Preliminary Engineering Report

Gustavus Septage Management Improvements

November 21, 2024

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EXECUTIVE SUMMARY

HDR Alaska, Inc. (HDR), is developing the Gustavus Septage Management Preliminary Engineering Report (PER) under Village Safe Water (VSW) work order 24-GST-TO-016. The project's scope is to identify and study alternatives for treatment and disposal of septage.

Gustavus is a community of 655 people and is located on the northern shore of Icy Passage, approximately 50 miles northwest of Juneau (see Figure 1). Gustavus is served by an airport with two asphalt runways with daily jet flights in the summer. Gustavus is also served by a weekly Alaska Marine Highway System (AMHS) ferry which docks in Icy Passage and a seaplane base located in Bartlett Cove to the north. Gustavus is not connected to the Alaska road system but is located on the AMHS.

Gustavus residents and businesses are served by on-site septic tanks, which require periodic pumping for proper operation. The pumped septage requires proper disposal. Currently, septage pumped from on-site septic tanks is transported to two 10,000-gallon septage transfer tanks located at the Disposal and Recycling Center (DRC), followed by transport via the AMHS in a large septage hauling tanker truck and septage pump truck to Juneau. In Juneau, the septage is disposed of at the wastewater treatment facility. The community desires a local treatment and disposal option to eliminate the reliance on other communities and the AMHS for disposal.

The goal of this PER is to recommend a method of local treatment and disposal of septage in a manner that meets Alaska Department of Environmental Conservation (ADEC) regulations and addresses Gustavus' needs. Given the relatively small volume of septage produced in Gustavus, a large, continually operating processing plant is likely not feasible. Large processing facilities or treatment plants are labor and resource-intensive, requiring large and continuous volumes of septage to operate efficiently. Although accepting septage from other Southeast Alaska communities could increase the total volume to be treated, it is unlikely that this would make a continually operating treatment facility economical. Since septic pumping is done in batches, treatment and disposal methods that can be operated intermittently will best meet project needs.

Information used in the development of this PER includes communication with VSW, Environmental Protection Agency (EPA), and Gustavus officials; prior studies conducted; publicly available government data; and data collected during a site visit in August 2024.

This PER examines several alternatives in two categories: stabilization and treatment of the septage, and disposal, if needed, of the solids.

Category 1: Septage Stabilization and Treatment Alternatives

- Alternative 1A: Mechanical Dewatering
- Alternative 1B: Passive Dewatering
- Alternative 1C: Aerobic Digestion
- Alternative 1D: Reed Bed Drying
- Alternative 1E: No Action

Category 2: Sludge Disposal Alternatives

- Alternative 2A: Incineration
- Alternative 2B: Monofill
- Alternative 2C: Ship to Juneau
- Alternative 2D: Land Application
- Alternative 2E: Composting
- Alternative 2F: No Action

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Acronyms and Abbreviations and Definitions

°F	degrees Fahrenheit
AACE	Association for the Advancement of Cost Engineering
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADOLWD	Alaska Department of Labor and Workforce Development
AIS	American Iron and Steel
AMHS	Alaska Marine Highway System
BABAA	Buy American Build American Act
BOD	biological oxygen demand
CFR	Code of Federal Regulations
City	City of Gustavus
DRC	Disposal and Recycling Center
EPA	U.S. Environmental Protection Agency
gpd	gallons per day
gpm	gallons per minute
HDPE	high-density polyethylene
HDR	HDR Alaska, Inc.
NPS	National Park Service
NRHP	National Register of Historic Places
PER	Preliminary Engineering Report
PFAS	Per- and Polyfluoroalkyl Substances
SHPO	State Historic Preservation Office
TKN	Total Kjeldahl Nitrogen
TP	Total Phosphorus
TSS	total suspended solids
VSW	Village Safe Water
septage	entire contents of a septic tank
sludge	mixture of solids and liquid settled at the bottom of a septic tank
solids	sludge that has undergone a dewatering process
STRB	Sludge Treatment Reed Bed
NUFWS	United States Fish and Wildlife Service
UV	ultraviolet

1. PROJECT PLANNING

The City of Gustavus (City) is looking to develop a plan to locally treat and dispose of septage from septic tanks around the community to effectively meet the long-term needs of the entire community. This Preliminary Engineering Report (PER) outlines the existing conditions and proposes alternative solutions to treat and dispose of septage and "No Action" alternatives. This document is intended to assist the City with identifying alternatives for pursuing future projects and funding.

1.1 Location

Gustavus is located on the northern shore of Icy Passage, approximately 50 miles northwest of Juneau (see Figure 1). The City is situated along the mouth of the Salmon river and is surrounded by Glacier Bay National Park and Preserve to the north, east, and west. Gustavus is served by an airport with two asphalt runways with daily jet flights in the summer. Gustavus is also served by a weekly Alaska Marine Highway System (AMHS) ferry which docks in Icy Passage and a seaplane base located in Bartlett Cove to the north. Gustavus is not connected to the Alaska road system but is located on the AMHS. The community can be accessed year-round by a 30-minute flight from Juneau or a 5-hour ferry ride from Juneau.

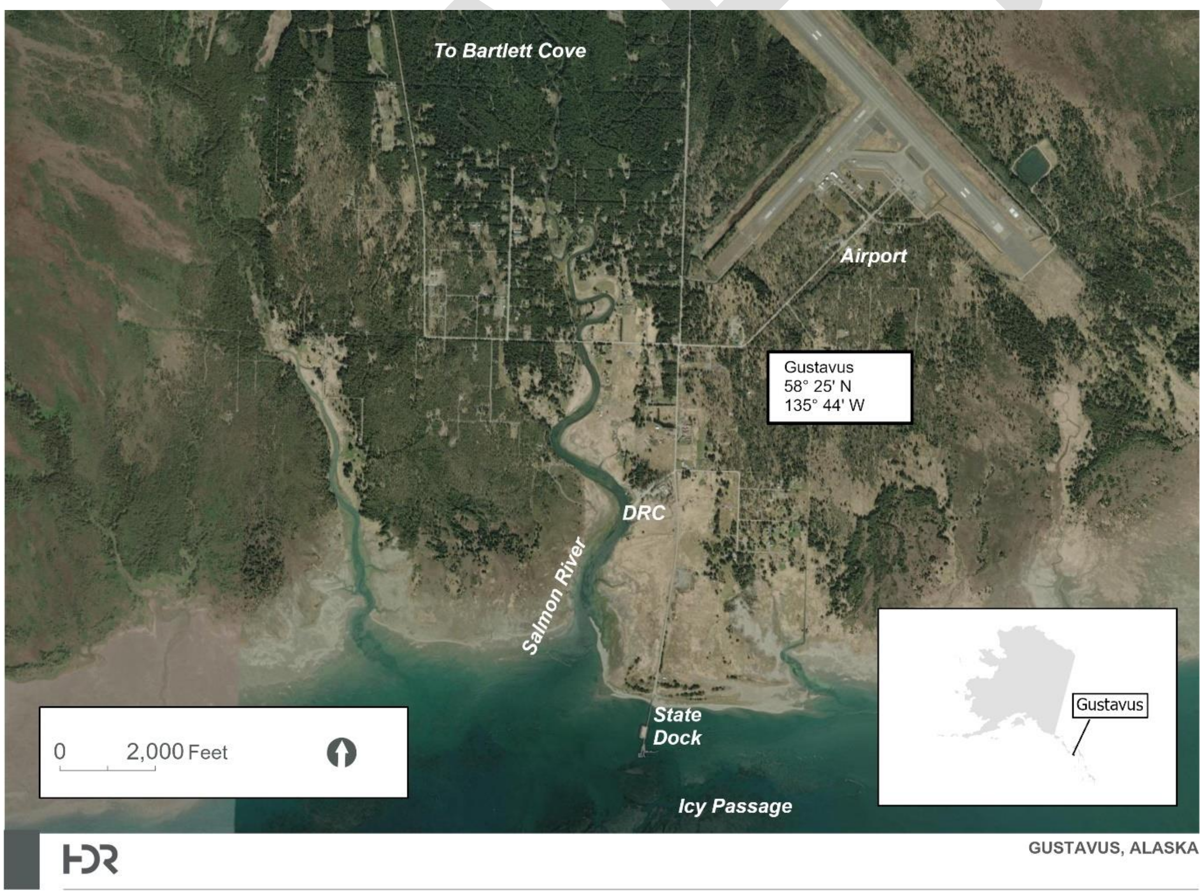


Figure 1. Gustavus vicinity map (ESRI Aerial 2024)

1.2 Environmental Resources Present

1.2.1 Climate

Gustavus is located in Icy Passage. It falls within the southeast maritime climate zone with cool summers, mild to cold winters, and heavy rain. Temperatures range generally near 30 degrees Fahrenheit (°F) during the winter to 55°F during summer. The historical mean minimum, maximum, average monthly temperatures, and mean precipitation for Gustavus are shown in Table 1.

Table 1. Historic Climate Data for the City of Gustavus

Month	Mean Maximum Temperature (°F)	Mean Minimum Temperature (°F)	Mean Average Temperature (°F)	Mean Precipitation (in.)
January	34.0	21.5	28.0	5.9
February	35.5	21.1	29.0	3.8
March	37.6	26.6	31.8	3.2
April	42.7	34.3	38.5	3.0
May	51.1	43.7	46.3	3.0
June	55.2	48.8	52.4	2.9
July	58.0	52.5	55.7	4.4
August	57.6	52.3	55.1	5.4
September	51.0	47.0	49.0	8.2
October	43.3	37.6	40.8	8.4
November	37.3	18.2	32.1	6.8
December	34.5	18.2	28.6	7.3

Source: NOAA (2024).

Note: °F = degrees Fahrenheit.

1.2.2 Geology and Soil Conditions

Gustavus can geographically be split into three different areas: Exclusion Ridge, Gustavus Flats, and the Bartlett Cove Moraine. Excursion Ridge lies at the northeast edge of the City and contains hemlock and spruce forests and wetlands with thick peat deposits. Below Excursion Ridge is limey mudstone bedrock. Gustavus Flats contains most of the City. The flats are mostly sandy soils with silt in areas near the shoreline. Well logs from the area show multiple layers of sand and silt. The Bartlett Cove moraine area in the northwest area of Gustavus contains a series of moraines with expanse of spruce, hemlock, alder, and some open meadows.

1.2.3 Archaeological Resources

A review of the Alaska Heritage Resources Survey site maintained by the Alaska Office of History and Archaeology State Historic Preservation Office (SHPO) lists the World War II Barge Landing site (the present boat loach) as the only archaeological site in the immediate vicinity of the Disposal and Recycling Center (DRC) and the proposed project area. This is a historic-era barge landing site to facility at the construction of the Gustavus Airport. It has been deemed not eligible for the National Register of Historic Places (NRHP) due to lack of integrity. The Gustavus Airport Historic District contains 29 documented cultural resources. The site encompasses the area surrounding the airport and was determined eligible for the NFHP for significant associations with the Civil Aeronautics Administration's role in aviation history of Southeast Alaska and the community development of Gustavus. Any project work occurring near the airport would need additional study to determine the impact on this district. Other, unknown sites may still exist in the area. Collaboration with agencies should occur to determine if a formal survey of the area is necessary. If historic, prehistoric, or archaeological sites, locations, remains, or objects are discovered, SHPO must be notified (AHRS 2024).

1.2.4 Wetlands and Wildlife

Several wetlands area have been identified by the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory in and around Gustavus. Areas along the seashore and the Salmon River have been identified as freshwater emergent and forested wetlands. The landfill area does not appear to be within identified wetlands.

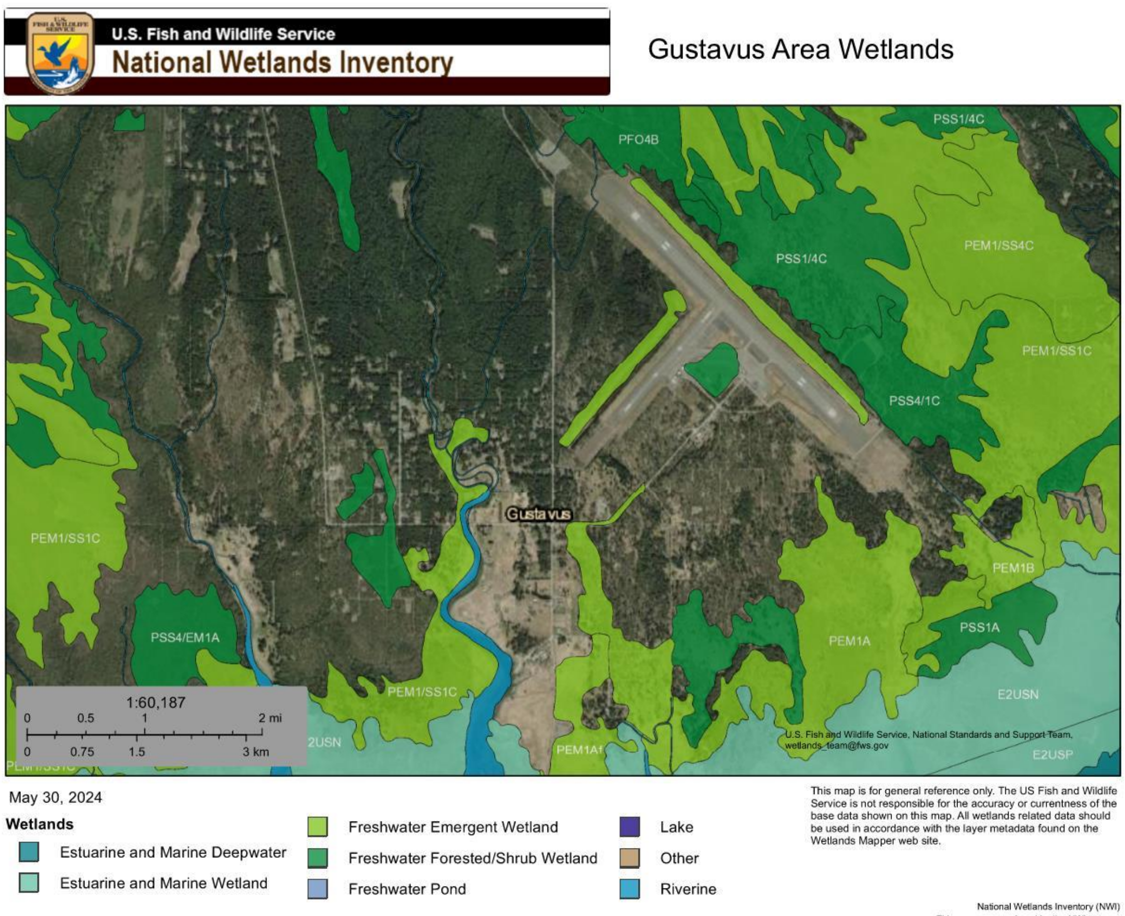


Figure 2. Wetlands in and around the City of Gustavus (USFWS 2024)

Records from the Alaska Department of Fish and Game (ADF&G) indicate that most, if not all streams in Gustavus are anadromous within the project area. ADF&G has identified coho, pink, chum, Dolly Varden, and Steelhead trout present in the creek. Other fish such as king (*Oncorhynchus tshawytscha*), sockeye (*Oncorhynchus nerka*) salmon, and halibut (*Hippoglossus stenolepis*) have been observed in Icy Passage. Dungeness Crab (*Metacarcinus magister*) has previously provided a significant commercial fishery. However, with the closure of Glacier Bay National Park to commercial fishing, the fishery's size has decreased dramatically.

Several species listed as threatened or endangered under the Endangered Species Act reside near Gustavus. The short-tail albatross (*Phoebastria albatrus*) is known to breed and nest in the vicinity. The Northern Sea Otter (*Enhydra lutris kenyoni*) are listed as located in the vicinity as well.

The west and central North Pacific populations of humpback whales (*Megaptera novaeangliae*) spend summers in Alaska waters feeding and may exist in Icy Passage. The North Pacific populations of blue whale (Balaenoptera musculus), right whale (*Eubalaena japonica*), sperm whale (*Physeter macrocephalus*), sei whale (*B. borealis*), and leatherback sea turtle (*Dermochelys coriacea*) are listed as endangered and may be in the vicinity.

The Gustavus area is also home to Sitka black-tailed deer (*Odocoileus hemionus sitkensis*), brown bears (*Ursus arctos*), an abundance of smaller fur-bearing animals, seals (*Pinnepedia*), sea lions (Otariinae), sea otters (*Enhydra lutris*), and numerous waterfowl.

A search of the Documented Eagle Nest Site Library maintained by the State of Alaska did not reveal any documented eagle nests within the city limits (State of Alaska 2024); however, bald eagles (*Haliaeetus leucocephalus*) have been observed in the area. As no significant tree clearing would be necessary for construction, it is unlikely that a raptor study would need to be necessary.

1.3 Population Trends

The U.S. Census Bureau population data presented in Table 2 provides a historic look at the population of Gustavus. Gustavus has been steadily growing since 1980, with an average annual growth rate of over 6 percent, fueled mostly by tourism.

Table 2. Gustavus, Alaska, Population History

Year	Population
1940	27
1950	82
1960	107
1970	64
1980	98
1990	258
2000	429
2010	442
2020	655

Source: U.S. Census Bureau (2020).

The population of Gustavus approximately triples during the summer season with increased tourism and the accompanying summer workers to serve the tourism industry. It is challenging to project future growth in rural Alaska, as interrelated factors such as available land and housing, changing climate, and industry changes can greatly impact population projections. It is often more informative to develop population range estimates by using past population data and extrapolating these numbers. For the purposes of this report the projected population range was bracketed by a 1 percent annual gain, which is approximately equal to a linear trendline of all population data and a 2 percent annual gain. A linear trendline of value using the only data from 1980 to 2020, translated so that it intersects the most recent census, falls somewhere in the middle. Using this approach, the 2045 population in Gustavus is estimated to fall within the range of 840 to 1075 people (see Figure 3). For the purposes of this PER, it is assumed that the population growth will generally follow the trendline shown. The 2045 projected population for this PER is 980 people

The Alaska Department of Labor and Workforce Development (ADOLWD) issues area population projections for each region of Alaska. ADOLWD projects an average annual population loss of 0.6 percent through 2045 for the Hoonah-Angoon Census Area. However, with the significant tourism draw of Glacier Bay National Park and Preserve, population trends for Gustavus likely do not match those of other rural communities in the area as projected by ADOLWD.

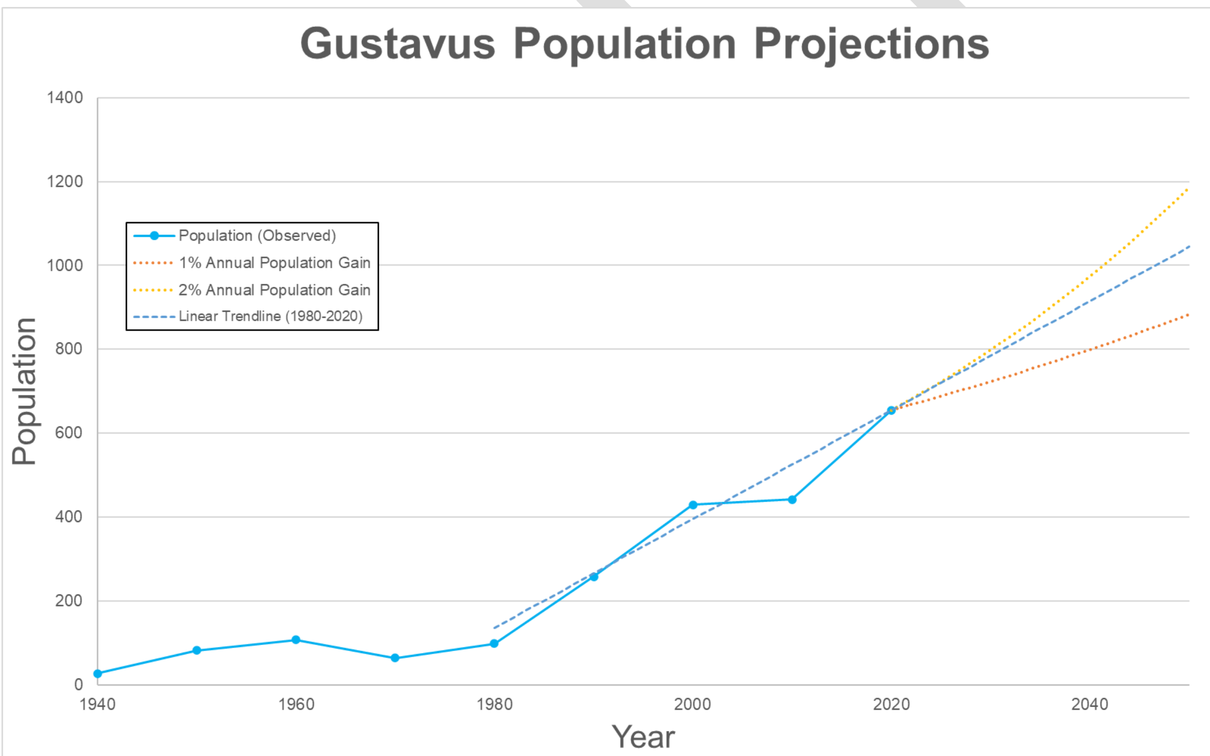


Figure 3. Future population projection in Gustavus, Alaska

1.3.1 Tourist and Transient Population Estimates

In addition to year-round residents, Gustavus sees an increase in population in the summer to match the increase of tourist traffic. The population is estimated to approximately triple in size during the tourism season.

