City and Borough of Juneau Solid Waste Study: Solid Waste Disposal Scenario Operating Costs and Feasibility Technical Report

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City and Borough of Juneau

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Jacobs Engineering Group Inc

3800 Centerpoint Drive
Suite 920
Anchorage, AK 99503
United States

T +1.907.762.1500
F +1.907.762.1199
www.jacobs.com

Executive Summary

Overview and Purpose

The City and Borough of Juneau (CBJ) is exploring various options for long-term management of solid waste. Currently, solid waste management in Juneau is handled exclusively by private companies; the CBJ has no active role in this process.[1] In addition, the CBJ does not have any formal flow control ordinance, regulatory role, or control in the Juneau collection and disposal components of the waste management system. Residents in Juneau can either bring their solid waste directly to the private landfill owned by Waste Management at a cost of $215 per ton (with a minimum charge of $153.32) or they can participate in curbside collection services provided by the privately owned company Alaska Waste. Waste hauling (but not landfill operation) is overseen by the Regulatory Commission of Alaska (RCA). Consequently, there is no public input in operational decisions or rate determination at the landfill. The CBJ's lack of control over solid waste management in its community is highly unusual for municipalities in Alaska and across the U.S. The CBJ has identified only three municipalities in Alaska – Juneau, Haines, and Glenallen – that do not have a role in their own solid waste management.

Given the impending closure of the Capitol Disposal Landfill anticipated to occur in the next 10 to 20 years[2], and the approximately 10-year timespan to plan and permit a new solid waste disposal facility, the CBJ is exploring future disposal options and assessing the high-level feasibility of possible solutions (Capitol Disposal, Inc. 2015).

Risks of Inaction

If the CBJ chooses not to prepare for the closure of the Capitol Disposal Landfill, it will leave solid waste management – an essential public health and safety utility – entirely in the hands of the private sector. This approach may have considerable risk and cost implications. Importantly, there is no requirement for the private sector to provide a disposal alternative for the community when the landfill closes. In addition, the operator of the existing landfill, Waste Management, has already signaled that service rates will increase, and higher prices are expected to become the industry norm (Riccobene 2025). A 2025 study of 351 U.S. landfills found that tipping fees at privately owned facilities averaged 34% higher than those at publicly owned sites (EREF 2025). Furthermore, if not provided by the CBJ, the private sector would likely need to invest in some type of a transfer processing facility[3] (that is, a transfer station) and incur costs for shipping waste offsite by barge or develop new local disposal options, the cost for which would be incorporated into customer fees. Finally, the Capitol Disposal Landfill was constructed in the 1960s, predating modern regulations. Any new landfill must meet today's more stringent environmental standards and absorb escalated material and construction costs. Without proactive planning and achieving milestones for program and service implementation, CBJ risks exposing residents and businesses to steep,

[1] The CBJ's involvement in the solid waste system is limited to the recycling center, junk vehicle program, and household hazardous waste (HHW) services. Residents and businesses bring sorted recyclables and HHW to the CBJ RecycleWorks facility. The CBJ contracts with Waste Management to transport and process recyclables offsite, and with Clean Harbors for HHW handling. In addition, the CBJ partners with Skookum Recycling to receive, process, and ship junk vehicles for scrap metal recycling. It is anticipated that these practices would continue under any scenario.

[2] Estimated timeline to closure based on the 2015 closure, post-closure, and financial assurance plan for the Capitol Disposal Landfill (Capitol Disposal, Inc. 2015)

[3] Transfer Processing Facility (that is, a transfer station): Centralized facility to manage all CBJ waste streams from residents (self-haul) and commercial haulers, perform some processing, and consolidate for efficient transportation to end markets. The transfer station may include additional segregation and diversion programs, if desired.

long-term cost increases driven by the private sector market rather than community priorities, and potentially facing an environmental and public health crisis if an alternative disposal solution is not implemented before landfill closure.

Solid Waste Disposal Scenarios

The CBJ has identified the following scenarios as the most likely long-term solid waste disposal options:

- **Scenario A:** Construct a new landfill and transfer station with recyclables, household hazardous waste (HHW), and junk vehicles exported by barge.
- **Scenario B:** Construct a transfer station with all waste, as well as recyclables, HHW, and junk vehicles, exported by barge for recycling and disposal.
- **Scenario C:** Construct a waste-to-energy (WTE) facility and transfer station for municipal solid waste (MSW) with noncombustible waste, noncombustible recyclables, HHW, junk vehicles, and ash sent south by barge for disposal.

Notably, all scenarios presented herein incorporate a transfer station, as a centralized point where all waste would be collected for consolidation and some processing prior to transporting for disposal. A transfer station is a critical component for future solid waste management because it provides the following benefits:

- Offers an interim waste management solution while the CBJ pursues additional siting, design, permitting, and construction for a local disposal facility, if desired.
- Enables the CBJ to quickly adapt to a sudden influx of disaster debris, tourism waste, or changing waste management needs as the landfill reaches capacity.
- Provides a one-stop-shop for residents and contractors, reducing vehicle traffic from waste collections and hauling to disposal facilities, cutting fuel and transportation costs, reducing emissions, and addressing safety and environmental concerns.
- Provides flexibility to consolidate recycling operations, increase waste diversion practices, and adapt practices for changing recovery and recycling markets.
- Could enable regional waste management partnerships and diversion opportunities.

Study Scope and Approach

The purpose of this Solid Waste Study is to provide a high-level evaluation of the economic and logistical feasibility for these scenarios. This technical report is part of the second phase of the CBJ Solid Waste Study; the study is conducted in a phased approach as follows:

Phase 1 – The first phase of the Solid Waste Study consisted of a limited high-level discussion of capital costs and technical feasibility of three scenarios for solid waste management. The scenarios were chosen by the CBJ based on findings from several past studies and Assembly-level conversations over the course of four decades (CBJ 2024a). The Phase 1 technical memorandum, titled the Juneau Solid Waste Disposal Facility Feasibility and Capital Costs – Technical Memorandum, is provided in Appendix A.

Phase 2 – The second phase of the Solid Waste Study evaluates the operational costs and customer rate impacts of Scenarios A and B. An analysis for Scenario C is not included in this second phase of the study because Scenario C was found to be the least desirable and feasible of the three scenarios during Phase 1, based on the high relative capital costs and minimal energy benefit for Juneau. Additional discussion of Scenario C is provided in Section 1.3. Phase 2 incorporates interviews with other Alaska jurisdictions, solid waste partners, and stakeholders to gather insights into the operational activities, costs, and considerations for solid waste facilities across Alaska.

The Solid Waste Study is designed to be a starting point for community conversations around future solid waste management. It was based on conceptual facility elements and waste flows and does not include site-specific or detailed facility designs, in-depth cost-benefit analyses of the scenarios, comparisons of different thermal treatment (incineration) technologies, or detailed discussion of diversion practices such as recycling or composting. In addition, this study does not include biosolids disposal in any of these options; the CBJ is in the planning stages of a standalone project for biosolids incineration (CBJ 2025d). Although each of these details are important considerations for overall solid waste planning, they are outside the scope of this study; the CBJ plans to evaluate them if the community chooses to move forward with the planning and construction of a publicly owned disposal facility.[4] The focus on disposal has been prioritized because of the looming closure of the only landfill within the community.

Key Takeaways

Based on the evaluation findings from this study and the ranking criteria outlined in Section 6, Scenario B (constructing a transfer station with all waste, as well as recyclables, HHW, and junk vehicles, exported by barge for recycling and disposal) is the preferred immediate solid waste disposal option for Juneau. This approach offers the lowest upfront costs, minimizes initial impacts on customer rates, and can be implemented immediately when the Capitol Disposal Landfill reaches capacity.

However, without a locally owned disposal facility, this option limits the CBJ's long-term control over disposal operations and costs. Under Scenario B, the CBJ will be subject to rates set by disposal and barge contractors, which are likely to increase over time. Even so, building a CBJ-owned transfer station provides a greater level of control over the solid waste system compared to the current setup and allows flexibility for future changes. The CBJ may begin preparing for offsite shipping of MSW while simultaneously developing the transfer station and engaging the community's interest in local disposal options. Implementing Scenario B as an initial step would not preclude the eventual implementation of Scenarios A or C, if those scenarios are further refined and become technically and economically viable in the future. Section 7 details the feasibility of each scenario and outlines recommended next steps in the planning process.

[4] Planning for future diversion facilities will take place separately from this Solid Waste Study.

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Acronyms and Abbreviations

Acronym	Description
AAC	*Alaska Administrative Code*
ADEC	Alaska Department of Environmental Conservation
AEL&P	Alaska Electric Light & Power Company
AML	Alaska Marine Lines
C&D	construction and demolition
CBJ	City and Borough of Juneau
CFR	*Code of Federal Regulations*
CH_4	methane
CO_2	carbon dioxide
CO_2e	Carbon dioxide equivalent
CPCN	Certificate of Public Convenience and Necessity
EPA	U.S. Environmental Protection Agency
g	gram(s)
GHG	greenhouse gas
HHW	household hazardous waste
kg	kilogram(s)
MSGP	Multi-Sector General Permit
MOA	Municipality of Anchorage
MSW	municipal solid waste
MT	metric ton(s)
N_2O	nitrous oxide
NEPA	National Environmental Policy Act

Acronym	Description
RCA	Regulatory Commission of Alaska
SEASWA	Southeast Alaska Solid Waste Authority
tpy	ton(s) per year
WTE	waste-to-energy

1. Solid Waste Management Scenarios

The City and Borough of Juneau (CBJ) is exploring various options for long-term management of solid waste. Given the impending closure of the Capitol Disposal Landfill, the only landfill in the area, anticipated to occur in the next 10 to 20 years[5], and the approximately 10-year timespan to plan and permit a new solid waste disposal facility, the CBJ is exploring future disposal options and assessing the high-level feasibility of possible solutions.

The CBJ has identified the following scenarios as the most likely long-term solid waste disposal options:

- **Scenario A:** Construct a new landfill and transfer station with recyclables, household hazardous waste (HHW), and junk vehicles exported by barge.
- **Scenario B:** Construct a transfer station with all waste, as well as recyclables, HHW, and junk vehicles, exported by barge for recycling and disposal.
- **Scenario C:** Construct a waste-to-energy (WTE) facility and transfer station for municipal solid waste (MSW) with noncombustible waste, noncombustible recyclables, HHW, junk vehicles, and ash sent south by barge for disposal.

This section provides an overview of the major considerations for each of the solid waste management scenarios based on analyses of the facilities, operating costs, and timeline and permitting considerations described in Sections 4 through 6 and the key findings from Phase 1 (Appendix A). The anticipated flow of waste in each of the three scenarios is depicted on Figure 1-1.

1.1 Scenario A

The key distinction in Scenario A is the construction of a landfill within the CBJ. In this scenario, waste would first be taken to a transfer station for processing prior to disposal, including consolidation and compaction or baling as appropriate. At this point, waste is consolidated and loaded into transfer trucks for transport to the landfill. Since the landfill is assumed to be within the CBJ's jurisdiction, the transportation distance between the transfer station and the landfill would be minimal (anticipated to be less than 15 miles) based on the 1993 landfill technical reconnaissance study[6] (Brown et al. 1993). Thus, the economics of hauling distance between the transfer station and the landfill is considered a negligible factor in this scenario[7]. The transfer station would provide the CBJ with additional control and flexibility for solid waste management, including the flexibility to add other waste diversion activities that could recover recyclables and reduce total disposal volumes.

Based on the findings from Phase 1 of this Solid Waste Study, a small transfer station, sized between 9,000 and 13,000 square feet, would suffice for Scenario A, giving the CBJ greater control over the waste stream with a local, CBJ-owned landfill.

Operating costs for a facility handling approximately 30,000 tons per year (tpy) of waste in Juneau were estimated using operating cost-per-ton data from other southeast Alaska transfer stations. These costs are estimated at approximately $79 per ton, with a range between $73 and $84 per ton. This translates to an

[5] Estimated timeline to closure based on the 2015 closure, post-closure, and financial assurance plan for the Capitol Disposal Landfill (Capitol Disposal, Inc 2015).

[6] A landfill site has not yet been selected; a new siting study would be required under this scenario.

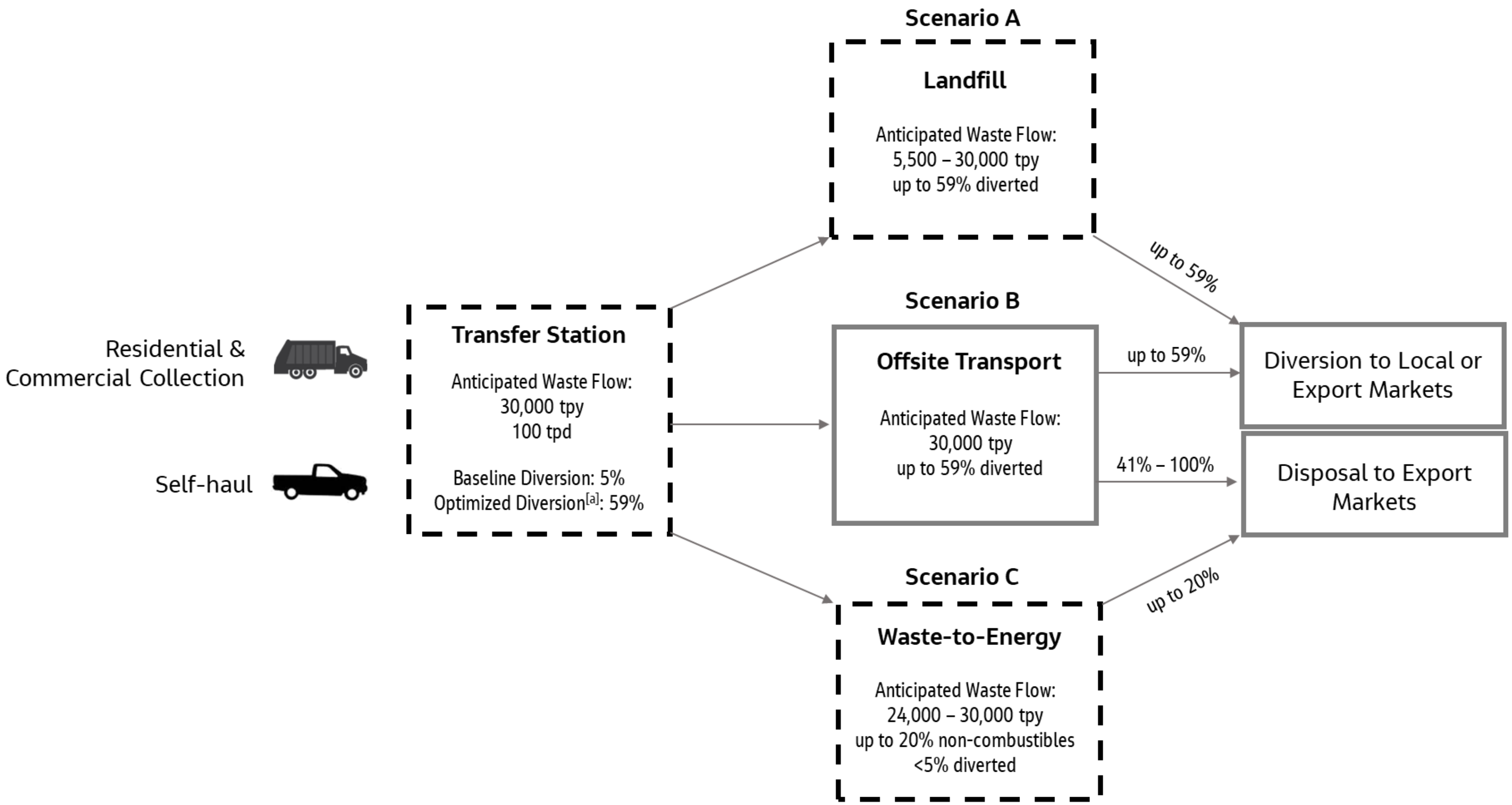
[7] Transportation from the transfer station to the landfill is anticipated to cost less than $10 per ton. This minimal expense is assumed to be covered within the contingency allowances included in the cost estimates for Scenarios A and B.

annual operating expense of about $2.4 million, with potential variation between $2.2 million and $2.5 million per year. This estimate includes costs associated with preparing MSW for disposal, as well as source-separated recyclables drop-off areas, because these services were common at the southeast Alaska facilities included in this analysis. However, it does not account for additional operations or diversion services that the CBJ may choose to implement, such as expanded recovery and recycling operations, reuse, or composting programs.

Operating costs for a landfill in Juneau with the capacity to receive 30,000 tpy are estimated to range from approximately $155 to $394 per ton. This corresponds to an estimated annual operating cost between $4.7 million and $11.8 million. These costs vary significantly depending on the operational needs and the extent of leachate management required. Leachate generated at the Capitol Disposal Landfill is currently treated at the CBJ wastewater treatment facility, which is anticipated to have adequate capacity to continue accepting leachate from a newly constructed landfill. Potential constraints on continued acceptance are expected to be driven primarily by changes in leachate chemistry, such as increased constituent concentrations or the presence of new contaminants, rather than by exceeding volume capacity. If the CBJ chooses to construct a new landfill under Scenario A, a study of anticipated leachate constituents would be necessary to evaluate treatability and to determine whether additional on-site treatment or pretreatment prior to discharge to the wastewater treatment facility would be required. Even so, new regulations for wastewater treatment facilities, such as PFAS effluent limitations, may drive landfill owners to pursue leachate treatment or recirculation solutions onsite at the landfill.

If a separate leachate treatment system is not needed, an estimated range of $155 to $270 per ton is considered reasonable for landfill operations in Juneau. This cost range is used throughout the analysis to compare operational scenarios and to calculate customer rates, as presented in Section 5 and summarized in Section 1.1.2.

Figure 1-1. Flow Diagram of Solid Waste Management Scenarios A, B, and C



[a] Optimized diversion of 59% was derived from the 2024 Waste Characterization Study (Cascadia Consulting Group 2024).

Note: Boxes with dashed outlines indicate facilities that are anticipated to be under CBJ ownership.

tpd = ton(s) per day

1.1.1 Capital Costs from Phase 1 Solid Waste Study

The estimated capital costs range from $59 million to $182 million for constructing both the transfer station and a 50-year landfill.[8] Landfills are constructed in stages, so capital costs are spread over their lifespan as new cells are added, rather than requiring all funding upfront. Because of the significant rainfall in Juneau, a designated leachate treatment plant may be necessary, which could be a substantial capital and operating expense for a new landfill. Importantly, since a site has not yet been selected for the landfill, siting and permitting could take 10 years, or longer with significant delays, to complete.

1.1.2 Impacts on Customer Rates for Scenario A

When accounting for the combined operating and capital costs of both a transfer station and a landfill in Juneau, the total annual expense is estimated to range from approximately $6.9 million to $14.3 million. These costs translate to customer rate increases of 10% to 16% as a low-range estimate and 28% to 39% as a high-range estimate for 48-gallon and 96-gallon carts serviced once per week, with a new MSW disposal management cost (tipping fee) estimated between $300 and $544 per ton. If a separate leachate treatment system is required, the MSW disposal management cost could reach as high as $668 per ton.

1.2 Scenario B

Alternatively, the CBJ may opt not to construct a new waste disposal facility in Juneau. Scenario B involves shipping nearly all solid waste generated in the CBJ to an offsite[9] landfill and recycling markets via barge. This approach avoids significant capital and operating costs for building and maintaining a disposal facility, but the CBJ relinquishes control over the final disposal of MSW, posing risks if barge services or offsite landfill operations are delayed or disrupted. The CBJ can mitigate this risk by ensuring increased storage space at the transfer facility; therefore, the transfer station is especially valuable under this scenario. A transfer station sized between 13,000 and 26,000 square feet would provide sufficient space for storage and processing under this scenario.

Although this increased storage capacity increases capital costs to build the larger facility, the daily operations are expected to remain the same. One potential difference that could arise, and impact operating costs, is if the CBJ decides to bale waste for shipment (under Scenario B) or for landfilling (under Scenario A) at the transfer station. Because the CBJ has not yet determined if baling or compaction will be used, the anticipated operating costs for the transfer station under Scenario B are assumed to be consistent with those in Scenario A. The cost to ship waste offsite for disposal at Roosevelt Regional Landfill in Washington State (one of a few possible disposal facilities) is projected to cost between $210 and $283 per ton with an annual cost between $6.3 million and $8.5 million per year. Thus, the total annual cost to operate the transfer station and ship waste offsite is projected to range between $8.5 million and $11 million.

It is important to consider that offsite transportation of waste and recyclables will increase transfer truck traffic, fuel consumption, and associated greenhouse gas (GHG) emissions from both truck and barge traffic (and likely rail traffic in Washington State or Oregon). In addition, contamination in the waste stream can pose hazards. Fires caused by waste contaminated with flammable materials or batteries have occurred during offsite transportation from Alaskan communities, leading to significant danger and

[8] The total estimated capital cost for Scenario A assumes construction of a 50-year landfill. Capital costs would be distributed throughout the lifetime of the landfill as new cells are constructed. Costs can vary significantly depending on the operating conditions and geometry of the landfill. The provided estimates are conservative.

[9] Offsite disposal refers to waste disposal at a facility located outside of the CBJ.

expense (Rose 2021). To mitigate this risk, baling or compacting waste in closed containers at the transfer station can minimize fire hazards and reduce transportation frequency; it is required by Alaska Marine Lines (AML).

1.2.1 Capital Costs from Phase 1 Solid Waste Study

The capital costs in Scenario B are solely based on construction of a transfer station with increased storage capacity, with capital costs ranging from $14 million to $40 million.

1.2.2 Impacts on Customer Rates for Scenario B

When accounting for the combined operating and capital costs of a transfer station in Juneau and offsite shipment, the total annual expense is estimated to range from approximately $8.5 million to $11 million. These costs translate to customer rate increases of 12% to 18% as a low-range estimate and 21% to 31% as a high-range estimate for 48-gallon and 96-gallon carts serviced once per week. A new MSW disposal management cost (tipping fee) is estimated between $316 and $439 per ton.

1.3 Scenario C

The distinguishing feature of Scenario C is the construction of a WTE facility. In this scenario, waste would first be taken to the transfer station, where it would be inspected for hazards, dried, and shredded in preparation for combustion. The waste then would be fed into the WTE plant and converted into energy. To maximize the efficiency of the WTE facility, nearly all MSW would be directed for combustion, with minimal diversion (such as recycling and composting).

The Phase 1 Solid Waste Study explored the feasibility of waste incineration with energy recovery. This study did not consider incineration without energy recovery because of permitting and implementation challenges. An incineration facility to process MSW from Juneau would be subject to air quality regulations and permitting requirements. The Municipality of Skagway Borough is one of the few communities in southeast Alaska that incinerates most of its waste using a batch incinerator. A key distinction between Skagway and Juneau is the volume of waste processed: Skagway handles less than 1,300 tons of MSW annually, qualifying it for a Class III permit and exemptions from Alaska Department of Environmental Conservation (ADEC) air quality regulations. In contrast, the CBJ generates more than 16 times that amount of MSW and would not be eligible for these exemptions. Moreover, Skagway's batch incinerator operates only two to three days per week to allow for cooling and cleaning between loads. Batch incineration systems typically are more expensive to operate on a per-ton basis compared to continuous systems. Given these factors, incinerating Juneau's waste without energy recovery is expected to be cost prohibitive, may be difficult to permit, and would eliminate any potential benefits associated with energy generation.

1.3.1 Capital Costs and Key Takeaways from Phase 1 Solid Waste Study

Key considerations from the Phase 1 study include the timeline and capital costs for permitting and constructing a WTE facility and the energy benefit for the CBJ. A small transfer station (9,000 to 13,000 square feet) would suffice with a WTE facility. Estimated capital costs range from $99 million to $110 million for constructing both the transfer station and a WTE facility. Because a site has not yet been selected, siting and permitting must be completed for this scenario; thus, the timeline is expected to be similar to or longer than that of the landfill in Scenario A.

Notably, the CBJ's electricity currently is nearly 100% renewable hydroelectric power and the utility company, Alaska Electric Light & Power Company (AEL&P), does not provide energy credits for surplus generation. As such, the power produced from a WTE plant would offset the parasitic load but not provide an electricity benefit for the CBJ. In addition, the Regulatory Commission of Alaska (RCA) requires that a power purchase agreement is established with the electric utility provider for the sale, transmission, and distribution of power. This would be a key aspect of future discussions to advance this scenario. Furthermore, WTE is an advanced technology that requires specialized skills for construction, operation, and maintenance. It may be difficult to find local technicians with the skillset to manage this type of facility, and it may be necessary to bring in and provide lodging for out-of-state contractors.

WTE will need significantly more time to implement than the other options and requires more specialized workers than the CBJ is equipped to provide at this point. The CBJ needs to provide a waste management solution in the immediate near term, and pursuing WTE is not an efficient use of the CBJ's resources.

Based on these limitations, Scenario C was determined to be the least desirable relative to Scenarios A and B; therefore, the operational costs for Scenario C were not evaluated during Phase 2 of this study. Although this study does not investigate or compare operational costs for Scenario C, it is important to note that available data show that the cost per ton to dispose of waste through a WTE facility is often higher, and in some cases more than twice the cost of local landfill disposal or offsite shipment to a distant landfill (Arsova et al. 2008; DOE 2019). In a recent comparison of tipping fees across the United States, fees were on average 28% higher for regions that use WTE for solid waste disposal (EREF 2025).

These initial findings do not preclude the CBJ from reassessing the feasibility of Scenario C at any time. Other varieties of WTE technologies may be considered by the CBJ in future evaluations. There has already been engagement with the National Renewable Energy Laboratory to evaluate a range of WTE technologies for Juneau, some of which could be operated in tandem with Scenarios A or B (Appendix B). A full comparison of these other WTE technologies is outside of the scope of this study but may be revisited by the CBJ at a later date.

2. Study Background and Limitations

The CBJ contracted with Jacobs under an agreement dated August 19, 2024, to complete a high-level evaluation of the feasibility of three potential solid waste management scenarios described in Table 2-1. Each scenario includes the construction of a transfer station to receive and process all waste generated in the CBJ before the waste is routed for final disposal or diversion.

Table 2-1. Summary of Three Solid Waste Management Scenarios for the City and Borough of Juneau

Scenario	Facilities	Key Partners	Waste Streams		
			Waste Disposal	Diversion	Residuals[a]
A. Construct a new landfill and transfer station with recyclables, HHW, and junk vehicles exported by barge.	Landfill and transfer station	Landfill operator; transfer station operator (if separate from CBJ)	Disposed of in new landfill on CBJ property	Recyclables diverted to local markets or transported south by barge	Residuals that cannot be landfilled are transported south by barge
B. Construct a transfer station with all waste, as well as recyclables, HHW, and junk vehicles, exported by barge for recycling and disposal.	Transfer station	Shipping company; offsite landfill; transfer station operator (if separate from CBJ)	CBJ agreement with offsite landfill for disposal; Transportation and disposal fees to be negotiated	Recyclables diverted to local markets or transported south by barge	All waste is transported offsite by barge
C. Construct a WTE facility and transfer station for MSW with noncombustible waste, noncombustible recyclables, HHW, junk vehicles, and ash sent south by barge for disposal.	WTE facility and transfer station	AEL&P; WTE operator; transfer station operator (if separate from CBJ)	Incinerated with energy recovery; CBJ energy agreement with AEL&P	Limited diversion to optimize efficiency of WTE plant operations	Noncombustible materials and ash transported offsite by barge[b]

[a] Residuals are defined as wastes that cannot be landfilled or diverted, such as hazardous waste.

[b] An alternative to shipping ash south by barge is to send it to a local monofil. A new monofil would need to be constructed and is not included as a part of these scenarios.

The high-level evaluation considered readily available data and literature, generalized assumptions for facility size and capacity, and information gathered from interviews with local jurisdictions, partners, and stakeholders to assess the feasibility of these three scenarios based on the following factors that may affect their feasibility or costs:

- Relative estimated capital and operating costs, including impacts to customer rates
- Feasibility to build, operate, and sustain the facilities
- Ability to address waste streams and the CBJ's goals for diversion, level of CBJ control, and timeline for implementation
- Overall environmental impacts, including GHG emissions
- Community and stakeholder buy-in

2.1 Study Methods and Assumptions

2.1.1 Study Methods

This report includes a high-level discussion of the findings from the operating cost evaluation for Scenarios A and B. In addition, this report describes the feasibility of these scenarios based on the high-level operational analyses conducted during Phase 2, impacts of implementation on customer rates, advantages and disadvantages of each scenario, risks and opportunities, and next steps for planning. The preliminary scenario rankings developed under Phase 1 were updated to consider new data and insights gathered during this phase of the study.

