0	0%	$0	$0	$0
23	Contingencies (15%) On Balance of Plant Minus LeachBuster®:	$1,426,000	0%	$0	$0	$1,426,000
24	Engineering (12%) On Balance of Plant Minus LeachBuster®:	$1,312,000	0%	$0	$0	$1,312,000
25	Contract Administration (5%):	$547,000	0%	$0	$0	$547,000
26	Commissioning, Training, Trouble Shooting, etc.:	$359,916	0%	$0	$0	$359,916
27	Bonding, Insurance:	$0	0%	$0	$0	$0
28						
	TOTAL ESTIMATED CONSTRUCTION COST	**$21,640,670**		**$2,379,851**	**$695,010**	**$20,945,659**
	ANNUAL OPERATION & MAINTENANCE COST DESCRIPTION	**EUAC**			**NET PRESENT WORTH**	
	EQUIPMENT	$8,000				$320,000
	SUPPLIES (Acid, Base, Detergent, Preservative for Clean-in-Place Cycle)	$42,520				$1,700,800
	UTILITIES	$90,000				$3,600,000
	LABOR	$100,000				$4,000,000
	LEACHBUSTER® SKID (Membranes, Supplies)	$295,000				$11,800,000
	PUMPING FEES	$0				$0
	TOTAL ESTIMATED ANNUAL COST (40 Years) USDA GRANT	**$535,520**		**GRANT**	**$21,420,800**	
	TOTAL NET PRESENT WORTH				**30%**	**-$6,492,201**
					$35,874,258	
	EUAC					**$1,583,521**
	Total Volume Treated = (200,000 x 365 x 0.9 x 0.5)	**32,850,000**	**Gallons**		**Fee/Gallon=**	**$0.048**
	(Assumed Plant Operating at 90% of time and at 50% Capacity)				**Fee/1000 Ga=**	**$48.20**
					Fee/3000 Ga=	**$145**

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant - 20,000 GPD Leachate + 215,000 GPD Septage

Single-pass Membrane Type Treatment and Pumping to Pond Equivalent Uniform Annual Cost (USDA Loan)

No.	Capital Cost Item Description	Price	Salvage Rate (40 yr)	Salvage Value	Present Worth of Salvage Value	Net Present Worth
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	$515,820	20%	$103,164	$30,128	$485,692
2	DEMOLITION	$114,000	0%	$0	$0	$114,000
3	SITE WORK (SEE DETAILS IN APPENDIX)	$381,500	20%	$76,300	$22,283	$359,217
4	ROAD WORK (SEE DETAILS IN APPENDIX)	$1,217,500	20%	$243,500	$71,112	$1,146,388
5	SUBSURFACE DRAINFIELD	$700,000	20%	$140,000	$40,886	$659,114
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	$71,014	20%	$14,203	$4,148	$66,866
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	$717,500	20%	$143,500	$41,908	$675,592
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	$828,500	20%	$165,700	$48,391	$780,109
9	SLUDGE BUNKER	$100,000	20%	$20,000	$5,841	$94,159
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	$800,000	10%	$80,000	$23,363	$776,637
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	$6,310,000	10%	$631,000	$184,277	$6,125,723
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	$1,920,000	10%	$192,000	$56,072	$1,863,928
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	$100,000	10%	$10,000	$2,920	$97,080
14	OVERALL PROCESS SENSORS, METERS, PLC	$360,000	10%	$36,000	$10,513	$349,487
15	INTERIOR TANKS AND SUPPORT STRUCTURES	$600,000	10%	$60,000	$17,522	$582,478
16	MEP - POWER AND WATER TO THE BUILDING	$100,000	20%	$20,000	$5,841	$94,159
17	WASTEWATER TREATMENT BUILDING	$1,755,000	20%	$351,000	$102,506	$1,652,494
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	$600,000	10%	$60,000	$17,522	$582,478
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	$1,350,000	10%	$135,000	$39,425	$1,310,575
20	OTHER (POWER, ETC.)	$175,000	0%	$0	$0	$175,000
21		$0	0%	$0	$0	$0
22		$0	0%	$0	$0	$0
23	Contingencies (15%) On Balance of Plant Minus LeachBuster®:	$1,438,000	0%	$0	$0	$1,438,000
24	Engineering (12%) On Balance of Plant Minus LeachBuster®:	$1,323,000	0%	$0	$0	$1,323,000
25	Contract Administration (5%):	$552,000	0%	$0	$0	$552,000
26	Commissioning, Training, Trouble Shooting, etc.:	$374,318	0%	$0	$0	$374,318
27	Bonding, Insurance:	$0	0%	$0	$0	$0
28						
	TOTAL ESTIMATED CONSTRUCTION COST	**$22,403,152**		**$2,481,367**	**$724,657**	**$21,678,495**
	ANNUAL OPERATION & MAINTENANCE COST DESCRIPTION	**EUAC**			**NET PRESENT WORTH**	
	EQUIPMENT	$10,000				$400,000
	SUPPLIES (Acid, Base, Detergent, Preservative for Clean-in-Place Cycle)	$45,000				$1,800,000
	UTILITIES	$97,000				$3,880,000
	LABOR	$120,000				$4,800,000
	LEACHBUSTER® SKID (Membranes, Supplies)	$322,000				$12,880,000
	PUMPING FEES	$0				$0
	TOTAL ESTIMATED ANNUAL COST (40 Years)	**$594,000**				**$23,760,000**
	USDA GRANT			**GRANT**	**30%**	**-$6,720,945**
	TOTAL NET PRESENT WORTH					**$38,717,549**
	EUAC					**$1,709,027**
	Total Volume Treated = (235,000 x 365 x 0.9 x 0.5)	**38,598,750**	**Gallons**		**Fee/Gallon=**	**$0.044**
	(Assumed Plant Operating at 90% of time and at 50% Capacity)				**Fee/1000 Ga=**	**$44.28**
					Fee/3000 Ga=	**$132.83**