1.3.2 Septic Tank and Septage Quantity Estimates

As septic pumping is not performed on an individual basis, but rather a per household basis, number of households is likely a better estimate of total volume of wastewater flow. The 2020 Census showed 302 total households in Gustavus. This number includes housing that is served by the Bartlett Cove Wastewater Treatment facility and would not need septic pumping services. A report from John Barry, PE, estimated 188 households that need septic pumping services (Neval Engineering 2023). This equates to approximately 3.5 total residents per septic tank. While some households are not served by septic systems, there are commercial properties that are not included in this count. For the purposes of this analysis, it is assumed that the present number of septic tanks that need to be pumped in Gustavus is approximately 200. This equates to one septic tank for every 3.3 people

The Septage Holding Tank Facility at the DRC is sized to accommodate approximately 50 septic tanks pumped per year over each summer. This results in each tank being emptied every four years. The Environmental Protection Agency (EPA) generally recommends septic tanks get pumped every 3 to 5 years (EPA 2002). Four years falls in line with industry standards of pumping frequency, while more frequent pumping could be recommended in the future depending on the condition of the tanks and sludge volume.

1.3.2.1 Septage Pumping Volume Estimates

The records of the 2023 septic tank pumping showed an average volume pumped per tank of 1,100 gallons per tank. If the number of total septic tanks per person stays consistent through the 20-year planning period and the pumping frequency remains at every four years, an estimate of the total number of septic tanks pumped per year and the total volume of septage pumped is shown in Table 3.

Table 3. Gustavus, Alaska, Septage Volume Estimates

Year	Population Estimate	Number of Septic Tanks (Estimate)	Number of Tanks Pumped Per Year[1]	Gallons per year pumped (Estimate)
2020	655	200	50	55,000
2025	720	220	55	60,400
2030	785	240	60	65,900
2035	850	259	65	71,300
2040	915	279	70	76,800
2045	980	299	75	82,200

[1] Assume each tank is pumped once every 4 years.

1.3.2.2 Septage Solids Estimate

Septage consists of, on average, 2 percent solids and 98 percent liquid. Table 4 shows estimates of the total dry weight, in tons, of the septage solids. These values assume that all liquid is removed from the septage.

Table 4. Gustavus, Alaska, Dry Solids Estimates

Year	Gallons per year pumped (Estimate)	Dry Weight of Septage Solids (tons)
2020	55,000	4.6
2025	60,400	5.1
2030	65,900	5.5
2035	71,300	6.0
2040	76,800	6.5
2045	82,200	6.9

1.4 Community Engagement

HDR Alaska, Inc. (HDR), engineers and a Village Safe Water (VSW) representative visited Gustavus on August 7th and 8th 2024, to meet with City officials and residents and to inspect the existing septage receiving facility, the landfill, and several other sites through Gustavus. A community meeting was held on August 7th about the septage disposal topic. The meeting was attended by several community members and council members. HDR described the PER process to the council and those present at the meeting and then described the current progress and the problem this PER will address. Several questions were answered regarding the project timeline, potential pitfalls, and some high-level theoretical possibilities for alternatives. Suggestions and inputs from the community were also received including aeration of the waste and per- and polyfluoroalkyl substances (PFAS) concerns.

2. EXISTING FACILITIES

To serve the needs of the community the City constructed a septage holding facility to facilitate the removal of septage from local septic tanks. In 2023, the facility was put into service at the DRC site. The facility consists of two buried 10,000-gallon fiberglass holding tanks with high water alarms and other controls. A septic pump truck pumps septage from local septic tanks and deposits it in the tanks. Periodically through the pumping season, generally June through September, a larger 4,500-gallon tanker trailer will utilize the AMHS ferry to transport the stored septage to Juneau for further processing. The ferry is only docked for 45 minutes, so the tanker trailer must quickly drive from the dock to the receiving facility, fill up and return before the ferry departs.

The receiving facility is very new and in good condition.

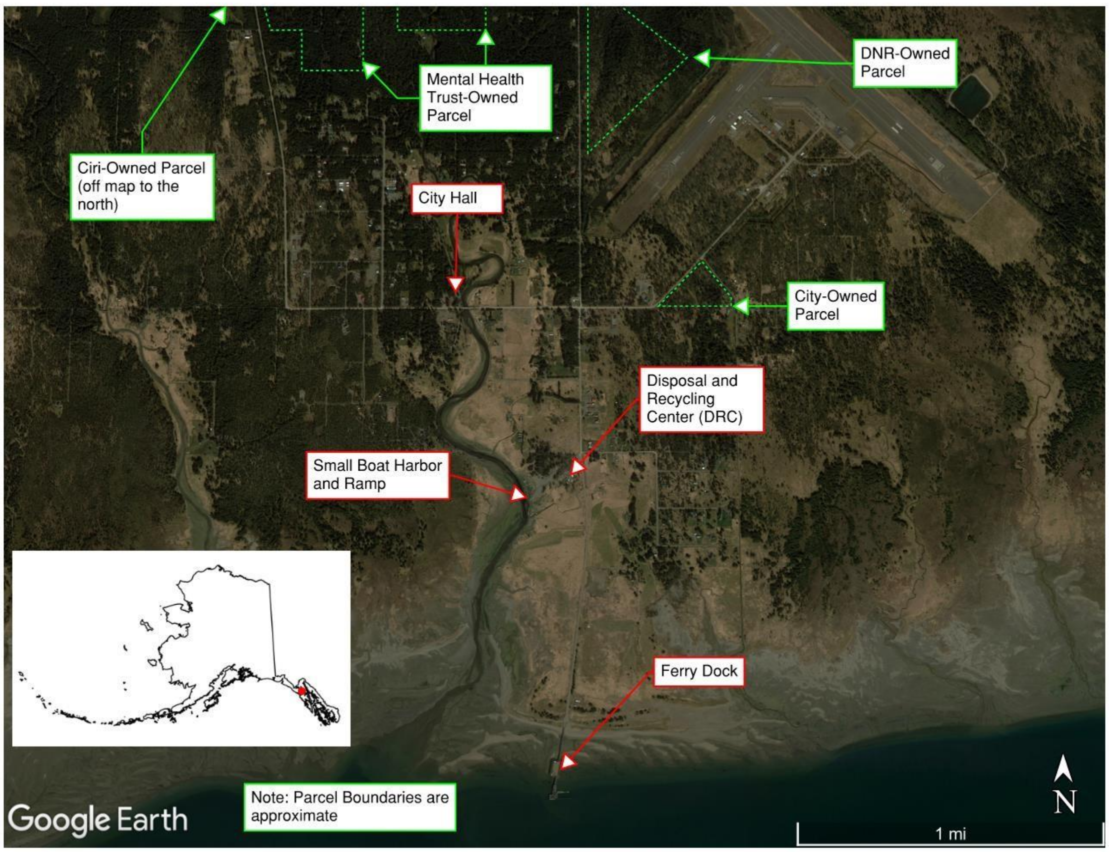


Figure 4. Location of infrastructure in Gustavus, Alaska and the parcels visited

2.1 Community History

The Gustavus area is the ancestral homeland of the Huna Tlingit people. The community as it exists today began as a homesteaded area in the 1910s. The homesteading process paused in 1939 with the enlargement of the Glacier Bay Monument to encompass all public land around Gustavus. During World War II, the airport and many other infrastructure facilities were constructed. After the war, with extensive effort from the local community, land was opened again for homesteading. With the growing popularity of Glacier Bay National Park and Preserve, the community has grown steadily since 1980.

Due to the dispersed development of the community, no centralized water distribution or wastewater collection systems exist. Buildings are served by groundwater wells for water and septic tanks and drainfields or composting toilets for wastewater.

2.1.1 Septage Disposal

Septage disposal in Southeast Alaska is notoriously difficult due to the small volumes and limited disposal methods. Starting 2011 after the establishment of ferry service to Gustavus in 2010, septic pumping service providers would load pump trucks on the ferry, pump several tanks, and return to Juneau. Due to the ferry schedule, this process would keep the trucks in Gustavus for much longer than necessary. This process was both very time intensive and kept the trucks away from the high volumes of septic pumping in Juneau. This process was not economically feasible in the long term.

To address the timing issue, the septage holding tank facility was constructed as referenced above.

2.1.2 Landfill Permit

The DRC is authorized to receive waste as a Class III Community Landfill under State of Alaska Solid Waste Permit Number SW3A017-25. The permit is effective through September 1, 2025. The permit does not currently allow the disposal of sewage solids.

2.2 Condition of Existing Facilities

2.2.1 Septage Holding Facility

The septage holding facility is very new and is in good condition. It is serviced by a gravel road. At the time of the site visit, one tank was found completely full and one partially full of the prior year's septic tank pumping. There were several open bung holes; however no odor was present from the tanks. Several pump hoses were also found to be left on site.

Figure 5. Location of the septage holding tanks

Figure 6. Caps of one of the septage holding tanks

2.2.2 PFAS Issues

Groundwater wells serve the residences and commercial properties in Gustavus. Well testing has shown extensive contamination of PFAS and other “forever chemicals.” The observed levels of these chemicals are in excess of current PFAS drinking water regulations and solutions are being formulated to provide clean drinking water to Gustavus. While there are no current regulations in relation to PFAS in wastewater, sludge, or sewage solids, there is a high probability of future regulatory action.

Due to PFAS in the groundwater wells, it is an almost certainty that PFAS is present in the pumped septage. Due to the presence of PFAS, when Gustavus’ septage is treated in Juneau, the resultant solids are shipped to a facility in the Lower 48 for disposal in a lined facility to limit environmental contamination.

As there are no current regulations pertaining to PFAS in solid waste, it would be premature to select alternatives solely upon their treatment or handing of contaminated sludge. Though provisions should be made in any selected alternative to allow for future installation of PFAS treatment systems or components that would reduce contamination of the environment from PFAS.

2.3 Financial Status of Existing Facilities

There is currently no cost to the City for the operation of the septage holding facility. Individual homeowners and businesses are invoiced separately by the septic services company. It is estimated that the bill for a septic tank pump is approximately $1,000. This includes the cost of depositing the septage in Juneau.

2.4 Water/Energy/Waste Audits

HDR is not aware of any water, energy, or waste audits, and none were obtained for this project.

3. NEED FOR THE PROJECT

3.1 Health, Sanitation, and Security

The primary need for this project is the health and sanitation of the community and environment. The current system requires the intervention of outside contractors and is reliant on the AMHS. Should the septic tanks at home not be able to be pumped, there is a risk of damage to the sub surface drainfields and possible overflow of septage onto the ground. Finding an effective and sustainable solution to septage management will greatly improve the area's health and sanitation.

Due to the unique aspects of this project and the functionality of the current system, there is not an applicable Indian Health Service deficiency level.

3.2 Aging Infrastructure

The current septage receiving infrastructure is quite new and in good condition. Aging infrastructure is not a driving factor for this project.

3.3 Reasonable Growth

The population of Gustavus has been trending upwards for the past 40 plus years. With the expansion of tourism in the area, it is expected that those trends will continue. This increase in population will only exasperate the sludge handling issues as the volume of sludge will increase. In town treatment and disposal of sewage sludge will reduce the cost and technical burden on the City as the population increases.

4. ALTERNATIVES CONSIDERED

HDR developed four alternatives (plus a No Action Alternative) for addressing the issues found with septage treatment and disposal in Gustavus. Alternatives were split into two categories: stabilization and treatment, and disposal. The goal of this PER is to select the preferred alternative with one method of stabilization and treatment of septage and one method for disposal. After consideration, the alternative relating to composting, while initially included in alternatives related to stabilization and treatment, was moved to Category 2. These alternatives are:

Category 1: Stabilization and Treatment of Septage

- Alternative 1A: Mechanical Dewatering
- Alternative 1B: Passive Dewatering
- Alternative 1C: Aerobic Digestion
- Alternative 1D: Reed Bed Drying
- Alternative 1E: No Action

Category 2: Septage Disposal

- Alternative 2A: Incineration
- Alternative 2B: Monofill
- Alternative 2C: Ship to Juneau
- Alternative 2D: Land Application
- Alternative 2E: Composting
- Alternative 2F: No Action

4.1.1 Alternative 2D – Land Application

Alternative 2D would involve disposing of dewatered, treated sludge by land application at a vacant site within the Gustavus Vicinity.

Land application of treated sludge requires that the sludge be treated to significantly reduce pathogens to create a classified biosolids product. Biosolids land application is governed by the EPA guidelines under 40 CFR Part 503. Class A and Class B biosolids are both able to be disposed by land application.

Class A biosolids have been treated to reduce pathogens to undetectable levels. Of the treatment alternatives proposed above, composting or reed bed drying would result in Class A biosolids. Class B biosolids are treated to significantly reduce pathogens; however, there still may be some detectable levels of pathogens. Of the treatment alternatives proposed above, aerobic digestion would result in Class B biosolids. Solids that are simply dewatered would not be eligible for land application.

While treatment of sewage sludge to a classified biosolids product will reduce or eliminate pathogens, none of the commercially available processes for sludge treatment eliminate PFAS contamination.

While PFAS will likely be expelled in the dewatering process, the treated sludge solids will continue to be contaminated with PFAS. The concentration of PFAS is unknown.

Any land application of sludge from Gustavus in the vicinity of groundwater wells or residents is not recommended. The application of biosolids will reintroduce PFAS into the environment and provide another avenue for contamination.

During the site visit, several properties were identified as locations for possible land application. Many of the unused properties are near residences and businesses to they would not be recommended for land application. On property near the National Park border on CIRI-owned land was visited. However, the area had high ground water, with water near ground level. Due to the high groundwater, PFAS contamination would likely seep into the groundwater at that location.

Due to the desire to not return PFAS back into the environment and the groundwater, land application is not a suitable alternative for disposal of biosolids from Gustavus and will not be further evaluated.

5. SEPTAGE STABILIZATION AND TREATMENT ALTERNATIVES

As stated in Sections 2 and 3, the existing wastewater management infrastructure in the City is not adequate to support its current and future populations. The following section presents alternatives that address the improvement of the existing wastewater treatment system and present plans for continuing maintenance of the system to adequately serve the community for years to come. These sections discuss how each solution works within the regulatory framework of the Alaska Department of Environmental Conservation (ADEC) and EPA.

5.1 General Design Criteria

The design criteria for wastewater flow for a 20-year period are presented in Table 5. These projected flows are applicable to the alternatives presented in the following sections. These flows assume the upper range estimate of population and estimates of the summer transient resident and tourist populations as presented in Section 1.3.

Table 5. Gustavus Wastewater Treatment Improvements Design Criteria

Criteria	Value	Unit
Design Period	20	Years
Year 2045 Resident Population	980	People
Year 2045 Septic Tanks	299	Tanks
Year 2045 Tanks Pumped Per Year	75	Tanks
Year 2045 Estimated Septage Pumped	82,200	Gallons
Year 2045 Estimated Septage Pumped with Accepting Sludge from other Communities[1]	95,800	Gallons
Year 2045 Estimated Dry Weight of Solids	6.9	Tons
Year 2045 Estimated Dry Weight of Solids with Accepting Sludge from other Communities	8.1	Tons

[1] An additional 50% of the communities projected growth is added to account for sludge delivered from other communities via the AMHS

5.1.1 Operator Certification Levels

As dewatering or septage receiving facilities do not involve significant wastewater treatment, it is unlikely a wastewater operator certification is required. However, it is desirable to have a certified operator to oversee the process. This operator would need to obtain a Level 1 certification.

5.2 Cost Estimates

All cost estimates in this PER are HDR's opinions of probable project cost and are considered approximately equivalent to Level 4 estimates as defined by the Association for the Advancement of Cost Engineering (AACE) International. These estimates represent the engineer's professional judgement based on the information available at the time of writing this PER and are based generally on process flow diagrams, major construction activities, and major equipment quotes. Per AACE guidelines, these estimates have an estimated accuracy of -15 to -30 percent and +20 to +50 percent on the low and high sides of total cost, respectively. To reflect this range of estimated accuracy and to account for cost complexities associated with remote work, a 30 percent contingency is added to the opinion of probable cost for each alternative. The 30 percent contingency also accounts for the recent market volatility and inflation and the resulting unpredictability of material and labor costs, especially for remote Alaska projects.

The American Iron and Steel Act (AIS) and Buy America Build America Act (BABAA) are applicable to this project. The cost estimates in this PER address AIS and BABAA with a 20 percent factor on applicable iron and steel components and 10 percent on other components. The costs borne by a construction contractor to administer AIS are accounted for with a line item that would cover the labor of an additional employee to handle the documentation.

5.3 Alternative 1A – Mechanical Dewatering

Alternative 1A would install a mechanical dewatering facility, likely located at the DRC. The existing septage receiving tanks would serve as the receiving station and flow equalization. Septage would be lime stabilized in the receiving tank in batches prior to dewatering. Septage would then be pumped into a mechanical dewatering process such as a screw press or belt filter press. Polymer would be added to enhance the dewatering process. Leachate from the dewatering process would be disposed of in a subsurface drainfield on site. Due to the high solids percentage, the dewatered septage, now sludge, could be disposed of by any number of methods discussed in Category 2.

The indoor facility would contain the lime and polymer feed systems and mechanic dewatering process with an indoor vehicle bay for a City-owned pumper truck or trailer to service the septic tanks.

5.3.1 Description

Mechanical dewatering is a common way for industries, including wastewater treatment, food processing, and paper production, to separate solids from liquids. In wastewater treatment, this process helps achieve several potential goals, including

- Reducing the volume, thus reducing storage and transportation costs,
- Eliminating free liquids before landfill disposal,
- Reducing fuel requirements if residuals are to be incinerated or dried,
- Producing a material which will have sufficient void space and volatile solids for composting when blended with a bulking agent,
- Avoiding the potential of biosolids pooling and runoff associated with liquid land application, and
- Optimizing subsequent processes such as thermal drying.

Three types of mechanical dewatering that would apply well to the scale of processing required in Gustavus are the use of a screw press, belt filter press, or centrifuge.

5.3.1.1 Screw Press

A screw press is a type of machine that uses a screw mechanism to exert pressure on a material, forcing liquid out and leaving behind a drier solid product. As the screw rotates, it pushes the material forward, while allowing water to escape through its perforated casing. As the sludge moves through the press, the pressure gradually increases, leaving the operator with the desired dewatered product. The liquid can be further filtered as it exits the apparatus.

Screw presses can come as either single-screw or twin-screw presses, with the former being simpler to design and operate, and the latter being more efficient and able to produce higher pressures, allowing for more effective dewatering. Figure 7 below shows the screw press schematic.