Jacobs conducted interviews with other Alaska jurisdictions, waste management partners, and stakeholders to understand key challenges, operating costs, feasibility considerations, facility and equipment needs, and local perceptions for the respective solid waste management systems or operations. The interviews were conducted with the following entities:

- Alaska jurisdictions: Anchorage, Sitka, Kodiak, Ketchikan, Skagway, and Fairbanks
- Solid waste management partners: Alaska Waste, Waste Management, AML, and Republic Services
- Key stakeholders: CBJ planners and engineers, Southeast Conference, Southeast Alaska Solid Waste Authority (SEASWA), ADEC, and AEL&P.

Jacobs analyzed information collected during the interviews and data provided by each entity, along with publicly available literature, to assess costs associated with facility operations and the preparation and transportation of waste streams. Facility size and capacity were estimated during Phase 1 of the Solid Waste Study using planning-level assumptions outlined in Section 2.1.2. Jacobs verified the operating cost data obtained from external sources by comparing the findings to outputs generated by cost modeling tools for facilities based on the size of the facility and 30,000 tpy of MSW generated in Juneau (provided by Waste Management, Table 2-2).

2.1.2 Assumptions

A variety of assumptions were necessary to perform this high-level evaluation, including the following:

- **Unchanging Waste Tonnage and Composition**: It is assumed that there will be no significant change in waste tonnage or composition over the lifetime of the project. Information on waste composition was derived from the 2024 Waste Characterization Study (Cascadia Consulting Group 2024).
  - Seasonal fluctuations, junk vehicles, and non-CBJ waste are not considered relevant for this comparison. Biosolids are currently shipped south by barge and planning is under way to build a pyrolysis unit at the wastewater utility for biosolids incineration, so separate treatment for biosolids is not included in this assessment.
  - Specific to tourism, this evaluation did not consider seasonal waste streams from cruise ships, which previously contributed 1,650 tons of waste in 2018 (CBJ 2024a). Under a Memorandum of Understanding between the CBJ and the Cruise Lines International Association, the amount of waste entering the Capitol Disposal Landfill from cruise ships was reduced to 125 tpy in 2022. However, the CBJ may choose to accept waste from the cruise industry in the future if the increased waste tonnage improves the efficiency and economics of the selected solid waste management scenario.
  - The population of Juneau has remained stable or has declined slightly over the past decade, hovering at approximately 32,000 residents. This evaluation assumes no population growth (Juneau Economic Development Council 2023).
  - The waste stream in the CBJ is assumed to remain consistent in terms of composition, based on the average MSW and construction and demolition (C&D) waste quantities from fiscal years 2016 to 2024 (Table 2-2). For this evaluation, the average waste stream was approximated at 30,000 tpy. Regional waste streams were not considered in this study but represent an additional 23,000 tpy (Southeast Conference 2006; Cascadia Consulting Group 2024).
- **Waste Collection Contracts:** All existing solid waste collection contracts the CBJ has in place will continue regardless of the waste management scenario chosen.
- **Transfer Facility Site Location:** The new transfer station is assumed to be in lower Lemon Creek on a 27-acre site owned by the CBJ, approximately 0.4 mile northeast of the Lemon Creek Correctional Center. The site is rural reserve and industrial, with the nearest residential area more than 0.5 mile away. The site was chosen for its central location, suitable soils, topography, and sufficient space to construct a transfer station. Other waste management facilities are in the planning process for this site, including a municipal composting facility, recycling center, and HHW facility. This study assumes the CBJ would address zoning for this property, as applicable.
- **Future Landfill Facility Locations**: Locations for the landfill have not been finalized and a new siting study will be necessary. Three sites were proposed based on an existing landfill study in the CBJ but are subject to change because the study was completed more than 30 years ago (Brown et al. 1993).
- **Landfill Gas Management:** At this stage, operating cost estimates do not consider differences in standard flare systems versus landfill gas capture with energy recovery. While a CBJ-owned landfill could be retrofitted post-construction to include energy recovery infrastructure, the economic feasibility of energy recovery may depend on the inclusion of additional waste streams (such as regional municipal waste or seasonal cruise ship waste) and finding use for that energy (powering an industrial facility or converting to a fuel source).
- **Long-Term Capacity Planning:** Landfill capacity calculations are based on standard 50- and 100-year waste stream projections. A regional facility taking more than the current CBJ waste stream would require further assessment of the materials and regions to be served.

- **Diversion Rates**: In this study, diversion is defined as waste materials that are systematically redirected from disposal to be reused, recycled, repurposed for beneficial use, or composted. Diversion does not include materials incinerated for WTE. This study accounts for management of MSW and C&D waste that is destined for the landfill and assumes that existing facilities are sufficient to manage the current stream of recyclables (approximately 5% of total waste tonnage), bulky or white goods,[10] compost, junk vehicles, and HHW. It is assumed that recyclables collected in the CBJ will continue to be diverted to Tacoma, Washington, through existing barge services.
- **Ownership and Operating Model**: At the time of this evaluation, it is assumed that the CBJ will obtain ownership of the solid waste facilities described in all three scenarios. The CBJ may choose to operate the facilities directly, engage private entities for design, construction, and/or operations, or contract specific services. Although a specific ownership and operating model is not chosen for this study, this study looked at a range of ownership and operational models used by other jurisdictions in Alaska and other regions (Section 3.1). Ultimately, the selected ownership and operational model will aim to balance risk transfer with maintaining control over the utility, while considering the desire for flexibility to select services and contractors through competitive bidding and reducing the strain on the CBJ's internal resources. For Scenario B specifically, it is assumed that offsite waste shipment from the transfer station to the final disposal site would be managed through a contract with the disposal company.
- **Barge Loading Facility Assumptions**: Existing facilities and processes for loading and offsite transportation of materials are assumed adequate for transporting all waste and recyclables to the Port of Seattle. Based on conversations with AML, the capacity to ship MSW may be strained in the summer months during peak fishing season, which could result in a few days' delay in barge transport. The CBJ may consider purchasing and owning intermodal containers or working with a disposal provider that would provide the intermodal containers. Transporting waste to a different port location, such as Anchorage or Whittier, would require coordination with a shipping partner to establish a new, direct freight line, which is outside the scope of this study. The CBJ may decide to participate in future operating scenarios and discussions with other regions interested in receiving Juneau's waste.

2.2 Overview of Solid Waste Management Operations in the CBJ

The CBJ faces several unique challenges in managing its solid waste. Being land-locked by the Juneau Ice Field and Inside Passage, Juneau is an isolated community, resulting in limited disposal and affordable recycling options. Furthermore, the CBJ does not own the Capitol Disposal Landfill or manage waste hauling services, resulting in limited control over the community's waste flow. The landfill is projected to reach capacity in 10 to 20 years, prompting the CBJ to explore alternative waste management solutions (CBJ 2024b).

Efforts to expand the landfill have been unsuccessful because of the inability of a private owner to acquire adjacent land, the proximity of the landfill to other land uses, and potential adverse environmental effects on nearby wetlands. The current solid waste management system is delocalized, with MSW, recyclables, HHW, junk vehicles, and C&D processed at different facilities that are geographically or operationally disconnected.

Since the establishment of the CBJ, the control of solid waste flow has remained in the hands of the private sector. Conversations between the CBJ, ADEC, and RCA have indicated that Juneau is one of only three municipalities in Alaska without public flow control, alongside Haines and Glenallen. The Capitol Disposal Landfill receives waste from both private commercial haulers and individuals (self-haul). Until the

[10] White goods are large household electrical products, such as refrigerators and washing machines, typically white in color.

early 2000s, some MSW was incinerated without energy recovery to reduce the volume sent to the landfill (CBJ 2024a). Currently, the CBJ operates a recycling center and an HHW facility at the landfill site, diverting approximately 5% of materials for recycling, including glass, aluminum, and steel cans (CBJ 2024b). In addition, Juneau Composts!, a private composting business established in 2017, offers collection and drop-off services for food scraps and yard debris, which are processed at its commercial composting facility.

The collection of solid waste is considered a utility in the state of Alaska; therefore, it is regulated by the RCA. For more than 60 years, the majority of MSW in the CBJ has been privately collected under an RCA Certificate of Public Convenience and Necessity (CPCN) held by various private entities and hauled to the privately owned Capitol Disposal Landfill. In previous years, the CBJ considered purchasing the CPCN from the certificate holder (currently Alaska Waste) along with other strategies as part of a larger solid waste management strategy (CBJ 2008). To distinguish between collection and disposal, it is not necessary to own a refuse hauling utility CPCN to operate a solid waste management disposal facility. The CPCN holder must justify all rate increases to the RCA and under the CPCN must seek out the lowest cost options for the rate payers served by the specific CPCN. The CBJ is not considering purchasing the RCA CPCN at this time, and rather would explore agreements with the CPCN holder to establish flow control for publicly owned solid waste facilities. Because this study is focused on post-collection disposal options, and to avoid skewing the capital cost estimates for a particular scenario, the purchase of the RCA CPCN is not included as a component of any scenario.[11]

2.3 Waste Stream Quantity and Composition

With a population of approximately 32,000 residents, the CBJ region generated an average of 30,000 tons of MSW annually from 2016 to 2024 (Table 2-2). Assuming that a waste management facility operates for 300 days a year (6 days per week less an allowance for some holidays and other closures), the CBJ generates an average of 100 tons of solid waste daily that must be managed. Given the relatively static population level in the CBJ, this total was applied to the entire period of the solid waste management scenarios. While outside waste streams were not considered as part of this evaluation, they could be factored into the scenarios as the CBJ moves forward with planning.

[11] The price to purchase the CPCN was quoted at $14 million in 2008 (Cascadia Consulting Group 2024, CBJ 2024a). Acquiring the RCA CPCN from the current certificate holder, Alaska Waste, is an independent action that could apply to any scenario.

Table 2-2. Tonnage of MSW and C&D Waste Landfilled in the CBJ Between 2016 and 2024

Fiscal Year (July to June)	MSW (tons)	C&D (tons)[a]	Total (tons)
2016	23,542	8,555	32,097
2017	23,760	8,065	31,825
2018	23,735	6,968	30,703
2019	23,867	6,011	29,878
2020	20,626	7,299	27,925
2021	22,398	5,730	28,128
2022	24,750	4,138	28,888
2023	22,346	5,176	27,522
2024[b]	23,000	5,900	30,300
Average	23,114	6,427	29,696
Rounded Average[c]	23,500	6,500	30,000

Source: MSW and C&D totals per Fiscal Year provided by Waste Management.

[a] C&D waste is variable based on local construction projects and timelines.
[b] Approximation for 2024 provided during interview with Waste Management.
[c] Values rounded up to the nearest 500th to approximate waste for capacity calculations.

In 2024, the CBJ contracted Cascadia Consulting Group to conduct a waste characterization study to evaluate the makeup of disposed-of waste. This study revealed a significant potential for increased waste diversion: 18% of waste currently disposed of is recyclable, 32% is compostable, 9% is reusable, for a total of 59% diverted under optimized diversion programs that are currently in place (Cascadia Consulting Group 2024).

Based on the waste disposal quantities provided by Waste Management (Table 2-2) and the types of waste from the CBJ's waste characterization study, the amount of diversion from disposed-of waste under each scenario is estimated to be as follows:

- Scenario A: recyclables for diversion
  - Baseline Diversion (5%): 1,500 tpy
  - Optimized Diversion (59%)[12]: 17,500 tpy
- Scenario B: recyclables for diversion
  - Baseline Diversion (5%): 1,500 tpy
  - Optimized Diversion (59%): 17,500 tpy
- Scenario C: noncombustible recyclables for diversion

[12] The optimized diversion rate is derived from the 2024 Waste Characterization Study performed by Cascadia Consulting Group (2024). This 59% diversion represents the total amount that *could be* diverted through diversion programs that are already in place, including recycling, composting, HHW disposal, and reuse, but may require considerable investment in public education and outreach, sorting and processing technologies.

- Baseline Diversion (5%): less than 500 tpy
- Optimized Diversion (59% of approximately 20% noncombustibles [Cascadia Consulting Group 2024]): 3,500 tpy

The amount exported for offsite disposal in each scenario is estimated to be as follows:

- Scenario A: less than 1,500 tpy of residuals for disposal
- Scenario B: 12,500 to 30,000 tpy of waste for disposal
- Scenario C: less than 6,000 tpy of noncombustibles for disposal

2.4 Zero Waste Campus

The CBJ is progressing the design of a zero waste campus concurrent with its larger waste management strategy. The zero waste campus will serve as a centralized hub for waste diversion and management activities. It is an important element of the CBJ's long-term vision for sustainable waste management.

The primary goal of the zero waste campus is to enhance diversion outcomes and foster public engagement in the waste management process. Planned features include a composting facility and future recycling and HHW operations, with additional desired activities such as a reuse warehouse for activities such as repair, restoration, and processing of used goods.

This study does not consider recycling, HHW, and junk vehicles operating costs for the zero waste campus because those will be evaluated separately by the CBJ and Recycle Works at a later stage. However, MSW accepted at the transfer station may be a component of the campus, and the operating costs described in this technical report may be used to support planning for the zero waste campus.

2.5 Concurrent Regional Planning

A separate effort is now underway by Southeast Conference and SEASWA to develop a regional MSW strategy. The project will include a thorough analysis of the current practices for the disposal of MSW across communities in southeast Alaska and provide recommendations based on best practices for solid waste management in the region. The strategy seeks to improve solid waste disposal services for southeast Alaska communities through a collaborative effort of towns and governmental agencies. The goal of the project is to identify how to achieve safer, more efficient, and cost-effective waste management systems for southeast Alaska communities by fully exploring available options and technologies used in the management of MSW, including diversion of compostable and recyclable materials, WTE opportunities, and finding mutually agreeable resolutions for southeast Alaska communities, Tribes, and SEASWA members (CBJ 2025c).

This Solid Waste Study is being conducted in advance of SEASWA's regional planning strategy and may not fully align with its recommendations. However, it is essential to move forward with the CBJ's Solid Waste Study to meet the planning needs of the CBJ and to enable the CBJ to gain greater control over Juneau's solid waste system, which is an important step toward potentially adopting a regional approach. Notably, Juneau's participation in any regional solution will likely require the CBJ to have control over the local solid waste management system through ownership of a local transfer station and/or disposal facilities and some level of statutory or public ordinance control.

While regional considerations are not the primary focus of this study, the CBJ and the Juneau community may choose to design a future disposal facility with the capacity to handle regional waste. This could improve economies of scale and offer neighboring communities a regional disposal solution.

3. Facilities: Estimates of Capacity and Operating Costs

This section presents the methodology used and estimates for the potential operating costs and activities of solid waste management facilities for the three scenarios. The solid waste management scenarios that are introduced in Table 2-1 and elaborated on in this section involve various combinations of these facilities; thus, this section describes each facility individually. For example, the transfer station is applicable to all scenarios, while the landfill is specific to Scenario A.

Jacobs estimated future facility operating activity needs based on a total generation of 30,000 tpy of waste for processing, transferring, and disposal, as shown in Table 2-2.

This study assesses the potential operating cost ranges for each scenario by conducting a high-level review of publicly available information on operating expenses, as well as operating and maintenance budgets from other Alaska jurisdictions. The cost ranges also incorporate internal estimates provided by Jacobs for other projects, as well as the industry expertise of Jacobs and its subconsultant, Raftelis. Prior to making financial decisions or establishing final budgets, the CBJ should conduct a detailed evaluation of capital and operating costs that is based on engineer's estimates that consider specific facility conditions and sites. In addition, as presented in this report, the ownership and operating model should be factored into the decision process.

The anticipated operating costs for a new transfer station and landfill were estimated using the operating costs of five U.S. transfer stations and six landfills. Because of the unknown timeline for financing and construction of the facilities in Juneau, operating costs per ton were calculated and inflated to 2025 prices using the U.S. Bureau of Labor and Statistics Consumer Price Index Inflation Adjustment tool. Alaska faces higher average costs for goods and services relative to regions in the lower 48 states, which also reflects in higher landfill tipping fees (EREF 2025). As such, costs from facilities located outside of Alaska were further adjusted to reflect Alaska pricing using regional Consumer Price Index data from the U.S. Bureau of Labor Statistics.

3.1 Facility Ownership and Operating Models and Financing Mechanisms

The CBJ is unique in its complete lack of a control mechanism or ownership role over Juneau's solid waste disposal system. Typically, public entities have some level of control or ownership over the solid waste system through ordinance or regulations that direct waste management, contracts for services, or public facilities. Five of the six Alaska jurisdictions examined in this study own and operate their solid waste facilities, and one jurisdiction (City and Borough of Sitka) owns its facilities but contracts operations to a private company. Appendix C provides a summary of ownership and operational structures for all six Alaska jurisdictions.

Without some level of public control or ownership, private companies hold all the decision-making power and have little incentive to address community solid waste challenges, unless there is a direct financial benefit. While private entities may be willing to propose solutions that meet their return-on-investment expectations, those solutions may increase costs for the community.

The CBJ may consider the following ownership and operating models for solid waste facilities[13]:

[13] Private entities often handle solid waste collection; collection is not considered in the provided examples.

- Public ownership and operation
- Public ownership, private operation
- Private ownership and operation

Each of these is further described as follows:

1. **Public ownership and operation:** The public entity finances, owns, and operates all solid waste management facilities using internal resources. The public entity may choose to involve the private sector in the design and construction of the facilities or for specific services such as equipment maintenance and transportation. These contracts generally are limited to short-term agreements that allow each party to perform specific functions for which they are best suited. Capital funding for facility construction can be secured through several mechanisms (as outlined in Sections 3.1.1 and 3.1.2). Public agencies often benefit from lower-interest loan options that are not available to private companies.

   In this model, the CBJ would have maximum control over the entire process from construction through operation, assume all financing responsibility and associated risks. This approach maximizes flexibility by avoiding long-term vendor contracts and allowing the CBJ to adjust operational strategies or upgrade facilities as needed, subject only to permitting requirements and budget approval. The key challenges with this model are securing sustainable funding, dedicating the internal staffing needed to operate facilities, and maintaining political support for ongoing investments while accepting all associated risks.

   Examples:

   - Kodiak Island Borough, Alaska (approximate population 13,000): Kodiak Island Borough operates a municipal Class I landfill and a leachate treatment facility, staffed by seven full-time employees. Both facilities were financed and constructed using public funds and are managed entirely by Borough personnel. Facility operations are funded through disposal fees and supplemented by remaining funds from other internal budgets. Other examples of public ownership and operation models in Alaska are presented in Appendix C.

   - Prince Rupert, British Columbia (approximate population 12,000): Prince Rupert, a remote Canadian port city, provides solid waste disposal as a fully municipal service. The City owns and operates its landfill and transfer stations using City staff and public funding. Disposal regulations and tipping fees are established by municipal bylaw, and all operational responsibilities are handled directly by the City.

2. **Public ownership, private operation:** A hybrid model combining public ownership with private-sector operations involvement can take many forms. This is a common model in the lower 48 states and typically comprises public ownership of facilities and a long-term contract with a private company to manage all operations. This approach also can consist of both public and private entities owning and operating different facilities (such as public ownership of the landfill with private operations, alongside private ownership and operations of a recycling facility).

   Service contracts under this model differ from those under the public ownership and operations approach because the public entity enters into long-term agreements with a single private firm or a consortium of private partners to deliver a comprehensive package of solid waste operational services.

Examples:

- Sitka, Alaska (approximate population 8,000): The City and Borough of Sitka owns a transfer station and Class III landfill for inert C&D waste, but contracts with private companies to handle day-to-day operations of both facilities. The scrap yard is owned and operated by the City and Borough of Sitka.
- Kittitas County, Washington (approximate population 48,000): Kittitas County in Washington State owns one limited-purpose landfill and two transfer stations, with a third new transfer station currently being constructed to replace one of the existing facilities. Waste Management is contracted to operate the two existing transfer station facilities and to provide waste hauling services. The County retains some operations (the County operates the scale houses) and oversight of these operations through contract provisions, including annual review and approval of Waste Management's operations plan.
- Key West, Florida (approximate population 26,000): Key West is an island city and tourism hub in the Florida Keys. The City contracts with Waste Management to provide comprehensive solid waste services; Waste Management handles garbage and recycling collection and operates the City's transfer station under a multi-year contract. The City owns the transfer station facility, but essentially everything from collection to off-island disposal is outsourced to the private company.

3. **Private ownership and operation:** In this model, a private company or a team of private partners designs, builds, finances, and operates solid waste facilities. A key distinguishing feature of this approach is the use of private capital: the private partner funds facility construction, and those capital costs are incorporated into service rates, eliminating the need for public financing. This approach is less common in smaller communities and was not used by any of the Alaska communities reviewed for this report. The public entity may still assume some control under this model if established upfront through ordinance, franchise, agreements, or contracts, whereas responsibility and risk are shared between the public and private sectors, with ownership, operational roles, and performance expectations clearly defined in the governing agreements.

   Private ownership and financing typically reduce short-term public debt but involve higher long-term costs than municipal borrowing and limit flexibility, making it difficult for the municipality to mitigate rate increases and implement programmatic changes. Some agreements include periodic review clauses, but these must be established upfront. At contract end, facility operations may revert to the public entity (in a build-operate-transfer arrangement) or be re-bid.

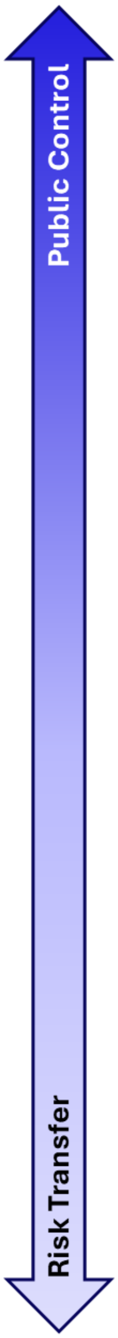
   At a minimum, under a private ownership system, local government entities typically maintain some level of control through ordinance, franchise, agreements, or contracts. The specific mechanisms used depend on the level and type of control the public entity wishes to maintain, such as authority over rate setting and service requirements, the ability to regulate which providers operate within the community, and the capacity to implement emergency or supplemental programs.

   Example:

   - Nantucket, Massachusetts (approximate population 14,000): Like Juneau, Nantucket is a tourism/resource-driven island with limited land for waste disposal, requiring most materials to be shipped off-island. Since 1997, it has operated under a public-private partnership with Waste Options Nantucket, LLC. Under the original 25-year agreement, Waste Options financed and built new facilities, including a material recovery facility and composting facility, and operated the landfill and transfer station, while the town retained ownership of the landfill site. In 2025, Nantucket began restructuring the partnership to move toward a hybrid approach. The new agreement will transfer ownership of the composting facility and transfer station to the town and allow it to retain all tipping fee revenue.

Table 3-1 provides a summary of these models, the benefits and risks, and examples.

Table 3-1. Ownership and Operating Models, Benefits, and Risks



Ownership /Operating Models[a]	Roles for Public and Private Entities	Benefits to Public Entity	Risks to Public Entity	Examples
Public Ownership and Operation	Public entity owns and operates all solid waste facilities Contracts with private entities are limited to specific services rather than overall operations	Maximum control over rates and services Public sector has access to low-cost public financing (municipal bonds, loans, or general fund contributions) Public accountability and transparency in operations No private profit markup in costs Flexibility to implement new programs or changes without contract constraints	Public entity accepts all risks and is responsible for all financing	Kodiak, AK Anchorage, AK Ketchikan, AK Skagway, AK Fairbanks, AK Prince Rupert, BC
Public Ownership, Private Operation	Public entity owns the facility and finances most or all capital costs, establishes competitive procurement process for private operations	Reduces burden on internal resources Some risks (performance, liability) are passed on to the private entity Leverages private expertise and innovation for efficiency	Subject to rate increases, especially if there are fewer competing contractors Public entity is responsible for financing majority of capital (debt and financial risk remain public) Fewer bidders in a remote region could limit competition	Sitka, AK Kittitas County, WA Key West, FL
Private Ownership and Operation	A private partner designs, builds, operates, and finances the facilities Public entity typically chooses to maintain control through ordinance or agreements Division of control, benefits, and risks determined by agreements	Reduces upfront cost burden for the public entity; capital costs for facilities is borne by private sector Risks transferred to private partner Significantly reduces burden on internal resources; public involvement may be limited to contract and program management and oversight	Long-term loss of direct control over facilities and pricing Private companies are typically subject to higher loan interest rates than public entities Profit incorporated into rates	Nantucket, MA

[a] General ownership models, regardless of chosen scenario, and not specific to Juneau.

3.1.1 Public Financing for Solid Waste Infrastructure

The CBJ has several pathways to finance solid waste facilities, ranging from traditional municipal funding mechanisms to private financing.[14] Municipalities often use municipal bonds, low-interest loans, or grants to raise the capital for solid waste infrastructure projects. Service fees, integrated into existing utility bills, taxes, or as a separate tipping fee, are primary revenue sources, designed to pay for the development and operation of solid waste collection facilities provided to a community. Additional revenue can sometimes come from the sale of recyclables, compost, or energy (landfill gas or waste-to-energy), which can help offset expenses or replenish the general fund. Most municipalities create an enterprise fund in which waste-related revenues (such as tipping fees) go only to waste-related operating expenses and debt service.

Areas that see a large influx of tourists also can implement a tourism fee to offset the costs associated with supporting visitors to the community, including those from managing waste and maintaining infrastructure. If Juneau chooses to increase acceptance of cruise ship waste in the future, a dedicated fee for waste management could generate substantial revenue. Other popular tourism regions have implemented a “green fee” to preserve natural resources in the community and invest in sustaining infrastructure that is stressed by tourism (Travel and Tour World 2024). Accepting regional waste from other Alaska communities also could reduce rates for the CBJ by increasing economies of scale and by collecting host fees from importing jurisdictions.

State and federal programs also provide municipalities with opportunities to reduce financing costs. The Alaska State Revolving Fund (SRF), administered by ADEC, offers low-interest loans for planning, design, and construction of water-quality projects, including landfill leachate collection and treatment systems (ADEC 2025). For example, the Anchorage Regional Landfill Leachate Lagoon was funded through a $13-million SRF loan, which covered liner replacement, pre-treatment equipment, expanded storage, and aeration systems (State of Alaska 2024).

Municipalities often bundle these financial mechanisms, so no single source is overburdened. For example, tipping fees might be supplemented by a small tourism surcharge and periodic grant infusions. Bundling revenue streams improves financial viability and distributes the cost.

3.1.2 Private Financing for Solid Waste Infrastructure

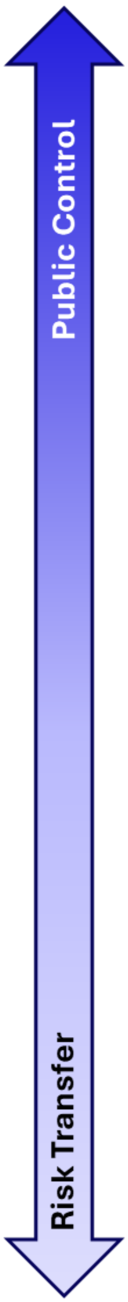
The CBJ also may choose to explore various levels of private involvement for financing and building new facilities, as described in Table 3-2. The most common approach for public infrastructure projects is design-bid-build, where the municipality owns and operates the facilities with design and construction provided by the private sector through competitive bidding. In the case of privately owned facilities, the private entity is responsible for all financing, the cost for which is incorporated into the service rates.

Private financing also may be secured to build publicly owned facilities, such as through a design-build-finance-operate procurement model, which shifts initial capital investment to private partners while maintaining public oversight. This preserves the public entity’s debt capacity but typically results in higher overall costs by adding profit and the added debt service cost from higher market interest rates for private firms. Long-term flexibility is limited under this option, because the public entity is locked into the arrangement with the private provider for the duration of the contract. Furthermore, if private industry competition is limited in the region, the public entity may have less control over future pricing after expiration of the initial contract and become more dependent on a single private firm. Overall, private

[14] Eligibility requirements and interest rates should be investigated further before selecting a financing mechanism.

financing and procurement models trade flexibility and likely higher rates for risk transfer and the use of private capital.

Table 3-2. Solid Waste Infrastructure Procurement Options, Benefits, and Risks



Procurement Options	Delivery	Benefits to Public Entity	Risks to Public Entity
Design-Bid-Build	Public entity owns and operates solid waste facilities; contracts with private sector through facility construction Linear competitive procurement for design and then construction of the facility Traditional delivery approach; most common for public infrastructure projects	Freedom to select services and contractors based on qualifications and cost	Public entity accepts operations risks and is responsible for all financing Linear process for design and then construction contracts, typically leading to a longer project duration
Design-Build	Public entity owns and operates solid waste facilities; contracts with private sector through facility construction Competitive procurement for design and construction of the facility; allows for overlap between contracts	Allows for collaboration between engineer and construction contractor Design and build services may be procured under a single contract for efficiency	Public entity accepts operations risks and is responsible for all financing Relationship between engineer and construction contractor may be complex
Design-Build-Operate	Public entity expands the design-build contract to include facility operation and maintenance services, often for an extended time period	Risks of operating the facility are passed on to the private entity Reduces operations burden on internal staff	Public entity is responsible for all financing Subject to rate increases for operations, especially if there are fewer competing contractors
Design-Build-Finance-Operate	Public entity owns facility but enters into an agreement with private entity to construct and operate; private bidder arranges for financing to cover capital costs	Risks of operating, maintaining, and financing the facility are passed on to the private entity Reduces operations burden on internal staff Reduces municipal debt for capital costs	Risks shared between public and private entity (specifics depend on division of roles) Subject to rate increases; difficult to modify contract terms or switch operators if conditions change

3.2 Transfer Station

The purpose of the transfer station is to provide the necessary space and flexibility to manage waste disposal and diversion, regardless of the scenario. As presented in the Phase 1 report, Jacobs recommends that the CBJ proceed to establish a transfer station to address Juneau's waste management needs. Importantly, a transfer station is necessary for all three scenarios for initial waste processing and consolidation prior to transporting to the final disposal or diversion facility.