MAT-SU BOROUGH

LeachBuster® Septage and Leachate Treatment Plant - 20,000 GPD Leachate + 250,000 GPD Septage

Single-pass Membrane Type Treatment and Pumping to Pond Equivalent Uniform Annual Cost (USDA Loan)

No.	Capital Cost Item Description	Price	Salvage Rate (40 yr)	Salvage Value	Present Worth of Salvage Value	Net Present Worth
1	MISC. SITE DEVELOPMENT COST (6% OF Plant Minus LeachBuster®)	$505,500	20%	$101,100	$29,525	$475,975
2	DEMOLITION	$114,000	0%	$0	$0	$114,000
3	SITE WORK (SEE DETAILS IN APPENDIX)	$381,500	20%	$76,300	$22,283	$359,217
4	ROAD WORK (SEE DETAILS IN APPENDIX)	$1,217,500	20%	$243,500	$71,112	$1,146,388
5	SUBSURFACE DRAINFIELD	$733,333	20%	$146,667	$42,832	$690,501
6	EFFLUENT PIPE AND MANHOLES TO DRAINFIELD (SEE DETAILS)	$71,014	20%	$14,203	$4,148	$66,866
7	LEACHATE PIPE FROM LEACHATE TANKS TO BLDG (SEE DETAILS)	$717,500	20%	$143,500	$41,908	$675,592
8	CONCENTRATE PIPE AND MANHOLES TO LANDFILL (SEE DETAILS)	$828,500	20%	$165,700	$48,391	$780,109
9	SLUDGE BUNKER	$100,000	20%	$20,000	$5,841	$94,159
10	SLUDGE MANAGEMENT SYSTEM (PART OF LB)	$800,000	10%	$80,000	$23,363	$776,637
11	LEACHBUSTER SYSTEM - SEPTAGE (PART OF LB)	$6,711,000	10%	$671,100	$195,988	$6,515,012
12	LEACHBUSTER SYSTEM - LEACHATE (PART OF LB)	$1,920,000	10%	$192,000	$56,072	$1,863,928
13	LEACHBUSTER INTERCONNECTION (PART OF LB)	$100,000	10%	$10,000	$2,920	$97,080
14	OVERALL PROCESS SENSORS, METERS, PLC	$400,000	10%	$40,000	$11,682	$388,318
15	INTERIOR TANKS AND SUPPORT STRUCTURES	$400,000	10%	$40,000	$11,682	$388,318
16	MEP - POWER AND WATER TO THE BUILDING	$100,000	20%	$20,000	$5,841	$94,159
17	WASTEWATER TREATMENT BUILDING	$2,025,000	20%	$405,000	$118,276	$1,906,724
18	EXTERIOR TANKS AND SUPPORT STRUCTURES	$300,000	10%	$30,000	$8,761	$291,239
19	SEPTAGE RECEIVING STATION + BUILDING + TANK	$1,350,000	10%	$135,000	$39,425	$1,310,575
20	OTHER (POWER, ETC.)	$200,000	0%	$0	$0	$200,000
21		$0	0%	$0	$0	$0
22		$0	0%	$0	$0	$0
23	Contingencies (15%) On Balance of Plant Minus LeachBuster®:	$1,417,000	0%	$0	$0	$1,417,000
24	Engineering (12%) On Balance of Plant Minus LeachBuster®:	$1,304,000	0%	$0	$0	$1,304,000
25	Contract Administration (5%):	$544,000	0%	$0	$0	$544,000
26	Commissioning, Training, Trouble Shooting, etc.:	$379,498	0%	$0	$0	$379,498
27	Bonding, Insurance:	$0	0%	$0	$0	$0
28						
	TOTAL ESTIMATED CONSTRUCTION COST	**$22,619,345**		**$2,534,069**	**$740,048**	**$21,879,297**
	ANNUAL OPERATION & MAINTENANCE COST DESCRIPTION	**EUAC**			**NET PRESENT WORTH**	
	EQUIPMENT	$10,000				$400,000
	SUPPLIES (Acid, Base, Detergent, Preservative for Clean-in-Place Cycle)	$51,000				$2,040,000
	UTILITIES	$118,000				$4,720,000
	LABOR	$120,000				$4,800,000
	LEACHBUSTER® SKID (Membranes, Supplies)	$358,000				$14,320,000
	PUMPING FEES	$0				$0
	TOTAL ESTIMATED ANNUAL COST (40 Years) USDA GRANT	**$657,000**		**GRANT**	**$26,280,000**	
	TOTAL NET PRESENT WORTH				**30%**	**-$6,785,803**
					$41,373,493	
	EUAC					**$1,826,262**
	Total Volume Treated = (270,000 x 365 x 0.9 x 0.5)	**44,347,500**	**Gallons**		**Fee/Gallon=**	**$0.0412**
	(Assumed Plant Operating at 90% of time and at 50% Capacity)				**Fee/1000 Ga=**	**$41.18**
					Fee/3000 Ga=	**$123.54**