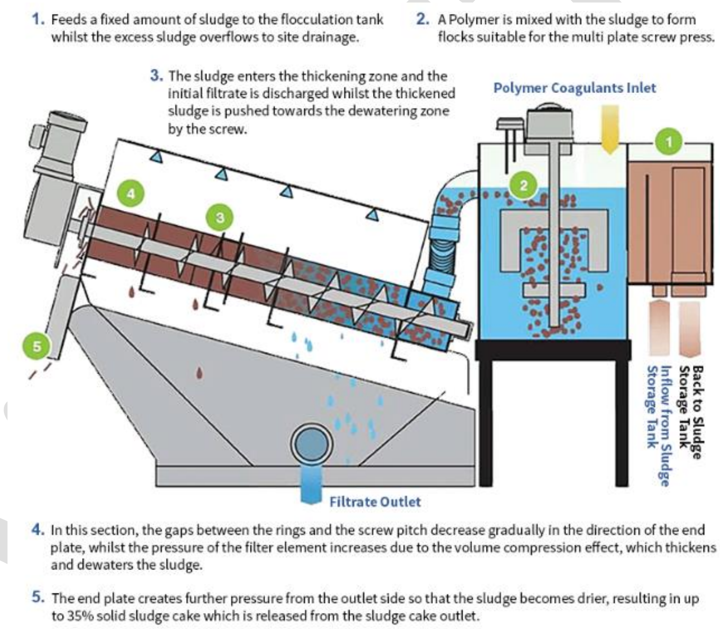
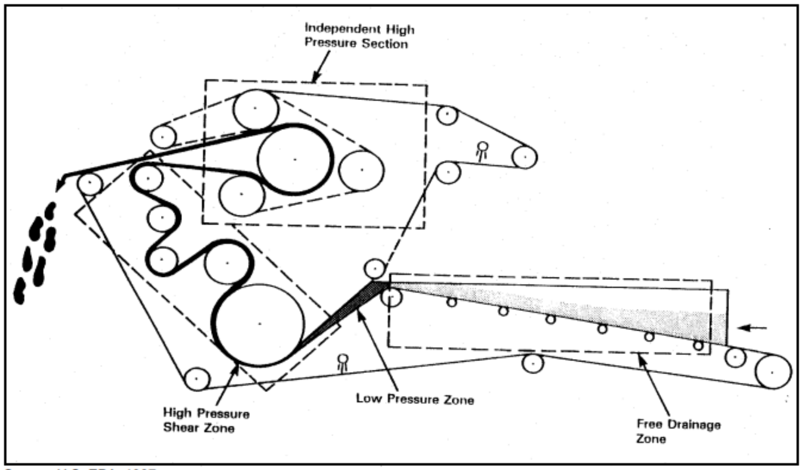


Figure 7. Screw press process (screwpressdewatering.com)

5.3.1.2 Belt filter press

A belt filter dewaters by applying pressure to the biosolids to squeeze out the water. Biosolids sandwiched between two tensioned porous belts are passed over and under rollers of various diameters. Increased pressure is created as the belt passes over rollers which decrease in diameter. Many designs of belt filtration processes are available, but all incorporate the following basic features: polymer conditioning zone, gravity drainage zones, low-pressure squeezing zone, and high-pressure squeezing zones. Advanced designs provide a large filtration area, additional rollers, and variable belt speeds that can increase cake solids by five percent. The general mechanical components of a belt filter press include dewatering belts, rollers and bearings, belt tracking and tensioning system, controls and drives, and a belt washing system. Figure 8 below depicts a typical belt filter press.



Source: U.S. EPA, 1987.

Figure 8. Belt Filter Press Schematic (EPA 2000)

5.3.1.3 Centrifuge

Centrifuges use the principle of centripetal acceleration to separate liquids from solids. In wastewater treatment, this means loading septage into the drum of a centrifuge and rotating it quickly, causing the denser solids to be pushed to the perimeter of the container, separating them from the less dense water. Then this dewatered sludge can be scraped off the inside, while sending the water to the next stage of treatment.

Centrifuges require more energy and maintenance than the previous two above-discussed methods of mechanical dewatering. While modern centrifuge designs use technology such as variable frequency drives to tune the rotational speed to the process demands, spinning a drum containing septage at high rotations per minute (RPMs) requires significant energy input. There are also many crucial mechanical components in a centrifuge, such as bearings, seals, and conveyors. The bowl of the machine also must be cleaned regularly and checked for imbalances, as sediment accumulation can have extreme impacts on the performance of the machine.

5.3.1.4 Dewatering Mechanism Selection

Selection of a mechanism for this alternative should be based on its ability to operate intermittently over the course of the year with relatively low operational costs. Based on discussions with several mechanical dewatering equipment manufacturers, a screw press is best suited for the applications that would be present in Gustavus. Belt filter presses are best operated continuously, and centrifuges have higher energy and maintenance costs. For this PER, a screw press is the recommended method of mechanical dewatering. This conclusion should be verified during the design study report, should this alternative be selected.

Site Plan

The existing holding tanks will serve as an equalization system, where the pumped septage will be dropped off. The septage will then be pumped into the screw press by a submersible pump. The screw press would deposit dewatered solids into a specialty sludge dumpster. A polymer feed system would meter coagulant into the stream to aid dewatering. The screw press, polymer feed system, and sludge dumpster would be located in a 1,200 square foot (SF) building located as shown in Figure 9.

As one dumpster is filled, it could be trailered away for disposal and the spare sludge dumpster, stored outside the building, would be placed in the building to receive dewatered solids.

Leachate from the screw press would flow into an approximately 4,000 SF sub-surface drainfield. Depending on design and elevations, leachate may need to be pumped.

A lime stabilization system would also be located in the building if necessary for the system.

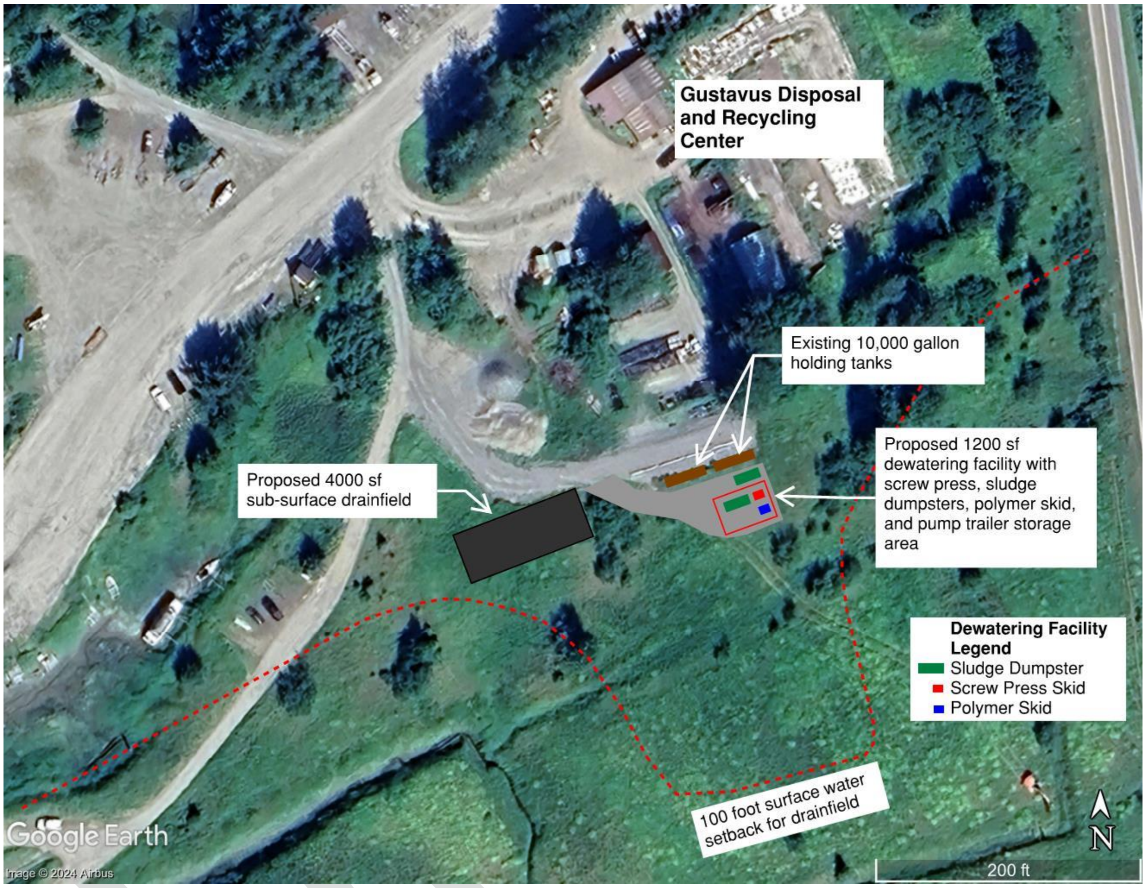


Figure 9. Alternative 1A site layout

5.3.2 Design Criteria

Based on the design criteria shown in Table 5, it is estimated that a dewatering facility will need to process approximately 82,200 gallons of septage from Gustavus by the end of the planning period, or up to 95,800 gallons of septage should the facility accept waste from other communities.

5.3.2.1 Screw Press Sizing

The characteristics of the sludge being processed impacts the performance of the screw press, so proposed configurations are likely to change, even batch to batch at the Gustavus facility. For design of a screw press, the most important factors are the size and pitch of the screw, and the geometry of the screen. During the design septage samples should be sent to the screw press manufacturer so that these factors can be determined.

Based on preliminary information, FKC Screw Press, who has recently provided a screw press to Skagway, Alaska provided flow rate information for several sizes of screw presses. A 250 millimeter (mm) screw press can process approximately 4.6 gallons per minute (gpm) of septage at 2 percent solids. The manufacturer states that the screw press will produce a cake of around 40 percent total solids and utilize between 10 to 15 pounds of polymer per dry ton of septage processed.

Table 6 below shows, for several different scenarios, the amount of processing time required to dewater one years' worth of pumped septage. The screw press does not require constant supervision, though an operator should be nearby to occasionally monitor the process.

Table 6. Screw Press Processing Volumes

Scenario	Gallons Treated	Hours to Process	Processing Days (8-hour assumed)	Polymer Required (lbs)	Volume for Disposal at 40% solids
2025	60,400	220	27	76	3,000 Gal 15 cubic yards
2045	82,200	298	37	105	4,100 Gal 21 cubic yards
2045 with waste from other communities	95,800	348	44	120	4,800 Gal 24 cubic yards

5.3.2.2 Drainfield

To dispose of the leachate, a mounded subsurface drainfield must be sized to accept the volume of liquid removed by the dewatering process. Based on a reduction in water volume from 2 percent solids to 40 percent solids at a rate of 4.6 gpm, the screw press will produce approximately 4.4 gpm, or around 2,090 gallons per day, of leachate for disposal. A drainfield should be sized to accommodate at least 3,135 gallons per day to account for a 50 percent safety factor.

Factors such as soil permeability and depth of groundwater will affect the size of the design. Based on discussions with engineer John Barry, the soil has good permeability in the area with groundwater at 5.5 to 6 feet of depth below the ground surface. Assuming a percolation rate of between 1 to 5 minutes per inch and a bed type design, the drainfield would need to be around 4,000 square feet. The construction of the drainfield is anticipated to be as follows:

1) Remove the organic layer (estimated to be around 6-inches thick
2) Place 6 inches of septic drain rock
3) Place drainpipe in a bed configuration, covered in more septic drain rock and a soil barrier
4) Place three feet of soil above the bed with 3:1 slopes down to the original grade.

The exact size and location of the drainfield would be determined during design.

5.3.2.3 Septic Pumping Trailer

Part of this, and several other alternatives, is the purchase of a septic pumping trailer. A 1,250-gallon pumping trailer would be sufficient to empty most septic tanks while still being manageable to tow with a pickup truck. This trailer could be stored in the building at the dewatering facility while not in use to protect it from the elements.

5.3.3 Environmental Impacts

5.3.3.1 Floodplains

Not applicable.

5.3.3.2 Wetlands

Construction of this alternative would involve no construction in wetlands. Figure 2 shows the wetlands as they are currently mapped around the Gustavus area.

5.3.3.3 Wildlife

Not applicable. This alternative would operate within existing developed areas of Gustavus, so no additional disruption would occur beyond construction noise. See Section 1.2.4 for a more in-depth discussion of wildlife in the Gustavus area.

5.3.3.4 Geotechnical Exploration

Geotechnical work will be necessary to during the construction of the building and for test holes to determine size and location of the drainfield.

5.3.3.5 Other Resources

Not applicable

5.3.4 Land Requirements

No additional land requirements, as this alternative would involve construction on land already within the boundaries of the DRC. The land required to construct Alternative 1A is shown in Figure 9.

5.3.5 Potential Construction Problems

Construction in Gustavus is a challenge, as most material will need to be shipped in.

The project will be subject to AIS requirements. Long lead times for AIS-compliant materials, supplies, and components should be anticipated when developing project schedules. Equipment and materials should be procured well in advance of construction such that construction is not unnecessarily delayed by the supply chain.

5.3.6 Sustainability Considerations

5.3.6.1 Water and Energy Efficiency

Additional energy would be required to operate a sludge dewatering system. However, significantly less energy would be required to dispose of the dewatered solids, as the volume transported would be less.

5.3.6.2 Green Infrastructure

Not applicable.

5.3.6.3 Other

Not applicable.

5.3.7 Cost Estimates

The capital cost estimates for Alternative 1A are based on present-day-value calculations of previous work conducted in comparable communities in Southeast Alaska, estimated quantities of raw materials, and allowances for construction contingency, logistic, permitting, legal, engineering, and VSW expenses. The total capital cost estimates for Alternative 1A are provided in Table 7. The capital cost estimates in Table 8 have been adjusted to reflect AIS and BABAA requirements that apply to this project.

Table 7. Alternative 1A Capital Cost Estimates (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Pumper Trailer	1	EA	$45,000	$45,000
Treatment Building	1,200	SF	$500	$600,000
Septage Pumping System	1	LS	$50,000	$50,000
Screw Press	1	EA	$100,000	$100,000
Driveway	1,000	SF	$50	$50,000
Polymer System	1	EA	$50,000	$50,000
Drainfield construction	4,000	SF	$30	$120,000
Dumpster for Disposal	4	EA	$15,000	$60,000
			Construction Subtotal	**$1,475,000**
			Mob/Demob/Construction Logistics (10%)	$147,500
			Construction Contingency (30%)	$442,500
			Total Construction	**$2,065,000**
			Permitting & Agency Consultation	$50,000
			Engineering and Design (12%)	$247,800
			Construction and Professional Services	**$2,362,800**
			VSW Project Management (8%)	$189,024
			Project Total	**$2,551,824**

Note: Demob = demobilization; EA = each; LF = linear feet; LS = lump sum; Mob = mobilization; SF = square feet; VSW = Village Safe Water.

Table 8. Alternative 1A Capital Cost Estimates with AIS/BABAA (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Pumper Trailer	1	EA	$49,500	$49,500
Treatment Building	1200	SF	$600	$720,000
Septage Pumping System	1	LS	$55,000	$55,000
Screw Press	1	EA	$495,000	$495,000
Driveway	1000	SF	$50	$50,000
Polymer System	1	EA	$55,000	$55,000
Drainfield construction	4000	SF	$33	$132,000

Dumpster for Disosal	4	EA	$18,000	$72,000
Note: Demob = demobilization; EA = each; LF = linear feet; LS = lump sum; Mob = mobilization; SF = square feet; VSW = Village Safe Water.			**Construction Subtotal**	**$1,628,500**
			Mob/Demob/Construction Logistics (10%)	$162,850
			AIS/BABA Administration	$75,000
			Construction Contingency (30%)	$488,550
			Total Construction	**$2,354,900**
			Permitting & Agency Consultation	$50,000
			Engineering and Design (12%)	$282,588
			Construction and Professional Services	**$2,687,488**
			VSW Project Management (8%)	$214,999
			Project Total	**$2,902,487**

Estimated operating expenses associated with Alternative 1A are shown in Table 9. Operating expenses consider power costs to operate the screw press and polymer system, polymer costs, costs to heat the building, and labor to operate the system. These costs would be distributed among the number of tanks pumped per year. Disposal costs would be accounted for in another alternative. These combined would determine the total cost to pump a septic tank.

Based on records of septage hauling, approximately 8 tanks can be pumped per day. For 2025 estimates, estimating that there is some extra time to pump with a trailer rather than a truck, 55 septic tanks could be pumped in eight 8-hour workdays. It is assumed that dewatering would occur during this time, with additional, non-pumping days required to complete the dewatering. Non-pumping dewatering days were assumed to be 4 hours of work per day to start up, shut down, and monitor the equipment.

Table 9. Alternative 1A Estimated Operating Expenses (2024 USD)

Item	Quantity	Unit	Unit Price	Cost
Labor Costs	140	Hour	$50	$7,000
Power Costs	700	Kilowatt Hour	$0.45	$315
Building Heat	150	Gallon	$5.50	$825
Polymer and Chemical Costs	1	Lump Sum	$300	$300
Total Annual Expenses				$8,440
			Tanks Pumped	55
			Expense per tank pumped	$153.45

5.4 Alternative 1B – Passive Dewatering

Alternative 1B would include the purchase of a septage pumper truck or trailer and a passive dewatering system, likely located at the DRC. Similar to Alternative 1A, septage would be pumped into one of the existing septage receiving tanks for equalization and lime stabilization, if needed for disposal. The septage would then be pumped into a passive dewatering process. Passive dewatering options could include geobags, a containerized dewatering unit, or other method. As with mechanical dewatering, passive dewatering will also include polymer addition to enhance dewatering.

Like Alternative 1A, leachate water would be disposed of in a drainfield at the DRC and dewatered sludge disposed of by an alternative selected in Category 2. This alternative would likely require an indoor facility to contain the lime feed and polymer feed systems with a vehicle bay for a City-owned pumper truck or trailer.

5.4.1 Description

Passive dewatering uses the force of gravity to separate solids from liquids. In wastewater treatment, this is to accomplish the goal of isolating solids, or drier, “cakier” sludge for further treatment or disposal. These processes generally use less energy and operational attention than the methods discussed in Alternative 1A, but often deliver solids with a higher liquid content. Depending on the method of septage disposal, a higher liquid content in the dewatered sludge might not be an issue. For example, if incineration were the disposal method, passive dewatering would not be a recommended dewatering method, as the solids would take much more energy to burn because of the need for initial burning-off of the excess liquid. However, in a reed bed or vertical flow constructed wetlands, a higher liquid content wouldn’t be very detrimental.

5.4.1.1 Geotextile Bags

Geotextile bags (Geobags) are large bags that act as filters, allowing leachate water to permeate through the fabric, while containing solids for further treatment of disposal. Lime-stabilized and polymer-treated waste is pumped or dumped into the bags. Then, gravity pulls the water through the membrane while solids settle to the bottom. For faster processing, sludge can be continually pumped into bigger bags, as the pump adds extra pressure to force water out faster. The leachate water is collected and disposed of in a drainfield, and the bags are then carried off for disposal.

Figure 10. Pumped (left) and gravity-fed (right) geotextile bags.

5.4.1.2 Containerized Dewatering Unit

A containerized dewatering unit is a Connex-like dewatering system that works similarly to a geotextile bag, with the advantage of being housed in its own structure. The box is usually a 20- or 40-foot unit with a removable top and/or openable end for easy unloading of waste material. The septage would be pumped from the holding tanks into the dewatering container where gravity would settle the solids on the bottom and pull the water out through permeable screens on the sides, shown below in Figure 11. The liquid leachate can then flow into the drainfield, and the solids can be removed from the bottom of the box for further treatment or disposal.

Figure 11. Dewatering Container Schematic and Exterior

5.4.1.3 Passive Dewatering System Type Selection

While geobags are an inexpensive and low maintenance system, they are difficult to dispose of once they have been filled. As it is anticipated that the dewatered sludge will need to be moved, either shipped out of town, or to another site for disposal, a containerized system will allow the sludge to be easily trailered. It is recommended that a containerized system be specified for this alternative

Site Plan

The existing holding tanks will serve as an equalization system, where the pumped septage will be dropped off. The septage will then be transferred into a containerized system by a submersible pump at a rate that does not overwhelm the dewatering container or the drainfield. Two dewatering containers would be located under a covered, fenced area with one in use at any time. A polymer feed system will be located in an equipment shed.

As one container fills with solids, it could be trailered away for disposal and the other container would be connected to the drainfield and submersible pump and be put into service. Should the need arise, septage could be pumped directly from the pump trailer and into the containers as well, so long as the capacity of the dewatering container or drainfield is not exceeded.