Functionally, waste from commercial haulers and residents is unloaded at the transfer station, sorted, and consolidated using a baler or preload compactor into intermodal containers or transfer vehicles for recycling and disposal elsewhere. The facility could be constructed with separate drop-off locations for source-separated recyclables and compostables.

3.2.1 Capacity and Sizing

The transfer station should have sufficient storage to handle temporary changes in the waste stream. The necessary storage, equipment, and operations at a transfer station depend on the ultimate disposal method (landfill, WTE, or offsite shipment) because different processes are required to prepare waste for disposal, shipment, or incineration (sorting, shredding, baling, or loading onto transfer trucks versus intermodal containers). Thus, the estimated size of the transfer station varies between the scenarios. The capacity of the transfer station is highly dependent on operating conditions; for example, the types and numbers of residential or commercial hauling vehicles, the desired storage capacity, and the degree of waste recovery and sorting.

When there are reliable waste disposal options nearby, such as a landfill or WTE facility, transfer stations generally are designed to have 1 to 2 days of storage capacity. Although more detailed calculations of facility space are required prior to the design stage, initial estimates suggest a tipping floor space of at least 6,000 square feet to manage 100 tpd of waste and a peaking factor of 2.3.[15,16] Comparisons to constructed transfer stations across the United States, along with CBJ input, indicate that a transfer station sized between 9,000 and 13,000 square feet would be sufficient to meet current and future needs and an allowance for the peaking factor, assuming reliable waste disposal facilities also are available within the CBJ.

However, if the CBJ chooses to transport all waste and recyclables to a distant offsite facility by barge (Scenario B), it is recommended to increase the size of the transfer station to include additional storage space in case of unexpected disruptions to offsite transportation services. This is especially important in a remote and isolated location such as Juneau. A transfer station that prepares waste for offsite disposal is assumed to be sized between 13,000 and 26,000 square feet to accommodate 7 to 14 days of storage and additional processing space.

The CBJ may consider facilities to centralize drop-off and processing of additional waste streams, such as white goods, organics, and junk vehicles, as well as a repair and reuse staging area. These additional prospective elements are not included in subsequent estimates of cost ranges.

[15] The EPA suggests approximating tipping floor space by starting with a base area of 4,000 square feet and adding 20 square feet for each ton of waste received in a day. This assumes the height of the waste pile at 6 feet. Using this approximation, the tipping floor space required to manage 100 tons per day of waste is at least 6,000 square feet.

[16] Peaking factor calculated from average and peak daily waste totals for 2024 provided by Waste Management.

3.2.2 Operating and Maintenance Costs

Table 3-3 outlines the approximate operating costs for five example transfer stations located in Alaska. These examples provide rough approximations of the estimated operating costs for transfer station facilities with various design capacities, services, and ownership and operating models. All facilities include tipping floor space with the equipment and staff to receive, process, and prepare MSW for disposal, while the larger facilities include additional features like enclosed offices and HHW drop-off areas. Operation of a small source-separated recycling drop-off area also is included in the comparison facilities. Most of these comparison facilities operate a baler to compact and prepare waste for offsite shipment. Additional information about each transfer station is provided in Appendix C.

The extent of services and operational details for the proposed transfer station in Juneau have not yet been fully defined. Without certainty about the design and services provided at the potential Juneau transfer station, operating costs for a Juneau transfer station were estimated using a cost-per-ton relationship determined from other transfer stations within the Alaska region, listed in Table 3-3. This relationship provides a reasonable planning-level estimate for expenditures associated with transfer station operations without a defined facility design or operating model. As shown in Table 3-3 and on Figure 3-1, larger facilities generally are more cost-effective per ton of waste.

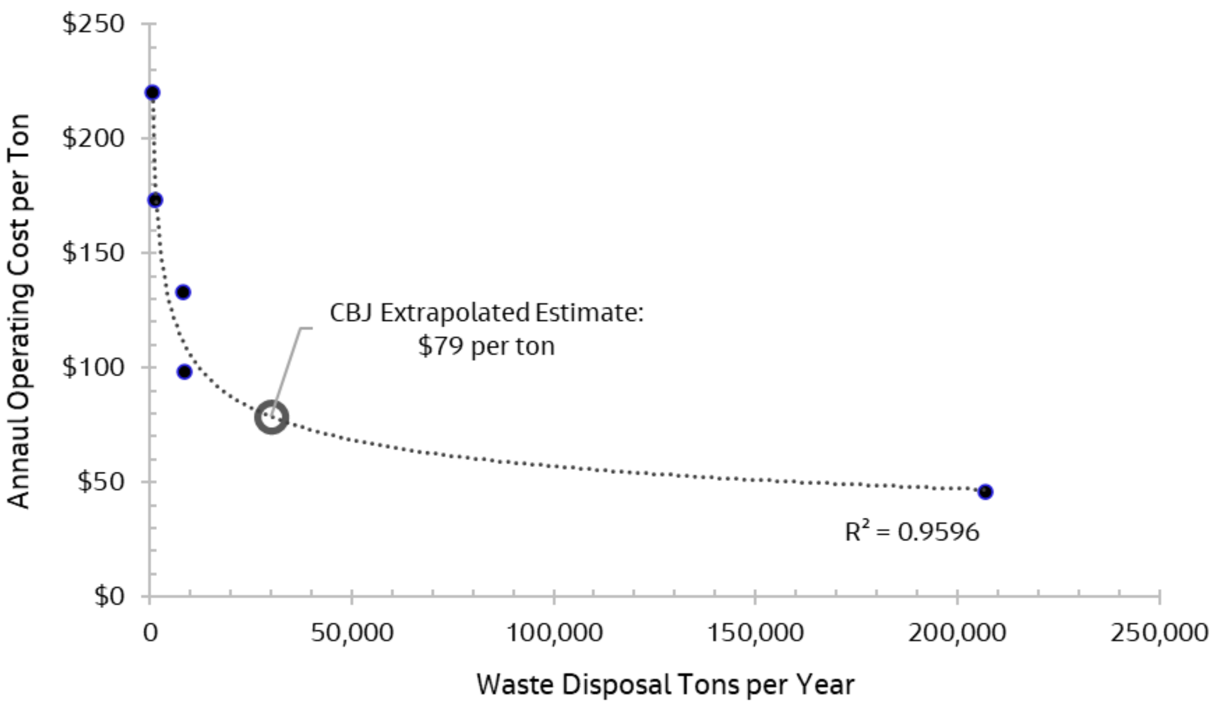
Table 3-3. Estimated Operating Costs for Five Example Transfer Stations

Name	Basis for Estimate	Annual Transfer Quantity (tpy)[a]	Annual Operating Cost[b]	Cost per Ton
Municipality of Anchorage Girdwood Transfer Station	2025 Municipal Operating and Capital Improvement Budgets; Municipality of Anchorage	700	$154,000	$220
Municipality of Skagway	FY25 Adopted Budget; Municipality of Skagway	1,300	$225,000	$173
City and Borough of Sitka Transfer Station	FY25 Consolidated Operating Budget; City of Sitka	8,200	$1,088,000	$133
City of Ketchikan Transfer Station	2025 General Government Operating Budget; City of Ketchikan	8,500	$830,000	$98
Municipality of Anchorage Central Transfer Station	2025 Municipal Operating and Capital Improvement Budgets; Municipality of Anchorage	207,000	$9,618,000	$46

[a] Facilities are sorted by Annual Transfer Quantity to highlight the economic efficiency of larger operations.
[b] Annual Operating Costs determined from 2025 municipal operating budgets, less debt service for development and construction costs.
FY25 = fiscal year 2025

Based on existing Alaska transfer stations, **a Juneau transfer station that receives 30,000 tons per year would have an operating cost of approximately $79 per ton and a total annual cost of approximately $2.4 million per year (Figure 3-1)**. Accounting for data variation from a power trend analysis (Figure 3-1), the range of costs for this transfer station is anticipated to be between $73 and $84 per ton and a total annual cost between $2.2 million and $2.5 million per year. The actual value of operating costs may change from this preliminary estimate depending on the services and processes at the transfer station. For example, if a new landfill is constructed near Juneau, a compactor or baler may not be necessary to consolidate MSW because ongoing maintenance costs may outweigh the benefits of an increased average payload to a nearby landfill. Overall, the operating cost of $79 per ton may be a conservative estimate as economies of scale would have a greater influence on operation costs than what is extrapolated from the power trend analysis on Figure 3-1.

Figure 3-1. Relationship Between Tons Received at a Transfer Station per Year and Operating Cost per Ton for Alaska Transfer Stations Included in this Study



Individual operating cost components of transfer stations include labor, staff benefits, equipment maintenance, facility/building maintenance, and supplies (Table 3-4). Each component was estimated based on other Alaska jurisdictions and Jacobs professional judgment from other transfer station facilities within the United States.

Table 3-4. Estimate of Transfer Station Operating Cost Components for a Juneau Transfer Station Receiving Approximately 30,000 Tons per Year

Transfer Station Operating Cost Component	Percent of Operating Costs	Annual Operating Cost Estimate
CBJ Staff Labor and Benefits	40%	$960,000
Equipment Maintenance	12%	$288,000
Facility/Building Maintenance	20%	$480,000
Supplies	13%	$312,000
Other/Miscellaneous	15%	$360,000
TOTAL	**100%**	**$2,400,000**

3.3 New Landfill

Anticipating future solid waste management needs, the CBJ identified three potential landfill sites in the early 1990s, based on regulatory requirements, CBJ-specific criteria, and in-person reconnaissance (Brown et al. 1993). All three sites have enough space for a landfill; are set back from population centers, homes, and the Juneau Airport; and are close to existing or planned roads. Two of these sites are owned by the CBJ and are near Lemon Creek in Hidden Valley between the CBJ's North Lemon Creek material source and the SECON company's material source, while the third is federal land in the Tongass National Forest across from Amalga Harbor (Appendix D). A new or updated siting study will be necessary for a Juneau landfill.

3.3.1 Capacity and Sizing

The size of a landfill and, therefore, the operating cost estimates can vary based on landfill geometry and design parameters. In addition, the lifespan of a landfill is highly variable, influenced by factors such as how the air space is filled, cover and soil utilization, compaction rate, and various operational parameters that depend on the selected site, implemented design, and operational efficiency. For example, a smaller footprint, such as 20 acres for a 100-year landfill, is possible with greater operational efficiencies and optimal geometry (including height) using the same values for all other estimating assumptions. Without an understanding of these unknowns, conservative estimates were used in calculations that resulted in a larger landfill footprint and increased the landfill operating costs.

The necessary size of a new landfill for both 50- and 100-year design capacities was estimated based on several possible geometries and a waste flow of 30,000 tpy. Sizing estimates were calculated for both the landfill fill area and the total site area. The landfill fill area refers to the lined modules that will receive the waste, while the total size area also accommodates access and operational roads, buffer space, environmental monitoring networks, stormwater and leachate management systems, equipment yards and maintenance areas, an entrance/gate area, security systems, scale houses, and gas collection and management systems.

Based on these factors, the approximate size of a 50-year landfill is as follows:

- Total landfill volume (including cover materials) = 2.5 million cubic yards
- Landfill fill area = 30 to 50 acres
- Total site area = 50 to 100 acres

The approximate size of a 100-year landfill is as follows:

- Total landfill volume (including cover materials) = 5 million cubic yards
- Landfill fill area = 60 to 100 acres
- Total site area = 100 to 200 acres

3.3.2 Operating and Maintenance Costs

Table 3-5 presents estimated landfill operating costs for six jurisdictions, with three located in Alaska and three located in the lower 48 states comparable in size to a proposed landfill in Juneau. The adjusted cost per ton shown in Table 3-5 escalates costs to 2025 dollars and reflects the estimated operating cost for Alaska, geographically adjusted using Consumer Price Index data from the U.S. Bureau of Labor Statistics. These examples provide rough approximations of the estimated operating costs for a Class I landfill in Juneau, given that the specific operating parameters are not yet defined. Each of the example landfills included in Table 3-5 is owned and operated by the local municipality, while specific services, such as equipment maintenance, are occasionally contracted with private companies as needed.

Table 3-5. Estimated Operating Costs for Six Example Landfills

Name	Location	Basis for Estimate	Annual Tons Received (tpy)[a]	Annual Operating Cost[b]	Cost per Ton[c]	Adjusted Cost per Ton[d]
Kodiak Island Borough Landfill[e]	Alaska	FY25 Adopted Budget; Kodiak Island Borough	11,700	$3,154,000	$270	$270
Canyonlands Solid Waste Authority Klondike Landfill	Utah	2023 Audit Report	16,800	$652,000	$39	$79
Laramie Landfill	Wyoming	2024 Annual Comprehensive Financial Report	45,500	$2,405,000	$53	$107
Fairbanks North Star Borough Solid Waste Facility	Alaska	FY 2025-2026 Approved Budget	107,700	$10,269,000	$95	$95
Madera County Solid Waste Management Fairmead Landfill	California	County Appropriations 2024–2025	164,700	$8,788,000	$53	$110
Anchorage Regional Landfill	Alaska	2025 Municipal Operating and Capital Improvement Budgets; Municipality of Anchorage	301,000	$18,484,000	$61	$61

[a] Facilities are sorted by Annual Tons Received to highlight the economic efficiency of larger operations in Alaska.

[b] Annual Operating Costs determined from municipal operating budgets and adjusted for inflation to Q3 2025, less debt service for development and construction costs and any funds set aside for closure or post-closure costs.

[c] For comparison, the tipping fee at Capitol Disposal Landfill in Juneau is $215 per ton. as of January 1, 2026. As leachate is currently treated by the CBJ's wastewater treatment plant, operation of a separate leachate treatment facility is not included in current tipping fees.

[d] The adjusted costs per ton were geographically adjusted using Consumer Price Index data from U.S Bureau and Statistics.

[e] Total annual operating costs for Kodiak Island Borough Landfill are $4,605,000, including $3,154,000 for landfill operations and $1,451,000 for leachate treatment operations.

Landfill operating costs vary significantly across the examples in Table 3-5, influenced by factors such as management practices, local regulations, regional climate, and landfill size. Notably, the landfills outside of Alaska are in dry, arid regions, in contrast with the high rainfall experienced in Juneau that results in notable costs for leachate management. A power trend analysis did not show a strong correlation between operating cost per ton and disposal tonnage at landfills, unlike the trend observed for transfer stations in

Section 4.2. Therefore, Juneau's landfill operating costs were estimated by comparing to similar landfill operations among these examples.

Among the landfills listed in Table 3-5, the Kodiak Island Borough Landfill is the most comparable to what would likely be required in Juneau. As with Juneau, Kodiak receives a small amount of waste relative to large regional landfills, experiences high rainfall, is in a remote area, and must implement wildlife controls for waste operations. Kodiak operates a Class I landfill with an annual operating cost of $270 per ton. Because of heavy rainfall, it also maintains a dedicated leachate treatment facility, adding another $124 per ton to its operating costs. Similarly, if Juneau's existing wastewater treatment plant cannot accommodate leachate from a new landfill, a separate treatment system would be necessary, which would result in higher operating costs comparable to those in Kodiak. As such, Kodiak's total annual operating cost of $394 per ton for the landfill and leachate treatment system serves as a high-end estimate for Juneau with operations of a leachate treatment plant.

However, this estimate does not account for operational efficiencies achieved through scale. Juneau is projected to dispose of approximately 30,000 tons per year – more than double Kodiak's 11,700 tons – potentially reducing per-ton operating costs. The Laramie Landfill in Wyoming provides a useful comparison for the low end of operating costs with a higher annual waste volume and operational challenges caused by freezing temperatures. Given the challenges Juneau faces with rainfall and leachate management, the adjusted operating cost of $107 per ton is likely underestimated. Accounting for some type of leachate management raises the low-end estimate to approximately $155 per ton.

Considering these two examples, landfill operating costs for a potential new facility in Juneau are estimated to range between $155 and $394 per ton. This equates to a total annual operating cost between $4.7 million to $11.8 million.

As shown for Kodiak Island Borough, a dedicated leachate treatment system significantly increases overall landfill operating costs and introduces considerable variability in cost estimates. Leachate generated at the Capitol Disposal Landfill is currently treated at the CBJ wastewater treatment facility, which is anticipated to have adequate capacity to continue accepting leachate from a newly constructed landfill. Potential constraints on continued acceptance are expected to be driven primarily by changes in leachate chemistry, such as increased constituent concentrations or the presence of new contaminants, rather than by exceeding volume capacity. **Because the need for a separate leachate treatment system has not yet been confirmed in this study, the operating cost range can be refined by temporarily excluding these additional expenses. Therefore, the subsequent analysis of customer rate impacts for Scenario A uses a narrower cost estimate for landfill operations in Juneau, ranging from $155 to $270 per ton.**

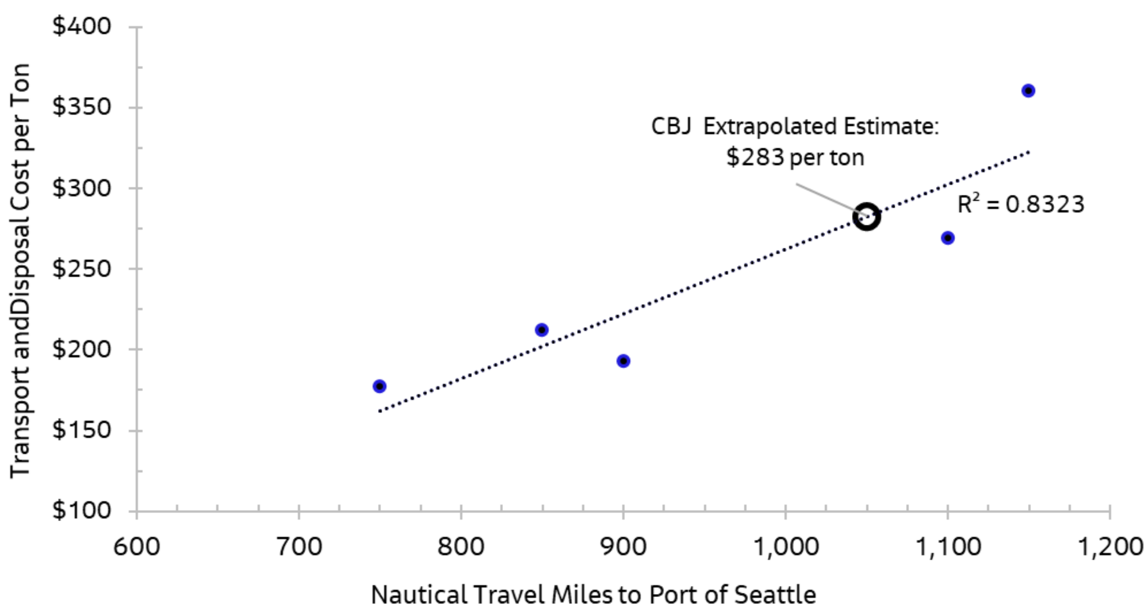
In addition to standard operating costs, landfills incur significant expenses when they reach capacity and must be capped and closed. These closure costs are not included in the annual operating expenses reflected in Table 3-5 because they are highly dependent on the financing mechanism and timeline. Post-closure requirements, mandated by regulatory agencies, include a minimum of 30 years of ongoing monitoring and reporting. To ensure these obligations are met, ADEC requires financial assurance for closure and post-closure activities, as outlined in Section 6.2. In a 2023 review of historic closure costs for 20 landfills in Tennessee, Georgia, Virginia, Pennsylvania, and North Carolina, the median closure cost order-of-magnitude estimate was $225,000 per acre, with an additional $2,000 per acre per year for post-closure maintenance (Smith Gardner Inc. 2023). For comparison, the State Guarantee Trust Account for the City of Laramie Landfill in Wyoming provides financial assurance totaling approximately $9.9 million for closure and $2.2 million for post-closure care of the permitted 250-acre landfill site, while Anchorage Regional Landfill budgets approximately $1.5 million per year for future landfill closure costs (WDEQ 2024; CBJ 2025b). These costs could be financed across the final 20 years of the landfill's operational life, after the debt for initial construction is paid off.

3.4 Shipping and Transport of MSW for Disposal

Exporting MSW to out-of-state landfills is a common practice for many small jurisdictions in southeast Alaska. This process typically involves loading MSW into 40-foot intermodal containers, which then are transported by barge to the lower 48 states. Currently, other jurisdictions in Alaska, including Ketchikan, Sitka, Skagway, Wrangell, and Petersburg, contract with Republic Services to manage the transport and disposal of MSW at the Roosevelt Regional Landfill in southeastern Washington State. Republic Services partners with AML to ship containers to the Port of Seattle and with BNSF Railway to move them by train to the landfill. Their service includes supplying intermodal containers tailored to each jurisdiction's needs and returning empty containers to the community.

While the cost of this service varies based on several factors, this analysis compared the cost to export MSW to Roosevelt Regional Landfill from four jurisdictions in Alaska, and transportation and disposal costs were compared against nautical miles to the Port of Seattle (Figure 3-2).

Figure 3-2. Relationship Between Approximate Nautical Travel Miles to Port of Seattle and Transport and Disposal Costs per Ton for Alaska Jurisdictions Contracting with Republic Services



Based on this comparison to export costs from other jurisdictions and discussions with Republic Services, the **estimated cost for full-service transport and disposal from a Juneau transfer station to Roosevelt Landfill ranges from $210 to $283 per ton. This equates to a total annual cost between $6.3 million and $8.5 million.**

This estimate may vary based on many factors that could change throughout the course of this study, including AML's shipping rates and the timing of contract negotiations. It is important to note that AML typically increases container transport rates by 3% to 4.5% annually.

3.4.1 Shipping MSW to Anchorage for Disposal

The option to export waste from Juneau to Anchorage (or to Anchorage through the Whittier Port) also was explored through discussions with the Municipality of Anchorage (MOA) and AML. The MOA has expressed strong interest in receiving MSW and other waste streams from Juneau. Current discussions are conceptual and in the early stages, so continued collaboration between both parties will be essential to assess feasibility and costs for this option. The intent of this initial evaluation is to support regional waste planning conversations, particularly as MOA continues to develop plans for a potential WTE facility. Notably, there may be fewer restrictions for barging if the vessels do not pass through the Canadian border, which could lead to lower costs to export waste to Anchorage than to the Pacific Northwest (ATS, Inc. n.d.; CBJ 2025a).

AML does not currently offer direct barge service between Juneau and Anchorage. Under existing barge routes, MSW would first be shipped from Juneau to Seattle via the southeast Alaska barge. From there, the intermodal containers would need to be transferred to the Central Alaska barge for transport to Anchorage. This indirect route results in an estimated minimum transit time of 15 days, which is significantly longer than the current transit time from Juneau to the Port of Seattle of 5 to 7 days. As a result, under existing infrastructure, this option is not considered financially viable.

While establishing a direct barge route between Juneau and Anchorage is technically possible in the future, it would require consistent and sufficient cargo volumes to justify the service through AML. AML indicated that their 340-foot and 380-foot barges have target capacities of 8,000 tons and 10,000 tons, respectively. Based on current MSW generation rates in Juneau, which are estimated to be more than 10 times lower than the target capacity of a 340-foot barge on a weekly schedule, Juneau would need to store and accumulate waste for more than 3 months, on average, to make such a route viable.

Alternatively, the CBJ may approach one of the inter-Alaska port connection barge services to evaluate the feasibility of establishing a new route between Juneau and Anchorage.

4. Impacts on Residential and Commercial Customer Rates

Impacts on residential and commercial customer rates for Scenario A and Scenario B were calculated using the estimated capital and operating cost for each scenario and comparing that rate to current waste hauling rates charged by Alaska Waste, which would not be valid when the current landfill closes. An estimated MSW disposal management cost per ton (tipping fee) was evaluated against the current Capitol Disposal Landfill tipping fee of $194.24 per ton paid by Alaska Waste (Alaska Waste-Juneau, LLC 2018). Table 4-1 summarizes the expected range of percent increases to customer rates, along with the new MSW disposal management cost for each scenario. It is important to note that costs are expected to increase when the Capitol Disposal Landfill closes, regardless of whether CBJ chooses to proceed with any scenario; however, the exact increase is unknown and was not factored into this analysis. For comparison, a 2025 study of 351 U.S. landfills found that tipping fees at privately owned facilities averaged 34% higher than those at publicly owned sites (EREF 2025).

MSW disposal management costs for each scenario were calculated using the estimated annual operating costs for Juneau, as outlined in Section 4, as well as debt issuance costs associated with capital infrastructure projects. Debt issuance interest rates were assumed to be 4.0% with a long-term bond of 30 years. This evaluation does not account for future rate changes from inflation or periodic adjustments. For instance, AML rates have historically increased by 3% to 4.5% annually, and operating costs for transfer stations and landfills are also expected to rise over time. Instead, this analysis estimates per-ton tipping fees sufficient to cover anticipated municipal expenses under each scenario. A formal rate study is recommended to assess long-term impacts on residential and commercial customer fees and to identify financing strategies for each capital infrastructure investment. All other components of MSW collection rates such as administration, collection costs, and profit margins are assumed to remain constant in this evaluation.

A conservative estimate of capital costs for landfill construction was presented in Phase 1 of the Solid Waste Study and reiterated in Section 1.1.1. It is standard practice to recover the costs to finance construction through landfill tipping fees and customer rates. Given that landfills are developed in phases, it is reasonable to assume that up to half of the total cost may be incurred upfront. The remaining portion of the construction costs would be funded during years 26 through 50 for a 50-year landfill, noting that debt service payments on the initial capital costs would end in year 30 under this analysis. Landfill closure costs and post-closure care costs are assumed to be financed in the last 20 years after the initial bond is paid off; thus, they are not included in this rate analysis.

Table 4-1. Impacts on Residential and Commercial Rates for Each Scenario Based on MSW Disposal Management Costs per Ton

Parameter	Scenario A	Scenario B
Current MSW Disposal Management Cost per Ton	$194.24	$194.24
New MSW Disposal Management Cost per Ton with no CBJ intervention[a]	Increase	Increase
New MSW Disposal Management Cost per Ton under each CBJ scenario	$300 – $544	$316 – $439
Percent Increase in Customer Rates, Low Estimate[b]	10% – 16%	12% – 18%
Percent Increase in Customer Rates, High Estimate[b]	28% – 39%	21% – 31%

[a] Costs are expected to increase when the Capitol Disposal Landfill closes, regardless of whether CBJ chooses to proceed with any scenario; however, the exact increase is unknown and was not factored into this analysis.

[b] Impacts to customer rates depend on container size and pickup frequency. The impact range shown for is for 48-gallon roll cart and 96-gallon roll cart serviced once per week.

5. Timeline and Costs for Permitting and Environmental Compliance

Regulations impacting the design, construction, and operation of new solid waste management facilities affect the cost and feasibility of each scenario. These facilities must comply with federal, state, and local regulations on land use, air quality, waste treatment and handling, and stormwater management. If discharging liquids into the municipal sanitary sewer system, wastewater monitoring and pretreatment may be required. Key considerations for regulations and permitting that impact the timeline and operating cost of each scenario are listed in the following sections.

The U.S. Environmental Protection Agency (EPA) has authorized Alaska to implement federal landfill requirements under the Resource Conservation and Recovery Act, Subtitle D. All facilities must adhere to the National Pollutant Discharge Elimination System, the Clean Air Act, and state and local permits for siting, design, construction, and operation.

Generally, in Jacobs' experience, transfer station permitting is less complex and, therefore, more streamlined than landfill and WTE permitting. Permitting is just one aspect of site development, which also includes siting, design, construction, and startup. Jacobs typically observes the following general timelines:

- Developing a new transfer station typically takes at least 5 years, assuming the site has been selected, and it includes design, permitting, construction, and startup.
- New landfill development usually takes 7 to 10 years, with siting being a major variable. Some projects have taken even longer because of delays in siting and permitting.
- WTE facilities are rarely developed nationwide, and none have been developed in Alaska to date under current siting and permitting requirements; as such, the design process is complex and the permitting cycles are not clearly defined. It is expected that permitting for a WTE facility would take at least as long as a landfill, if not longer. Preconstruction air quality monitoring and permitting alone can take 3 years or more.