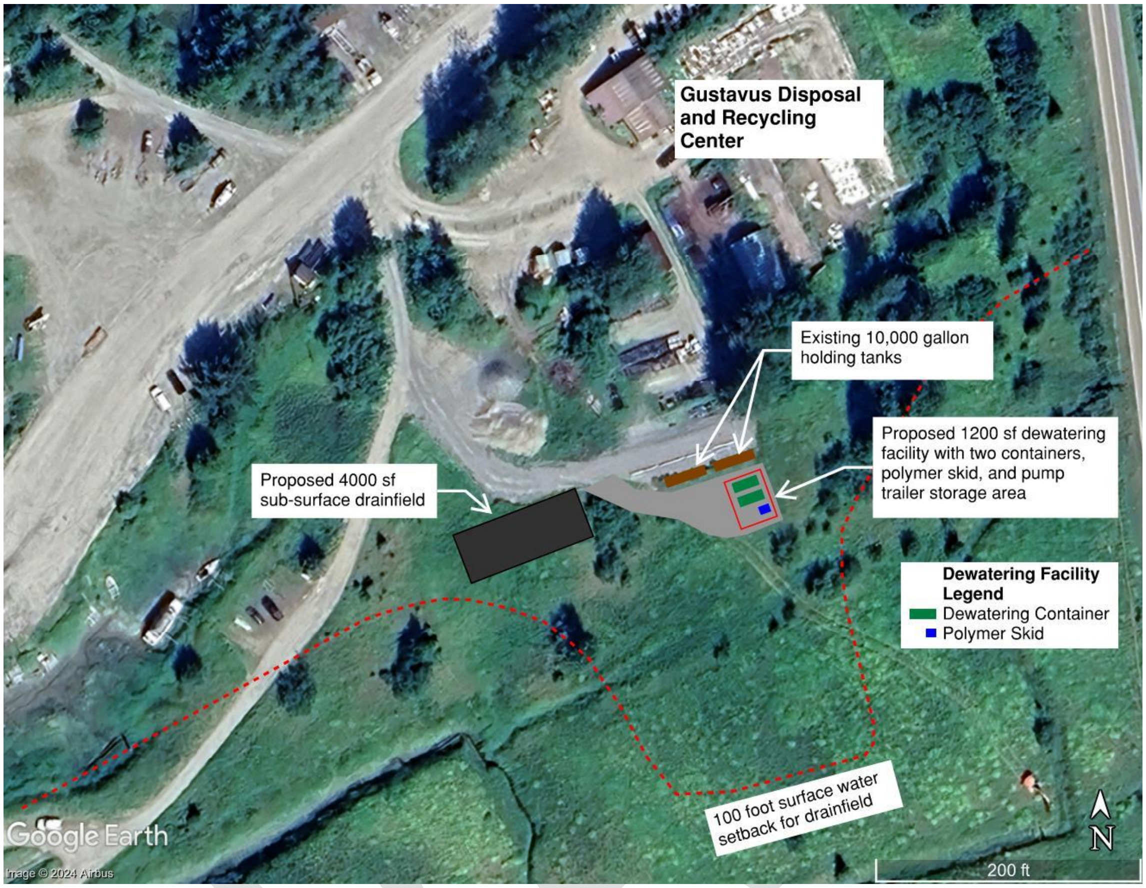


Figure 12. Alternative 1B site layout

5.4.2 Design Criteria

Based on the design criteria shown in Table 5, it is estimated that a dewatering facility will need to process approximately 82,200 gallons of septage from Gustavus by the end of the planning period, or up to 95,800 gallons of septage should the facility accept waste from other communities.

5.4.2.1 Dewatering Container Sizing

Like the screw press, the characteristics of the sludge being processed impacts the performance of the passive dewatering process, so proposed configurations could change during design.

Based on preliminary information provided by NewTech Environmental, which produces containerized dewatering facility, a single dewatering box can process up to 30,000 gallons at 1.5 percent solids (1.8 dry tons) and produce approximately 3,000 gallons of dewatered sludge at 15 percent solids.

Table 10 below shows, for several different scenarios, the volume of dewatered septage and an estimate for the polymer required to dewater on years' worth of pumped septage. The number of dewatering loads assume that each load carries approximately 1.8 dry tons of material, or 2,100 gallons at 15 percent solids. It is likely that more time in the dewatering container would produce higher solids percentage and could decrease the number of loads required.

Purchase of two dewatering containers would allow for continuous dewatering while the waste in one container is being disposed of or if one is undergoing maintenance.

Table 10. Gravity Dewatering Processing

Scenario	Gallons Pumped (2% solids)	Dry Tons of Solids	Polymer Required (lbs)	Volume at 15% solids	Dewatering Container Loads (1.8 dry tons each)
2025	60,400	5.1	76	6,000 Gal 30 cubic yards	3
2045	82,200	6.9	105	8,200 Gal 41 cubic yards	4
2045 with waste from other communities	95,800	8.1	120	9,600 Gal 48 cubic yards	5

5.4.2.2 Drainfield

To dispose of the leachate, a subsurface drainfield must be sized to accept the volume of liquid removed by the dewatering process. Should an entire day's worth of pumped septage (approximately eight 1,000-gallon tanks) be dewatered in one day, this would produce approximately 7,000 gallons of leachate that must be absorbed by the subsurface drainfield. This would require a very large drainfield. To alleviate this, the existing holding tanks will be used as equalization and the septage would be metered into the dewatering containers at a rate consistent with what is able to be absorbed by the drainfield.

Based on the drainfield sizing from Alternative 1A, a 4,000 square foot bed-style drainfield would not be unmanageably large, but still able to accommodate up to 3,135 gallons per day if necessary. This would allow the treatment of around 3,500 gallons of pumped sludge per day. The construction of the drainfield would be similar to the drainfield proposed in Alternative 1A. The exact size and location of the drainfield would be determined during design.

5.4.2.3 Septic Pumping Trailer

Part of this, and several other alternatives, is the purchase of a septic pumping trailer. A 1,250-gallon pumping trailer would be sufficient to empty most septic tanks while still being manageable to tow with a pickup truck. This trailer could be stored under the cover where the dewatering containers are located while not in use to protect it from the elements.

5.4.3 Environmental Impacts

5.4.3.1 Floodplains

Not applicable.

5.4.3.2 Wetlands

Construction of this alternative would involve no construction in wetlands. Figure 2 shows the wetlands as they are currently mapped around the Gustavus area.

5.4.3.3 Wildlife

Not applicable. This alternative would operate within existing developed areas of Gustavus, so no additional disruption would occur beyond construction noise. See Section 1.2.4 for a more in-depth discussion of wildlife in the Gustavus area.

5.4.3.4 Geotechnical Exploration

Geotechnical work will be necessary to during the construction of the building and for test holes to determine size and location of the drainfield.

5.4.3.5 Other Resources

Not applicable.

5.4.4 Land Requirements

No additional land requirements, as this alternative would involve construction on land already within the boundaries of the DRC. The land required to construct Alternative 1B is shown in Figure 12.

5.4.5 Potential Construction Problems

Construction in Gustavus is a challenge, as most material would need to be shipped in.

The project will be subject to AIS requirements. Long lead times for AIS-compliant materials, supplies, and components should be anticipated when developing project schedules. Equipment and materials should be procured well in advance of construction such that construction is not unnecessarily delayed by the supply chain.

5.4.6 Sustainability Considerations

5.4.6.1 Water and Energy Efficiency

This alternative is more energy efficient than the similar Alternative 1A as the only energy requirement is the submersible pump in the holding tanks and the polymer feed system. The dewatering process does not require energy. Less energy would be required to ship the dewatered solids compared to the existing system and there would be significantly lower volume to transport.

5.4.6.2 Green Infrastructure

Not applicable.

5.4.6.3 Other

Not applicable.

5.4.7 Cost Estimates

The capital cost estimates for Alternative 1B are based on present-day-value calculations of previous work conducted in comparable communities in Southeast Alaska, estimated quantities of raw materials, and allowances for construction contingency, logistic, permitting, legal, engineering, and VSW expenses. The total capital cost estimates for Alternative 1B are shown in Table 11. Capital cost estimates in Table 12 have been adjusted to reflect AIS and BABAA requirements that apply to this project.

Table 11. Alternative 1B Capital Cost Estimates (in 2023 U.S. Dollars)

Item	Quantity	Units	Unit Cost	Cost
Pumper Trailer	1	EA	$45,000	$45,000
Treatment Building	1,200	SF	$500	$600,000
Septage Pumping System	1	LS	$50,000	$50,000
Dewatering Dumpsters	3	EA	$40,000	$120,000
Driveway	1,000	SF	$50	$50,000
Polymer System	1	EA	$50,000	$50,000
Drainfield construction	4,000	SF	$30	$120,000
			Construction Subtotal	**$1,050,000**
			Mob/Demob/Construction Logistics (10%)	$105,000
			Construction Contingency (30%)	$315,000
			Total Construction	**$1,470,000**
			Permitting & Agency Consultation	$50,000
			Engineering and Design (12%)	$176,400
			Construction and Professional Services	**$1,696,400**
			VSW Project Management (8%)	$135,712
			Project Total	**$1,832,112**

Note: Demob = demobilization; EA = each; LF = linear feet; Mob = mobilization; SF = square feet; VSW = Village Safe Water.

Table 12. Alternative 1B Capital Cost Estimates including AIS/BABAA (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Pumper Trailer	1	EA	$49,500	$49,500
Treatment Building	1,200	SF	$600	$720,000
Septage Pumping System	1	LS	$55,000	$55,000
Dewatering Dumpsters	3	EA	$48,000	$216,000
Driveway	1,000	SF	$50	$50,000
Polymer System	1	EA	$55,000	$55,000
Drainfield construction	4,000	SF	$33	$132,000
			Construction Subtotal	**$1,277,500**
			Mob/Demob/Construction Logistics (10%)	$127,750
			AIS/BABAA Administration	$100,000
			Construction Contingency (30%)	$383,250
			Total Construction	**$1,888,500**
			Permitting & Agency Consultation	$50,000
			Engineering and Design (12%)	$226,620
			Construction and Professional Services	**$2,165,120**
			VSW Project Management (8%)	$173,210
			Project Total	**$2,338,330**

Note: AIS = American Iron and Steel Act; BABAA = Build America, Buy America Act; Demob = demobilization; EA = each; LF = linear feet; Mob = mobilization; VSW = Village Safe Water.

Estimated operating expenses associated with Alternative 1B are shown in Table 13. Operating expenses consider power costs to operate the and polymer system, polymer costs, and labor to operate the system. These costs would be distributed among the number of tanks pumped per year. Disposal costs would be accounted for in another alternative. These combined would determine the total cost to pump a septic tank.

Based on records of septage hauling, approximately 8 tanks can be pumped per day. For 2025 estimates, estimating that there is some extra time to pump with a trailer rather than a truck, 55 septic tanks could be pumped in eight 8-hour workdays. It is assumed that dewatering would occur during this time, with additional, non-pumping days required to complete the dewatering. Non-pumping dewatering days were assumed to be 2 hours of work per day to pump stored septage into the contain monitor the equipment.

Table 13. Alternative 1B Estimated Operating Expenses (2024 USD)

Item	Quantity	Unit	Unit Price	Cost
Labor Costs	100	Hour	$50	$5,000
Power Costs	100	Kilowatt Hour	$0.45	$45
Building Heat	150	Gallon	$5.50	$825
Polymer and Chemical Costs	1	Lump Sum	$300	$300
Total Annual Expenses				$6,170
			Tanks Pumped	55
			Expense per tank pumped	$112.18

5.5 Alternative 1C – Aerobic Digestion and Dewatering

Alternative 1C would construct an aerobic digestion treatment plant to treat septage. The septage would be batch processed in a digester with bubble aerators to promote the activity of microbes which breaks down the septage and makes it dewater more efficiently and effectively. This process would use electric-powered blowers to provide oxygen into the digester. Digested sludge would then be dewatered using a screw press. Decant from the digester and leachate from dewatering would be disposed of in a subsurface drainfield near the facility.

5.5.1 Description

Aerobic digestion is the degradation of the organic sludge solids in the presence of oxygen. The oxygen is introduced as fine bubbles of air into the reactor. The micro-organisms in the sludge convert the organic material and oxygen to carbon dioxide and water, and the ammonia and amino species to nitrate.

These systems require aeration blowers to maintain dissolved oxygen levels in the equalization, aeration, and sludge tanks. The blowers are the most energy intensive component of the system and must remain in service at all times. A schematic of a single vessel aerobic digestor is shown in Figure 13.

Digestate liquid from the digester would be disposed of a sub-surface drainfield. The digested sludge would still need to be dewatered, but the digestion process already achieves a significant reduction in sludge volume and elimination of pathogens for a high-quality product. The aerobic digestive process however does reach temperatures that would eliminate PFAS from the waste stream. While the end product of the process would likely meet Class A biosolids requirements, PFAS contamination would likely eliminate the possibility of utilizing the biosolids in any sort of soil amendment or fertilizer context.

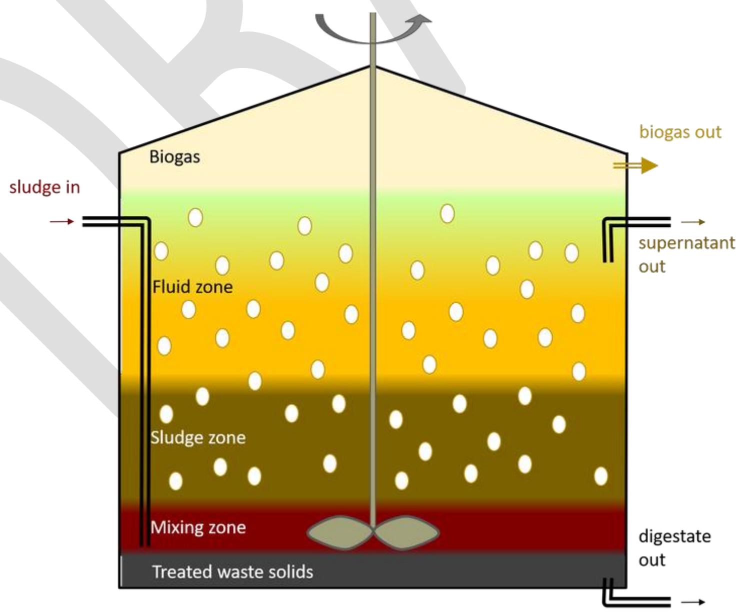


Figure 13. Aerobic Digestor Process Schematic

5.5.1.1 Site and Process Plan

In this alternative, the existing holding tanks would be used as an equalization basin for the incoming septage. Septage would then be dosed into the aerobic digestor. The sludge would then be digested into a high quality, slightly dewatered digestate. This digestate would be pumped into a screw press for further dewatering with the assistance of a polymer feed system. The aerobic digestion process makes the dewatering process much easier and more effective. Dewatered sludge would then be put into a dumpster for disposal. All these processes would be located in a building located near the existing holding tanks. The building would also contain space for storage of spare parts and a sewage pump trailer.

The digestate from the digestor and the leachate from the screw press would be disposed of in a subsurface drainfield. A site plan is shown in Figure 14.

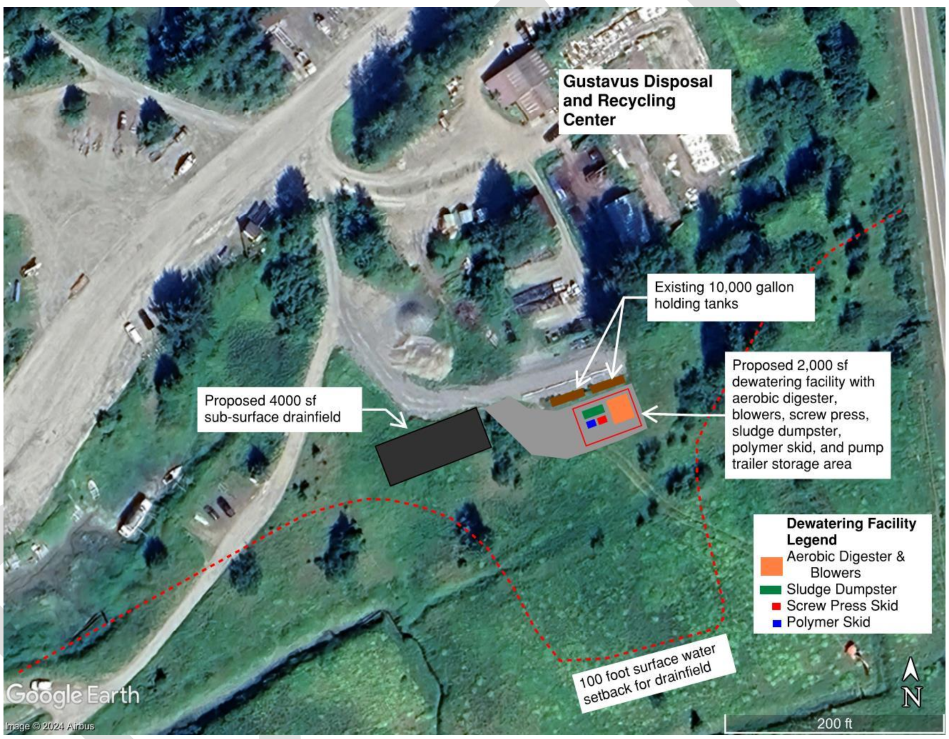


Figure 14. Alternative 1C site layout

5.5.2 Design Criteria

The design flow criteria for the treatment facility are listed in Table 5. The precise sizing of the aeration blowers and aerobic digestor volume and process would be determined during a design study report. A schematic diagram of the aerobic digestor process is shown in Figure 15.

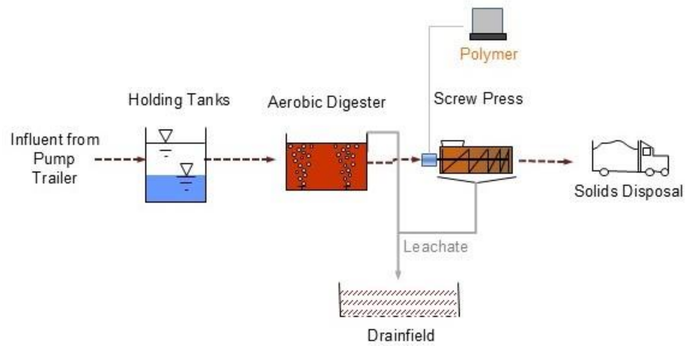


Figure 15. Aerobic Digestor Process Diagram

5.5.3 Environmental Impacts

5.5.3.1 Floodplains

Not applicable.

5.5.3.2 Wetlands

Construction of this alternative would involve no construction in wetlands. Figure 2 shows the wetlands as they are currently mapped around the Gustavus area.

5.5.3.3 Wildlife

Not applicable. This alternative would operate within existing disturbed areas of Gustavus, so no additional disruption would occur beyond construction noise. See Section 1.2.4 for a more in-depth discussion of wildlife in the Gustavus area.

5.5.3.4 Geotechnical Exploration

Geotechnical work will be necessary to during the construction of the building and for test holes to determine size and location of the drainfield.

5.5.3.5 Other resources

Not Applicable

5.5.4 Land Requirements

No additional land requirements, as this alternative would involve construction on land already within the boundaries of the DRC. The land required to construct Alternative 1C is shown in Figure 14.

5.5.5 Potential Construction Problems

Construction in Gustavus is a challenge, as most material would need to be shipped in.

The project will be subject to AIS requirements. Long lead times for AIS-compliant materials, supplies, and components should be anticipated when developing project schedules. Equipment and materials should be procured well in advance of construction such that construction is not unnecessarily delayed by the supply chain.

5.5.6 Sustainability Considerations

5.5.6.1 Water and Energy Efficiency

Alternative 1C would involve significantly higher energy consumption than the current system due to the installation of numerous electrically powered systems and large-capacity aeration blowers. It would also likely need the construction and implementation of one of the dewatering processes in Alternative 1A or 1B.

5.5.6.2 Green Infrastructure

Not applicable.

5.5.6.3 Other

Not applicable.

5.5.7 Cost Estimates

The capital cost estimates for Alternative 1C are based on present-day-value calculations of previous work conducted in comparable communities in Southeast Alaska, estimated quantities of raw materials, and allowances for construction contingency, logistic, permitting, legal, engineering, and VSW expenses. The total capital cost estimates for Alternative 1C are shown in Table 14. Capital cost estimates in Table 15 have been adjusted to reflect AIS and BABAA requirements that apply to this project.

Table 14. Alternative 1C Capital Cost Estimates (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Pumper Trailer	1	EA	$45,000	$45,000
Treatment Building	2,000	SF	$500	$1,000,000
Septage Pumping System	1	LS	$50,000	$50,000
Aerobic Digester	1	EA	$600,000	$600,000
Screw Press	1	EA	$450,000	$450,000
Aeration Blower	2	EA	$60,000	$120,000
Polymer System	1	EA	$50,000	$50,000
Disposal Dumpsters	3	EA	$15,000	$45,000
Drainfield construction	4,000	SF	$30	$120,000
Driveway	1,000	SF	$50	$50,000
			Construction Subtotal	**$2,530,000**
			Mob/Demob/Construction Logistics (10%)	$253,000
			Construction Contingency (30%)	$506,000
			Total Construction	**$3,289,000**
			Permitting & Agency Consultation	$50,000
			Engineering and Design (12%)	$394,680
			Construction and Professional Services	**$3,733,680**
			VSW Project Management (8%)	$298,694

Note: Demob = demobilization; CY = cubic yard; EA = each; LF = linear feet; LS = lump sum; Mob = mobilization; SF = square feet; VSW = Village Safe Water.

Project Total	**$4,032,374**

Table 15. Alternative 1C Capital Cost Estimates including AIS (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Pumper Trailer	1	EA	$49,500	$49,500
Treatment Building	2,000	SF	$600	$1,200,000
Septage Pumping System	1	LS	$55,000	$55,000
Aerobic Digester	1	EA	$660,000	$660,000
Screw Press	1	EA	$495,000	$495,000
Aeration Blower	2	EA	$66,000	$132,000
Polymer System	1	EA	$55,000	$55,000
Disposal Dumpsters	3	EA	$18,000	$54,000
Drainfield construction	4,000	SF	$33	$132,000
Driveway	1,000	SF	$50	$50,000
	Construction Subtotal			**$2,882,500**
	Mob/Demob/Construction Logistics (10%)			$288,250
	AIS/BABAA Administration			$100,000
	Construction Contingency (30%)			$864,750
	Total Construction			**$4,135,500**
	Permitting & Agency Consultation			$50,000
	Engineering and Design (12%)			$496,260
	Construction and Professional Services			**$4,681,760**
	VSW Project Management (8%)			$374,541
	Project Total			**$5,056,301**

Note: Demob = demobilization; CY = cubic yard; EA = each; LF = linear feet; LS = lump sum; Mob = mobilization; SF = square feet; VSW = Village Safe Water.

Estimated operating expenses associated with Alternative 1C are shown in Table 16. Operating expenses consider power costs to operate the blower, screw press, and polymer system, polymer and other chemical costs, and labor to pump the tanks and operate the system. These costs would be distributed among the number of tanks pumped per year. Disposal costs would be accounted for in another alternative. These combined would determine the total cost to pump a septic tank.

Based on records of septage hauling, approximately 8 tanks can be pumped per day. For 2025 estimates, estimating that there is some extra time to pump with a trailer rather than a truck, 55 septic tanks could be pumped in eight 8-hour workdays. As the aerobic digestor must be continually operated to keep the microbes alive, it is assumed that a 1/4 full time equivalent worker would need to be employed to perform both the septage hauling and the system operations. This alternative would likely also require that the worker possess an ADEC operator certification.

Table 16. Alternative 1C Estimated Operating Expenses (2024 USD)

Item	Quantity	Unit	Unit Price	Cost
Labor Costs (1/4 FTE)	500	Hour	$50	$25,000
Building Heat	200	Gallon	$5.50	$1,100

Item	Quantity	Unit	Unit Price	Cost
Power Costs	20,000	Kilowatt Hour	$0.45	$9,000
Polymer and Chemical Costs	1	Lump Sum	$750	$750
Total Annual Expenses				$35,850
			Tanks Pumped	55
			Expense per tank pumped	$651.82

5.6 Alternative 1D – Reed Bed Drying

Planted reed bed filters have been used extensively in Europe to dewater and treat septage as well as in several operations in Canada. The reed bed operates like a conventional drying bed with additional treatment from the planted reeds. A lined lagoon is constructed with a geomembrane to contain the leachate liquid from the septage. Layers of gravel and coarse sand are added over perforated filtrate collection pipes as shown in Figure 16. Once the planted reeds are established, a layer of sludge can be added after a rough bar screen directly from a septic pumper truck and distributed through the reed bed. New layers of sludge can be added to the bed once or twice a month during the summer without a negative impact.

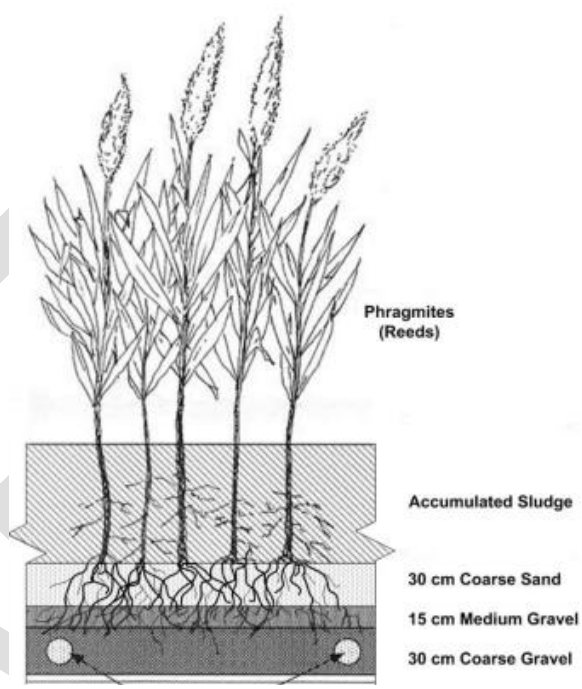


Figure 16. Reed Bed Schematic (Kowalik 2014)

Filtrate would be disposed of in a subsurface drainfield, and dewatered sludge can accumulate for up to a decade and then be collected and disposed of using a method described in Category 2. The product of the reed bed process is suitable for land application or could be used as cover at the landfill.

5.6.1 Description

Alternative 1D would take the septage either from the existing holding tanks or directly from a septage pump truck or trailer and put through a bar screen to remove trash and large solids. An example of a septage bar screen is shown in Figure 17. The cleaned septage would then flow into the reed bed. Once inside the reed bed, the wastewater undergoes a series of natural treatment processes as it moves laterally through the root zone from one end of the bed to the other. The wetland plants leak small amounts of oxygen out through their roots, creating oxygenated sites within an otherwise anaerobic environment. This mix of aerobic and anaerobic conditions creates an ideal environment for the growth of micro-organisms on the surface of the gravel and plant roots. These micro-organisms are largely responsible for the pollutant removal that occurs in a reed bed, as they feed on and breakdown organic matter and nutrients and compete against pathogenic organisms.


Figure 17. Example Septage Bar Screen (Or-Tech)

During the loading period, the particulate matter in the influent septage is physically retained on the top surface of the reed bed, with the liquid leachate will percolating through the reed bed and is released into a subsurface drainfield via a drainage system. Studies in Ontario have tested dewatered sludge after treatment in a septage treatment reed bed to be around 23 percent solids. The leachate was tested to have a 99 percent reduction in biological oxygen demand, total suspended solids, total phosphorus, and total Kjeldahl nitrogen (Kinsley 2014).

5.6.2 Design Criteria

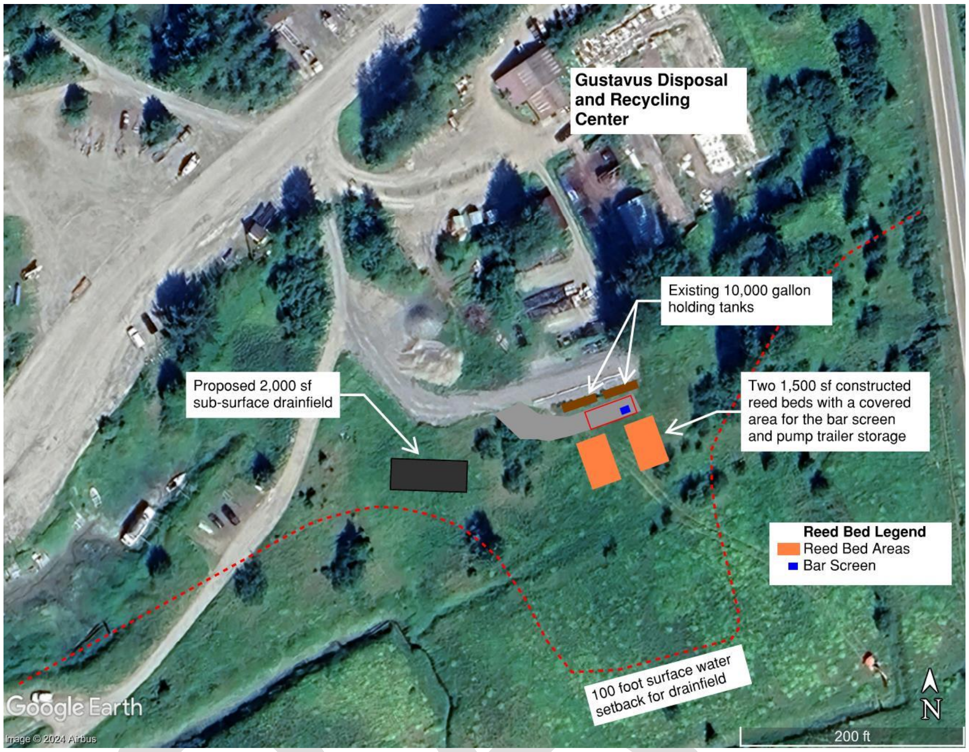


Figure 18. Alternative 1E site layout

5.6.2.1 Reed Bed Sizing

Sizing of a septage treatment reed bed is key to allow for sufficient space for treatment without using excessive area. Based on an ultimate design population of 980 and design flow of 95,800 gallons as shown in Table 5 and the sizing of other septage receiving beds, the bottom area needed is approximately 4,300 square feet. This area was split into three separate beds so that fields could be used in alternate years. Each 1,500 square foot bed would have 6 feet of freeboard above the level of the gravel and sand layers.

With a 2:1 slope, the dimensions of each bed would be approximately 75 feet by 55 feet with a total volume of 15,000 cubic feet. Given the design flow from Table 5 and a dewatering performance of 23 percent, each bed would last approximately 10 years before it is too full to use. Construction of two beds would be sufficient for at least 20 years of septage treatment. A site layout is shown in Figure 18.

Once a bed is full, it could remain in place, or the dewatered sludge utilized as cover for the landfill. After a season of sitting, the pathogen levels will likely be reduced enough to be categorized as Class A or B biosolids. As discussed in Section 4.1.1, land application of biosolids from Gustavus septage would not be feasible due to PFAS contamination.

5.6.2.2 Drainfield

The dewatering process in a reed bed is generally slower than those in Alternative 1A or 1B, so a smaller subsurface drainfield would be required. An entire days' worth of pumped septage (approximately eight 1,000-gallon tanks) would be dewatered over the course of about one week, this would produce approximately 1,000 gallons of leachate that must be absorbed by the subsurface drainfield per day.

Based on the drainfield sizing from Alternative 1A, a 2,000 square foot bed-style drainfield would not be unmanageably large, but still able to accommodate up to 1,600 gallons per day. The construction of the drainfield would be similar to the drainfield proposed in Alternative 1A and would likely require a pump station to lift the leachate from the reed bed drain to the drainfield. The exact size and location of the drainfield would be determined during design.

5.6.2.3 Septic Pumping Trailer

Part of this, and several other alternatives, is the purchase of a septic pumping trailer. A 1,250-gallon pumping trailer would be sufficient to empty most septic tanks while still being manageable to tow with a pickup truck. This trailer could be stored under the cover where the bar screen is located while not in use to protect it from the elements.

5.6.3 Environmental Impacts

5.6.3.1 Floodplains

Not applicable.

5.6.3.2 Wetlands

Construction of this alternative would involve no construction in wetlands. Figure 2 shows the wetlands as they are currently mapped around the Gustavus area.

5.6.3.3 Wildlife

This alternative would operate within existing disturbed areas of Gustavus, so no additional disruption would occur beyond construction noise. It is possible that the reed beds will attract animals such as bird; therefore, increasing habitat diversity in the area. See Section 1.2.4 for a more in-depth discussion of wildlife in the Gustavus area.

5.6.3.4 Geotechnical Exploration

Geotechnical work will be necessary to during the construction of the covered area and for test holes to determine final size and location of the drainfield.

5.6.3.5 Other Resources

Not applicable.

5.6.4 Land Requirements

This alternative requires a similar amount of land as the other alternatives which use drainfields. This will fit in the area surrounding the DRC. See Figure 18 for a proposed site layout.

5.6.5 Potential Construction Problems

Building in the City is challenging due to its remote location. However, reed beds are simple to construct and operate due to their relative lack of man-made infrastructure.

5.6.6 Sustainability Considerations

5.6.6.1 Water and Energy Efficiency

This method uses very little energy and water in processing the septage. It represents the most carbon-efficient way to stabilize and dewater septage that we are considering, as the process in the reed beds sequesters carbon from the septage and atmosphere using plants.

5.6.6.2 Green Infrastructure

A reed bed treatment system is an environmentally friendly, green solution to septage treatment that requires less resources to achieve high levels of treatment.

5.6.6.3 Other

Not applicable.

5.6.7 Cost Estimates

The capital cost estimates for Alternative 1D are based on present-day-value calculations of previous work conducted in comparable communities in Southeast Alaska, estimated quantities of raw materials, and allowances for construction contingency, logistic, permitting, legal, engineering, and VSW expenses. The total capital cost estimates for Alternative 1D are shown in Table 14. Capital cost estimates in Table 15 have been adjusted to reflect AIS and BABAA requirements that apply to this project.

Table 17. Alternative 1D Capital Cost Estimates (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Pumper Trailer	1	EA	$45,000	$45,000
Bar Screen	1	EA	$150,000	$150,000
Covered Area	1,500	SF	$150	$225,000
Unusable Excavation	1,200	CY	$60	$72,000
Reed Bed Construction	2	EA	$150,000	$300,000
Leachate Pump Station	1	LS	$40,000	$40,000
Drainfield Construction	2,000	SF	$30	$60,000
Note: Demob = demobilization; CY = cubic yard; EA = each; LF = linear feet; LS = lump sum; Mob = mobilization; SF = square feet; VSW = Village Safe Water.	**Construction Subtotal**			**$892,000**
	Mob/Demob/Construction Logistics (10%)			$89,200
	Construction Contingency (30%)			$178,400
	Total Construction			**$1,159,600**
	Permitting & Agency Consultation			$50,000
	Engineering and Design (12%)			$139,152
	Construction and Professional Services			**$1,348,752**
	VSW Project Management (8%)			$107,900

Project Total	**$1,456,652**

Table 18. Alternative 1D Capital Cost Estimates including AIS/BABAA (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Pumper Trailer	1	EA	$49,500	$49,500
Bar Screen	1	EA	$165,000	$165,000
Covered Area	1,500	SF	$165	$247,500
Unusable Excavation	1,200	CY	$60	$72,000
Reed Bed Construction	2	EA	$165,000	$330,000
Leachate Pump Station	1	LS	$44,000	$44,000
Drainfield Construction	2,000	SF	$33	$66,000
			Construction Subtotal	**$974,000**
			Mob/Demob/Construction Logistics (10%)	$97,400
			AIS/BABAA Administration	$100,000
			Construction Contingency (30%)	$292,200
			Total Construction	**$1,463,600**
			Permitting & Agency Consultation	$50,000
			Engineering and Design (12%)	$175,632
			Construction and Professional Services	**$1,689,232**
			VSW Project Management (8%)	$135,139
			Project Total	**$1,824,371**

Note: Demob = demobilization; CY = cubic yard; EA = each; LF = linear feet; LS = lump sum; Mob = mobilization; SF = square feet; VSW = Village Safe Water.

Estimated operating expenses associated with Alternative 1D are shown in Table 16. Operating expenses consider power costs to operate the bar screen and pump station, and labor to maintain the reed beds and operate the system. These costs would be distributed among the number of tanks pumped per year. Disposal costs would be accounted for in another alternative. These combined would determine the total cost to pump a septic tank.

Based on records of septage hauling, approximately 8 tanks can be pumped per day. For 2025 estimates, estimating that there is some extra time to pump with a trailer rather than a truck, 55 septic tanks could be pumped in eight 8-hour workdays.

Table 19. Alternative 1C Estimated Operating Expenses (2024 USD)

Item	Quantity	Unit	Unit Price	Cost
Labor Costs	100	Hour	$50	$5,000
Power Costs	100	Kilowatt Hour	$0.45	$45
Total Annual Expenses				$5,045
			Tanks Pumped	55
			Expense per tank pumped	$91.73

5.7 Alternative 1F – No Action

Alternative 1F would take no action. The alternative would continue operation of the existing holding tank system and pumping as described in Section 2 with no capital or operational improvements.

5.7.1 Description

Alternative 1F would perform no work and continue the deposition of untreated septage into two existing 10,000 gallon holding tanks to await transport to a sewage treatment plant.

5.7.2 Design Criteria

Not applicable.

5.7.3 Environmental Impacts

Selecting the No Action Alternative would create no new additional environmental impacts.

5.7.3.1 Floodplains

Not applicable.

5.7.3.2 Wetlands

Not applicable.

5.7.3.3 Wildlife

Not applicable.

5.7.3.4 Geotechnical Exploration

Not applicable.

5.7.3.5 Other Resources

Not applicable.

5.7.4 Land Requirements

Not applicable.

5.7.5 Potential Construction Problems

Not applicable.

5.7.6 Sustainability Considerations

5.7.6.1 Water and Energy Efficiency

Not applicable.

5.7.6.2 Green Infrastructure

Not applicable.

5.7.6.3 Other

Not applicable.

5.7.7 Cost Estimates

Alternative 1F does not include capital costs; therefore, no capital cost estimate is provided.

Alternative 1F would cause no change in the current operations and maintenance costs. It is estimated that each pumping costs approximately $1,000 per occurrence.

6. SLUDGE DISPOSAL ALTERNATIVES

Once the septage has been processed through an alternative in Category 1, the resultant dewatered sludge must be disposed of. These alternatives cover possible methods for disposal of sludge.

6.1 Alternative 2A – Incineration

Alternative 2A would involve the installing a solids incinerator at the dewatering site (the DRC). While it was initially proposed to utilize the incinerator at the Bartlett Cove Wastewater Treatment Facility (BCWTF), based on the hesitation of the National Parks Service (NPS) to consider or enter into any agreement to treat septage at their wastewater treatment facility, an agreement between the City and the NPS is unlikely to occur. For this alternative, a diesel-fired incinerator would burn dewatered sludge, and the ash would be landfilled.

6.1.1 Description

Presently, incineration of sewage sludge is a relatively uncommon method for disposing of septage. There are approximately 170 sewage sludge incineration plants in the United States. These plants use different methods of creating an extremely high-heat environment in which fecal solids can be converted to ash, which can then be disposed of more easily without as much consideration to the leaching of toxic material.

6.1.1.1 Bartlett Cove Wastewater Treatment Facility

BCWTF is a small wastewater treatment facility located 7 miles north of Gustavus, accessible via Park Road. The facility produces solids that are dewatered in a sludge bagger. The facility uses an incinerator to dispose of both sewage solids and other waste. While this alternative assumes that the City would operate its own incinerator due to the unwillingness of the NPS to enter into formal contracts for waste disposal, should a contract be possible, there could be much lower capital expenses associated with this alternative as well as likely a reduced operations and maintenance (O&M) costs.

6.1.1.2 New Incinerator

Several types of incinerators are produced that can burn sewage solids. A multiple hearth furnaces are a vertically oriented cylinder with several zones (or hearths) that process and burn the biosolids. Multiple hearth furnaces are more energy intensive than more modern, fluidized bed furnaces. Fluidized beds are a vertically oriented shell with a bed of sand at the bottom on which the biosolids are placed. Over the years, fluidized bed furnaces replaced many multiple hearth furnaces due to the lower operating costs and higher quality emissions. A fluidized bed furnace is recommended for this alternative.