Public concerns can make it difficult to site new solid waste facilities, particularly landfills and WTE plants, near population centers because of concerns about nuisances, visual impacts, and potential health and safety risks (EPA 2002). The National Environmental Policy Act of 1969 (NEPA), a federal law that establishes a national policy for protecting the environment, and the public engagement and hearing processes for permits typically are the primary avenues for capturing these concerns. Therefore, permitting any type of solid waste facility can take many years, or even decades, because of multiple stages of review, partner engagement, public consultation, and potential legal challenges. If a NEPA process is not triggered, a public comment period of at least 30 days is required by ADEC to ensure the public has an opportunity to provide input on applicable permits. There could be a range of other public comment periods, meetings, or involvement cycles depending on the nature of construction, such as whether land use designation changes are required or the extent of air permits required. In general, regardless of NEPA, the CBJ should anticipate the permitting timeline to be a multi-year process with project siting, design, regulatory review, and public engagement.

5.1 Alaska State Permitting Timeline and Costs

MSW landfills in Alaska must adhere to state permitting requirements for waste disposal management, including applying for a waste disposal permit and complying with siting, design, and operating standards, as defined by the ADEC under Title18 of the *Alaska Administrative Code* (AAC), Chapter 60, including requirements for landfill location, liners, leachate collection and removal, operating practices, stormwater controls, groundwater and landfill gas monitoring, landfill closure, post-closure requirements, and financial assurance.

Permitting timelines and costs for solid waste facilities in Alaska vary depending on the type of facility and the waste quantity. For landfills, the typical permitting process takes between 1 to 3 months, including the public notice period. Factors that can influence the timeline include the season (fall is generally faster because of lower workloads), site conditions, and the need for baseline environmental data. For example, 2 years of groundwater monitoring is standard, and air quality data may be required if emissions are expected to exceed regulatory thresholds.

Inert waste monofils, which do not require liners or leachate collection systems, would require the standard public notice period and would likely take a minimum of 6 weeks to issue a permit. These facilities are more common in dry regions and still require groundwater monitoring and waste screening to prevent hazardous waste contamination.

A transfer station permitting process is more streamlined with fewer permitting requirements. These facilities can often be permitted under a general permit, which typically can be approved within 1 month.

The permitting costs also vary by facility type. A Class I landfill permit costs approximately $9,000 per year, with a separate, individual permit required for leachate treatment. Incinerator permits cost approximately $11,000 annually, with an additional $2,000 for a cooling water general permit. Transfer stations require a Multi-Sector General Permit (MSGP), which costs approximately $700 per year. If multiple facilities are proposed, such as a landfill and WTE facility, ADEC recommends a Comprehensive Permit, which costs $11,000 annually and covers both operations. Additional individual permits may be needed for groundwater, leachate, and air quality monitoring, and any waiver requests are billed hourly based on ADEC’s published rates.

Relevant permitting costs are included in the facility operating estimates provided in Section 3 and Appendix C and, thus, are captured in the anticipated operating costs for Juneau’s solid waste management scenarios.

5.2 Landfill Closure and Post-Closure Financial Assurance

Owners or operators of landfills are required to provide financial assurance for the cost of landfill closure and post-closure. Under 18 AAC 60.265, all permitted solid waste facilities, including landfills, monofils, and treatment facilities, must demonstrate financial responsibility to cover closure and post-closure monitoring costs. This financial assurance must be in place before the initial receipt of waste, and the CBJ will need to provide up-to-date financial audit records as part of the financial assurance process.

For Class I landfills, 18 AAC 60.398 requires compliance with the more-detailed federal standards outlined in 40 *Code of Federal Regulations* (CFR) 258 Subpart G. The CBJ may choose to follow the guidance under 40 CFR 258 Subpart G for a treatment facility or inert waste monofil; in which case, the ADEC would review the financial assurance proposal under 18 AAC 60.265. There are 11 allowable financial assurance mechanisms under 40 CFR 258 Subpart G, such as trust funds, surety bonds, letters of credit, insurance, and various government financial tests and guarantees. For example, the Alaska Municipal League Investment Pool is an Alaska state-approved closure and post-closure financing mechanism used by Delta Junction. Most Class I landfill operators in Alaska, including Anchorage, Fairbanks, Kodiak, and others, use the Local Government Financial Test. Ultimately, the ownership and operating model chosen by the CBJ will be the primary factor that determines the appropriate financial assurance mechanism.

5.3 Federal Clean Air Act and Clean Water Act

Any new solid waste management facilities constructed in Juneau would need to comply with federal environmental regulations, including those established under the Clean Air Act and the Clean Water Act. Stormwater and regional hydrology, along with consistent high precipitation, would need to be considered during the design, construction, and operating stages of all facilities to ensure site stability and proper drainage. If stormwater runoff from a site discharges to surface waters, it triggers regulatory requirements under the Clean Water Act. In Alaska, this means the operator must obtain coverage under the Alaska Pollutant Discharge Elimination System program, which is typically obtained through the MSGP for industrial activities, described in Section 6.1. This permit requires the development and implementation of a Stormwater Pollution Prevention Plan and the application of appropriate control measures to minimize pollutant discharge.

Under the Clean Air Act, facilities must obtain a Title V Operating Permit if they are considered major sources of air pollutants. The threshold for triggering this requirement is 100 tons per year of any regulated air pollutant. For MSW landfills, the Title V permit requirement is also triggered if the design capacity is equal to or greater than 2.5 million megagrams or 2.5 million cubic meters. Title V permits typically are obtained after the facility begins operations, when emissions data or design capacity thresholds are confirmed. Federal permitting costs can vary depending on the facility type and complexity, although $5,000 per year is a reasonable estimate for the base cost of a Title V permit in Alaska. Additional fees may apply for monitoring, reporting, and modifications.

6. Environmental Considerations

As the CBJ evaluates future solid waste management strategies, environmental impacts are an important consideration. The construction of solid waste management facilities or the offsite shipment of waste involves a variety of environmental considerations. This section briefly discusses environmental review processes for construction, with additional detail provided in Section 5, followed by an analysis of the GHG emission impacts associated with Scenarios A and B.

If federal action[17] or funding is necessary for the construction of a future solid waste disposal facility, it may trigger NEPA. The project proponent (the CBJ) will be the entity responsible for NEPA compliance; this process typically involves partner engagement, environmental review, and some level of permitting depending upon the site location. The NEPA process addresses many types of environmental and cultural resource impacts, which could obstruct development of a new project. In addition, watershed and other site-specific impacts would be evaluated during siting of a new landfill in Juneau and as required for the development permit through the CBJ Community Development Department.

GHG emissions are a major air pollutant and the leading contributor to global climate change. They represent a key environmental metric relevant to both Scenario A and Scenario B. This section offers a high-level qualitative comparison of GHG emissions associated with each scenario, including emissions from landfill construction and operation, as well as offsite transportation of waste. While this analysis does not include a full life cycle assessment or a detailed quantitative breakdown of all emission sources, it is intended to help the CBJ consider the broader environmental impacts of its waste management decisions. A more comprehensive study would be necessary to accurately quantify GHG emissions for each scenario.

Incorporating GHG emissions into the solid waste scenario decision-making process is an effective way to support citywide climate goals and align with the Juneau Commission on Sustainability's objectives. Based on the findings from Juneau's GHG inventory (CBJ 2023), solid waste treatment accounts for 4.3% of the total communitywide GHG emissions, or 12,904 metric tons of carbon dioxide-equivalent (MT CO_2e). To support Juneau's *Climate Action & Implementation Plan* (CBJ 2011), future waste management solutions should aim to reduce, or, at the very least, avoid increasing, emissions relative to the current baseline.

Activities associated with solid waste management that contribute significant emissions include construction, transportation, landfill operations, and waste decomposition. This report provides a qualitative review of the first three activities (construction, transportation, and operational emissions) because they vary between scenarios and offer opportunities for mitigation. Emissions from waste decomposition are not compared in this study because both scenarios result in landfilling the same amount of waste; however, it is important to recognize that landfilling waste is inherently a significant source of GHG emissions, primarily from methane generation from organic material breakdown.

6.1 Construction Emissions

Construction emissions are highly dependent on the ultimate size, design, and location of the landfill. As such, only a general overview of construction emissions is possible at this stage of the assessment. The primary contributions of GHG emissions from construction activities are the fuel used in construction machinery, embodied carbon emissions in materials (including the emissions associated with transportation of materials to Juneau), and emissions from electricity used for construction (Table 6-1).

[17] NEPA is triggered by a major federal action, which is any activity carried out, assisted, permitted, or licensed by a federal agency.

Emissions may be reduced by using alternative materials, such as low-carbon concrete, or alternative fuels for equipment.

Construction emissions are mainly relevant to the construction of a new landfill in Juneau under Scenario A; however, it can be assumed that Scenario B would ultimately contribute to the need for new landfill cell construction at the ultimate disposal location, which would result in emissions from those construction activities as well. To provide a quantitative comparison between the scenarios, a comprehensive GHG emissions study would need to be conducted to estimate emissions based on the landfill design, bill of materials, and energy sources for construction activities.

Table 6-1. Construction-related Emission Sources

Construction Activity	Source of Emissions
Site preparation	Machinery or equipment fuel combustion emissions; road construction embodied carbon in materials; onsite electricity use
Excavation/fill/earthwork	Machinery or equipment fuel combustion emissions; onsite electricity use
Liner installation	Machinery or equipment fuel combustion emissions; embodied carbon emissions of liner material; onsite electricity use for construction use
Construction of leachate and gas collection	Machinery or equipment fuel combustion emissions; embodied carbon emissions of piping material; onsite electricity use
Support facilities construction	Machinery or equipment fuel combustion emissions; embodied carbon emissions of concrete, steel, and other construction materials; onsite electricity use

6.2 Transportation Emissions

Transportation of MSW for disposal is an important differentiator for the overall GHG emissions of Scenarios A and B. Table 6-2 identifies the three modes of transportation included in the two scenarios and the associated emissions factors from the EPA Emissions Hub (EPA 2025). According to the emissions factors provided by the EPA, carbon dioxide (CO_2) emissions from diesel are estimated to be consistent across all mobile sources, but methane (CH_4) and nitrous oxide (N_2O) emissions are specific to the engine type.

Table 6-2. Fuel Emission Factors for Potential Modes of Transportation

Mode of Transportation	Assumed Fuel Type	Emissions Factor		
		CO_2	CH_4	N_2O
Truck	Diesel	10.21 (kg CO_2/gallon)	0.0095 (g CH_4/ vehicle-mile)	0.0431(g N_2O/ vehicle-mile)
Barge	Diesel	10.21 (kg CO_2/gallon)	6.51 (g CH_4/gallon)	0.17 (g N_2O/gallon)
Train	Diesel	10.21 (kg CO_2/ gallon)	0.8 (g CH_4/ gallon)	0.26 (g N_2O/gallon)

g = gram(s)
kg = kilogram(s)

To standardize emissions values into a CO_2-equivalent (CO_2e), 100-year global warming potentials are commonly used. These potentials represent the relative heat-trapping potential of each gas compound compared to CO_2.

The global warming potential values are as follows (IPCC 2024):

- CO_2 = 1
- CH_4 = 30
- N_2O = 265

These values are applied to calculate the total CO_2e emissions. For this comparison, it is assumed that each intermodal container contains approximately 25 tons of waste. Table 6-3 presents transportation-related emissions per ton of landfilled material for Scenarios A and B. In this analysis, the emissions from Scenario A include only the transportation from the transfer station to a new landfill in Juneau, while Scenario B includes transportation from the transfer station to the barge by truck, then to Seattle by barge, and finally to a regional landfill by railway. These estimates are provided only for a high-level comparison. Precise estimates would need to be calculated based on the final design and location of the landfill and transfer station, the type of transport equipment used, and the actual weight of waste and containers. In addition, a comprehensive analysis should account for emissions generated during the production, processing, and delivery of fuel (that is, well-to-tank emissions). A more detailed study would be required to accurately quantify total transportation-related greenhouse gas emissions.

Table 6-3. Estimated Distance, Fuel Use, and Transportation Emissions by Scenario

Scenarios	Truck		Barge		Train		Total CO_2	Total CH_4	Total N_2O	Total CO_2e
	Distance	Fuel Economy	Distance	Fuel Economy	Distance	Fuel Economy				
Scenario A	15 miles	2.53 mpg[a]	Not applicable	Not applicable	Not applicable	Not applicable	0.24 kg CO_2/ton	0.006 g CH_4/ton	0.002 g N_2O/ton	**0.248 kg CO_2e/ton**
Scenario B	15 miles	2.53 mpg	800 miles	574.8 ton-miles per gallon[b]	240 miles	528.0 ton-miles per gallon[c]	19.13 kg CO_2/ton	9.426 g CH_4/ton	0.352 g N_2O/ton	**19.478 kg CO_2e/ton**

[a] AFDC 2024.
[b] Baumel et al. N.d.
[c] CSX 2024.

6.3 Emissions from Landfill Operation

The third source of emissions to consider in this study is landfill operations. While both scenarios involve managing the same volume of waste, actual GHG emissions will vary depending on specific design choices and operational practices. Factors such as landfill scale, equipment efficiency, and operational protocols can significantly influence emissions.

For example, Scenario B involves operations at a large, regional landfill, which would handle substantially more waste than the proposed landfill to manage 30,000 tons per year of waste from Juneau under Scenario A. The scale of a large regional landfill may enable process efficiencies and lower per-ton emissions. Conversely, a newly constructed landfill in Juneau could benefit from modern, fuel-efficient equipment and optimized design.

To illustrate the impact of scale, conclusions from a different project are considered. A life cycle assessment of Spokane's waste management options found the following (Ecology 2024):

- Roosevelt Landfill emitted an estimated[18] 30,117 metric tons of CO_2e during 30 years for 250,000 tons per year of MSW, or 4.0 kg of CO_2e per ton annually.
- The Spokane facility, which is roughly 10 times smaller, emitted an estimated 109,582 metric tons of CO_2e during the same period for the same waste volume, or 14.6 kg of CO_2e per ton annually.

These figures are not direct estimates for a landfill in Juneau, but rather are provided to illustrate how operational scale can influence emissions.

For the purposes of this comparison, while there is the potential for high variability based on the operations at each site, a reasonable assumption is that each scenario involves handling of the same amount of waste. If operational practices are similar between a potential landfill in Juneau and a large regional facility, the difference in scale could still lead to notable variation in GHG emissions per ton of waste. Larger facilities may benefit from economies of scale and more efficient processes, while smaller landfills might rely on newer, more fuel-efficient equipment. Furthermore, variations in how landfill gas is captured or treated can significantly influence emissions from landfill operations. If greater distinction is desired, these factors should be considered through a more detailed analysis of the emissions impacts for each scenario.

[18] EPA WARM Version 15 model was used to calculate GHG emissions from waste (Ecology 2024).

7. Summary and Recommendations

This study provides an initial, high-level evaluation of three solid waste management scenarios. Table 7-1 outlines the estimated capital costs, pros, and cons for each scenario discussed in Sections 3 through 6 and also provides a relative feasibility ranking based on the following criteria agreed to with the CBJ as part of the project kickoff and as refined over the course of the project:

1. Relative estimated capital and operating costs, including impacts to customer rates
2. Feasibility to build, operate, and sustain the facilities
3. Ability to address waste streams and the CBJ's goals for diversion, level of CBJ control, and timeline for implementation
4. Overall environmental impacts, including GHG emissions
5. Community and stakeholder buy-in

The rankings provided in Table 7-1 are based on current information and may change as the CBJ continues to explore one or more of these scenarios in more depth. In addition, the rankings assume that landfill development could proceed successfully, including effective site selection, public engagement, and other factors identified during detailed planning and cost analysis.

Table 7-1 separately lists the capital and operating cost estimates, and the remaining criteria are included as part of the overall pros and cons. A high-level discussion of the GHG emissions from construction, transportation, and operations is provided in Section 6; however, it is important to acknowledge the limitations of this qualitative comparison. A more in-depth assessment of GHG emissions, potential pollutants, land use impacts, and other environmental metrics would be necessary to adequately compare the environmental impacts of the scenarios. Community and key partner buy-in will be addressed by the CBJ separately from this high-level feasibility evaluation. In addition, all the alternatives seem to be feasible from an operations and timeline perspective. However, if Scenario A is selected, construction of a landfill would need to commence as soon as possible to avoid a situation where the Capitol Disposal Landfill reaches capacity and is closed before a new landfill is open to accept waste. Timely decisions and action are critical to ensure uninterrupted waste disposal.

Table 7-1. Pros, Cons, Cost Ranges, and Relative Feasibility Rankings for Each Scenario

Scenario	Annual Operating Cost Range	Capital Cost Range[a]	Pros	Cons	Feasibility Ranking
A. Construct a new landfill and transfer station with recyclables, HHW, and junk vehicles transported offsite by barge for diversion.	Transfer station = $2.2 million – $2.5 million Landfill = $4.7 million – $11.8 million **Total = $6.9 million – $14.3 million** **MSW Disposal Management Cost per Ton = $300 – $544** (with separate leachate treatment system up to $668)	Transfer station = $9 million – $20 million 50-year Landfill[b] = $50 million – $162 million Total = $59 million – $182 million	High level of control over operating costs, rates, and solid waste flow.	Construction of a new landfill is expensive. Siting and permitting would be required, adding to the timeline for a new facility to be operational. Operations staff would be sustained by the CBJ unless the CBJ enters into an operating agreement with a private company. Leachate treatment and stormwater management are significant cost factors.	2
B. Construct a transfer station with all waste, as well as recyclables, HHW, and junk vehicles, transported offsite by barge for recycling and disposal.	Transfer station = $2.2 million – $2.5 million Offsite shipment = $6.3 million – $8.5 million **Total = $8.5 million – $11 million** **MSW Disposal Management Cost per Ton = $316 – $439**	Transfer station = $14 million – $40 million (offsite shipping costs negotiated in transportation contract)	No capital costs to construct a new solid waste disposal facility. Minimal regulatory requirements without a landfill or WTE facility.	Offsite transportation costs, impacts, and availability of markets to accept material are outside of CBJ control; exposure to financial risks. Operating costs are transferred into higher fees from the hauler and operator. Likely associated with higher GHG emissions from transportation, based on an initial qualitative analysis.	1

Scenario	Annual Operating Cost Range	Capital Cost Range[a]	Pros	Cons	Feasibility Ranking
C. Construct a WTE facility and transfer station for MSW with noncombustible waste, noncombustible recyclables, HHW, junk vehicles, and ash exported by barge for disposal.	Operating costs for a WTE facility were not considered in Phase 2 of this Solid Waste Study because of the findings from Phase 1 and the lower feasibility ranking relative to the other scenarios.	Transfer station = $9 million – $20 million WTE = $90 million[c] Total = $99 million – $110 million	High level of control over operating costs, rates, and solid waste flow. Minimizes solid waste volume and land use area and impacts.	Diversion would be minimized to optimize efficiency of energy recovery. No potential for revenue from net metering. Does not improve the renewable energy profile for the CBJ. WTE requires a high level of expertise and is more expensive to construct, maintain, and operate than the other scenarios.	3

[a] Capital costs are not applied over the same time period across all scenarios. For example, the landfill capital would be applied over a 50-year period, while the transfer station and WTE may require significant replacement capital over the same 50-year period. Assessment of these factors would be completed with a more comprehensive economic analysis.

[b] Landfill construction costs are calculated based on the estimated size and capacity of a 50-year or 100-year landfill for the CBJ. Costs can vary significantly depending on the operating conditions and geometry of the landfill. The provided estimates are conservative.

[c] This estimate is considered an order-of-magnitude Class 5 as defined by the Association for the Advancement of Cost Engineering International with a range of accuracy between +100% to -50%. The capital cost for a WTE facility was derived using different estimating methods than for a landfill and transfer station, and the variability in the estimate is reflected in this range of accuracy.

7.1 Feasibility Discussion

As described in Section 7 and considering overall cost and impact to customer rates as the primary factor, Jacobs and the CBJ have assigned the following relative feasibility ranking of the three scenarios in Juneau[19]:

1. Scenario B: Construct a transfer station with all waste, as well as recyclables, HHW, and junk vehicles, exported by barge for recycling and disposal.
2. Scenario A: Construct a new landfill and transfer station with recyclables, HHW, and junk vehicles exported by barge.
3. Scenario C: Construct a WTE facility and transfer station for MSW with noncombustible waste, noncombustible recyclables, HHW, junk vehicles, and ash sent south by barge for disposal.

7.1.1 Discussion of Feasibility and Ranking for Scenario B

Scenario B may offer a lower-cost option initially for customers and can be implemented immediately when the Capitol Disposal Landfill reaches capacity. However, it offers the lowest level of control over waste disposal operations and costs for the CBJ because it will be subject to rates designated by the contractor selected for disposal and to AML rates. To avoid service disruptions when the Capitol Disposal Landfill reaches capacity, the CBJ should engage in discussions with shipping providers and offsite landfills to negotiate contract terms and rates for offsite shipping and disposal. Given the timeline of landfill closure, this may be a necessary action regardless of the selected scenario.

Although shipments of MSW between Juneau and Anchorage via AML may not be feasible in the near term based on the CBJ's relatively low waste generation, the CBJ and the MOA should continue exploring this option by engaging in discussions and reaching out to alternative shipping partners to further evaluate feasibility and cost effectiveness.

7.1.2 Discussion of Feasibility and Ranking for Scenario A

Scenario A provides the CBJ with greater control over future waste diversion, MSW management, rate increases over time, and risk mitigation, which is particularly advantageous during sudden waste influxes, such as the disaster debris from the 2023 and 2024 glacial outburst flood events. In addition, Scenario A is anticipated to produce lower overall GHG emissions than Scenario B based on shorter transportation distances, although a more-detailed analysis is necessary to quantitatively compare emissions and overall environmental impact between the two scenarios.

Scenario A may result in higher initial customer rate increases compared to offsite shipment under Scenario B. To better understand public priorities, the CBJ should begin engaging with the community to gauge concerns about potential rate impacts, local landfill nuisance, and environmental implications. Capital construction costs are a key driver of the estimated rate impacts; therefore, selecting a landfill location and initiating design planning will be essential to refine cost estimates. Funding strategies for landfill development also should be carefully evaluated during this process.

Based on economies of scale, it is more cost effective to build and operate landfills that can manage large volumes of waste from a broader geographic area. Consequently, there has been a trend toward regional

[19] The rankings are subject to change as the CBJ investigates funding opportunities, landfill feasibility, and offsite shipping contracts.

landfills during the past 20 years. Since 2006, the Southeast Conference and SEASWA have explored regional solutions for remote communities in southeast Alaska (Southeast Conference 2006). Juneau produces more waste than all nine SEASWA communities combined, potentially making a regional disposal approach more viable. However, transportation challenges have been a major barrier to implementing a regional strategy. If desired, the CBJ may choose to continue discussions with SEASWA regarding the potential for a regional landfill or WTE facility.

As an alternative to constructing a full-scale landfill for all MSW, the CBJ may consider a hybrid approach by developing an inert waste monofil in Juneau to handle C&D waste and other sorted waste streams. Inert waste monofils are subject to fewer regulatory requirements, making them less costly to construct. The remaining MSW would be shipped offsite for disposal.

7.1.3 Transfer Station

Meanwhile, the CBJ should continue with planning for a transfer station regardless of the selected scenario. As described in Section 1, a transfer station would provide many benefits for the CBJ and is a key component of all three scenarios. Ideally, the facility would have sufficient space to expand, in case Scenario B is determined to be the best long-term solution. In concurrence with the objectives of the zero waste campus, the CBJ may consider establishing drop-off and processing areas for all MSW, recycling, organics, C&D, white goods, and bulky waste to enhance efficiency and waste diversion.

7.1.4 Additional Considerations

While this report outlines the key considerations and differentiating factors for the three waste management scenarios, several factors outside the scope of this review may impact operating costs and customer rate changes. For instance, the following aspects could affect the overall financial viability of these scenarios:

- **Ownership and Operation Model:** The ownership model, as described in Section 3.1, will impact the CBJ's share of capital and operating costs. For example, the level of staffing that is sourced through the CBJ compared to contracted services will impact operating costs. The CBJ should evaluate the staffing needs for the selected scenario and facilities, depending on the size, services, and design capacity of the facility.
- **Financial Assurance Funding Mechanism:** The availability and terms of financing options will impact affordability, operating costs, and customer rate changes. As described in Section 3.1, financing mechanism options include municipal bonds, state or federal grants, or loans. The timing of financing and market conditions may impact interest rates and eligibility for funding.
- **Regulatory Changes:** The changing regulatory environment may change the feasibility of constructing new facilities in Juneau by adding or removing requirements for environmental assessments or infrastructure upgrades.
- **Market Prices:** Fluctuations in fuel prices or labor rates will affect transportation and operating costs.
- **Staffing Availability:** The availability of skilled labor for specialized operations may change in advance of implementing the chosen scenario. A publicly owned and operated facility may require higher upfront investment in staffing, training, and infrastructure. A contracted service model could reduce internal staffing needs but introduce variability in vendor pricing and service quality. The CBJ should analyze staffing capacity based on the facility size, services, and design capacity.
- **Contractual Agreements:** At this stage, no formal contracts or vendor quotes have been secured. As such, there may be changes in rates and contract fees during the negotiation process. The entry of new

competitors into the regional market may significantly influence vendor pricing and contract service rates.

Consequently, the actual costs may vary; detailed scopes and cost estimates are necessary before making financial decisions or setting final budgets. These external variables should be carefully evaluated during implementation and financial planning.

7.2 Recommended Actions

With the current landfill nearing capacity, time is pressing; thus, Jacobs recommends the following next steps, many of which can be completed concurrently:

1. **Determine the CBJ Role in Solid Waste Management**. Decide whether to stay with the "status quo" – leaving all solid waste disposal decisions in Juneau to the private sector with no public involvement – or have the CBJ and the community gain a level of control over the solid waste system by owning and possibly operating a future disposal facility via one of the ownership models described in Section 3.1. The desired level of ownership, operations, and permit authority over the solid waste management system is a key differentiating factor between Scenarios A and B.

2. **Proceed to Develop Transfer Station**. Initiate and proceed to develop a publicly owned transfer station that can be used regardless of the scenario selected with design considerations for future expansion and regardless of the operating model selected. The CBJ also should evaluate regulatory options that establish flow control so that solid waste collected within the community is directed to a publicly owned transfer station or disposal facility while compliant with RCA requirements for the solid waste collections utility.

3. **Communicate Study Findings to Juneau Community.** Early public engagement through outreach, education, and/or opportunities for input is crucial to ensure community participation and support for these initiatives.

4. **Pursue Funding Source(s)**: Based on the CBJ's preferred level of ownership, assess and pursue appropriate funding options for solid waste infrastructure and operations, such as municipal bonds, loans, grants, and private capital. Develop a long-term financial strategy to maintain reliable solid waste services for the community.

5. **Develop Comprehensive Long-Term Solid Waste Facility or System Road Map**. Informed by the findings of the CBJ Solid Waste Study and decisions on an ownership and operating model, the road map should document the selected waste facility and program ownership, operations, and revenue sources necessary to implement the desired scenario(s). This may involve selecting a single scenario to pursue with full commitment or adopting a phased approach that advances both scenarios with varying levels of urgency and priority. Regional solutions, and the feasibility and economic benefits or costs of a regional approach, should be evaluated more thoroughly as a part of this road map.

6. **Begin Implementing the CBJ's Solid Waste Facility or System Road Map.** The solid waste road map will inform the implementation activities, which may include:

    a. **Prepare for Future Offsite Shipping of MSW.** Engage with offsite waste disposal and shipping partners to begin assessing the contractual requirements and contract negotiations. This may be pursued as a long-term solution for solid waste management or as a temporary measure to bridge the gap between the closure of the existing landfill and the development of a new disposal facility.

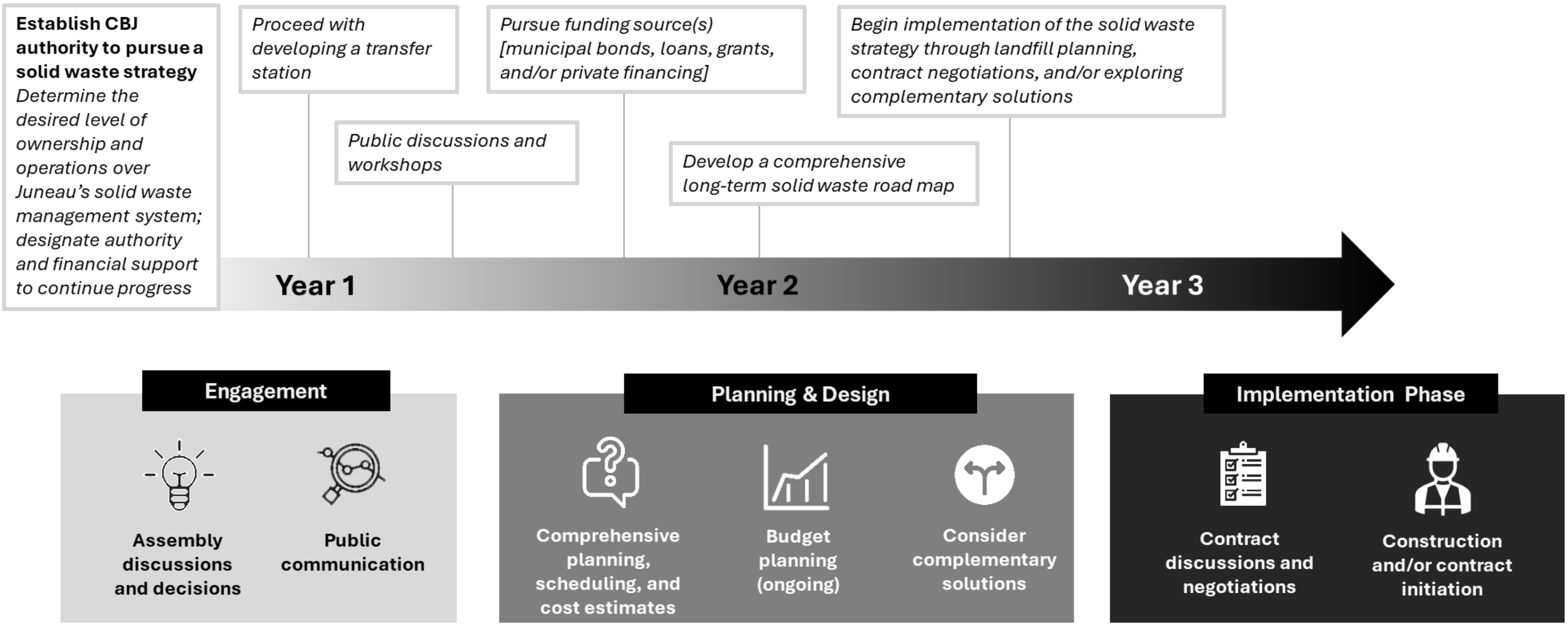
b. **Pursue Landfill Locations and Funding**. Actively assess potential locations and funding options to construct a landfill for Scenario A, which would provide the CBJ with a higher level of control over future solid waste disposal costs and diversion relative to Scenario B.

c. **Explore Complementary Solutions.** Consider how small-scale solutions fit into the larger waste management picture, such as small, material-specific WTE technologies or an inert waste monofil.

7.2.1 Timeline for Critical Decisions

With the pending closure of the Capitol Disposal Landfill and the timelines for planning, design, permitting, and construction discussed in Section 5, it is imperative for the CBJ to act quickly to prepare for Juneau's future solid waste disposal needs. Given the urgency of these decisions, it is recommended that the CBJ consider the timeline proposed on Figure 7-1.

Figure 7-1. Timeline for Critical Decisions and Actions



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Appendix A
Solid Waste Study Phase 1 Technical Memorandum

Juneau Solid Waste Disposal Facility Feasibility and Capital Costs – Technical Memorandum

Date: March 20, 2025
Project Name: CBJ Solid Waste Study
Project No: CBJSWS01
Company: City and Borough of Juneau (CBJ)
Prepared By: Jacobs
Contract No: E24-328

Jacobs Engineering Group Inc.
3800 Centerpoint Drive
Suite 920
Anchorage, AK 99503
United States
T +1.907.762.1500
F +1.907.762.1600
www.jacobs.com

1. Executive Summary

The City and Borough of Juneau (CBJ) is exploring various options for long-term management of solid waste. Currently, solid waste management in Juneau is exclusively handled by private companies, with the CBJ having no active role in this process. Residents in Juneau can either bring their solid waste directly to the private landfill owned by Waste Management, at a cost of $215 per ton (with a minimum charge of $153.32), or they can participate in curbside collection services provided by the privately owned company Alaska Waste. Waste hauling is overseen by the Regulatory Commission of Alaska (RCA). Consequently, there is no public input into operational decisions or rate determination, apart from waste hauling. The CBJ has identified only three municipalities in Alaska – Juneau, Haines, and Glenallen – that do not have a role in solid waste management. Given the impending closure of the Capitol Disposal Landfill, anticipated to occur in the next decade, and the approximately 10-year timespan to plan and permit a new solid waste disposal facility, the CBJ is exploring future disposal options and assessing the high-level feasibility of possible solutions. Operational costs will be an important aspect of planning for a future facility. This study's scope was to focus on the high-level feasibility and capital costs for the three scenarios. Operational costs should be explored in detail in the future.

This study is a limited high-level discussion of capital costs and technical feasibility of three scenarios chosen by the CBJ based on several past studies and Assembly-level conversations over the course of four decades (CBJ 2024a). It is intended to be a starting point for community conversations around future solid waste management. It does not include in-depth analyses of operational costs, cost-benefit analyses of the scenarios, comparisons of different thermal treatment (incineration) technologies, or much discussion of diversion practices such as recycling or composting. Additionally, this study does not include biosolid disposal in any of these options, as the CBJ are in the planning stages of a stand-alone project for biosolid incineration (CBJ 2025d). Although each of these are important considerations for overall solid waste planning, they are outside the scope of this study and will be evaluated if the community chooses to move forward with the planning and construction of a publicly owned disposal facility.[1] The focus on disposal has been prioritized due to the looming closure of the only landfill within the community. Section 5.2 provides the recommended next steps in the planning process.

[1] Planning for future diversion facilities will take place separately in early-to-mid 2025.

The CBJ is considering the following three scenarios; notably, each scenario includes a transfer processing facility[2]:

Scenario A: Construct a new landfill and transfer processing facility with recyclables sent south by barge for diversion.

Scenario B: Construct a transfer processing facility with waste and recyclables sent south by barge for recycling and disposal.

Scenario C: Construct a Waste-to-Energy (WTE) facility and transfer processing facility for municipal solid waste (MSW) with noncombustibles, recyclables, and ash sent south by barge for disposal.

The purpose of this Solid Waste Study is to provide a high-level evaluation of the economic feasibility, logistical feasibility, and level of flow control in relation to these scenarios. Although operational costs are an important aspect of the decision-making process, estimating those costs accurately are outside the confines of this study and will need to be addressed later if the CBJ moves forward with any of the proposed scenarios. A brief overview of operational considerations is provided in Section 3.1. This technical memorandum provides an overview of the scenarios and presents the findings from the evaluation to inform elected officials and key partners of the feasibility of the three scenarios. The sections of this technical memorandum are organized as follows:

1. Executive Summary
2. Study Background and Limitations
3. Facilities: Capacity, Sizing, and Capital Costs
4. Regulations and Permitting
5. Summary and Recommendations

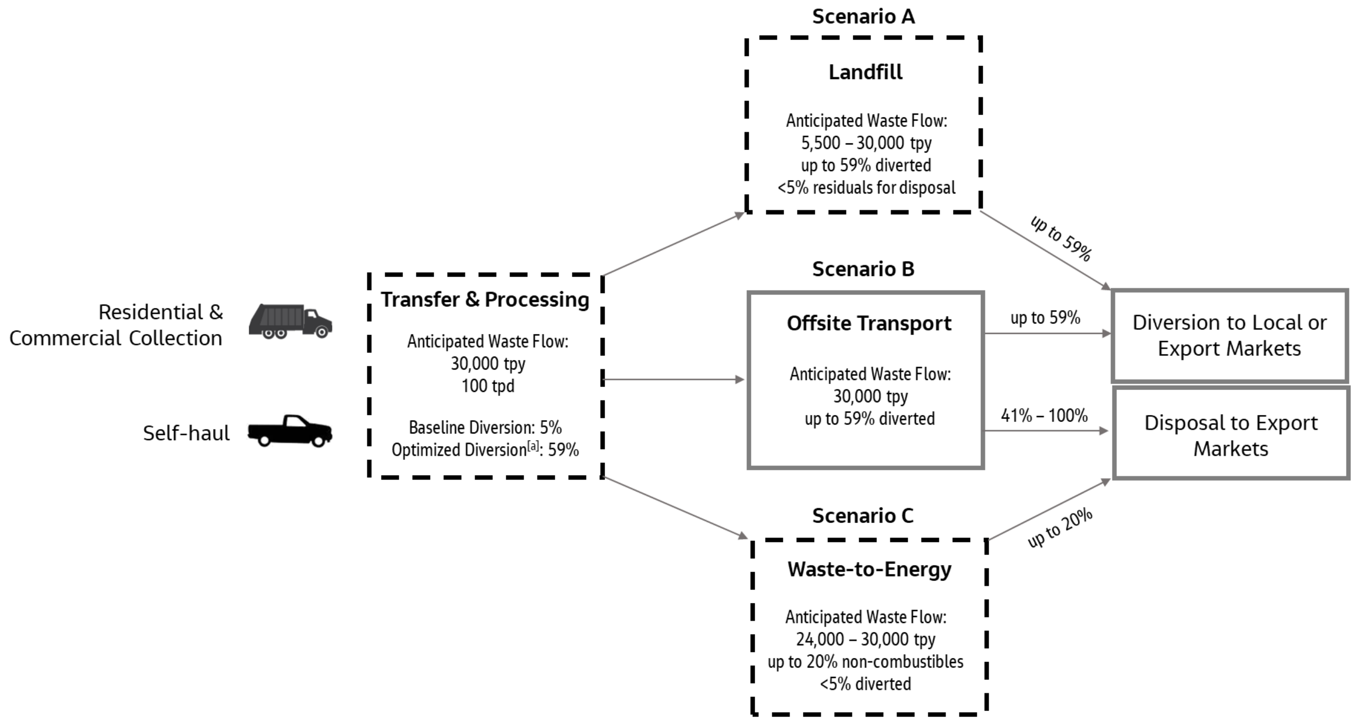
Section 1 synthesizes information from subsequent sections of this technical memorandum to provide an overview of the facility needs, estimated total costs, and considerations for each of the solid waste management scenarios. Section 2 introduces the study objectives and key assumptions required for this high-level evaluation. Sections 3 and 4 summarize the findings from an evaluation of the facilities, permit, and compliance requirements. Section 5 offers a high-level feasibility ranking for each scenario based on the current information, along with the recommended next steps.

1.1 Solid Waste Management Scenarios

This subsection provides an overview of the major considerations for each of the solid waste management scenarios based on analyses of the facilities, costs, and regulatory considerations described in Sections 3 and 4. The anticipated flow of waste in each of the three scenarios is depicted on Figure 1.

[2] Transfer Processing Facility (that is, a Transfer Station): Centralized facility to manage all CBJ waste streams from residents (self-haul) and commercial haulers and consolidate for efficient transportation to end markets.

Figure 1. Flow Diagram of Solid Waste Management Scenarios A, B, and C



[a] Optimized Diversion of 59% was derived from the 2024 Waste Characterization Study (Cascadia Consulting Group 2024).

Note: Boxes with dashed outlines indicate facilities that are anticipated to be under CBJ ownership.

1.1.1 Scenario A

The key distinction in Scenario A is the construction of a landfill within the CBJ. In this scenario, waste would first be taken to a transfer processing facility for processing. At this point, waste is consolidated and loaded into transfer trucks for transport to the landfill. Since the landfill is assumed to be within the CBJ's jurisdiction, the transportation distance between the transfer processing facility and the landfill would be minimal (anticipated less than 15 miles) based on the 1993 landfill siting study (Brown et al. 1993). The transfer processing facility would provide the CBJ with additional control and flexibility for solid waste management, thus the economics of hauling distance between the transfer processing facility and the landfill is not considered as a factor in this scenario.

Key considerations in this scenario include the timeline and capital costs for permitting and constructing a new landfill. A small transfer processing facility, sized between 9,000 and 13,000 square feet, would suffice since the CBJ would have greater control over the waste stream with a local, CBJ-owned landfill. The estimated capital costs range from $59 million to $182 million for constructing both the transfer processing facility and a 50-year landfill.[3] Because of the significant rainfall in Juneau, leachate treatment will be a substantial capital and operating expense for a new landfill. Importantly, since a site has not yet been selected for the landfill, siting and permitting could take 10 years, or up to 30 years with significant delays, to complete.

[3] Landfills are constructed in stages; thus, the total estimated capital cost assumes construction of a 50-year landfill is provided for this initial estimate for Scenario A. Costs can vary significantly depending on the operating conditions and geometry of the landfill. The provided estimates are conservative.

1.1.2 Scenario B

Alternatively, the CBJ may opt not to construct a new landfill or WTE facility. Scenario B involves shipping nearly all solid waste generated in the CBJ to an offsite landfill and recycling markets via barge. This approach avoids significant capital and operating costs for building and maintaining a disposal facility, but the CBJ relinquishes control over the final disposal of MSW, posing risks if barge services are delayed or disrupted. The CBJ can mitigate this risk by ensuring increased storage space at the transfer facility; therefore, the transfer processing facility is especially valuable under this scenario.

The capital costs in this scenario are solely based on construction of a transfer processing facility with increased storage capacity, with capital costs ranging from $14 million to $40 million for a transfer processing facility sized between 13,000 and 26,000 square feet. In this scenario, the cost of offsite transportation is a significant portion of annual costs that may be negotiated with the transportation company. Barge transportation fees vary based on the type of waste (for example, hazardous materials may incur higher costs), volume and weight of the waste, and the distance traveled. Costs for offsite transportation and disposal have been reported to reach up to $250 per ton (DMC Technologies 2003, CBJ 2025b).[4] Fuel surcharges fluctuate based on current fuel prices and will add to the overall cost.

It is important to consider that offsite transportation of waste and recyclables will increase transfer truck traffic, fuel consumption, and associated greenhouse gas emissions from both truck and barge traffic. Additionally, contamination in the waste stream can pose hazards. Fires caused by contaminated waste have occurred during offsite transportation from Alaskan communities, leading to significant danger and expense (Rose 2021). To mitigate this risk, baling or compacting waste in closed containers at the transfer processing facility can minimize fire hazards and reduce transportation frequency. However, this requires local baling equipment and costs, and not all receiving facilities can accommodate bales.

1.1.3 Scenario C

The distinguishing feature of Scenario C is the construction of a WTE facility. In this scenario, waste would first be taken to the transfer processing facility, where it would be inspected for hazards, dried, and shredded in preparation for combustion. The waste then would be fed into the WTE plant and converted into energy. To maximize the efficiency of the WTE facility, nearly all MSW would be directed for combustion, with minimal diversion (such as recycling and composting).

Key considerations include the timeline and capital costs for permitting and constructing a WTE facility and the energy benefit for the CBJ. A small transfer processing facility (9,000 to 13,000 square feet) would suffice with a WTE facility. Estimated capital costs range from $99 million to $110 million for constructing both the transfer processing facility and a WTE facility. Because a site has not yet been selected, siting and permitting must be completed for this scenario; thus, the timeline is expected to be similar to or longer than that of the landfill in Scenario A.

Notably, the CBJ's electricity currently is nearly 100% renewable hydroelectric power and the utility company, AEL&P, does not provide energy credits for surplus generation. As such, the power produced from a WTE plant would offset the parasitic load but not provide an electricity benefit for the CBJ. In addition, the RCA requires that a power purchase agreement (PPA) is established with the electric utility provider for the sale, transmission, and distribution of power. This would be a key aspect of future discussions to advance this scenario.

[4] The cost for the CBJ to ship and dispose of biosolids ranges between $216 to $930 per ton depending on whether the biosolids are shipped wet or dry. The cost is $6,500 per container.

Furthermore, WTE is an advanced technology that requires specialized skills for construction, operation, and maintenance. It may be difficult to find local technicians with the skillset to manage this type of facility, and it may be necessary to bring in and provide lodging for out-of-state contractors. There are many options for waste incineration, including incineration without energy recovery and varieties of WTE technologies, some of which have not been vetted or proven feasible on a commercial scale; a comparison of these options is outside the scope of this study but may be considered by the CBJ in future evaluations.

2. Study Background and Limitations

The CBJ contracted with Jacobs under agreement number E24-328 dated August 19, 2024, to complete a high-level evaluation of the feasibility of three potential solid waste management scenarios, described in Table 1. Each scenario includes the construction of a transfer processing facility to receive and process all waste generated in the CBJ before the waste is routed for final disposal or diversion.

Table 1. Summary of Three Solid Waste Management Scenarios for the City and Borough of Juneau

Scenario	Facilities and Potential Ownership	Key Partners	Waste Streams		
			Waste Disposal	Diversion	Residuals[a]
A. Construct a new landfill and transfer processing facility with recyclables sent south by barge for diversion.	CBJ-owned landfill; CBJ-owned or private partnership transfer facility	Landfill operator; transfer station operator (if separate from CBJ)	Disposed of in new landfill on CBJ property; potential to contract with private company for operation of the landfill	Recyclables diverted to local markets or transported south by barge	Residuals that cannot be landfilled are transported south by barge
B. Construct a transfer processing facility with waste and recyclables sent south by barge for recycling and disposal.	CBJ-owned or private partnership transfer facility	Shipping company; offsite landfill; transfer station operator (if separate from CBJ)	CBJ agreement with offsite landfill for disposal Transportation and disposal fees to be negotiated	Recyclables diverted to local markets or transported south by barge	All waste transported south by barge
C. Construct a WTE facility and transfer processing facility for MSW with noncombustibles, recyclables, and ash sent south by barge for disposal.	CBJ-owned or private partnership transfer facility and WTE facility	AEL&P; WTE operator; transfer station operator (if separate from CBJ)	Incinerated with energy recovery; CBJ energy agreement with AEL&P	Limited diversion to optimize efficiency of WTE plant operations	Noncombustible materials and ash transported south by barge[b]

[a] Residuals are defined as wastes that cannot be landfilled or diverted, such as hazardous waste.

[b] An alternative to shipping ash south by barge is to send it to a local monofill. A new monofill would need to be constructed and is not included as a part of these scenarios.

AEL&P = Alaska Electric Light & Power Company

The evaluation considered readily available data and literature to assess the feasibility of these three scenarios based on the following factors that may affect their feasibility or costs:

- Waste stream composition and quantity
- Estimated capital costs for construction of each facility with a discussion of operating cost components and facility needs
- Federal, state, and local regulations and permit requirements

2.1 Study Assumptions

A variety of assumptions were necessary to perform this high-level evaluation, including the following:

- **Unchanging Waste Tonnage and Composition**: It is assumed that there will be no significant change in waste tonnage or composition over the lifetime of the project. Information on waste composition was derived from the 2024 Waste Characterization Study (Cascadia Consulting Group 2024).
  - Seasonal fluctuations, junk vehicles, and non-CBJ waste are not considered relevant for this comparison. Biosolids are currently shipped south by barge, and planning is underway to build a pyrolysis unit at the wastewater utility for biosolids incineration, so separate treatment for biosolids is not included in this assessment.
  - Specific to tourism, this evaluation did not consider seasonal waste streams from cruise ships, which previously contributed 1,650 tons of waste in 2018 (CBJ 2024a). Under a Memorandum of Understanding (MOU) between the CBJ and the Cruise Lines International Association, the amount of waste entering the Capitol Disposal Landfill from cruise ships was reduced to 125 tons per year (tpy) in 2022.
  - The population of Juneau has remained stable or has declined slightly over the past decade, hovering around 32,000 residents. This evaluation assumes no population growth (Juneau Economic Development Council 2023).
  - The waste stream in the CBJ is assumed to remain consistent in terms of composition, based on the average MSW and construction and demolition (C&D) waste quantities from fiscal years 2016 to 2023. For this evaluation, the average waste stream was approximated at 30,000 tpy. Regional waste streams were not considered in this study but represent another 23,000 tpy (Southeast Conference 2006; Cascadia Consulting Group 2024).
- **Transfer Facility Site Location**: The new transfer processing facility is assumed to be in lower Lemon Creek on a 27-acre site owned by CBJ, approximately 0.4 mile northeast of the Lemon Creek Correctional Center. The site is rural reserve and industrial, with the nearest residential area more than 0.5 mile away. The site was chosen for its central location, suitable soils, topography, and sufficient space to construct a transfer processing facility. Other waste management facilities are in the planning process for this site, including a municipal composting facility, recycling center, and household hazardous waste facility. This study assumes the CBJ would address zoning for this property, as applicable.
- **Other Future Facility Locations**: Locations for the landfill and WTE facility have not been selected yet and additional siting may be necessary.
- **Long-Term Capacity Planning**: Facility capacity calculations are based on standard 50- and 100-year waste stream projections. A regional facility taking more than the current CBJ waste stream would require further assessment of the materials and regions to be served.
- **Diversion Rates**: In this study, diversion is defined as waste materials that are systematically redirected from disposal to be reused, recycled, repurposed for beneficial use, or composted. Diversion does not

include materials incinerated for WTE. This study accounts for management of MSW and C&D waste that is destined for the landfill and assumes that existing facilities are sufficient to manage the current stream of source-separated recyclables (approximately 5% of total waste tonnage), bulky or white goods[5], and household hazardous waste (HHW).

- **Barge Loading Facility Assumptions**: Existing facilities and processes for loading and offsite transportation of materials are assumed adequate for transporting all waste and recyclables. The CBJ may need to further evaluate barge facilities and services to better compare the operating expenses of the scenarios.

2.2 Overview of Solid Waste Management Operations in the CBJ

The CBJ faces several unique challenges in managing its solid waste. Being land-locked by the Juneau Ice Field and Inside Passage, Juneau is an isolated community, resulting in limited disposal and affordable recycling options. Furthermore, the CBJ does not own the Capitol Disposal Landfill or manage waste hauling services, resulting in limited control over the community's waste flow. The landfill is projected to reach capacity in 10 to 15 years, prompting the CBJ to explore alternative waste management solutions (CBJ 2024b).

Since the establishment of the CBJ, the control of solid waste flow has remained in the hands of the private sector. Conversations between the CBJ, the Alaska Department of Environmental Conservation (ADEC), and the RCA have indicated that Juneau is one of only three municipalities in Alaska without public flow control, alongside Haines and Glenallen. For more than 60 years, the majority of MSW in the CBJ has been privately collected under an RCA Certificate of Convenience held by various private entities and hauled to the privately owned Capitol Disposal Landfill. The Capitol Disposal Landfill receives waste from both private commercial haulers and individuals (self-haul). Until the early 2000s, some MSW was incinerated without energy recovery to reduce the volume sent to the landfill (CBJ 2024a). Currently, the CBJ operates a recycling center and an HHW facility at the landfill site, diverting approximately 5% of materials for recycling, including glass, aluminum, and steel cans (CBJ 2024b). Additionally, Juneau Composts!, a private composting business established in 2017, offers collection and drop-off services for food scraps and yard debris, which are processed at their commercial composting facility.

Efforts to expand the landfill have been unsuccessful because of the inability of a private owner to acquire adjacent land, the proximity of the landfill to other land uses, and potential adverse environmental effects on nearby wetlands. The current solid waste management system is delocalized, with MSW, recyclables, HHW, junk vehicles, and C&D processed at different facilities that are geographically or operationally disconnected.

2.3 Waste Stream Quantity and Composition

With a population of approximately 32,000 residents, the CBJ region generated an average of 30,000 tons of MSW annually from 2016 to 2023 (Table 2). Assuming that a waste management facility operates for 300 days a year (6 days per week less an allowance for some holidays and other closures), the CBJ generates an average of 100 tons of solid waste daily that must be managed. Given the relatively static population level in CBJ, this total was applied to the entire period of the solid waste management scenarios. While outside waste streams were not considered as part of this evaluation, they could be factored into the scenarios as the CBJ moves forward with planning.

[5] White goods are large household electrical products, such as refrigerators and washing machines, typically white in color.

Table 2. Tonnage of MSW and C&D waste Landfilled in the CBJ Between 2016 to 2023

Fiscal Year (July to June)	MSW (tons)	C&D (tons) [a]	Total (tons)
2016	23,542	8,555	32,097
2017	23,760	8,065	31,825
2018	23,735	6,968	30,703
2019	23,867	6,011	29,878
2020	20,626	7,299	27,925
2021	22,398	5,730	28,128
2022	24,750	4,138	28,888
2023	22,346	5,176	27,522
Average	23,128	6,493	29,621
Rounded Average[b]	23,500	6,500	30,000

Source: MSW and C&D totals per Fiscal Year provided by Waste Management.

[a] C&D waste is variable based on local construction projects and timelines.

[b] Values rounded up to the nearest 500th to approximate waste for capacity calculations.

In 2024, the CBJ contracted Cascadia Consulting Group to conduct a Waste Characterization Study. This study revealed a significant potential for increased waste diversion: 18% of waste is recyclable, 32% is compostable, 9% is reusable, for a total of 59% diverted under optimized diversion programs that are currently in place (Cascadia Consulting Group 2024).

Based on the waste quantities provided by Waste Management (Table 2) and the types of waste from the CBJ's Waste Characterization Study, the amount of diversion under each scenario is estimated to be as follows:

- Scenario A: recyclables for diversion
  - Baseline Diversion (5%): 1,500 tpy
  - Optimized Diversion (59%)[6]: 17,500 tpy
- Scenario B: recyclables for diversion
  - Baseline Diversion (5%): 1,500 tpy
  - Optimized Diversion (59%): 17,500 tpy
- Scenario C: non-combustible recyclables for diversion
  - Baseline Diversion (5%): less than 500 tpy
  - Optimized Diversion (59% of approximately 20% non-combustibles [Cascadia Consulting Group 2024]): 3,500 tpy

The amount exported for offsite disposal in each scenario is estimated to be as follows:

[6] The optimized diversion rate is derived from the 2024 Waste Characterization Study performed by Cascadia Consulting Group (2024). This 59% diversion represents the total amount that could be diverted through diversion programs that are already in place, including recycling, composting, household hazardous waste disposal, and reuse.

- Scenario A: less than 1,500 tpy of residuals for disposal
- Scenario B: 12,500 – 30,000 tpy of waste for disposal
- Scenario C: less than 6,000 tpy of noncombustibles for disposal

2.4 Concurrent Regional Planning

An effort is now underway by Southeast Conference and the Southeast Alaska Solid Waste Authority (SEASWA) to develop a Regional Municipal Solid Waste Strategy. The project will include a thorough analysis of methods and processes for the disposal of MSW to better control the costs of handling, processing, shipping, and ultimate disposal of MSW in the region. The strategy seeks to improve solid waste disposal services for Southeast Alaska communities through a collaborative effort of towns and governmental agencies. The goal of the project is to identify how to achieve safer, more efficient and cost-effective waste management systems for Southeast Alaska communities by fully exploring available options and technologies used in the management of MSW, including diversion of compostable and recyclable materials, waste to energy opportunities, and finding mutually agreeable resolutions for Southeast Alaska communities, Tribes, and SEASWA members (CBJ 2025c).

Although not the focus of this technical memorandum, the community of Juneau and the CBJ may choose to consider sizing a future disposal facility to capture this regional waste in order to maximize efficiencies of scale, which could help financially support the operational needs of the facility while providing other communities with a regional disposal option.

3. Facilities: Estimates of Capacity, Sizing, and Costs

This section presents the methodology used and estimates for the capacity, sizing, and potential capital costs of solid waste management facilities for the three scenarios. The solid waste management scenarios that are introduced in Table 1 and elaborated on in Section 4 involve various combinations of these facilities; thus, this section describes each facility individually. For example, the transfer processing facility is applicable to all three scenarios, while the landfill and WTE facility are specific to Scenarios A and C, respectively.

Jacobs estimated future facility capacity needs based on a total generation of 30,000 tpy of waste for processing, transferring, diversion, and disposal, as shown in Table 1.

This study assesses the potential cost ranges for each scenario by conducting a high-level review of publicly available information on construction and operating expenses. The cost ranges also incorporate internal estimates provided by Jacobs for other projects, as well as the industry expertise of Jacobs and their subconsultant, Raftelis. With expertise in economic and feasibility analyses for Juneau, Raftelis provided industry insight to validate the estimated WTE facility costs and assumptions for this study. Prior to making financial decisions or establishing final budgets, the CBJ should conduct a detailed evaluation of capital and operating costs that is based on engineer's estimates and considers specific facility conditions and sites.

The anticipated capital costs for a new transfer processing facility and landfill were estimated using the construction costs of five U.S. transfer stations and three landfills. Because of the unknown timeline for financing and construction of the facilities in Juneau, costs per unit area were calculated and inflated to first quarter (Q1) 2025 prices using the *Engineering News-Record* (ENR) Construction Cost Index. These costs were further adjusted for Juneau-specific expenses using the RSMeans 2024 City Cost Index. An additional 30% markup was added to the adjusted unit costs for facility examples located outside of Alaska based on the CBJ's experience with actual cost inflations for factors such as materials shipping and storage in Juneau (CBJ 2025a).