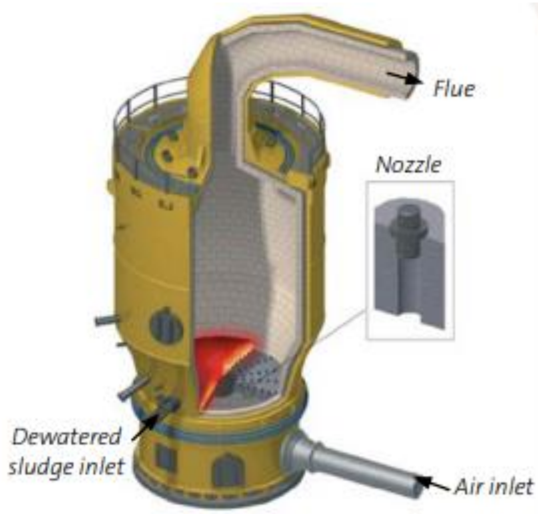


Figure 20. Fluidized Bed Incinerator Schematic (Veolia)

6.1.2 Design Criteria

Sizing the incinerator is key to balancing the volume of dewatered sludge disposed of at one time with energy usage. A larger incinerator costs more to construct and operate, where a smaller incinerator would need to be operated for a longer period of time. Incinerators are most efficient when operated continuously until the volume needed to be disposed of is completely consumed. Most dewater sludge specific installations are for larger volumes than will be seen in Gustavus, so procurement of an appropriately-sized incinerator designed to receive dewatered sludge may be difficult.

The installation of the incinerator and other elements of the disposal process, such as emissions controls, and the blower would be located in a building at the DRC. A site plan for construction of an incineration facility at the DRC is shown in Figure 19.

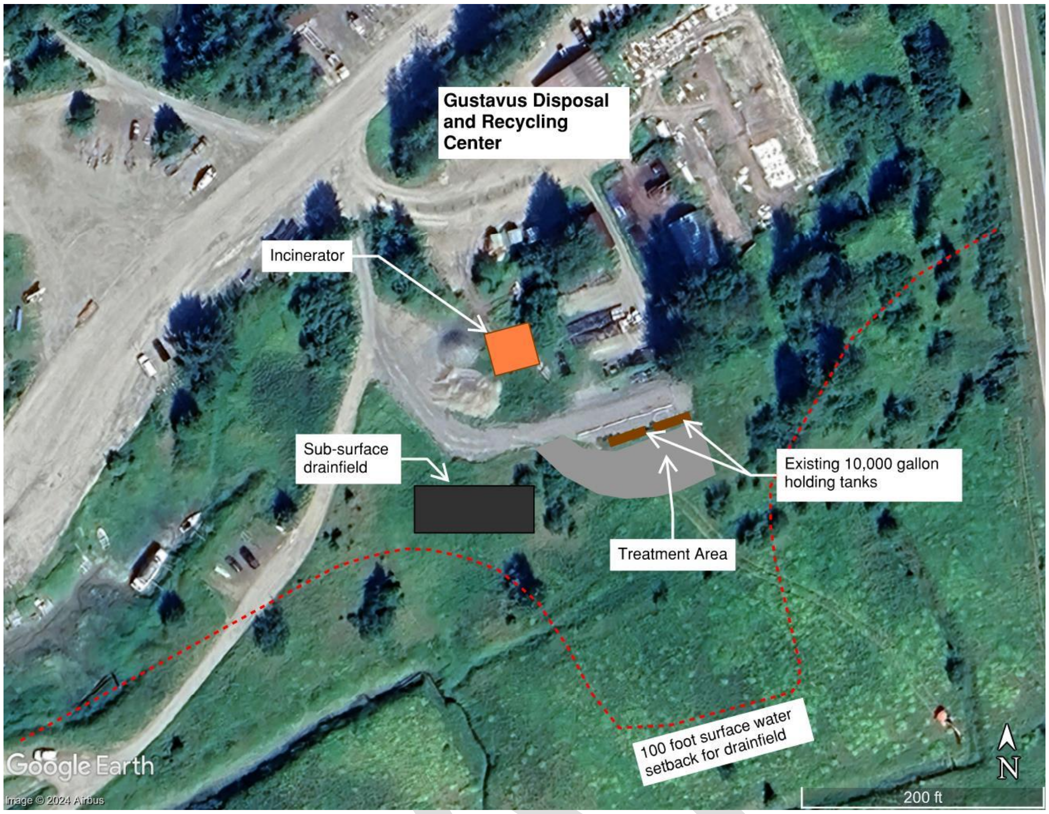


Figure 19. Alternative 2A site layout

6.1.3 Environmental Impacts

Overall, installation of incinerators has been decreasing due to the high volume of contaminants that are emitted to the environment during the process. Measures can be taken to reduce these effects, such as adding afterburners to increase the temperature or catchment of the containment before they are exhausted into the environment. These measures can be costly and are difficult to monetize on Gustavus' scale.

6.1.3.1 Floodplains

Not applicable.

6.1.3.2 Wetlands

Construction of this alternative would involve no construction in wetlands. Figure 2 shows the wetlands as they are currently mapped around the Gustavus area.

6.1.3.3 Wildlife

Not applicable. This alternative would operate within existing disturbed areas of Gustavus, so no additional disruption would occur beyond construction noise. See Section 1.2.4 for a more in-depth discussion of wildlife in the Gustavus area.

6.1.3.4 Geotechnical Exploration

It is likely that little to no geotechnical exploration would be necessary, as this alternative at most would only add a small amount of infrastructure in the same location as other alternatives.

6.1.3.5 Other Resources

Not applicable.

6.1.4 Land Requirements

Alternative 2A could use existing infrastructure if the BCWTF option is selected. The local landfill may need an increase in size if ash deposition occurs at a large enough scale. If the City constructs their own incineration facility it would be able to use DRC land.

6.1.5 Potential Construction Problems

No significant issues beyond the basic challenges of remote construction.

The project will be subject to AIS requirements. Long lead times for AIS-compliant materials, supplies, and components should be anticipated when developing project schedules. Equipment and materials should be procured well in advance of construction such that construction is not unnecessarily delayed by the supply chain.

6.1.6 Sustainability Considerations

6.1.6.1 Water and Energy Efficiency

The use of incineration to process the dewatered sludge would be far more energy intensive than more passive disposal methods because of the need to use more fuel in the existing incineration facility at Bartlett Cove or a new facility. This fuel use is slightly offset by the lack of need to ship the dewatered sludge long distances.

6.1.6.2 Green Infrastructure

Not applicable.

6.1.6.3 Other

Not applicable.

6.1.7 Cost Estimates

The capital cost estimates for Alternative 2A are based on present-day-value calculations of previous work conducted in comparable communities in Southeast Alaska, estimated quantities of raw materials, and allowances for construction contingency, logistic, permitting, legal, engineering, and VSW expenses. The total capital cost estimates for Alternative 2A are provided in Table 20. The capital cost estimates in Table 21 have been adjusted to reflect AIS and BABAA requirements that apply to this project.

Table 20. Alternative 2A Capital Cost Estimates (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Incinerator Building	1,200	SF	$500	$600,000
Fluidized bed Incinerator	1	EA	$650,000	$650,000
Aeration Blower	1	EA	$100,000	$100,000
Misc Connections	1	LS	$50,000	$50,000
Note: Demob = demobilization; EA = each; LF = linear feet; LS = lump sum; Mob = mobilization; VSW = Village Safe Water.			**Construction Subtotal**	**$1,400,000**
			Mob/Demob/Construction Logistics (10%)	$140,000
			Construction Contingency (30%)	$420,000
			Total Construction	**$1,960,000**
			Permitting & Agency Consultation	$50,000
			Engineering and Design (12%)	$235,200
			Construction and Professional Services	**$2,245,200**
			VSW Project Management (8%)	$179,616
			Project Total	**$2,424,816**

Table 21. Alternative 2A Capital Cost Estimates with AIS/BABAA (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Incinerator Building	1,200	SF	$600	$720,000
Fluidized bed Incinerator	1	EA	$715,000	$715,000
Aeration Blower	1	EA	$110,000	$110,000
Misc Connections	1	LS	$55,000	$55,000
Note: Demob = demobilization; EA = each; LS = lump sum; Mob = mobilization; VSW = Village Safe Water.			**Construction Subtotal**	**$1,600,000**
			Mob/Demob/Construction Logistics (10%)	$160,000
			AIS/BABAA Administration	$100,000
			Construction Contingency (30%)	$480,000
			Total Construction	**$2,340,000**
			Permitting & Agency Consultation	$50,000
			Engineering and Design (12%)	$280,800
			Construction and Professional Services	**$2,670,800**
			VSW Project Management (8%)	$213,664
			Project Total	**$2,884,464**

Estimated operating expenses associated with Alternative 2A are shown in Table 22. These costs would be distributed among the number of tanks pumped per year. Treatment/dewatering costs would be accounted for in another alternative. These combined would determine the total cost to pump a septic tank.

It is assumed that the labor costs to run and maintain the incinerator are approximately 160 hours per year. Other major costs for Alternative 2A are the power cost to run the aeration blower and the diesel fuel to power the incinerator. The estimate in Table 22 is based on dewatered solids at 40 percent. Should the solids percentage be lower than that due to either poor dewatering or a different method, the fuel costs could be significantly higher. Environmental monitoring and testing are also necessary due to the nature of incineration.

Table 22. Alternative 2A Estimated Operating Expenses (2024 USD)

Item	Quantity	Unit	Unit Price	Cost
Labor Costs	160	Hour	$50	$8,000
Power Costs	10,000	Kilowatt Hour	$0.45	$4,500
Incinerator Fuel	2,000	Gallon	$5.50	$11,000
Monitoring and Testing	1	Lump sum	$7,500	$7,500
Total Annual Expenses				$31,000
			Tanks Pumped	55
			Expense per tank pumped	$563.64

6.2 Alternative 2B – Monofill

Alternative 2B would include the permitting and construction of a monofill on the existing landfill property to accept dewatered sludge. The dewatered sludge would be transferred from one of the Category 1 dewatering processes to the new sewage solid monofill as defined in 18 AAC 60.470. Once the sludge is placed in the monofill, cover material would be spread over the sludge per ADEC regulations.

6.2.1 Description

A monofill is a landfill, or part of a landfill, that accepts dewatered sludge. The process of monofilling consists of preparing the site, transferring the sludge to the site, and covering the sludge with a layer of cover material. Because of the concentration of PFAS pollutants found in existing Gustavus biosolids, site preparation would include installing a liner to prevent contaminants from leaching into the surrounding environment. Groundwater and air monitoring would need to be installed to test for lateral migration of contaminants

Landfilling of sludge in monofill is regulated by the Environmental Protection Agency under Subpart C of 40 CFR, Part 503, Standards for the Use and Disposal of Sewage Sludge as surface disposal and ADEC regulations 18 AAC 60 Article 4. If the concentration of any of these pollutants exceeds the criteria, the facility must be lined. The regulations also allow establishment of site-specific pollutant limits at the discretion of the permitting authority. These regulations also require that biosolids placed in a landfill meet either Class A or Class B pathogen reduction requirements or that they be covered with soil or other material at the end of each operating day. Based on monitoring requirements listed in 18 AAC 60.470(j) and estimated capacity in Section 6.2.2, monitoring of sewage solid material would need to be completed annually, and explosive gas testing would not be required. Treatment alternatives 1C, 1D, and 1E would likely allow for the monofill to remain uncovered. Alternatives to cover material require submitting a waiver request with approval from the ADEC. Class B pathogen reduction could be achieved in alternatives 1A and 1B with the addition of lime stabilization.

This Alternative would consist of a lined monofill area adjacent to the existing landfill area. A leachate collection system would collect any additional liquids in the lined area and dispose of them in the subsurface drainfield. Leachate collection and disposal requirements must follow requirements of 18 AAC 72.

Sludge would be collected from the dewatering and/or treatment system and placed in the monofill on a yearly or biyearly basis. The sludge would be covered by soil or an impervious geomembrane. Once the monofill is filled, it would be closed permanently and monitored for a minimum of three years per AAC 60.470(o) and 18 AAC 60.245 with leachate collected and disposed of and a new monofill or lateral expansion would need to be constructed.

6.2.2 Design Criteria

A monofill would need to be sized for disposal of waste for at least 20 years. The volume of sludge needing disposal depends on the alternative from Category 1 chosen. The volume needing disposal if Alternative 1A is chosen is between 15 and 24 cubic yards as shown in Table 6. The volume needing disposal under Alternative 1B is between 30 and 48 cubic yards as shown in Table 10. Based on these estimates, a 1,000 cubic yard monofill would be sufficient for 20 years of disposal with room for liners, covers, leachate systems, and any necessary buffer zones. A site plan for a monofil site is shown in Figure 20.

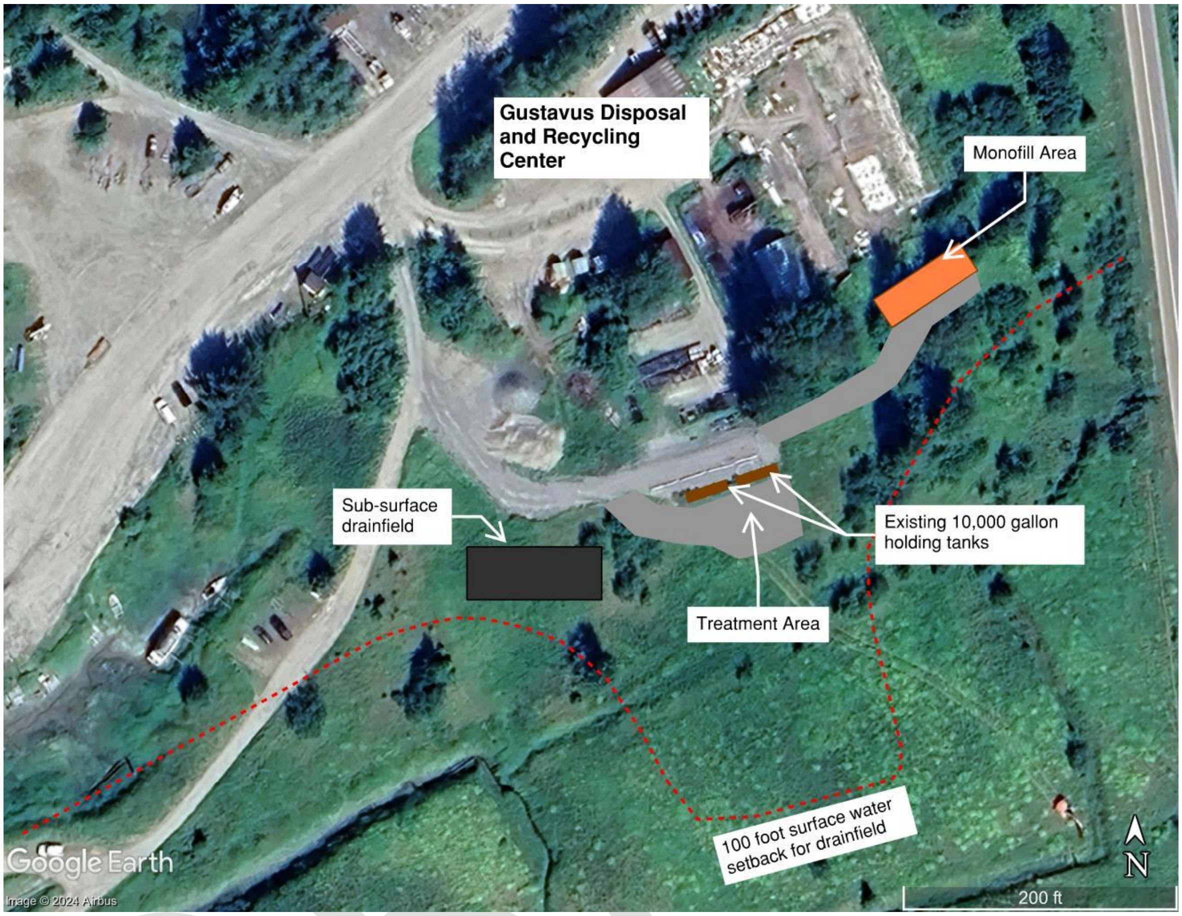


Figure 20. Alternative 2B site layout

6.2.3 Environmental Impacts

There are several potential environmental impacts associated with landfilling of dewatered sludge. Leachate from the landfill may transport nitrate, metals, organics, and/or pathogens to groundwater if the landfill site has not been properly selected or if the liner has been damaged. Rainfall runoff from an active landfill may carry contaminates to nearby surface waters if the monofill was not designed for runoff to be contained in the liner and treated as leachate. The monofill may release landfill gases during decomposition; however, due to the estimated size of the sewage sludge monofill gas generated is expected to be minimal concentrations that dissipate and will not require monitoring per 18 AAC 60.470(j).

6.2.3.1 Floodplains

This monofill should be located in a place not affected by flooding concerns.

6.2.3.2 Wetlands

Construction of this alternative would involve no construction in wetlands. Figure 2 shows the wetlands as they are currently mapped around the Gustavus area.

6.2.3.3 Wildlife

Not applicable. This alternative would operate within existing disturbed areas of Gustavus, so no additional disruption would occur beyond construction noise. See Section 1.2.4 for a more in-depth discussion of wildlife in the Gustavus area.

6.2.3.4 Geotechnical Exploration

It is likely that geotechnical exploration will be necessary. This work would occur concurrently with geotechnical work for the treatment alternative.

6.2.3.5 Other Resources

Not applicable.

6.2.4 Land Requirements

Alternative 2B involves the creation of a new monofil. A new area within the confines of the DRC would need to be allocated for the monofil and would be unavailable for other landfill activities.

6.2.5 Potential Construction Problems

No significant issues beyond the basic challenges of remote construction.

6.2.6 Sustainability Considerations

6.2.6.1 Water and Energy Efficiency

Disposing of the solids locally would be more energy efficient than shipping them to Juneau and/or beyond.

6.2.6.2 Green Infrastructure

Not applicable.

6.2.6.3 Other

Not applicable.

6.2.7 Cost Estimates

The capital cost estimates for Alternative 2B are based on present-day-value calculations of previous work conducted in comparable communities in Southeast Alaska, estimated quantities of raw materials, and allowances for construction contingency, logistic, permitting, legal, engineering, and VSW expenses. The total capital cost estimates for Alternative 2B are provided in Table 20. The capital cost estimates in Table 21 have been adjusted to reflect AIS and BABAA requirements that apply to this project.

Table 23. Alternative 2B Capital Cost Estimates (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Monofill Construction	1	LS	$850,000	$850,000
Leachate Piping	1	LS	$20,000	$20,000
Driveway	3500	SF	$50	$175,000
			Construction Subtotal	**$1,045,000**
			Mob/Demob/Construction Logistics (10%)	$104,500
			Construction Contingency (30%)	$313,500
			Total Construction	**$1,463,000**
			Permitting & Agency Consultation	$50,000
			Engineering and Design (12%)	$175,560
			Construction and Professional Services	**$1,688,560**
			VSW Project Management (8%)	$135,085
			Project Total	**$1,823,645**

Note: AIS = American Iron and Steel Act; BABAA = Build America, Buy America Act; Demob = demobilization; LF = linear feet; Mob = mobilization; VSW = Village Safe Water.

Table 24. Alternative 2B Capital Cost Estimates with AIS/BABAA (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Monofill Construction	1	LS	$935,000	$935,000
Leachate Piping	1	LS	$24,000	$24,000
Driveway	3500	SF	$50	$175,000
			Construction Subtotal	**$1,134,000**
			Mob/Demob/Construction Logistics (10%)	$113,400
			AIS/BABAA Administration	$100,000
			Construction Contingency (30%)	$340,200
			Total Construction	**$1,687,600**
			Permitting & Agency Consultation	$50,000
			Engineering and Design (12%)	$202,512
			Construction and Professional Services	**$1,940,112**
			VSW Project Management (8%)	$155,209
			Project Total	**$2,095,321**

Note: AIS = American Iron and Steel Act; BABAA = Build America, Buy America Act; Demob = demobilization; LF = linear feet; Mob = mobilization; VSW = Village Safe Water.

Estimated operating expenses associated with Alternative 2B are shown in Table 25. These costs would be distributed among the number of tanks pumped per year. Treatment/dewatering costs would be accounted for in another alternative. These combined would determine the total cost to pump a septic tank.

It is assumed that the labor costs to monitoring and disposal would consist of two hours per week of monitoring and approximately 80 total hours to coordinate disposal of solids in the monofil. Other costs for Alternative 2B are the power cost to run the leachate pump and testing costs.