The cost to build a new WTE facility was modeled based on the construction costs for 18 different WTE plants of varying capacities constructed in the United States, United Kingdom, and Asia. The modeled capital costs for a WTE facility were adjusted to Q1 2025 and inflated for Juneau by applying a 30% markup to the forecasted construction cost.

The collection of solid waste is considered a utility in the state of Alaska; therefore, it is regulated by the RCA. In previous years, the CBJ considered purchasing the Certificate of Convenience and Public Necessity from the certificate holder (currently Alaska Waste) along with other strategies as part of a larger solid waste management strategy (CBJ 2008). It is not necessary to own a refuse hauling utility Certificate of Convenience to operate a solid waste management disposal facility. The Certificate of Convenience holder must justify all rate increases to the RCA and will seek out the lowest cost options for their rate payers.

As this study is focused on post-collection disposal options, and to avoid skewing the capital cost estimates for a particular scenario, the purchase of the RCA Certificate of Convenience is not included as a component of any scenario.[7]

3.1 Additional Preconstruction and Operating Costs

In addition to facility construction costs described in the following sections, preconstruction costs can be approximated as a percent of total capital costs from 15% to 25% of the total project cost.[8] These expenses cover site surveys; environmental impact assessments; state and local permitting; creation of architectural, design, and engineering plans; and services during construction. Proper planning in this phase is crucial to ensure the project meets all regulatory requirements and operates efficiently.

Operating costs include labor, equipment, maintenance, utilities, and insurance, all of which are necessary to keep the facilities running smoothly. Labor and equipment commonly constitute the largest portion of overall operating costs. For instance, at the Great Falls Landfill in Montana, heavy equipment rental, labor hours, and benefits make up 74% of the estimated operating expenses (AE_2S and Jacobs 2021). Operating WTE facilities may require advanced equipment and facilities, which require specialized skills at a higher labor expense.

Although this study does not investigate or compare operational costs for these facilities, it is important to note that available data shows that the cost per ton to dispose of waste through a WTE facility is often higher, and in some cases more than twice the cost of landfill disposal or offsite shipment (Arsova et al. 2008, DOE 2019).

These preconstruction and operating costs are not included in subsequent estimates of cost ranges provided in this evaluation because of the many unknowns associated with these activities. The level of analysis needed for estimating operating costs is beyond the scope of this evaluation and should be considered as the CBJ moves forward with planning.

3.2 Ownership Models

The CBJ can explore various ownership models for new facilities and solid waste management services that are described in this memorandum. The CBJ may choose to form a partnership with the private sector for financing, ownership, and operations of the solid waste management system to find a balance of

[7] The price to purchase the Certificate of Convenience was quoted at $14 million in 2008 (Cascadia Consulting Group 2024, CBJ 2024a). Acquiring the RCA Certificate of Convenience from the current certificate holder, Alaska Waste, is an independent action that could apply to any scenario.

[8] Approximate range based on industry practice.

control and risk (Table 3). In addition to the current model of private ownership and operation, examples of different ownership models include the following:

- **Public-private partnership**: The public and private entities share responsibility and risk for different aspects of the solid waste management system, such as collection, transportation, processing, and disposal facility ownership and operation. Sometimes, a public entity will provide the land for a solid waste facility but then enter into an agreement with a private entity for the design/build or design/build/operation of a solid waste facility. The division of control and financing is determined by agreements between the public and private entities, such as publicly owned facilities with privately owned or contracted collection services.
- **Publicly owned with limited private involvement under contract**: The public entity contracts with private companies for select roles. Potential roles that the private sector could contribute to are facility design, construction, and some collection or operating activities. The public entity is responsible for financing the facility and relinquishes some control over rate changes, but with reduced risks and staffing requirements.
- **Publicly owned and operated**: The public entity finances, owns, and operates the entire solid waste management system using internal resources. The public entity has maximum control over the entire process from construction through operation, is responsible for all financing, and accepts all risks.

Table 3. Benefits, Risks, and Examples of Ownership and Operation Models

Ownership/ Operation Model[a]	Public Entity's Role	Benefits to Public Entity	Risks to Public Entity	Example
Public-Private Partnership	Division of control and financing determined by agreements	Benefits shared between public and private entity (specifics depend on division of roles)	Risks shared between public and private entity (specifics depend on division of roles)	Public entity owns facility but enters into an agreement with private entity to construct and operate; private bidder arranges for financing to cover capital costs
Publicly Owned, Limited Private Involvement Under Contract	Facility and RCA ownership, establishes competitive procurement process for private services	Freedom to select services and contractors through bids; reduces burden on internal resources	Subject to rate increases, especially if there are fewer competing contractors	Public entity owns entire solid waste management system and contracts with private entities for specific services through competitive process
Publicly Owned & Operated	Owns and manages entire solid waste management system	Maximum control over rates and services	Public entity accepts all risks and is responsible for all financing	Public entity finances construction and manages all solid waste operations

[a] General ownership models, regardless of chosen scenario, and not specific to Juneau.

3.3 Transfer Processing Facility

The purpose of the transfer processing facility is to provide the necessary space and flexibility to manage waste disposal and diversion, regardless of the scenario. The CBJ assumes that a transfer processing facility is necessary for all three scenarios for initial waste processing and consolidation prior to transporting to the final disposal or diversion facility.

Functionally, waste from commercial haulers and residents is unloaded at the transfer processing facility, sorted, and consolidated into intermodal containers or transfer vehicles for recycling and disposal elsewhere. The facility could be constructed with separate drop-off locations for source-separated recyclables and compostables.

3.3.1 Capacity and Sizing

The transfer processing facility should have sufficient storage to handle temporary changes in the waste stream. The necessary storage, equipment, and operations at a transfer processing facility depend on the ultimate disposal method (landfill, WTE, or offsite shipment) because different processes are required to prepare waste for disposal, shipment, or incineration (sorting, shredding, or loading onto transfer trucks versus intermodal containers). Thus, the estimated size of the transfer station varies between the scenarios. Additional discussion of transfer station needs for each scenario is included in Section 4. The capacity of the transfer processing facility is highly dependent on operating conditions; for example, the types and numbers of residential or commercial hauling vehicles, the desired storage capacity, and the degree of waste recovery and sorting.

When there are reliable waste disposal options nearby, such as a landfill or WTE facility, transfer stations generally are designed to have 1 to 2 days of storage capacity. Although more-detailed calculations of facility space are required prior to the design stage, initial estimates suggest a tipping floor space of at least 6,000 square feet to manage 100 tons of waste per day (tpd) and a peaking factor of 2.3.[9,10] Comparisons to constructed transfer stations across the United States, along with CBJ input, indicate that a transfer processing facility sized between 9,000 and 13,000 square feet would be sufficient to meet current and future needs and an allowance for the peaking factor, assuming reliable waste disposal facilities also are available within the CBJ.

However, if the CBJ chooses to transport all waste and recyclables to a distant offsite facility by barge (Scenario B), it is recommended to increase the size of the transfer processing facility to include additional storage space in case of unexpected disruptions to offsite transportation services. This is especially important in a remote and isolated location such as Juneau. A transfer processing facility that prepares waste for offsite disposal is assumed to be sized between 13,000 and 26,000 square feet to accommodate 7 to 14 days of storage and additional processing space.

The CBJ may consider facilities to centralize drop-off and processing of additional waste streams, such as white goods, organics, and junk vehicles, as well as a repair and reuse staging area and compost sales area. These additional prospective elements are not included in subsequent estimates of cost ranges.

3.3.2 Construction Costs

Table 4 outlines the approximate unit construction costs for five example transfer stations located across the western United States. These examples provide rough approximations of estimated construction costs for transfer station facilities with various design capacities and services. All facilities include tipping floor space with at least 1 day of waste storage and vehicle stalls, while the larger facilities include additional features like office buildings, parking areas, and recycling and HHW drop-off areas. These examples are

[9] The U.S. Environmental Protection Agency suggests approximating tipping floor space by starting with a base area of 4,000 square feet and adding 20 square feet for each ton of waste received in a day. This assumes the height of the waste pile at 6 feet. Using this approximation, the tipping floor space required to manage 100 tons per day of waste is at least 6,000 square feet.

[10] Peaking factor calculated from average and peak daily waste totals for 2024 provided by Waste Management.

based on estimates acquired at different stages, such as planning level to engineer's estimates, to provide a range of potential construction costs. The adjusted cost per unit size illustrates the escalated unit costs through Q1 2025 and adjusted for Juneau. As demonstrated by these examples, larger facilities generally are more cost-effective per unit area.

Table 4. Examples of Estimated Construction Costs for Four Example Transfer Stations

Name	Location	Estimate Stage	Estimate Year	Facility Size (SF)	Cost per SF	Adjusted Cost per SF[a]
Central Transfer and Recycling Station (Clark County Environmental Health 2023)	Washington	Class 3 planning estimate	2023	63,000	$540	$800
North Area Recovery Station (County of Sacramento 2023, Jacobs 2020)	California	Engineer's estimate	2023	51,000	$680	$920
Municipality of Anchorage Central Transfer Station (Waste Advantage 2024)	Alaska	Construction estimate	2024	133,000	$800	$1,000
Great Falls Transfer Station (AE_2S and Jacobs 2023)	Montana	Class 4 planning estimate	2023	11,000	$630	$1,040
New Transfer Station in Portland Region[b]	Oregon	Order-of-magnitude estimate	2023	13,000	$1,000	$1,550

[a] The adjusted costs per acre were inflated to Q1 2025$ using the ENR Construction Cost Index and tailored for Juneau using City Cost Index values from RSMeans, as well as an additional 30% markup to account for cost inflations for materials shipping and storage in Alaska.

[b] Costs were derived from internal estimates for other projects, which are not publicly available.

SF = square foot (feet)

Based on the examples in Table 4 and assuming the higher range of per-unit construction costs for smaller facilities, the estimated construction cost ranges for a transfer processing facility are as follows:

- Transfer processing facility, prepares MSW for local disposal: $9 million to $20 million (2025$)
- Transfer processing facility, prepares MSW for offsite transport: $14 million to $40 million (2025$)

These estimated capital costs are for the initial cost of the facility and do not include equipment replacement costs, which typically occur every 5 to 20 years, or infrastructure repairs, typically every 50 to 75 years.[11] These estimates also do not factor in construction additions such as roads, utility connections, bridges, water management, intermodal container loading areas, or geotechnical needs for the site, which could add considerable costs. Furthermore, optional features such as centralized drop-off areas and public amenities may add to the size estimates. These features may be considered based on the needs of the CBJ and goals for creating a centralized drop-off location for waste.

[11] Approximate range based on industry practice.

3.4 New Landfill

Anticipating future solid waste management needs, the CBJ identified three potential landfill sites in the early 1990s, based on regulatory requirements, CBJ-specific criteria, and in-person reconnaissance (Brown et al. 1993). All three sites have enough space for a landfill; are set back from population centers, homes, and the Juneau Airport; and are close to existing or planned roads. Two of these sites are owned by CBJ and are near Lemon Creek in Hidden Valley between the CBJ's North Lemon Creek material source and the SECON company's material source, while the third is federal land in the Tongass National Forest across from Amalga Harbor. A new or updated siting study will be required for a Juneau landfill.

3.4.1 Capacity and Sizing

Capital estimates can vary based on landfill geometry and design parameters. Additionally, the lifespan of a landfill is highly variable, influenced by factors such as how the air space is filled, cover and soil utilization, compaction rate, and various operational parameters that depend on the selected site, implemented design, and operational efficiency. For example, a smaller footprint, such as 20 acres for a 100-year landfill, is possible with greater operational efficiencies and optimal geometry (including height) using the same values for all other estimating assumptions. Without an understanding of these unknowns, conservative estimates were used in calculations that result in a larger landfill footprint and increase the landfill capital cost.

The necessary size of a new landfill for both 50- and 100-year design capacities was estimated based on several possible geometries and a waste flow of 30,000 tpy. Sizing estimates were calculated for both the landfill fill area and the total site area. The landfill fill area refers to the lined modules that will receive the waste, while the total size area also accommodates access and operational roads, buffer space, environmental monitoring networks, stormwater and leachate management systems, equipment yards and maintenance areas, an entrance/gate area, security systems, scale houses, and gas collection and management systems.

Based on these factors, the approximate size of a 50-year landfill is as follows:

- Total landfill volume (including cover materials) = 2.5 million cubic yards
- Landfill fill area = 30 to 50 acres
- Total site area = 50 to 100 acres

The approximate size of a 100-year landfill is as follows:

- Total landfill volume (including cover materials) = 5 million cubic yards
- Landfill fill area = 60 to 100 acres
- Total site area = 100 to 200 acres

It is important to note that capital costs are not applied over the same time period across all constructed facilities. For example, the landfill capital would be applied over a 50-year period, while the transfer station and WTE may require significant replacement capital over the same 50-year period. Assessment of these factors would be completed with a more comprehensive economic analysis.

3.4.2 Construction Costs

The basic costs for landfill construction include expenses for ground clearing, excavation, and constructing landfill cell components such as perimeter berms, clay liners, geomembranes, soil modification, and leachate conveyance systems. A contingency fund of 10% to 30% of the total construction cost is commonly included to cover unforeseen expenses and project delays.[12] Table 5 outlines the unit construction costs for three landfills located in Alaska and California for comparison. The adjusted cost per unit size illustrates adjusted costs through Q1 2025 and inflated for Juneau.

Table 5. Examples of Estimated Construction Costs for Three Example Landfills

Name	Location	Estimate Stage	Estimate Year	Landfill Footprint (Acres)	Cost per Acre	Adjusted Cost per Acre[a]
Anchorage Landfill Expansion[b][c]	Alaska	Construction bid	2020	15	$419,500	$477,500
Western Placer Waste Management Authority Landfill (Jacobs and CH2M 2019)	California	Class 4 planning estimate	2018	253	$1,008,000	$1,654,000[d]
Kodiak Landfill[c]	Alaska	Payment Records	2013 to 2016	10	$2,282,500	$3,232,000

[a] The adjusted costs per acre were inflated to Q1 2025$ using the ENR Construction Cost Index and tailored for Juneau using City Cost Index values from RSMeans.

[b] Costs to construct landfill cells only; operating and maintenance facilities not included.

[c] Costs were derived from internal estimates for other projects, which are not publicly available.

[d] Adjusted cost includes an additional 30% markup to account for cost inflations for materials shipping and storage in Alaska.

The landfill construction for Anchorage was a landfill cell expansion project; therefore, the costs did not include the construction of operational buildings for staff or equipment or other components for new landfills that would add to the costs. In contrast, the Kodiak landfill project is more comparable to what would be required in Juneau. The construction cost for the Kodiak landfill included major access roads and a dedicated leachate treatment plant with operations control rooms for staff. Since the lined landfill cells generated large volumes of leachate that could not be processed by the existing wastewater treatment plant, a new leachate treatment plant was necessary. Similarly, a new landfill in the CBJ may need its own leachate treatment plant if the existing wastewater treatment plant cannot handle the leachate treatment, leading to higher construction costs that are comparable to those of the Kodiak landfill. In addition, similar to Kodiak, factors such as high rainfall, glacial soils, remote location, and seasonal weather events leading to construction delays will increase capital costs for a new landfill in the CBJ.

Based on the examples in Table 5 and assuming the higher range of per-unit construction costs, the estimated construction cost ranges for the landfill footprint are as follows:

- 50-year landfill: $50 million to $162 million (2025$)
- 100-year landfill: $99 million to $323 million (2025$)

The landfill costs can vary significantly depending on the operating conditions and geometry of the landfill, so the provided estimates are conservative.

Because a landfill is built in stages, a reasonable assumption at this time would be that up to half of this cost would be paid up front. The initial capital outlay could be much lower than the total capital costs identified above, as these capital costs are provided as a conservative estimate for landfill cell

[12] Approximate range based on industry practice.

construction. Additional capital for future landfill cell construction could be accrued as part of tip fees. These estimates also do not factor in excessive construction additions such as major roads, utility connections, bridges, water management, or geotechnical needs for the site, which could add considerable costs.

When a landfill is at capacity, the landfill must be capped and covered, the costs for which are not included in these capital cost estimates. Post-closure requirements include a minimum of 30 years of ongoing monitoring and reporting.

3.5 Waste-to-Energy Facility

A WTE facility uses waste as fuel to initiate the conversion of combustible waste into electrical power under tight environmental controls. WTE can reduce the volume of landfilled materials by up to 90% and requires a smaller footprint compared to landfills. However, given the relatively low waste tonnage within the CBJ, diversion practices such as recycling and composting will need to be minimized to maximize operating efficiency. Additionally, WTE facilities also can mitigate issues related to odor and wildlife attraction because the waste is enclosed. A facility that recovers and utilizes combined heat and electricity will have similar limitations.

A siting study is needed to evaluate potential locations. Interconnecting the WTE facility involves considerations such as connecting to transformers and transmission lines, ensuring reliability during emergencies, having backup energy sources, managing peak and deficit periods, and assessing the energy's value. The facility must be near the existing power infrastructure or have space for new transformers, roads, and utilities. Early consultation with CBJ's public utilities company, AEL&P, is essential for siting and costing the WTE facility.

3.5.1 Capacity and Sizing

Fewer than 10% of WTE facilities in the United States are designed to process less than 200 tpd of waste. In contrast, 60% of these facilities handle more than 800 tpd of waste (Michaels and Krishna 2018). Constructing and operating larger facilities likely offers improved economics due to economies of scale. At just 100 tpd of waste generated in Juneau, the CBJ will likely want to consider minimizing diversion and routing all combustible recyclables to the WTE system to make it economical, and even so would likely suffer from low thermal efficiency and power output. Adding regional waste could add approximately 77,000 tpd (23,000 tpy) but will also require increased inter-regional shipping options (Southeast Conference 2006). The design and capacity of the WTE plant is further impacted by parameters of the selected technology, such as the boiler system pressure, type of condensing device (air or water cooled), heat source to pre-heat combustion air, and the number of boilers and turbines.

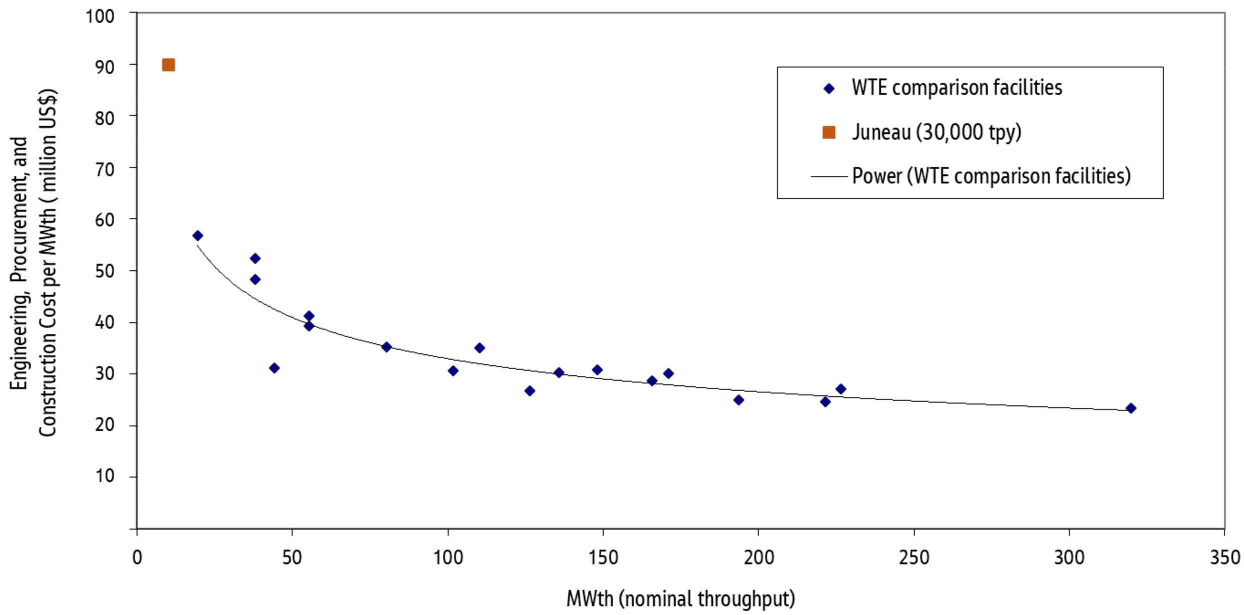
3.5.2 Construction Costs

Figure 2 depicts the forecasted construction cost for a small WTE facility to process 30,000 tpy of MSW at approximately $90 million (2025$).[13] It is notable that facilities of this small capacity are limited, and the dataset used to generate the estimate did not include any facilities below an annual waste throughput of 60,000 tpy, which may introduce additional uncertainty to the estimate. Construction costs for WTE plants will be impacted predominantly by the size and capacity of the facility and the caloric value of the waste

[13] This estimate is considered an order-of-magnitude Class 5 as defined by the Association for the Advancement of Cost Engineering International (AACE International) with a range of accuracy between +100% to -50%. An additional 30% markup was added to account for cost inflations for materials shipping and storage in Alaska. The capital cost for a WTE facility was derived using different estimating methods than for a landfill and transfer processing facility, and the variability in the estimate is reflected in this range of accuracy. All cost estimates should be reassessed for budgeting and financing.

stream. The calculations for the 30,000 tpy facility used a calorific value of 9.2 megajoules per kilogram, which is typical for MSW in the U.S. The CBJ's waste likely will have a higher moisture content, leading to a lower heating value.

Figure 2. Modeled Engineering, Procurement, and Construction Costs per Megawatt of Nominal Throughput



These estimated capital costs are for the initial cost of the facility and do not include equipment replacement costs, which typically occur every 5 to 20 years, or infrastructure repairs, typically every 50 to 75 years.[14] The highly complex nature of WTE systems could increase the frequency of facility or equipment replacement. These estimates also do not factor in excessive construction additions such as roads, utility connections, bridges, water management, or geotechnical needs for the site, which could add considerable costs.

As the power trendline in Figure 2 indicates, there is an economic benefit of constructing large facilities with the capacity to produce approximately 100 megawatts or more of thermal energy (MWth). For example, in 2019, Anchorage, Alaska, estimated that a WTE facility constructed to manage greater than 300,000 tpy of MSW would cost approximately $322.7 million (2019$) (Municipality of Anchorage 2019). In contrast, the municipality of Skagway operates a batch load incinerator to process just 1,300 tpy of waste (Respec 2024). Batch load incineration processes, preferred over continuous systems for smaller communities, use a dual-chamber system with intermittent burning and cooling periods, requiring a smaller footprint and fewer pollution control systems. The total construction cost for this facility was $2.4 million (1998$) (Southeast Conference 2021). As a simple comparison, the facility costs per ton of waste managed by the facility are as follows:[15]

- Anchorage: $322.7 million/300,000 tpy = $1,076 per ton (2019$)
- Skagway: $2.4 million/1,300 tpy = $1,846 per ton (1998$)

[14] Approximate range based on industry practice.

[15] Provided as a high-level comparison to illustrate the impact of economies of scale on WTE facility costs. The actual cost per ton for a WTE facility is affected by several factors, including the caloric efficiency of the waste stream, operational expenses, revenues from power generation, and additional considerations not included in this simplified calculation.

Despite more than 20 years of inflation, differing regulatory requirements, and advancements in technology, the per-ton cost to construct the smaller Skagway facility was approximately 70% higher than the estimate for the Anchorage facility.

4. Regulations and Permitting

Regulations impacting the design, construction, and operation of new solid waste management facilities affect the feasibility of each scenario. These facilities must comply with federal, state, and local regulations on land use, air quality, waste handling, and stormwater management. If discharging liquids into the municipal sanitary sewer system, wastewater monitoring and pretreatment may be required. This section summarizes the key components and highlights major regulations and permitting. A comprehensive list of relevant regulations and permits is provided in Appendix A. Key considerations for regulations and permitting are listed in the following sections.

The U.S. Environmental Protection Agency (EPA) has authorized Alaska to implement federal landfill requirements under the Resource Conservation and Recovery Act (RCRA), Subtitle D. All facilities must adhere to the National Pollutant Discharge Elimination System, the Clean Air Act, and state and local permits for siting, design, construction, and operation.

4.1 Waste Storage, Disposal, and Operations

Municipal solid waste landfills in Alaska must adhere to state permitting requirements for waste disposal management, including applying for a waste disposal permit and complying with siting, design, and operating standards, as defined by the ADEC under Title18 of the Alaska Administrative Code (AAC), Chapter 60, including requirements for landfill location, liners, leachate collection and removal, operating practices, stormwater controls, groundwater and landfill gas monitoring, landfill closure, post-closure requirements, and financial assurance.

Transfer facilities must comply with waste accumulation, storage, and treatment requirements for nuisance, animals and vector control, and runoff requirements (18 AAC 60.010). There also may be waste storage limits anticipated in the permits for transfer and WTE facilities. Owners or operators of landfills are required to provide financial assurance for the cost of landfill closure and post-closure under 18 AAC 60.265, which should be considered alongside an assessment of the operating model.

4.2 Environmental and Hydrology

If federal funding is secured for the construction of a future solid waste disposal facility, it may trigger the National Environmental Policy Act of 1969 (NEPA), which is a federal law that establishes a national policy for protecting the environment. The project proponent (CBJ) will be the entity responsible for NEPA compliance; this process typically involves partner engagement, environmental review, and some level of permitting depending upon the site location. The NEPA process addresses a broad grouping of environmental and cultural resource impacts, which could obstruct development of a new project.

Stormwater and regional hydrology, along with consistent high precipitation, would need to be considered during the design, construction, and operating stages of all facilities to ensure site stability and proper drainage. If stormwater runoff from the site reaches surface waters, an Industrial Stormwater Permit, which includes a Stormwater Pollution Prevention Plan and the application of control measures, would be necessary.

4.3 Air Quality

Subtitle D of RCRA and the Clean Air Act are the typical federal regulations to control pollutants and ensure air quality standards. The EPA requires that landfill gas is controlled by converting it to energy, by collecting and selling it, or by flaring it to convert methane into carbon dioxide (dependent on operating size). Furthermore, if a landfill generates 25,000 metric tons or more of carbon dioxide equivalent annually, it must report greenhouse gas emissions through the EPA's Greenhouse Gas Reporting Program.

Air quality regulations tend to be the primary concern for WTE facilities in particular. The EPA New Source Performance requires enhanced air emissions monitoring for new WTE facilities, and ADEC has adopted these standards by reference under 18 AAC 50.040. In addition, all facilities subject to federal emission standards of the Clean Air Act must obtain a Title V Operating Permit. Particulate matter in the form of fugitive dust and fly ash, as well as noxious gases such as hydrogen chloride, sulfur oxides, volatile organic compounds (VOCs), hazardous air pollutants (HAP), and nitrogen oxides, are regulated under an operating permit and thus must be controlled from WTE facility emissions. WTE facilities use various air pollutant control technologies to eliminate these emissions, including scrubbers, filters, and reaction vessels. Continuous monitoring may be required to demonstrate that emissions are within air quality limits. A minor permit through ADEC is required for facilities with the potential to emit over permit thresholds and with a capacity greater than 1,000 pounds per hour (18 AAC 50.050(a) and (b)). Locally, the Mendenhall Valley Area has a Particulate Matter Maintenance Plan that might need to be considered during design, operation, and monitoring.

The future of federal air pollution regulations for municipal combustion facilities is unknown; the EPA has delayed the final update to air pollution regulations for large municipal waste combustors until December 22, 2025 (Wallace 2024a). Political opposition and regulatory changes could be an ongoing barrier to the success of WTE facilities in the United States (Wallace 2024b; Senior 2024).

4.4 Ash

For WTE facilities, ash consists of remaining solids that were not converted to energy during combustion. Typically, ash makes up 5 to 15% of the volume of processed MSW. If ash generated from waste combustion exceeds toxicity limits under 40 *Code of Federal Regulations* Section 261.24, it is considered a hazardous waste and must be considered as such when preparing it for transportation to offsite disposal. This situation is common. However, even if the ash does not exceed toxicity limits, it is still considered a nonhazardous secondary material and may require special permitting and disposal precautions (EPA 2024).

4.5 Timeline Considerations

Public opposition often makes it difficult to site new solid waste facilities, particularly landfills and WTE plants, near population centers because of concerns about nuisances, visual impacts, and potential health and safety risks (EPA 2002). NEPA and the public engagement and hearing processes for permits typically are the primary avenues for capturing these concerns. Therefore, permitting any type of solid waste facility can take many years, or even decades, because of multiple stages of review, partner engagement, public consultation, and potential legal challenges. If a NEPA process is not triggered, a public comment period of at least 30 days is required by ADEC to ensure the public has an opportunity to provide input on applicable permits. There could be a range of other public comment, meetings, or involvement cycles depending on the nature of construction, such as whether land use designation changes are required or the extent of air permits required. In general, regardless of NEPA, the CBJ should anticipate the permitting timeline to be a multi-year process with project siting, design, regulatory review, and public engagement.

Generally, in Jacobs' experience, transfer station permitting is less complex and, therefore, more streamlined than landfill and WTE permitting. Permitting is just one aspect of site development, which also includes siting, design, construction, and startup. Jacobs typically observes the following general timelines:

- Developing a new transfer station typically takes at least 5 years, assuming the site has been selected and includes design, permitting, construction, and startup.
- New landfill development usually takes 7 to 10 years, with siting being a major variable. Some projects have taken more than 30 years because of delays in siting and permitting.
- WTE facilities are rarely developed nationwide, and none have been developed in Alaska to date; as such, the design process is complex, and the permitting cycles are not clearly defined. It is expected that permitting for a WTE facility would take at least as long as a landfill, if not longer. Preconstruction air quality monitoring and permitting alone can take 3 years or more.

5. Summary and Recommendations

This study provides an initial, high-level evaluation of three solid waste management scenarios. Table 6 outlines the estimated capital costs, pros, and cons for each scenario discussed in Sections 2 through 4 and also provides a relative feasibility ranking based on the following criteria agreed to with the CBJ as part of the project kickoff and as refined over the course of the project:

- Relative estimated capital costs and discussion of operating cost components
- Overall environmental impacts
- Ability to address waste streams and the CBJ's goals for diversion

Table 6 separately lists the capital costs, and the remaining criteria are included as part of the overall pros and cons. Community and key partner buy-in will be addressed by the CBJ separately from this high-level feasibility evaluation. Additionally, all the alternatives seem to be feasible from a regulatory standpoint, although their complexity and timelines will differ. The rankings are subject to change as the CBJ investigates funding opportunities and offsite shipping contracts.

Table 6. Pros, Cons, Cost Ranges, and Relative Feasibility Rankings for Each Scenario

Scenario	Capital Cost Range[a]	Pros	Cons	Feasibility Ranking
A. Construct a new landfill and transfer processing facility with recyclables sent south by barge for diversion.	Transfer Processing Facility = $9 million – $20 million 50-year Landfill[b] = $50 million – $162 million **Total = $59 million – $182 million**	▪ High level of control over operating costs, rates, and solid waste flow.	▪ Construction of a new landfill is expensive. ▪ Siting and permitting likely to take an extensive amount of time. ▪ Operating costs would be sustained by the CBJ unless the CBJ enters into an operating agreement with a private company. ▪ Leachate treatment and stormwater management could be a significant cost factor.	2
B. Construct a transfer processing facility with waste and recyclables sent south by barge for recycling and disposal.	**Transfer Processing Facility = $14 million – $40 million** (offsite shipping costs negotiated in transportation contract)	▪ No capital costs to construct a new solid waste management facility. ▪ Minimal regulatory requirements without a landfill or WTE facility.	▪ Offsite transportation costs, impacts, and availability of markets to accept material are outside of CBJ control; exposure to financial risks. ▪ Operating costs are transferred into higher fees from the hauler and operator.	1
C. Construct a WTE facility and transfer processing facility for MSW with noncombustibles, recyclables, and ash sent south by barge for disposal.	Transfer Processing Facility = $9 million – $20 million WTE = $90 million[c] **Total =** **$99 million – $110 million**	▪ High level of control over operating costs, rates, and solid waste flow. ▪ Minimizes solid waste volume and land use impacts.	▪ Diversion would likely be minimized to optimize efficiency of energy recovery. ▪ No potential for revenue from net metering. ▪ Does not improve the renewable energy profile for the CBJ. ▪ WTE requires a high level of expertise and is more expensive to construct and operate than the other scenarios.	3

[a] Capital costs are not applied over the same time period across all scenarios. For example, the landfill capital would be applied over a 50-year period, while the transfer station and WTE may require significant replacement capital over the same 50-year period. Assessment of these factors would be completed with a more comprehensive economic analysis.

[b] Landfill construction costs are calculated based on the estimated size and capacity of a 50-year landfill for the CBJ. Costs can vary significantly depending on the operating conditions and geometry of the landfill. The provided estimates are conservative.

[c] This estimate is considered an order-of-magnitude Class 5 as defined by AACE International with a range of accuracy between +100% to -50%. The capital cost for a WTE facility was derived using different estimating methods than for a landfill and transfer processing facility, and the variability in the estimate is reflected in this range of accuracy.

5.1 Feasibility Discussion

As described in Section 5 above, Jacobs and the CBJ have assigned the following relative feasibility ranking of the three scenarios in Juneau[16]:

1. Scenario B: Construct a transfer processing facility with waste and recyclables sent south by barge for recycling and disposal.
2. Scenario A: Construct a new landfill and transfer processing facility with recyclables sent south by barge for diversion.
3. Scenario C: Construct a WTE facility and transfer processing facility for MSW with noncombustibles, recyclables, and ash sent south by barge for disposal.

Considering that 30,000 tpy of solid waste is generated in Juneau, Scenario C is the least desirable and feasible of the three scenarios because of the high relative cost of constructing and operating a small capacity WTE facility, particularly without an energy benefit for Juneau (AEL&P does not provide energy credits for surplus generation). Additionally, a WTE facility would require specialized labor and technologies that may not be available locally and thus are anticipated to increase the costs of construction and operation.

A transfer processing facility would provide many benefits for the CBJ and is a key component of all three scenarios. A transfer processing facility provides the following:

- Offers an interim waste management solution while the CBJ pursues additional siting, design, permitting, and construction for a local landfill or WTE facility, if desired.
- Enables the CBJ to quickly adapt to a sudden influx of disaster debris, tourism waste, or changing waste management needs as the landfill reaches capacity.
- Provides a one-stop-shop for residents and contractors, reducing vehicle traffic from waste collections and hauling to disposal facilities, cutting fuel and transportation costs, reducing emissions, and addressing safety and environmental concerns.
- Provides flexibility to consolidate recycling operations, increase waste diversion practices, and adapt practices for changing recovery and recycling markets.
- Could enable regional waste management partnerships and diversion opportunities.

Ideally, the facility would have sufficient space to expand, in case Scenario B is later determined to be the best long-term solution. The CBJ may consider establishing drop-off and processing areas for all MSW, recycling, organics, C&D, white goods, and bulky waste to enhance efficiency and waste diversion. The CBJ also has proposed a reuse staging area to provide storage and processing for repair, restoration, and other processing activities to encourage reuse and repurpose activities for diversion. Adding these services likely would increase the size estimates for the transfer processing facility.

Scenario A provides the CBJ with greater control over future waste diversion, MSW management, and risk mitigation, which is particularly advantageous during sudden waste influxes, such as the disaster debris from the 2023 and 2024 glacial outburst flood events. However, the capital costs for constructing a new landfill may be prohibitively high if funding is not available. Therefore, the CBJ should consider developing funding options for landfill development while simultaneously engaging in discussions with shipping providers and offsite landfills to negotiate contract terms and rates for offsite shipping and disposal. This

[16] The rankings are subject to change as the CBJ investigates funding opportunities and offsite shipping contracts.

will allow for a detailed comparison of long-term costs and help determine the breakeven point between Scenarios A and B.

Economic barriers lower the feasibility ranking of Scenario C because the small quantity of waste generated in the CBJ would make a WTE facility inefficient. In addition, the energy produced would not benefit the CBJ given its current renewable energy mix. The CBJ may choose to re-evaluate the feasibility of WTE under new conditions, such as incorporating additional waste streams, or exploring options for combined heat and power generation, or using the energy to power other nearby facilities.

Based on economies of scale, it is more cost-effective to build and operate landfills that can manage large volumes of waste from a broader geographic area. Consequently, there has been a trend toward regional landfills during the past 20 years. Since 2006, the Southeast Conference and the SEASWA have explored regional solutions for remote communities in southeast Alaska (Southeast Conference 2006). Juneau produces more waste than all nine SEASWA communities combined, potentially making a regional disposal approach more viable. However, transportation challenges have been a major barrier to implementing a regional strategy. If desired, the CBJ may choose to continue discussions with SEASWA regarding the potential for a regional landfill or WTE facility.

While this memorandum outlines the key considerations and differentiating factors for the three waste management scenarios, several factors outside the scope of this review may impact capital costs, operating costs, and customer rate changes. For instance, the following aspects could affect the overall financial viability of these scenarios:

- **Limited Construction Season and Long Lead Times**: Alaska's construction season is limited because of weather and, even during the construction season, the CBJ experiences frequent rain delays. Combined with the need to have materials ready when needed, there is a resulting long lead time to order materials and a resulting need to store them securely, which adds expense.
- **Location Accessibility**: Shipping costs can vary significantly depending on whether the project is on the Alaska road system, near a port, or only accessible by cargo aircraft. Additionally, the most cost-effective shipping methods may only be available during the summer.
- **Number of Bidders**: Projects with only one bidder often incur higher costs compared to those with at least three bidders. Because of its geographic isolation, there tend to be fewer contractors responding to bid opportunities in Alaska, particularly for specialty services. There may be additional transportation and lodging costs incurred to bring in out-of-state contractors.
- **Local Housing and Food Services**: The availability of local housing and food services can impact costs. If these are not available, contractors may need to provide housing and kitchen services onsite.
- **Liquidated Damages and Construction Schedule**: The amount of liquidated damages agreed upon in the construction contract and the feasibility of the construction schedule without extra effort from the contractor can affect costs. Sometimes, extending the schedule by a year is a more practical decision.
- **Pre-engineered Buildings and Equipment Lead Times**: If the project includes a pre-engineered building, delivery times can add up to a year to the project timeline. Recently, long lead times for electrical equipment have been a significant factor for construction projects throughout the U.S., not just in Alaska.
- **Ownership and Operation Model:** The ownership model, as described in Section 3.2, will impact the CBJ's share of capital and operating costs.

Consequently, the actual costs may vary; detailed scopes and cost estimates are necessary before making financial decisions or setting final budgets. The CBJ should consider the feasibility of compliance with the financial assurance requirements of 18 AAC 60.265.

5.2 Next Steps

With the current landfill near capacity, time is pressing; thus, Jacobs recommends the following next steps:

1. Decide whether to stay with the "status quo"—leaving all solid waste disposal decisions in Juneau to the private sector with no public involvement—or have the CBJ and the community gain a level of control over the solid waste system by owning a future disposal facility via one of the ownership models described in Section 3.2.
2. Proceed to develop a transfer processing facility that can be used regardless of the scenario selected with design considerations for future expansion.
3. Engage with shipping partners to evaluate the capacity of the current shipping facility and network to further evaluate the feasibility of Scenario B and to begin assessing the contractual requirements.
4. Estimate the present value cost and associated service cost (tipping fees and collection fees) for Scenarios A and B (including operating costs). Consider a lifecycle cost evaluation of one or more scenarios that enables a more robust comparison.
5. Evaluate waste facility and program ownership, operations, and revenue to implement the desired scenario(s).
6. Assess the CBJ community interest in landfill options through public discussions and workshops. Early public engagement through outreach, education, and opportunities for input is crucial to ensure community participation and support for these initiatives.
7. Based on the findings from Steps 3 through 6, reconsider locations, funding options, and feasibility to construct a landfill for Scenario A, which would provide the CBJ with a higher level of control over future solid waste disposal costs and diversion relative to Scenario B.

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Appendix A

Applicable Federal, State, and Local Regulations

Name	Relevant Section(s)	Summary	Applicable Facility
Federal Regulations			
EPA Air Quality Requirements - Incinerators	40 CFR 60, Subpart AAAA, Standards of Performance for Small Municipal Waste Combustion Units	Establishes new source performance standards for new small municipal waste combustion units with a capacity greater than 35 tons per day but less than 250 tons per day.	Waste-to-Energy
	40 CFR 60, Subpart EEEE, Other Solid Waste Incinerators	Other Solid Waste Incinerators are very small MSW combustion units with a capacity less than 35 tons per day. Exemption from federal standard if the incinerator qualifies as a small power production facility under section 3(17)(C) of the Federal Power Act, though permitting could be required through Federal Power Act requirements.	Waste-to-Energy
EPA Air Quality Requirements - Major Source Operating Permit	Title V Operating Permit for Air Quality under the Clean Air Act (covering federal and state requirements)	Alaska has adopted Subparts WWW, HH, EEEE, and AAAA by reference in state regulations. Facilities are subject to comply with other applicable Subparts that are not adopted by reference.	Landfill, Waste-to-Energy
EPA New Source Review	New Source Review preconstruction permit for new or modified sources under the Clean Air Act	Preconstruction air quality review requirement for construction permits. Prevention of Significant Deterioration permits required for new major sources in accordance with National Ambient Air Quality Standards. Nonattainment permits require installation of the lowest achievable emission rate, emission offsets, and an opportunity for public involvement. A Minor New Source Review applies for facilities that do not require the permits identified above. ADEC issues the applicable permit before construction begins, then requests a Title V operating permit application within 6 months if there is potential for emissions that crosses operating permit thresholds.	Waste-to-Energy
RCRA Requirements - Subtitle D	40 CFR 239 - 259 Solid Waste	Major criteria for municipal landfills in 40 CFR Part 258 (location, liners, leachate collection/removal, operating practices, groundwater monitoring, closure and post-closure, corrective action, financial assurance) 40 CFR Part 240 applies to thermal processing facilities designed to process 50 tons or more per day of municipal-type solid wastes The EPA has authorized Alaska to implement federal landfill requirements under RCRA Subtitle D	Landfill, Waste-to-Energy
RCRA Requirements - Standardized Permit	40 CFR 124 Subpart G - Procedures for RCRA Standardized Permit (Hazardous Waste)	Eligible when: (1) the facility generates hazardous waste and then store or non-thermally treat the hazardous waste on-site in containers, tanks, or containment buildings; or (2) You receive hazardous waste generated off-site by a generator under the same ownership as the receiving facility, and then you store or non-thermally treat the hazardous waste in containers, tanks, or containment buildings. Exemption for small quantity generators who generate less than 1,000 kg of hazardous waste and less than 10 kg of acutely hazardous waste per month.	Consider for Transfer Processing Facility, dependent on hazardous waste generation
NEPA Requirements	Applies when federally permitted or funded (ex: if Title V applies)	Environmental Impact Statement or Environmental Assessment prior to construction	Landfill, Transfer Processing Facility, Waste-to-Energy
NPDES Requirements - General Permit	40 CFR 122 Subpart B (Permit application 122.21,Stowmwater discharges 122.26, General permits 122.28)	Dependent on point (40 CFR Part 445 for landfills) vs non-point discharge, and where discharge occurs (surface water, stormwater system, publicly owned treatment system).	Landfill, Transfer Processing Facility, Waste-to-Energy
NPDES Requirements - Industrial Stormwater Permit	40 CFR 122.26(b)(14)(v): Landfills and Land Application Sites - for runoff from landfills to surface water.	Stormwater Pollution Prevention Plan, implementation of control measures, and submittal of request for permit coverage (NOI)	Landfill, Transfer Processing Facility, Waste-to-Energy
EPA National Pretreatment Program	40 CFR 403 - federal leachate pretreatment requirements	Facilities that discharge leachate into a POTWs must comply with regulations (limiting pollutant concentrations - like heavy metals, pH levels, and other contaminants)	Landfill
ADEC Waste Disposal Management 18 AAC 60			
State Class Number	18 AAC 60.300 Purpose, scope, and applicability; classes of Municipal Solid Waste Landfills	23,000 tons annually ~ 63 tons/day, Class I landfills "accepts, for incineration or disposal, 20 tons or more of municipal solid waste and other solid wastes daily, based on an annual average"	Landfill
Accumulation, storage, and treatment	18 AAC 60.010 for transfer stations designed to hold >20 cubic yards of waste	Nuisance, animal, disease vector control, and runoff requirements (18 AAC 60.010(f)).	Transfer Processing Facility
State Waste Disposal Permit	18 AAC 60.200	Permit application (18 AAC 60.210), design approval (18 AAC 60.203), approved liner & leachate system (18 AAC 60.213), and additional requirements (18 AAC 60.217 - 18 AAC 270)	Landfill
State Siting (Location) Standards	18 AAC 60.305 - 18 AAC 60.320	Airport runway proximity (18 AAC 60.305), floodplains (18 AAC 60.310), wetlands (18 AAC 60.315), fault areas and seismic zones (18 AAC 60.320)	Landfill
State Design Standards	Established in 18 AAC 60.330 (supplement 18 AAC 60.220 – 18 AAC 60.230)	The department will consider hydrogeologic characteristics, climatic factors, and the volume and physical and chemical characteristics of the leachate.	Landfill
State Operating Standards	Must be applied in conjunction with 18 AAC 60.220 – 18 AAC 60.240, and are established in 18 AAC 60.335 – 18 AAC 60.380	Liquid restrictions (18 AAC 60.360), co-disposal of sewage solids (18 AAC 60.365), corrective action (18 AAC 60.375), recordkeeping (18 AAC 60.380)	Landfill
State Groundwater Monitoring Standards	18 AAC 60.820 - 18 AAC 60.860	Groundwater monitoring and corrective action requirements if the facility has potential to discharge to an aquifer.	Landfill
ADEC Air Quality Control 18 AAC 50			
Air Quality Requirements - Incinerators	18 AAC 50.050(a) and (b)	Permit Required when the incinerator capacity is >1,000 pounds per hour.	Waste-to-Energy
New Source Performance Standards	18 AAC 50.040	Alaska has adopted Federal standards by reference in state regulations	Waste-to-Energy
Minor Air Permit	18 AAC 50.502 – 18 AAC 50.560	Required when a new source has the potential to emit >15 tons per year of PM-10 or >10 tons per year of PM-2.5.	Landfill, Transfer Processing Facility (unlikely to apply, but consider for fugitive dust), Waste-to-Energy

Name	Relevant Section(s)	Summary	Applicable Facility
ADEC Environmental Discharge Permits			
Construction General Permit	The 2021 Construction General Permit became effective on February 1, 2021 and will expire on January 31, 2026.	Large and small construction-related activities that result in a total land disturbance of >= 1 acre and where those discharges enter waters of the U.S. (directly or through a stormwater conveyance system) or a municipal separate storm sewer system (MS4) leading to waters of the U.S. subject to the conditions set forth in the permit.	Landfill, Transfer Processing Facility, Waste-to-Energy
Alaska Pollutant Discharge Elimination System	18 AAC 83.990, effective April 2024	Facility operator must apply for permit if discharging to surface waters or land, including wastewater and storm water discharges.	Landfill, Transfer Processing Facility, Waste-to-Energy
Local City and Borough of Juneau Regulations and Concerns			
Mendenhall Valley Area Particulate Matter Maintenance Plan	18 AAC 50.030(a)(2) adopts by reference the Code of the City and Borough of Juneau, Alaska, Chapter 36.40 Serial No. 2008-28, sec. 2	Purpose to respond to increases in particulate matter releases less than 10 microns in diameter (PM-10)	Landfill, Transfer Processing Facility (unlikely to apply, but consider for fugitive dust), Waste-to-Energy
City of Juneau Code of Ordinances	75.20.080 - Use of public sewers; regulations. 75.02.090 - Prohibited discharges.	75.20.080(d) - Where preliminary treatment facilities are provided for any waters or wastes, they shall be maintained continuously in satisfactory and effective operation by the owner at the owner's expense. Preliminary treatment facilities shall not be permitted for or in residential neighborhoods.	Landfill, Transfer Processing Facility, Waste-to-Energy
City and Borough of Juneau Permits	Development Permit, City/State project and Land Action Purview, Floodplain Development, Flood Zone Exemption, Noise permit	Dependent on construction, operation, and location of facilities.	Landfill, Transfer Processing Facility, Waste-to-Energy

EPA = Environmental Protection Agency
RCRA = Resource Conservation and Recovery Act
NEPA = National Environmental Policy Act
ADEC = Alaska Department of Conservation

Appendix B
National Renewable Energy Laboratory Report – Resource and Energy Recovery Opportunities from Waste in Juneau, Alaska

Resource and Energy Recovery Opportunities from Waste in Juneau, Alaska

Report prepared by Anelia Milbrandt, Robert M. Baldwin, and Kelcie Kraft for the City and Borough of Juneau, Alaska
March 21, 2025

Introduction

The City and Borough of Juneau, Alaska has engaged with NREL through the Waste-to-Energy (WTE) Technical Assistance program to provide subject-matter expertise concerning options for waste resource and energy recovery from the City's municipal solid waste (MSW) resources. Initial motivation for the study stems from concerns regarding landfill availability and options for waste minimization with the goal of a zero-waste outcome at some point in the future.

This study provides a high-level overview of available options with the objective of helping to identify potential technology solution pathways. It focuses primarily on WTE technologies, including biological, thermochemical, and mechanical conversion processes that generate energy or energy products from waste. While some technologies overlap with resource recovery, the assessment does not cover conventional recycling or other dedicated resource recovery strategies. By concentrating on energy-producing solutions, this study provides a targeted evaluation of alternative waste management options that align with Juneau's broader energy and economic priorities.

Waste Composition and Quantity

A MSW characterization for Juneau was completed and published by Cascadia Consulting Group in 2023, providing data to inform this analysis.[1] The waste was originally grouped into four categories: recyclable, compostable, recoverable, and reusable. For this study, those classifications have been restructured to align with resource recovery and WTE conversion technologies, as follows:

- Organics (largely food waste)
- Paper and cardboard
- Metal
- Plastics
- Wood (including construction and demolition [C&D] wood)
- Tires
- Textiles

Assumptions and restrictions: In the case of plastics, it is assumed that no attempt will be made to recover recyclables such as PET, PP, PS, and HDPE plastics[2] from the waste stream; indeed

[1] City and Borough of Juneau Waste Characterization Study (2024), Cascadia Consulting Group, https://juneau.org/wp-content/uploads/2024/10/Juneau-Waste-Characterization-Study-2024-Report_2024-10-8.pdf

[2] PET = polyethylene terephthalate; PP = polypropylene; PS = polystyrene; HDPE = high-density polyethylene

these recyclable plastics comprise less than 2% of the total waste stream and costs to implement sorting for purposes of recovery of recyclable plastics are likely to be greater than revenue Some textiles contain significant amounts of materials that could also be classified as organics (e.g., cotton, wool) or plastics (e.g., synthetic performance fabrics). Carpet falls into this mixed-material category as well; however, due to the lack of detailed composition data—and because carpets can be made from either synthetic (e.g., nylon) or natural (e.g., wool) fibers—it has been excluded from the Textile category. This analysis does not include other potentially available waste streams—such as wastewater treatment solids—which could offer additional feedstock for some of the WTE pathways under consideration.

Waste resources quantity: The City and Borough of Juneau disposed of 22,346 tons of waste in 2023 consisting of a composite from commercial, residential, and self-haul sources (Table 1). A more detailed composition of the City's MSW waste stream is presented in Table A1 (Appendix). Some of the data have been excluded from this analysis (called out in the footnotes to Table 2) as being either not relevant or poorly defined. The majority (approximately one third) of the waste is classified as organics (e.g., food waste, yard trimmings) and almost half is comprised of organics and paper/cardboard which are excellent feedstocks for many resource recovery and WTE technologies. This breakdown is important and will be used to inform the analysis of each technology pathway under consideration.

Table 1. Composition and Quantity of MSW Generated in City and Borough of Juneau

Type	Organics	Paper & Cardboard	Metal & Glass	Plastics	Clean Wood	Tires	Textiles	Other*	TOTAL
Tons/Y	6,053	4,312	1,824	2,084	2,149	134	2,202	3,588	22,346
%	27	19	8	9	10	0.5	10	16	100

*Other materials include e-waste, carpet, refrigerant-containing items, mattresses, household hazardous waste, etc.

Waste-to-Energy and Resource Recovery Technologies

The diverse waste streams in Juneau present opportunities for WTE and resource recovery technologies. WTE and resource recovery are related but not identical concepts. Both aim to extract value from waste and reduce landfill disposal. They often overlap, as some WTE technologies (e.g., anaerobic digestion) recover both energy and materials. While WTE focuses on converting waste into energy (electricity, heat, or transportation fuels), resource recovery emphasizes reclaiming valuable materials (e.g., metals, plastics, organics) for reuse or recycling. In an integrated waste management system, resource recovery typically comes first (e.g., recycling and composting), with WTE handling non-recyclable waste.

While some of these processes exhibit economies of scale, small-scale and modular applications may also be feasible. However, successful implementation of these technologies will require some level of waste sorting to ensure feedstock quality and process efficiency. Many WTE technologies perform best when waste is pre-sorted to remove contaminants and separate high-energy-value materials. Sorting can be accomplished through source-separation programs, material recovery facilities (MRFs), or a combination of mechanical and manual processing methods. Without proper sorting, contamination could reduce system efficiency, increase operational costs, and limit marketability of recovered resources.

Below is an overview of suitable WTE and resource recovery technologies for waste streams.

Biological conversion technologies are well-suited for processing organic waste, including food waste, animal manure, wastewater sludge, yard trimmings, and fats, oils, and greases (FOG). Once separated from other waste streams, these organics can be converted into valuable products through composting or anaerobic digestion. FOG could also be collected and provided to existing regional biodiesel or renewable diesel plants where FOG can supplement other feedstock, such as vegetable oils. Technologies for biodiesel and renewable diesel production are not evaluated in this analysis, but additional information is available upon request. Similarly, data on animal manure and wastewater sludge are not included here but can be provided if needed.

Composting is a biological process that takes place in an open-air environment where microorganisms break down biodegradable material in the presence of oxygen. The produced product is compost, which can be used as a soil amendment. With composting, no energy (e.g., biogas) is produced, and any energy required in the process must be supplied from an outside source. Composting results in a net greenhouse gas (GHG) emissions of negative 0.12 metric tons carbon dioxide equivalent ($MTCO_2E$) per ton of organics as compared to traditional landfilling. Potential revenue streams from composting include revenue from tipping fees, compost sale, and any relevant policy incentives. Generally speaking, a lower level of training is required to run a compost system versus an anaerobic digestion system.[3]

Composting can have different cost and land requirements depending on the system used. In windrow composting, organics are piled in long rows and the piles are periodically turned to aerate the system. While this system is the simplest, it also requires a large footprint, about 15 to 20 acres on average. Capital costs for windrow composting can be $4.3 million for a 30,000 ton per year system. Operating costs for a 30,000 ton per year system range from $437 to $765 thousand annually, while operating costs for a 25,000 ton per year system were found to be $362 thousand. Costs are listed in 2020$.[4]

In aerated static pile (ASP) composting, the piles are placed directly over an air source, providing air circulation without physical manipulation of the piles. ASP is moderate in complexity and has a smaller land footprint than windrow, about 6 to 8 acres on average.[5] Capital and operating costs for ASP systems of various sizes can be seen in Table 2.

[3] https://www.nrel.gov/docs/fy22osti/81024.pdf
[4] https://www.nrel.gov/docs/fy22osti/81024.pdf
[5] https://www.nrel.gov/docs/fy22osti/81024.pdf

Table 2. Capital & Operating Costs for ASP Composting Systems

System capacity (tons/year)	Capital cost (million USD)	Operating costs (thousand USD/yr)
1,800	1.7	247
5,200	2.6	NA
40,000	8.9	NA
180,000	25	1,000

NA – data not available. Data in 2020 USD[6]

In-vessel is the most compact system of composting, but also the most complex. Organics are confined within a building, container, or vessel, and thus air flow and temperature are better controlled. In-vessel composting has a small footprint, about 3 to 6 acres on average.[7] These systems come in a variety of sizes: as little as 100 pounds per day to over 10 tons daily.[8] Capital costs also vary depending on complexity and location. For example, the capital cost for a 1,000 pounds per day facility could be up to $850/ton.[9]

Ohio University, OH – In 2009, Ohio University, a public university of approximately 30,000 students, launched a solar powered in-vessel composting system. The system is designed to accept two tons of material per day, with an overall capacity of twenty-eight tons. The facility site includes a rainwater harvesting system to assist with system water needs and a 10-kW photovoltaic array, which provides roughly fifty percent of the electricity needed for operation. Capital costs for the facility were around $800,000 (2009USD). A 2012 expansion allowed for an additional four tons per day of processing capacity. Annual operating costs are about $225,000, with three employees running the facility.[10] More information about the project can be found at Ohio University's website.[11]

For more information on in-vessel composting, BioCycle has a guide on *In-Vessel Composting Options for Medium-Scale Food Waste Generators*. The guide contains important considerations, as well as a hypothetical case study, and a list of companies that sold mid-sized in-vessel composting units at the time of publishing.[12] Sustainable Generation also has a list of project profiles and case studies of locales utilizing GORE® covered compost systems.[13]

[6] ttps://www.nrel.gov/docs/fy22osti/81024.pdf
[7] https://www.nrel.gov/docs/fy22osti/81024.pdf
[8] https://resource-recycling.com/recycling/2019/03/30/data-corner-the-ins-and-outs-of-in-vessel-composting/
[9] https://resource-recycling.com/recycling/2019/03/30/data-corner-the-ins-and-outs-of-in-vessel-composting/
[10] https://www.biocycle.net/site-large-scale-food-waste-composting/
[11] https://www.ohio.edu/facilities/grounds/compost
[12] https://www.biocycle.net/in-vessel-composting-options-for-medium-scale-food-waste-generators/
[13] https://www.sustainable-generation.com/project-profiles

Anaerobic digestion (AD) is a biological process in an enclosed environment where microorganisms break down biodegradable material in the absence of oxygen. The main product is biogas, a mixture of methane and CO_2, which is an intermediate that can be used to produce heat, electricity, or renewable natural gas (RNG). AD results in a net GHG emissions ranging from negative 0.04 to negative 0.14 $MTCO_2E$ per ton of organics as compared to traditional landfilling, depending on the type of AD – wet or dry – and whether the digestate is further cured or directly land applied. While AD requires energy input into the system, the energy can be supplied through its own production of biogas.[14] AD is widely practiced in cold weather climates such as Northern Europe. The low average annual temperatures in places such as Sweden and Finland can be accommodated by process design and recycle of waste heat from power generation.