Table 25. Alternative 2B Estimated Operating Expenses (2024 USD)

Item	Quantity	Unit	Unit Price	Cost
Monitoring and Disposal Labor	184	hour	$50	$9,200
Leachate Pump Costs	100	kilowatt hour	$0.45	$45
Monitoring and Testing	1	Lump sum	$5,000	$5,000
Total Annual Expenses				$14,245
			Tanks Pumped	55
			Expense per tank pumped	$259.00

6.3 Alternative 2C – Ship to Juneau for Drying

Alternative 2C would involve shipment of dewatered sludge to Juneau for drying and final disposal. This alternative would differ slightly from current septage disposal as the water content would be greatly reduced and the total volume needed to ship would be less, resulting in lower costs and a smaller operation.

6.3.1 Description

This alternative uses elements of the current system of septage disposal in Gustavus, namely shipment to Juneau via the AMHS. The difference with the current conditions is that after dewatering or treatment, the dewatered sludge would have a much lower volume and would be more solid. Dewatered sludge would be transferred via tipping dumpster on the AMHS ferry to Juneau and trucked to the Juneau Mendenhall Wastewater Treatment Facility where the newly operational solids dryer is located. Gustavus would contract the Juneau Public Works Department for drying and ultimate disposal of the solids.

A truck from Juneau would travel on the AMHS to Gustavus. During the ferry's idle time in Gustavus, the truck would drive to the DRC and retrieve a full sludge dumpster and return to the ferry. The truck would then deposit the solids in Juneau. The contractor would either return the dumpster to Gustavus or store the dumpster until it can be returned during the next sludge retrieval.

6.3.2 Design Criteria

Alternative 2C would use existing infrastructure, including dumpsters designed for sludge handling that can be dumped into the Juneau sludge drying facility. The dumpsters would be purchased as part of a treatment alternative as the number depends on the efficiency of dewatering.

The Juneau Wastewater Treatment Facility is not currently permitted to accept dewatered sludge, and some modifications to the drying facility would be necessary to allow for acceptance of dewatered solids.

6.3.3 Environmental Impacts

6.3.3.1 Floodplains

Not applicable.

6.3.3.2 Wetlands

Not applicable.

6.3.3.3 Wildlife

Not applicable.

6.3.4 Geotechnical Exploration

Not applicable.

6.3.5 Other Resources

Not applicable.

6.3.6 Land Requirements

Not applicable.

6.3.7 Potential Construction Problems

Not applicable.

6.3.8 Sustainability Considerations

6.3.8.1 Water and Energy Efficiency

This alternative would lower the energy costs compared to the existing conditions and a much lower volume would need to be shipped to Juneau.

6.3.8.2 Green Infrastructure

Not applicable.

6.3.8.3 Other

Not applicable.

6.3.9 Cost Estimates

The costs involved with this alternative are transportation of the sludge to Juneau via the AMHS and costs to dry and dispose of the dewatered sludge at the Juneau Wastewater Treatment Facility and the costs to permit and perform improvements to the facility in Juneau to receive dewatered sludge. Permitting costs are higher than other alternatives, due to the anticipated coordination with the Regulatory Commission of Alaska in order to create a tariff to accept dewatered sludge.

The capital cost estimates for Alternative 2C are based on present-day-value calculations of previous work conducted in comparable communities in Southeast Alaska, estimated quantities of raw materials, and allowances for construction contingency, logistic, permitting, legal, engineering, and VSW expenses. The total capital cost estimates for Alternative 2C are shown in Table 26. Capital cost estimates in Table 27 have been adjusted to reflect AIS and BABAA requirements that apply to this project.

Table 26. Alternative 2E Capital Cost Estimates (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Improvements to Juneau Facility	1	LS	$200,000	$200,000
Note: Demob = demobilization; EA = each; LF = linear feet; LS = lump sum; MMBR = moving bed bioreactor; Mob = mobilization; SF = square feet; V = volts; VSW = Village Safe Water.			**Construction Subtotal**	**$200,000**
			Mob/Demob/Construction Logistics (10%)	$20,000
			Construction Contingency (30%)	$60,000
			Total Construction	**$280,000**
			Permitting & Agency Consultation	$100,000

Engineering and Design (12%)	$33,600
Construction and Professional Services	**$413,600**
VSW Project Management (8%)	$33,088
Project Total	**$446,688**

Table 27. Alternative 2E Capital Cost Estimates including AIS/BABAA (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Improvements to Juneau Facility	1	LS	$240,000	$240,000
Note: Demob = demobilization; EA = each; LF = linear feet; LS = lump sum; MMBR = moving bed bioreactor; Mob = mobilization; SF = square feet; V = volts; VSW = Village Safe Water.			**Construction Subtotal**	**$240,000**
			Mob/Demob/Construction Logistics (10%)	$24,000
			AIS/BABAA Administration	$50,000
			Construction Contingency (30%)	$72,000
			Total Construction	**$386,000**
			Permitting & Agency Consultation	$100,000
			Engineering and Design (12%)	$46,320
			Construction and Professional Services	**$532,320**
			VSW Project Management (8%)	$42,586
			Project Total	**$574,906**

Operational costs vary depending on the volume of dewatered sludge needed to transport. Table 28 shows the costs associated with mechanical dewatering, and Table 29 shows the costs associated with a passive dewatering system.

To transport sludge to the Juneau, it is assumed that a flatbed truck would be contracted from Juneau and travel to Gustavus on the AMHS Ferry. It would then pick up the sludge trailer and transport it back to Juneau on the same day for disposal. Conversations with Juneau Engineering and Public Works Department estimated that the cost of dispose of a 15-yard dumpster of dewatered solids would be $5,000.

Table 28. Alternative 2C Estimated Operating Expenses – Mechanical Dewatering (2024 USD)

Item	Quantity	Unit	Unit Price	Cost
Transport Costs	1	Per Trip	$2,000	$2,000
AMHS Costs	1	Per Trip	$1,500	$1,500
Disposal Costs	1	Per Trip	$5,000	$5,000
Total Annual Expenses				$8,500
			Tanks Pumped	55
			Expense per tank pumped	$154.54

Table 29. Alternative 2C Estimated Operating Expenses – Passive Dewatering (2024 USD)

Item	Quantity	Unit	Unit Price	Cost
Transport Costs	3	Per Trip	$2,000	$6,000
AMHS Costs	3	Per Trip	$1,500	$4,500
Disposal Costs	3	Per Trip	$5,000	$15,000
Total Annual Expenses				$25,500
			Tanks Pumped	55
			Expense per tank pumped	$463.63

6.4 Alternative 2E – Composting

Sludge composting is an aerobic digestive process that produces a stabilized biosolid that can be used for soil amendment or mulch. Alternative 2E would construct a sludge composting facility to receive and process septage and facilitate composting. The composting process creates a stable biosolid suitable as a soil amendment, land application, or for disposal.

6.4.1 Description

Composting is a type of aerobic digestion. Sewage sludge is combined with a bulking agent or amendment such as wood chips or sawdust, prior to composting to provide a pasteurized product.

The process begins with receiving dewatered sludge, this alternative assumes that a mechanical screw press is utilized for dewatering. Then bulking agents such as wood chips or saw dust are added to the sludge at the beginning of the composting process. After that, decomposition is accelerated by mechanical turning. Next, the bulking agent can be removed if not degraded, and the compost can be stored to provide continued stabilization and then final disposal.

Composting employs natural mesophilic and thermophilic aerobic degradation within a largely static system which is aerated by natural diffusion and the periodic mechanical turning and, therefore, has a very low energy demand. The process results in a high-quality class A biosolids product. However, composting is a lengthy process that requires large land areas and would not eliminate PFAS contamination. It is likely that biosolids that were composted from septage in Gustavus would contain PFAS and should not be used for soil fertilizers or soil amendment. Often, composted biosolids can be sold to homeowners or farmers; however, because of the PFAS issue, this is not recommended for Gustavus.

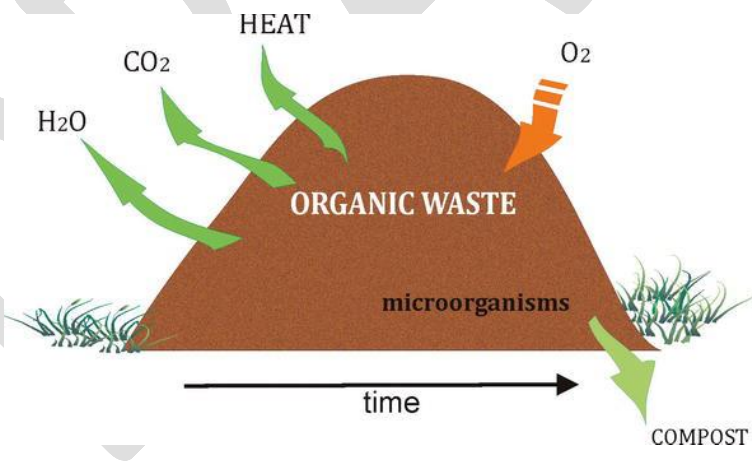


Figure 21. Sludge composting schematic

Site and Process Plan

For this alternative, septage would be pumped into the existing holding tanks where it would be metered into a mechanical dewatering screw press with a polymer feed system to enhance flocculation. Dewatered sludge would be placed into a covered area for the addition of bulking agents, like the current composting process occurring at the DRC.

The compost pile would be periodically mechanically turned, and the temperature of the pile monitored to ensure the process is occurring as intended. Once the process is completed, the compost would be distributed. Due to the PFAS contamination issue, it is recommended that the compost be used for cover at the landfill.

6.4.2 Design Criteria

The size of the composting facility would require volume to process the volume of dewatered sludge output from the dewatering mechanism. That volume is shown in Table 6. The design volume of sludge to be composted is estimated at 4800 gallons, or 24 cubic yards of material per year.

While the precise size of the facility would be confirmed in a design study report, the space required to compost this volume of sludge is approximately 4,000 square feet. This number is based on the size of composting facility located in Petersburg, Alaska, and scaled to the volume of sludge processed in Gustavus. This alternative estimates that a total of 4,500 square feet of covered area with a concrete pad sloped to drain would be sufficient for composting to allow for dewatering facilities.

While the DRC operates a composting facility currently for food waste and other compostables, it is assumed that the two facilities would be separated. The current compost is used by residents for gardening and soil amendments, and it is likely that there would be significant pushback against combining the composting streams that would result in PFAS contaminated compost.

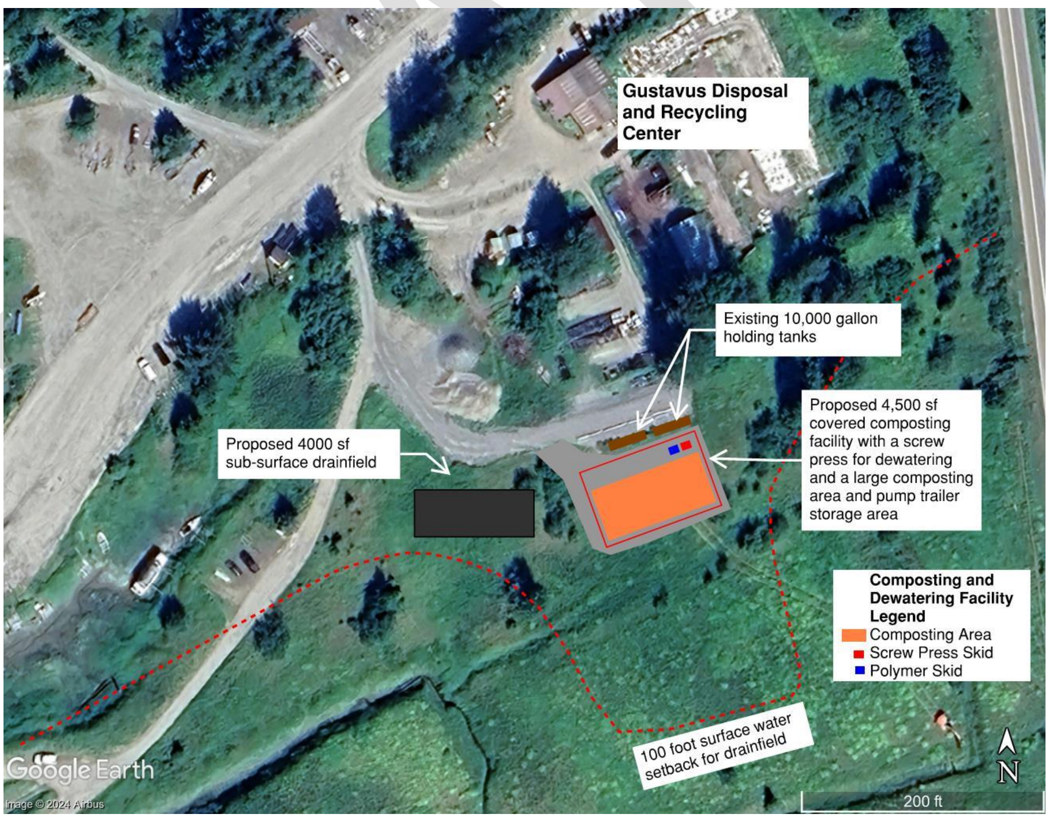


Figure 22. Alternative 2E site layout

6.4.3 Environmental Impacts

6.4.3.1 Floodplains

Not applicable.

6.4.3.2 Wetlands

Construction of this alternative would involve no construction in wetlands. Figure 2 shows the wetlands as they are currently mapped around the Gustavus area.

6.4.3.3 Wildlife

Not applicable. This alternative would operate within existing disturbed areas of Gustavus, so no additional disruption would occur beyond construction noise. See Section 1.2.4 for a more in-depth discussion of wildlife in the Gustavus area.

6.4.3.4 Geotechnical Exploration

Geotechnical work will be necessary to during the construction of the covered composting area and for test holes to determine size and location of the drainfield.

6.4.3.5 Other Resources

Not applicable.

6.4.4 Land Requirements

No additional land requirements, as this alternative would involve construction on land associated with the DRC. The land required to construct Alternative 2E is shown in Figure 22.

6.4.5 Potential Construction Problems

Construction in Gustavus is a challenge, as most material would need to be shipped in.

The project will be subject to AIS requirements. Long lead times for AIS-compliant materials, supplies, and components should be anticipated when developing project schedules. Equipment and materials should be procured well in advance of construction such that construction is not unnecessarily delayed by the supply chain.

6.4.6 Sustainability Considerations

6.4.6.1 Water and Energy Efficiency

This alternative can have a similar energy use to Alternatives 1B, as the same dewatering process could be used, and potentially could eliminate the energy use of long-distance shipping if the compost was stabilized enough for local use. However, the existence of PFAS would still require safer disposal elsewhere.

6.4.6.2 Green Infrastructure

Not applicable.

6.4.6.3 Other

The risk of PFAS getting back into the environment due to the use of this alternative should the compost be used as a soil amendment is an issue that must not be overlooked.

6.4.7 Cost Estimates

The capital cost estimates for Alternative 2E are based on present-day-value calculations of previous work conducted in comparable communities in Southeast Alaska, estimated quantities of raw materials, and allowances for construction contingency, logistic, permitting, legal, engineering, and VSW expenses. The total capital cost estimates for Alternative 2E are shown in Table 30. Capital cost estimates in Table 31 have been adjusted to reflect AIS and BABAA requirements that apply to this project. Alternative 2E includes the costs to implement a mechanical dewatering system as it can be housed in the composting facility and does not need to be a separate facility.

Table 30. Alternative 2E Capital Cost Estimates (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Pumper Trailer	1	EA	$45,000	$45,000
Covered Composting Facility	4500	SF	$300	$1,350,000
Septage Pumping System	1	LS	$50,000	$50,000
Screw Press	1	EA	$450,000	$450,000
Driveway	1000	SF	$50	$50,000
Polymer System	1	EA	$50,000	$50,000
Drainfield construction	4000	SF	$30	$120,000
Note: Demob = demobilization; EA = each; LF = linear feet; LS = lump sum; MMBR = moving bed bioreactor; Mob = mobilization; SF = square feet; V = volts; VSW = Village Safe Water.			**Construction Subtotal**	**$2,115,000**
			Mob/Demob/Construction Logistics (10%)	$211,500
			Construction Contingency (30%)	$634,500
			Total Construction	**$2,961,000**
			Permitting & Agency Consultation	$50,000
			Engineering and Design (12%)	$296,520
			Construction and Professional Services	**$3,366,320**
			VSW Project Management (8%)	$269,306
			Project Total	**$3,635,626**

Table 31. Alternative 2E Capital Cost Estimates including AIS/BABAA (2024 USD)

Item	Quantity	Units	Unit Cost	Cost
Pumper Trailer	1	EA	$49,500	$49,500
Covered Composting Facility	4500	SF	$360	$1,620,000
Septage Pumping System	1	LS	$55,000	$55,000
Screw Press	1	EA	$495,000	$495,000
Driveway	1000	SF	$50	$50,000
Polymer System	1	EA	$55,000	$55,000
Drainfield construction	4000	SF	$33	$132,000

Note: Demob = demobilization; EA = each; LF = linear feet; LS = lump sum; MMBR = moving bed bioreactor; Mob = mobilization; SF = square feet; V = volts; VSW = Village Safe Water.	**Construction Subtotal**	**$2,456,500**
	Mob/Demob/Construction Logistics (10%)	$245,650
	AIS/BABAA Administration	$100,000
	Construction Contingency (30%)	$736,950
	Total Construction	**$3,539,100**
	Permitting & Agency Consultation	$50,000
	Engineering and Design (12%)	$424,692
	Construction and Professional Services	**$4,334,895**
	VSW Project Management (8%)	$321,103
	Project Total	**$4,334,895**

Estimated operating expenses associated with Alternative 2E are shown in Table 32. Operating expenses consider labor costs to maintain the dewatering, and composting facility, power costs for the dewatering facility, polymer costs, and equipment costs to mechanically turn the compost. These costs would be distributed among the number of tanks pumped per year. Unlike most disposal alternatives, treatment costs are not needed as these alternative covers both treatment and disposal.

It is assumed that a ¼ full time equivalent worker would need to be employed to perform both the septage hauling and the system operations.

Table 32. Alternative 2E Estimated Operating Expenses (2024 USD)

Item	Quantity	Unit	Unit Price	Cost
Labor Costs (1/4 FTE)	500	Hour	$50	$25,000
Equipment Costs	1	Lump Sum	$3,000	$3,000
Power Costs	1,000	kilowatt hour	$0.45	$450
Polymer Costs	1	Lump Sum	$500	$500
Total Annual Expenses				$28,950
			Tanks Pumped	55
			Expense per tank pumped	$526.36

6.5 Alternative 2F – No Action

Alternative 2F would be to take no action. This alternative would continue the use tanker trucks and the AMHS ferry to transport the untreated septage to Juneau.

6.5.1 Description

Alternative 2F would perform no work and would require the current users to continue paying around $1000 per system and pump every 4 years. It would also require the continued practice of quickly disembarking, filling, and embarking a tanker truck from/to the Juneau ferry in the 45 minutes it stops in Gustavus.

This alternative relies upon an outside contractor to perform the work.

6.5.2 Design Criteria

Not applicable.

6.5.3 Environmental Impacts

Selecting the No Action Alternative would create no new additional environmental impacts.

6.5.3.1 Floodplains

Not applicable.

6.5.3.2 Wetlands

Not applicable.

6.5.3.3 Wildlife

Not applicable.

6.5.3.4 Geotechnical Exploration

Not applicable.

6.5.3.5 Other Resources

Not applicable.

6.5.4 Land Requirements

Not applicable.

6.5.5 Potential Construction Problems

Not applicable.

6.5.6 Sustainability Considerations

6.5.6.1 Water and Energy Efficiency

Not applicable.

6.5.6.2 Green Infrastructure

Not applicable.

6.5.6.3 Other

Not applicable.

6.5.7 Cost Estimates

Alternative 2F does not include capital costs; therefore, no capital cost estimate is provided.

The current cost to pump a tank in Gustavus is $1,000. Table 33 shows those cost annualized.

Table 33. Alternative 2E Estimated Operating Expenses (2024 USD)

Item	Quantity	Unit	Unit Price	Cost
Contractor Pump Cost	55	Per Tank	$1,000	$55,000
Total Annual Expenses				$55,000
			Tanks Pumped	55
			Expense per tank pumped	$1,000

7. SELECTION OF AN ALTERNATIVE

As there are a number of alternatives for both treatment and disposal of septage, Table 34 and Table 35 show advantages and disadvantages of each alternative.

Table 34. Treatment Alternatives Advantages and Disadvantages

Alternative	Advantages	Disadvantages
1A – Mechanical Dewatering	Simple process with some operator intervention needed	Requires mechanical components Without lime stabilization produces low quality biosolids with no pathogen reduction that would need to be disposed of in a landfill, WWTF, or incinerated
1B – Passive Dewatering	Simple process with low operator intervention Few mechanical components	Without lime stabilization produces low quality biosolids with no pathogen reduction that would need to be disposed of in a landfill, WWTF, or incinerated Does not dewater as much as Alternative 1A
1C – Aerobic Digestion	Simple process Produces high quality biosolids	High power costs Large building required Additional process beyond dewatering
1D – Reed Bed Drying	Simple process	No consistent history of operations, especially in Alaska

Table 35. Disposal Alternatives Advantages and Disadvantages

Alternative	Advantages	Disadvantages
2A – Incineration	On-site disposal Small volume of waste to dispose of	High operational costs Significant testing and emissions regulations Increased environmental impact Emissions into the environment, near residences
2B – Monofill	On site disposal Low disposal cost	Limits space at the DRC for additional landfill expansion Requires monitoring
2C – Shipment to Juneau	Similar process to existing operations Lower cost to dispose waste versus current operations	Higher disposal cost Operationally complex with transporting dewatered septage Reliant on outside contractor to move and dispose of septage
2E – Composting	No shipping of waste Similar process to existing composting operations	No market for PFAS contaminated compost Would likely need to be used as landfill cover versus beneficial reuse Odor could be an issue

7.1 Life-Cycle Cost Analysis

Life-cycle cost analysis was conducted for the three issues identified in Section 4: Alternatives Considered. Each was compared to the No Action Alternative, as shown in Figure 23 and Figure 24.

Planning Period (years)	20				
Real Discount Rate	2.5%				Circular A-94 Appendix C
USPW Factor	**15.59**				
SPPW Factor	**0.6103**				
	Alt 1A Mechanical Dewatering	**Alt 1B** Passive Dewatering	**Alt 1C** Aerobic Digester	**Alt 1D** Reed Bed Drying	**Alt 1E** No Action
Capital Cost, 2024	$ 2,467,152	$ 1,832,112	$ 4,032,374	$ 1,456,652	$ -
Annual O&M Cost, 2024	$ 8,440	$ 6,170	$ 35,850	$ 5,045	$ -
USPW of O&M Costs	$ 131,573	$ 96,185	$ 558,871	$ 78,647	$ -
Short Lived Assets Replacement Costs	$ 100,000	$ 25,000	$ 150,000	$ 20,000	$ -
Salvage Value, 2045	$ -	$ -	$ -	$ -	$ -
SPPW of Salvage Value	$ -	$ -	$ -	$ -	$ -
Total Net Present Value	**$ 2,698,725**	**$ 1,953,297**	**$ 4,741,246**	**$ 1,555,299**	**$ -**

Note: Annual O&M Costs for Alternative 1E does not include any O&M costs as those are addressed in the disposal alternatives

Figure 23. Life-Cycle Cost Analysis Treatment Alternatives

Short-lived asset replacement costs include the following:

- Alternative 1A: Sludge transfer pumps, polymer dosing pumps, pump trailer components, and screw press motors
- Alternative 1B: Sludge transfer pumps, polymer dosing pumps, and pump trailer components
- Alternative 1C: Aeration system blowers, sludge transfer pumps, polymer dosing pumps, pump trailer components, and screw press motors
- Alternative 1D: Pump trailer components, and leachate pumps

Planning Period (years)	20				
Real Discount Rate	2.5%				Circular A-94 Appendix C
USPW Factor	**15.59**				
SPPW Factor	**0.6103**				
	Alt 2A Incineration	**Alt 2B** Monofil	**Alt 2C** Ship to Juneau	**Alt 2E** Composting	**No Action** No Action
Capital Cost, 2024	$ 2,424,816	$ 1,823,645	$ 446,688	$ 3,635,626	$ -
Annual O&M Cost, 2024	$ 31,000	$ 14,245	$ 8,500	$ 28,950	$ 55,000
USPW of O&M Costs	$ 483,264	$ 222,068	$ 132,508	$ 451,306	$ 857,404
Short Lived Assets Replacement Costs	$ 60,000	$ 10,000	$ -	$ 100,000	$ -
Salvage Value, 2045	$ -	$ -	$ -	$ -	$ -
SPPW of Salvage Value	$ -	$ -	$ -	$ -	$ -
Total Net Present Value	**$ 2,968,080**	**$ 2,055,712**	**$ 579,196**	**$ 4,186,932**	**$ 857,404**

Figure 24. Life-Cycle Cost Analysis Disposal Alternatives

Short-lived asset replacement costs include the following:

- Alternative 2A: Air Blowers, Incinerator components
- Alternative 2B: Leachate transfer pump
- Alternative 2E: Polymer dosing pumps, pump trailer components, and screw press motors

7.1.1 Total Cost of Pumping Comparison

In order to fully compare each alternative, combination of a treatment and disposal alternative must be combined to determine the full cost to pump a tank. Based on the values found in Table 36, scenarios involving mechanical dewatering, and the reed bed drying are the most economical. All scenarios are less expensive than the current process.

Table 36: Total Cost Comparison per Tank to Pump

Scenario	Treatment Alternative	Disposal Alternative	Treatment Cost	Disposal Cost	Total Cost
1	Passive Dewatering	Ship to Juneau	$112	$464	$576
2	Mechanical Dewatering	Ship to Juneau	$153	$155	$308
3	Mechanical Dewatering	Monofil	$153	$259	$412
4	Mechanical Dewatering	Incineration	$153	$564	$717
5	N/A	Composting		$526	$526
6	Reed Bed Drying	Ship to Juneau	$92	$155	$246
7	Aerobic Digester	Monofil	$652	$259	$911
8	No Action	No Action	N/A	$1,000	$1,000

7.2 Non-Monetary Factors

7.2.1 Treatment Alternatives Non-Monetary Factors Comparison

Non-monetary factors for Alternatives 1A through 1E are summarized in Table 37. The matrix measures the impact of each alternative on three key non-monetary metrics: (1) regulatory compliance, (2) system resilience, and (3) ease of operation. Each category is measured on a scale of 1–10.

The summation of both the non-monetary factor scores provides an overall category score for each alternative that addresses wastewater treatment.

Criteria were considered using the following definitions:

- Resilience – Alternative's ability to expand to meet increasing demands or changing environmental and other conditions
- Ease of Operation – Alternative's complexity of operation, with ideally not requiring additional staff or expertise
- Reliability – Limited or simple moving parts and a proven track record of treatment of septage treatment

Table 37. Non-Monetary Factors Treatment Alternatives

Criteria		Alternative 1A: Mechanical Dewatering	Alternative 1B: Passive Dewatering	Alternative 1C: Aerobic Digester	Alternative 1D: Reed Bed Drying	Alternative 1F: No Action
Resilience	Resilience, sub-score (1–10)	8	8	7	5	0
	Weighting Factor (1–10)	6	6	6	6	6
	Overall Resilience Score	**48**	**48**	**42**	**30**	**0**
Ease of Operation	Ease of Operation, sub-score (1–10)	7	8	3	6	10
	Weighting Factor (1–10)	8	8	8	8	8
	Overall Operation Score	**56**	**64**	**24**	**48**	**80**
Reliability	Reliability, sub-score (1–10)	5	7	2	4	0
	Weighting Factor (1–10)	4	4	4	4	4
	Overall Operation Score	**20**	**48**	**8**	**16**	**0**
	Total Score	**124**	**140**	**74**	**94**	**80**

7.2.1.1 Resilience

Alternatives 1A and 1B were ranked highly in the Resilience category, as they can be meet the needs of the community should it grow as they would simply need to be operated more often or for longer. Alternative 1C is slightly more restricted in ability to grow, however an aerobic digestion system is quite resilient to changing conditions. Alternative 1D requires the growth and maintenance of plants to properly treat septage.

7.2.1.2 Ease of Operation

Alternative 1A and 1B are relatively simple to operate, with 1A being slightly more complex with the screw press. Alternative 1C requires a higher operator skill level and effort to properly maintain. Once the bed is established Alternative 1D is low maintenance option, however there is some upfront work as well as effort once the treatment is complete to collect the dewatered and treated sludge. Alternative 1F requires zero operator input as there is no operation occurring.

7.2.1.3 Reliability

Establishing a simple, reliable alternative with a low number of parts to break with a good track record of performance is important. Alternative 1A requires some moving parts, but the technology is proven to work with examples in use in Southeast Alaska. Alternative 1B has much fewer moving parts and redundancy with multiple dewatering dumpsters. Alternative 1C has significantly higher number of potential parts to break with the addition of blowers and more pumps. Alternative 1D is a low-tech solution, but it has not been proven in similar communities in Southeast Alaska.

7.2.1.4 Results

Alternatives 1B and 1A are the top two scoring alternatives. Should there be a suitable avenue for disposal of the product of either of these two alternatives, from a non-monetary factor analysis, these are preferred.

7.2.2 Disposal Alternatives Non-Monetary Factors Comparison

Non-monetary factors for Alternatives 2A through 2F are summarized in Table 38. The matrix measures the impact of each alternative on three key non-monetary metrics: (1) ease of operation, (2) environmental impact, and (3) reliability and self-reliance. Each category is measured on a scale of 1–10. A score of 10 is most preferable and a score of 1 is least preferable.

The summation of the non-monetary factor scores provides an overall category score for each alternative that addresses disposal.

Criteria were considered using the following definitions:

- Ease of Operation – Alternative’s complexity of operation for local operators.
- Environmental Impacts – Effect on the environment of the disposal. This includes removal of PFAS from the local environment, and possible effects on the surrounding area from sight, spell, or odor.
- Reliability and Self-Reliance – Ability of the City to maintain and operate the disposal by itself with minimal moving parts that need repair

Table 38. Non-Monetary Factors Disposal Alternatives

Criteria		Alternative 2A: Incineration	Alternative 2B: Monofill	Alternative 2C: Shipment	Alternative 2E: Composting	Alternative 2F: No Action
Ease of Operation	Ease of Operation, sub-score (1–10)	2	5	10	2	10
	Weighting Factor (1–10)	6	6	6	6	6
	Overall Operation Score	**12**	**30**	**60**	**12**	**60**
Environmental Impact	Environmental Impact, sub-score (1–10)	2	5	8	4	7
	Weighting Factor (1–10)	8	8	8	8	8
	Overall Environmental Impact Score	**16**	**40**	**64**	**32**	**56**
Reliability	Reliability, sub-score (1–10)	5	8	4	8	2
	Weighting Factor (1–10)	4	4	4	4	4
	Overall Reliability Score	**20**	**32**	**16**	**32**	**8**
	Total Score	**48**	**102**	**140**	**76**	**124**

7.2.2.1 Ease of Operation

Alternatives 2C and 2F were ranked highly in the Ease of Operation category, as they require little to no input from local operators. Alternatives 2A, 2B, and 2E all require some level of operator input with Alternatives 2A and 2E requiring significant operator intervention.

7.2.2.2 Environmental Impact

Incinerators (Alternative 2A) release significant volumes of pollutants into the environment during the incineration process. While mitigation measures can be taken, there are still emissions, and the operation of the incinerator can be disturbing to local residents. Alternative 2B keeps all pollutants within the confines of the DRC in a lined monofil, but there is the potential for odor to impact neighboring properties. Alternative 2C removes the waste into a certified landfill and away from the local population. Alternative 2E has no effective way to remove PFAS and other contaminants from the environment as the biosolids would need to be disposed of locally. Composting also could have a significant odor issue for neighboring properties.

7.2.2.3 Reliability and Self-Reliance

Alternatives 2A, 2B, and 2E all keep the sludge within the City, so the City has full control. Alternative 2A does have a significant number of mechanical items which would require lengthy repair times if something does go wrong. Alternative 2C requires the use of the AMHS and an outside contractor, but the City does have the ability to store dewatered solids in dumpsters for some time if there is an issue with disposal. Alternative 2F is solely reliant on the AMHS and an outside contractor for every aspect of disposal.

7.2.2.4 Results

While Alternative 2C was ranked the highest in this analysis with Alternative 2B being the next highest-ranking alternative that is not no action.

8. PROPOSED PROJECT (RECOMMENDED ALTERNATIVE)

At this time, HDR recommends the following alternatives:

- Alternative 1A – Mechanical Dewatering
- Alternative 2B – Monofill

  or

- Alternative 2C – Shipment to Juneau

See Section 5.3, Section 6.2, and Section 6.3 for a full description and cost estimate of each respective recommended alternative. This section will be completed once community feedback is received and the 65% PER draft is reviewed and comments received from VSW and the Review Committee.

8.1 Preliminary Project Design

8.2 Project Schedule

8.3 Permit Requirements

8.4 Sustainability Considerations

8.4.1 Water and Energy Efficiency

8.4.2 Green Infrastructure

8.4.3 Other

8.5 Total Project Cost Estimate

8.6 Annual Operating Budget

9. CONCLUSIONS AND RECOMMENDATIONS

To be developed in 95% Draft PER

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Appendix A

Kickoff Meeting Agenda

Agenda

Project:	VSW 24-GST-TO-016 Gustavus Septage Management PER
Subject:	Kick-Off Meeting
Date:	Friday, October 06, 2023
Location:	Remote
Attendees:	Anson Moxness (HDR) KC Kent (HDR) Anita Erickson (VSW) City of Gustavus Representatives

Introductions

Project Overview (Anita /Anson)

Discussion

- **Project Goals and Expectations**
  - **Community**
  - **VSW**
- **Site Visit Logistics and Plan**
- **Anticipated Alternatives (HDR)**
  - **Status of the Barlett Cove WWTF**

Questions/Wrap up

Appendix B

Site Visit Report

Trip Report

Date:	Wednesday, August 14, 2024
Project:	Gustavus Septage Management PER
To:	Anita Erickson, P.E. – Village Safe Water
From:	Anson Moxness, P.E., HDR; KC Kent, HDR
Subject:	Gustavus Site Visit

HDR Alaska, Inc. (HDR) engineers Anson Moxness, PE and KC Kent conducted a site visit to Gustavus, Alaska to inspect the existing septage management system as part of the Gustavus Septage Management Preliminary Engineering Report (PER), work order 24-GST-TO-016. The scope of the project is to identify and study alternatives for addressing issues with the wastewater management and treatment facilities associated with storage and treatment of solids.

HDR engineers arrived in Gustavus at approximately 10:30 am on August 7th and met with Kathy Leary, City Administrator, John Berry, Local Engineer, and Mike Taylor, city council member to discuss site visit plans. The project team and Mr. Berry visited the Disposal and Recycling Center (DRC) where they observed the existing septage storage tanks and received a site tour from Ian Barrier, the DRC operator. Mr. Berry and Mr. Barrier identified land intended for DRC expansion and pointed out preferred locations for additional treatment facilities neighboring the DRC.

One septage storage tank appeared to be full of solids from the previous year's septage hauling and one storage tank appeared to be partially full. The tanks were in good condition; however the bung hole caps had been left open and several fill and drain hoses had been left on site. Mr. Berry indicated this was due to an incident with the pumper truck during the winter. The truck is currently undergoing repairs in Juneau and there has been no septage pumping service to homes or to empty the storage tank from Juneau Septic Services in the last 8 months. It was noted that despite the open bung holes, there was minimal to no odor being emitted from the septic tanks.

HDR engineers, Mr. Berry, and Ms. Leary visited several other possible sites which could be designated for septage treatment facilities and/or disposal areas on Cook Inlet Regional Inc (CIRI) owned land and Alaska Mental Health Trust owned parcels. The CIRI-owned parcel had large amounts of ponding water in low lying areas which indicates likely high groundwater. Mr. Taylor and HDR engineers visited a State of Alaska Department of Natural Resources (DNR) owned parcel adjacent to local housing and a City of Gustavus owned parcel directly off of the main road through town. These sites were generally forested but appeared to have a lower groundwater table then the CIRI parcel.

The team attended a community meeting in the evening of August 7th. The meeting was attended by several community members, city council members, and Anita Erickson, the VSW Project Manager. HDR described the PER process to the council and those present at the meeting and then went into describing the current progress and the problem that this PER will address. Several questions were answered regarding the project timeline, potential pitfalls, and some high-level theoretical possibilities for alternatives. Suggestions and inputs from the community were also received including aeration of the waste and PFAS concerns.

The morning of August 8th, HDR met with operators at the National Park Service Barlett Cove wastewater treatment facility. HDR was given a tour of the facility including the solids handling apparatus and activated sludge treatment system.

Next steps include the development of alternatives.

The following pages contain photographs documenting the site visit.

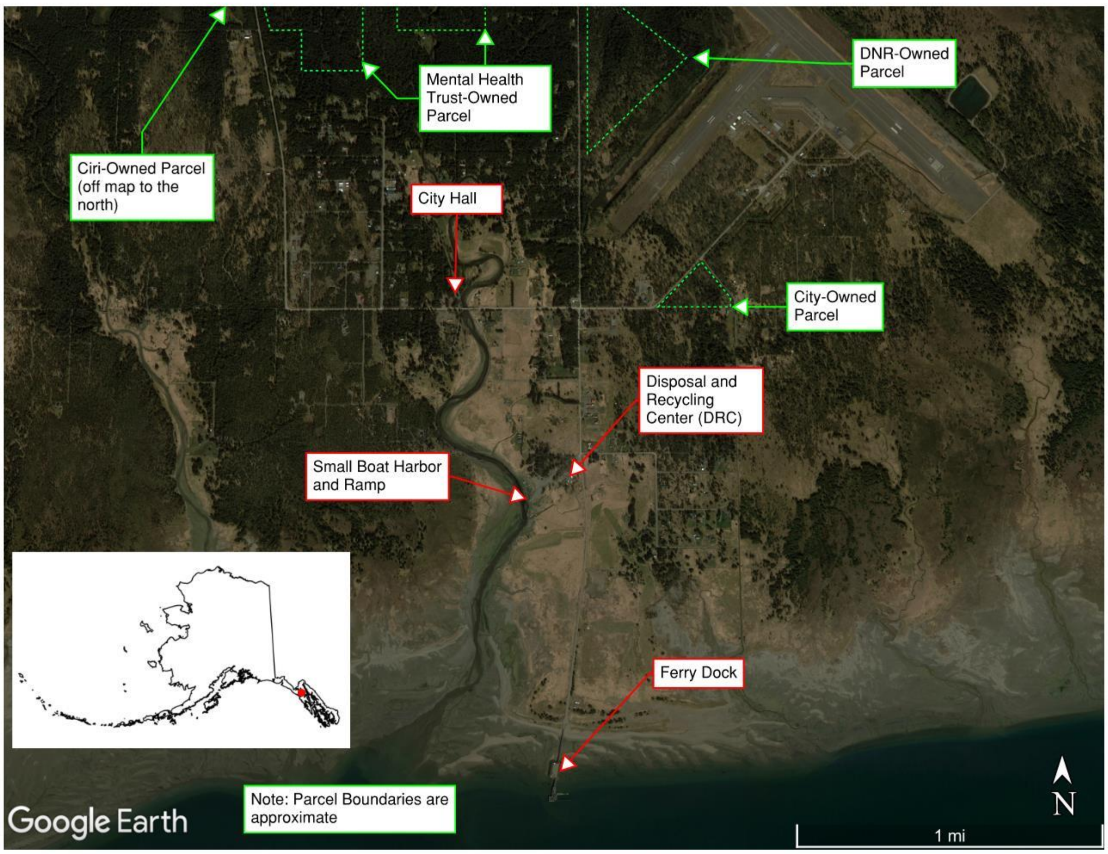

Figure 1. Location of infrastructure in Gustavus, Alaska, and the visited parcels.

Figure 2. Location of the two underground 10,000 gallon fiberglass septage holding tanks

Figure 3. Caps of one of the septage holding tanks

Figure 4. DRC composting area

Figure 5. Potential area for future development, owned by the Alaska Department of Transportation

Figure 6. Wastewater treatment facility at Bartlett Cove

Figure 7. The sludge bagger at Bartlett Cove wastewater treatment facility.