Feedstocks for AD must be pre-sorted to remove inorganics such as glass and metal, as well as contaminants from C&D waste, including drywall. Plastics are non-reactive under AD conditions and should also be excluded. Several waste stream characteristics influence the feasibility of AD:

1. Organics: Well-suited for AD, with high moisture content (up to 50% by weight) that does not hinder the process.
2. Wood, paper, and cardboard: These materials are rich in recalcitrant biopolymers like cellulose and lignin, resulting in slow reaction rates and low biogas yields. However, pretreatment methods such as steam explosion can significantly improve their digestibility and gas production potential.[15]

Potential revenue streams from AD include revenue from tipping fees, selling electricity or RNG, and relevant incentives. It is important to recognize that the residual material from the AD unit (the digestate) may pose a disposal problem. Digestate is typically separated into a solid and liquid fraction. The amount of each fraction is difficult to estimate; solids are approximately equal to the fixed carbon content of the feedstock to the digester. The liquids can be re-used in the digester to some extent or for crop irrigation. The solid fraction can be used as fertilizer, animal bedding, or pelletized and used for heating, as well as used for construction material (e.g., fiberboard) and in other applications that can bring additional revenue.

Modeled capital and operating costs for AD systems of different capacities can be found in Table 3. The complexity of AD can vary depending on the system; newer systems, which have become easier to operate and maintain, have moderate complexity. A properly designed and operated AD system is very safe. However, strict gas handling standards must be maintained.[16]

[14] https://www.nrel.gov/docs/fy22osti/81024.pdf
[15] https://joneseng.com/additional-services/bioenergy/
[16] https://www.nrel.gov/docs/fy22osti/81024.pdf

Table 3. Capital & Operating Costs for Anaerobic Digestion Systems

System capacity (tons/year)	Capital cost (million USD)	Operating costs (thousand USD/yr)
2,500	3.0	85
5,000	4.7	171
25,000	12.3	854
50,000	18.6	1,707
100,000	28.2	3,415
200,000	42.7	6,830

Data in 2020 USD[17]

AD is generally less land intensive than composting, with a typical requirement of 3-6 acres. Modern systems can be even more streamlined to reduce their footprint. Since AD systems are fully enclosed, odors are contained. If the system is run inefficiently, such as in the case of digester spills, odor may occur. More information on AD can be found at Milbrandt, 2021[18].

Thermochemical conversion processes are effective for managing both solid and, to some extent, wet waste, including materials like plastics, tires, and wood (e.g., clean pallets, residential or utility tree trimmings, brush and branches from wildfire mitigation). Once separated, these materials can be transformed into valuable products through processes like combustion, pyrolysis, and gasification.

Combustion for Combined Heat and Power (CHP): In principle, simple combustion provides a feasible and low-cost solution that could be applied to woody feedstock. Combustion of biomass to generate heat and power is commercial technology. Recovery and/or sequestration or utilization of CO_2 from the combustor flue gas (carbon capture and sequestration [CCS]) is an option that could be considered for this application; however, further evaluation of the systems required to carry out CCS would be needed. Use of wood for CHP technology at small scale has been demonstrated and deployed broadly (e.g., hospitals, schools, and office buildings) and some examples are presented below.

New Hanover County, NC – New Hanover County began recycling pallets as part of its C&D recycling efforts in 2005. Pallets are collected along with mixed C&D waste at the county landfill at a cost to disposers of $59 per ton. Pallets and clean wood waste are sorted from the mixed C&D material until approximately 800 tons have accumulated, at which point pallets are ground using a contract grinder, and the mulch material is sold as boiler fuel. Costs to run the program are embedded in the total cost to manage a low-level C&D recycling operation. The C&D pad is operated by two landfill employees and the county negotiated a highly competitive rate for the grinding services[19].

Carson City, NV: In June 2009, the Northern Nevada Correctional Center (NNCC), located in Carson City, Nevada, completed installation of a $6.4 million biomass system. The CHP system

[17] https://www.nrel.gov/docs/fy22osti/81024.pdf
[18] https://www.nrel.gov/docs/fy22osti/81024.pdf
[19] https://www.deq.nc.gov/environmental-assistance-and-customer-service/wooden-pallets/newhanovercounty/download

produces 1 MW of electricity and requires 16,000 tons of wood annually. The system is estimated to save the NNCC $1 million per year. The wood is sourced from slash piles created from forest management activities as well as landfills where it would otherwise be buried[20].

University of Idaho, ID - University of Idaho uses a district energy system to heat and cool the campus. In 1986 the university secured and built a wood chip-fueled boiler using wood waste/residues from lumber mills[21].

Pyrolysis: The process of pyrolysis consists of heating a material to temperatures in the range between (generally) 500 – 600 °C in the absence of air such that combustion does not take place. Feedstocks suitable for pyrolysis include dewatered wet waste (e.g., sludge), paper and cardboard, plastics, wood, tires, and textiles, which represent most of the waste resources considered in this study and available in Juneau. Products from thermal pyrolysis include char, non-condensable gases (largely carbon monoxide [CO] and CO_2 with some light hydrocarbons), and a condensable organic liquid known as bio-oil. This bio-oil retains much of the heating value of the feed biomass and could be used for generating electricity in either a steam or gas turbine or used for home or district heating. Pyrolysis can be classified as fast or slow process depending on the heating rate, temperature, residence time, and pressure. Slow heating rates on the order of just a few degrees per minute produce mostly char with some bio-oil; fast heating rates (flash or fast pyrolysis) of hundreds of degrees per second produce more bio-oil; 60 to 70% of the feedstock can be liquefied to make bio-oil using fast pyrolysis.

The type and composition of the feedstock plays a crucial role in determining the properties of the resulting products. Bio-oil produced from the fast pyrolysis of MSW can be highly acidic (low pH), unstable, and unsuitable for direct use unless extensively upgraded to reduce its organic oxygen and water content. Char from organic sources (e.g., wood, biosolids) can be used in agriculture and environmental remediation while char from inorganic matter (e.g., waste plastic and tires) is mostly used in industrial applications.

Pyrolysis of plastic waste is still in its early stages of commercial development. Several companies are working in this space with differing end products and business models. For example, New Hope Energy (Tyler, Texas) focuses on producing petrochemical feedstocks. These feedstocks are supplied to TotalEnergies, which further processes them into circular polymers—recycled plastics suitable for food-grade packaging and other applications.

As noted earlier, pyrolysis converts waste materials into char, a valuable carbon-based product, commonly referred to as biochar when derived from biomass and recovered carbon black (rCB) when sourced from waste tires. While both are carbon-rich materials, they serve distinct purposes based on their properties and applications.

- Biochar is a porous, high-carbon product derived from biomass sources such as wood waste, crop residues, and biosolids. It is primarily used as a soil amendment, improving

[20] https://www.hurstboiler.com/news/hurst_boiler_sponsors_fuels_for_schools
[21] https://www.uidaho.edu/dfa/division-operations/utilities/energy

water retention, nutrient absorption, and carbon sequestration.[22] Additionally, biochar has applications in contaminant remediation, including binding per- and poly-fluoroalkyl substances (PFAS) and heavy metals in soil to prevent leaching into groundwater. The domestic biochar market is expanding, with California leading the country in both production and demand. Market prices in California range from $600 to $1,300 per ton, while production costs range from $200 to $1,000 per ton (2021 USD). Companies such as GECA and Biochar Now have successfully commercialized biochar production from clean wood waste, while Silicon Valley Clean Water has demonstrated biochar production from biosolids.

- Recovered Carbon Black (rCB) is a fine black powder produced from the pyrolysis of waste tires. Unlike biochar, rCB has high surface area but lacks the porosity needed for soil applications. Instead, it is used as a reinforcing filler in rubber, plastics, and coatings, providing a sustainable alternative to virgin carbon black. Companies such as Bolder Industries, Delta Ducon, and Klean Industries have developed pyrolysis technologies to recover rCB from tires. Bolder Industries produces BolderBlack®, a sustainable rCB used in new tires, coatings, and plastics, while Klean Industries integrates rCB into tire manufacturing, reducing reliance on fossil-based carbon black. These companies also produce bio-oil as byproduct, supporting further waste material valorization.

Gasification is another thermochemical conversion process that can transform MSW into valuable energy and products. Unlike pyrolysis, which operates in the absence of oxygen, gasification usually occurs in the presence of limited oxygen, enabling the partial oxidation of waste materials. This process generates syngas (a mixture of CO and hydrogen) and CO_2, which can be used to produce electricity, heat, or fuels. Gasification offers a flexible solution for MSW, particularly in areas with large waste volumes, by reducing landfill dependency while producing renewable energy. While gasification technologies require substantial infrastructure, they can be adapted to smaller-scale operations, making them suitable for both large municipal systems and more localized energy generation needs.

Large-scale MSW gasification has been successfully implemented in Europe and Asia, where it is commonly used for CHP applications. In these regions, gasification systems are integrated into district heating networks or industrial processes, providing a reliable and sustainable source of energy while reducing dependence on landfills. For instance, gasification plants in countries like Sweden and Japan have been in operation for years, demonstrating the feasibility of large-scale gasification to convert MSW into syngas for electricity and heat generation. These projects benefit from economies of scale, advanced technologies, and supportive waste management policies, making them more cost-effective compared to smaller operations. However, projects focused on fuel production, such as those by Enerkem in Edmonton, Alberta, and Fulcrum Sierra Biofuels in Reno, Nevada, have struggled to achieve the same level of success. These projects face challenges related to feedstock supply, high capital costs, and the complex nature of downstream processes required to convert MSW-derived syngas into liquid fuels, which has delayed commercial-scale operations.

[22] Kalu, S., Kulmala, L., Zrim, J., Peltokangas, K., Tammeorg, P., Rasa, K., Kitzler, B., Pihlatie, M., and Karhu, K. Potential of biochar to reduce greenhouse gas emissions and increase nitrogen use efficiency in boreal arable soils in the long-term. Front. Environ. Sci., 10. DOI: 10.3389/fenvs.2022.914766.

Small-scale MSW gasification projects provide a flexible, modular solution for localized waste-to-energy needs, particularly in smaller municipalities or rural areas. These systems are easier to scale and deploy, making them attractive for regions with limited waste streams. However, their success depends on feedstock consistency, technology maturity, and financial backing. Economic sustainability remains a challenge, especially in areas with low waste generation, as the economics of small-scale gasification are still evolving. In China, small-scale projects (ranging from 3 t/day to 20 t/day) have successfully used modular gasification technology to convert MSW into syngas for local power generation, showcasing the potential of small-scale solutions to meet urban waste and energy needs.[23]

Mechanical conversion processes include **densification** which is the process of increasing the bulk density of the feedstock (biomass, MSW) by reducing its bulk volume.[24] Pelletization and briquetting are the most common densification processes. Densified products (pellets and briquettes) have benefits over raw feedstock such as more uniform properties, increased energy density, and reduced transportation costs and storage space.[25] For example, the calorific value of raw MSW is about 1,000 kcal/kg while that of fuel pellets is 4,000 kcal/kg.[26] The major markets for these products are residential and industrial heating and electricity generation. They can also be used as a uniform feed for thermochemical processes such as pyrolysis and gasification. Various biomass resources could be used to generate densified products. Typically, mill residues, forest residues, and low-quality logs are used in the production of densified products, but agricultural waste could also be used as feedstock, as well as mixed MSW or individual components such as paper/cardboard or wood pallets.[27]

Wood pellet manufacturing is a well-established process, and the general steps include drying, crushing, compressing, and cooling of the final product. In addition to being a high energy-value product, wood pellets can be easily handled and transported efficiently over long distances. The cost of a biomass pellet project can vary widely depending on several factors, including scale, feedstock, equipment, infrastructure, and labor. The project cost can range between $50,000 and $200,000 for a 1-1.5 tons/hour project to between $380,000 and $1.5 million for a 15-20 tons/hour project. [28] It takes 1.1 million British Thermal Units (MBTUs) of electrical energy to produce a ton of delivered pellets, which could be supplied with renewable energy such as solar panels.[29] While most wood pellets manufacturing in the United States occurs in the Southeast, there are recent efforts in other states as well (e.g., California, Rocky Mountain states) focused on using pine beetle kill wood and brush/branches from wildfire mitigation. There are also companies using clean wood pallets to produce pellets such as Energy Pellets of America, Hay Creek Companies, and Easy Heat Wood Pellets.

[23] https://task33.ieabioenergy.com/wp-content/uploads/sites/33/2023/11/China.pdf
[24] https://ohioline.osu.edu/factsheet/fabe-6605
[25] https://www.sciencedirect.com/science/article/abs/pii/S1364032123003775?via%3Dihub
[26] https://www.biopelletmachine.com/biopellet-making-guidance/municipal-solid-waste-pellets-making.html#:~:text=MSW%20fuel%20pellet%20or%20briquett,excellent%20substiture%20for%20fossil%20fuels.
[27] https://biomassmagazine.com/articles/pellets-from-pallets-15549
[28] https://www.richipelletmachine.com/biomass-pellet-project-cost/
[29] https://utia.tennessee.edu/publications/wp-content/uploads/sites/269/2023/10/W214.pdf

Briquetting is a similar process to pelletization but it uses different production equipment (briquette press) and produces larger densified products (briquettes) with defined shapes such as cylinders or squares. The average briquette plant cost is $60,000 which will vary depending on configuration.[30] Biomass Secure Power Inc. (BMS PF) is developing a torrefied biomass briquette plant at Natchitoches, Louisiana. The facility will process forest residuals, cull, thinnings, slash, tree tops, woodchips, lumber mill residuals and branches. Construction will proceed in 3 phases with phase 1 producing 240,000 tonnes/yr of briquettes.[31]

Discussion and Conclusions

The waste resources identified in the City and Borough of Juneau illustrate a range of potential feedstocks in the area, offering various pathways for energy and resource recovery. The choice of technology ultimately depends on the desired end products—whether the community prioritizes energy generation, soil amendments like compost or biochar, or other resource recovery applications. Given the city's relatively small waste generation, technologies must be appropriately sized to ensure economic feasibility.

For **biological processes**, AD and composting present viable options for managing organic waste in Juneau. The total organic waste available for AD amounts to approximately 5,400 tons per year, comprising of 4,324 tons of food waste, 893 tons of grass/leaves, and 187 tons of other compostable material. Depending on the feedstock composition and digester system, organic waste can generate between 3,000 and 6,000 cubic feet of biogas per ton.[32] This suggests a potential annual biogas production of roughly 16 to 32 million cubic feet, which could be used for heat, electricity generation, or upgraded to RNG. In energy terms, this equates to approximately 96,000 to 192,000 therms of natural gas or 9,600 to 19,200 MMBtu per year. However, upgrading biogas to RNG requires significant capital investment in gas purification technology, which can be cost-prohibitive for small-scale projects due to economies of scale.

Composting offers a simpler, lower-cost alternative for organic waste management. On average, composting reduces the original feedstock weight by 40-50%, meaning Juneau could produce approximately 2,100 to 2,700 tons of compost per year. However, the feasibility of composting depends on the local/regional demand for soil amendment. If there is no viable market or end use for the compost, the investment may not be justifiable.

When comparing these two approaches, AD involves higher capital expenditures but provides the added benefit of renewable energy generation, whereas composting is more cost-effective but relies on strong local demand for compost. The decision should consider both the city’s energy needs and market potential for soil amendment products. Based on the previously outlined waste composition, roughly one quarter of the total waste stream is suitable for AD and/or composting, highlighting significant potential for waste reduction.

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[30] https://www.abcmach.com/news/biomass-briquette-plant-cost-Middle-East.html

[31] http://bmspf.com/html/projects.html

[32] https://www.tandfonline.com/doi/full/10.1080/10962247.2017.1316326?utm_source=chatgpt.com#abstract

Thermochemical conversion processes, including combustion, pyrolysis, and gasification, provide alternative pathways for energy recovery. The city generates approximately 17,000 tons of waste resources annually suitable for thermochemical conversions addressing over 75% of the total waste stream (excluding metal, glass, and other materials) and thus presenting an attractive option for waste minimization. These waste streams could serve as feedstock for small- to medium-scale systems which convert waste into CHP, biochar, and other valuable products. However, these technologies can be capital-intensive, requiring careful cost-benefit analysis. Another attractive option, and potentially more cost-effective approach, may involve **densifying** MSW into fuel pellets. On average, about 15-20 tons of pellets can be produced from every 100 tons of processed waste, meaning Juneau's select MSW could yield roughly 2,500–3,400 tons of fuel pellets per year.[33] These pellets could be used for local heating applications or marketed externally, depending on regional demand and infrastructure. When comparing all these approaches, gasification and pyrolysis have high capital and operating costs, while pelletization may be more economically feasible and provide a transportable fuel product.

An estimated 2,149 wet tons (approximately 1,700 dry tons) of **clean MSW wood** are available annually within the City and Bourgh of Juneau. This supply could be supplemented with additional woody biomass from sources such as prunings, fire-prevention thinnings, and natural tree mortality, helping improve economies of scale. Given Juneau's surrounding forested landscape, it is reasonable to assume that a substantial volume of woody biomass from forest maintenance is available through ongoing sustainable land management practices. With this resource base, Juneau could explore a range of conversion technologies, including CHP via combustion for local use, pyrolysis for biochar or bio-oil production, gasification to generate CHP or syngas, or pelletization for fuel manufacturing. Using a conservative estimate of 5,000 Btu per pound of dry wood, Juneau's clean MSW wood could generate around 17 billion Btu per year which could significantly contribute to heat and power consumption at a school, municipal building, or other local facility. One ton of woody biomass can produce approximately 30% biochar by weight (300kg), meaning Juneau's clean MSW wood could yield roughly 510 tons of biochar annually. Using the average conversion of 15–20 tons of fuel pellets per 100 tons of raw feedstock noted earlier, Juneau's clean MSW wood could produce 250–340 tons of pellets annually. These estimates would be much higher if additional woody biomass is considered as feedstock for any of these applications. When comparing all these approaches, CHP provides local energy benefits, biochar may have niche markets, while pellets can be a scalable and transportable product.

This assessment provides a high-level overview of technology options and their feasibility, serving as a foundation for more detailed evaluations. Next steps could include a cost-benefit analysis for different pathways comparing capital cost, operational expenditures, and revenue potential to determine each pathway's economic viability. If Juneau determines a specific end-product preference, a detailed feasibility study could refine technical and economic aspects further, including an examination of site-specific logistics, detailed feedstock availability, permitting requirements, and potential off-takers for energy or material products. Additionally, a market analysis would help identify demand for potential products like compost, biochar, or fuel

[33] https://www.biopelletmachine.com/biopellet-making-guidance/municipal-solid-waste-pellets-making.html#:~:text=MSW%20fuel%20pellet%20or%20briquett,excellent%20substiture%20for%20fossil%20fuels.

pellets, ensuring alignment with local and regional opportunities. Ultimately, the best approach will balance technical feasibility, economic viability, and community needs to maximize the value of available waste resources. By pursuing these next steps, the City and Borough of Juneau can make informed decisions on alternative waste management and energy solutions that align with its economic and environmental goals. Whether through localized energy generation, soil amendment production, or material recovery, these strategies have the potential to enhance resilience and resource utilization in the community.

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Appendix

Table A1. Detailed overall (composite) municipal solid waste characterization, Juneau (2023)

Confidence intervals calculated at the 90% confidence level. Percentages and tons for subtotals are rounded and may not sum to the totals shown.

Material	Est. %	+ / -	Est. Tons	Material	Est. %	+ / -	Est. Tons
Recyclable	**18.0%**	**2.8%**	**4,025**	**Food**	**19.4%**	**4.2%**	**4,324**
Compostable	**31.7%**	**6.6%**	**7,083**	Food - Packaged Edible	6.1%	1.3%	1,356
Potentially Recoverable	**22.4%**	**5.2%**	**4,998**	Food - Packaged Inedible	3.8%	4.1%	853
Reusable	**8.5%**	**5.2%**	**1,907**	Food - Unpackaged Edible	3.6%	1.2%	804
Non-recoverable	**19.4%**	**2.5%**	**4,333**	Food - Unpackaged Inedible	5.3%	1.7%	1,183
Paper & Cardboard	**19.3%**	**3.6%**	**4,312**	Beverages	0.6%	0.1%	128
Uncoated Corrugated Cardboard	4.4%	1.4%	992	**Yard Debris**	**5.7%**	**1.3%**	**1,267**
Typically Recyclable Paper	5.5%	2.3%	1,225	Leaves & Grass	4.0%	1.1%	893
Food Soiled/Compostable Paper	5.8%	1.0%	1,298	Woody Yard Debris	1.7%	1.1%	374
Non-recyclable or Non-compostable Paper	3.6%	1.1%	796	**Other Organics**	**11.7%**	**5.4%**	**2,610**
Plastic	**9.3%**	**1.2%**	**2,084**	Manures	-	-	-
#1 PET Rigid Plastic Packaging	1.0%	0.1%	234	Remainder/Composite Organic - Compostable	0.8%	0.4%	187
#2 HDPE Rigid Plastic Packaging	0.6%	0.1%	123	Other Clean Wood	1.4%	1.0%	316
#4 LDPE Rigid Plastic Packaging	0.0%	0.0%	4	Reusable Clean Wood	6.5%	5.3%	1,459
#5 PP Rigid Plastic Packaging	0.7%	0.2%	150	Remainder/Composite Organic - Non-compostable	2.9%	0.9%	649
Compostable Rigid Plastic Packaging	0.0%	0.0%	5	**Special Materials**	**11.7%**	**2.9%**	**2,615**
Compostable Plastic Single Use Food Service Ware	0.0%	0.0%	2	Other Inert Construction Debris	6.1%	2.6%	1,370
Other Rigid Plastic Packaging	0.4%	0.1%	97	Carpet	1.5%	1.6%	333
Other Durable Rigid Plastic Items	0.4%	0.1%	91	E-waste	0.7%	0.3%	148
Reusable Durable Rigid Plastic Items	1.4%	0.8%	304	Tires	0.6%	0.6%	134
Non-compostable Plastic Single Use Food Service War	0.1%	0.0%	14	Refrigerant-containing Items	0.1%	0.1%	19
Single-layer Plastic Film	3.9%	0.5%	865	Mattresses	0.0%	0.0%	0
Multi-layer Plastic Film	0.3%	0.0%	62	Broken Metal Furniture	1.0%	0.6%	219
Durable Film Plastic Items	0.0%	0.0%	0	Household Hazardous Waste	0.3%	0.2%	69
Remainder/Composite Plastic	0.6%	0.3%	131	Reusable Inert Construction Debris	0.3%	0.4%	74
Metal	**4.4%**	**1.0%**	**988**	Reusable Wood Furniture	0.3%	0.3%	70
Tin/Steel Cans	0.6%	0.2%	145	Reusable Metal Furniture	0.0%	0.0%	0
Aluminum Cans	0.6%	0.1%	142	Special Waste	0.5%	0.4%	122
Other Ferrous	1.7%	0.8%	370	Broken Wood Furniture	0.3%	0.2%	56
Other Non-ferrous	0.4%	0.1%	95	**Textiles**	**9.9%**	**4.3%**	**2,202**
Remainder/Composite Metal	1.1%	0.6%	236	Textiles - Organic	0.1%	0.1%	33
Glass	**2.8%**	**0.6%**	**617**	Textiles - Synthetic, Mixed, & Unknown	9.7%	4.3%	2,169
Glass Bottles & Containers	2.4%	0.5%	545	**Other Materials**	**5.9%**	**0.9%**	**1,328**
Remainder/Composite Glass	0.3%	0.3%	72	Fines	2.8%	0.5%	621
				Mixed Residue	3.2%	0.7%	707
Sample Count	*76*			**Total**	**100%**		**22,346**

Source: City and Borough of Juneau Waste Characterization Study (2024), Cascadia Consulting Group, https://juneau.org/wp-content/uploads/2024/10/Juneau-Waste-Characterization-Study-2024-Report_2024-10-8.pdf

Notes

1. Inert Construction Debris is considered to be not suitable for any of the WTE technology pathways considered in this report.
2. E-waste, carpet, refrigerant-containing items, mattresses, household hazardous waste, and special waste are excluded from this analysis.
3. Wood furniture is coated with chemicals and thus not considered suitable for resource and energy recovery although these materials, along with others, are often combusted in MSW incinerators.
4. Other Materials are excluded due to lack of information on characteristics.

Appendix C
Alaska Jurisdiction Solid Waste Summary Tables

Parameter	Anchorage	Ketchikan	Kodiak	Sitka	Skagway	Fairbanks
General Jurisdiction Information						
Approximate Population [1]	286,100	8,200	12,700	8,400	1,200	95,000
Total Waste Generation (Tons)	301,000[2]	13,000[3]	11,700[4]	8,200[5]	1,300[6]	107,725
Solid Waste Collection Information						
Provides Publicly Operated Waste Collection Utility?	Yes	Yes	No	No	Yes	Yes
Waste Collection Private Entity	Alaska Waste	Alaska Waste	Alaska Waste	Alaska Waste	None	Alaska Waste
Description of Solid Waste Collections	Municipality of Anchorage provides waste collection services for the downtown area and some neighborhoods east and south of downtown. Alaska Waste services all other neighborhoods for residential collection.	City of Ketchikan operates waste collections within city boundary. All other waste collections provided by Alaska Waste outside of the city boundaries.	Provides residential, multifamily, and commercial collections. Residents may also self-haul waste and drop off material at no charge at a designated dump location or at the KIB landfill.	Contracts with Alaska Waste to provide solid waste collection services for residential, multifamily, and commercial customers.	Municipality of Skagway provides waste collection for services for residential, multifamily, and commercial customers.	City of Fairbanks Public Works Department provides weekly garbage collection to more than 6,300 households. Fairbanks North Star Borough also offers solid waste collection services and contracts with Alaska Waste and Golden Heart Waste Management to provide solid waste collection services for approximately 18% and 10% of waste generated in the region respectively. Recycles cardboard, mixed paper, #1 and #2 plastics, aluminum cans, and electronics at Central Recycling Facility.

Parameter	Anchorage	Ketchikan	Kodiak	Sitka	Skagway	Fairbanks
Transfer Station Information						
Transfer Station Within Jurisdiction	Yes (Central Transfer Station [CTS], and Girdwood Transfer Station [GTS])	Yes	No	Yes	Yes	1 Primary Transfer Station (Solid Waste Facility) and 11 additional satelite transfer station facilities
Transfer Station Owner	Municipality of Anchorage	City of Ketchikan	Not Applicable	City and Borough of Sitka	Municipality of Skagway	Fairbanks North Star Borough
Transfer Station Operator	Municipality of Anchorage	City of Ketchikan	Not Applicable	Alaska Waste	Municipality of Skagway	Fairbanks North Star Borough
Transfer Station Size (ft^2)	CTS: 97,000 ft^2 and GTS: 12,000 ft^2	15,300	Not Applicable	3,200	11,500	Not Applicable
Transfer Station Staffing (Full Time Equivalent, FTE)	CTS: 25 GTS: 1.0	3.5[7]	Not Applicable	5 to 6	1.5	Not Applicable
Average Tons Received and Transfer per Year	CTS: 207,000 GTS: 700	8,500	Not Applicable	8,200	1,300	Not Applicable
Transfer Station Annual Operating Cost (2025$)	CTS: $9,618,000 GTS: $154,000	$830,000	Not Applicable	$1,088,000	$225,000	Not Applicable
Transfer Station Operating Costs per Ton of MSW (2025$/Ton)	CTS: $46 GTS: $220	$98	Not Applicable	$133	$173	Not Applicable
Are hauling cost incorporated into Operating Budget	No	No	No	No	No	Not Applicable
Description of Transfer Station Operations	CTS receives on average approximately 600 tons per day and transfers material to the Anchorage Regional Landfill using open top trailers with approximately 20 tons per load. CTS is staffed with 25 FTE and contains a HHW disposal location, appliance disposal, and community compost drop off. This facility is across the street from a municipal owned recycling center. The Girdwood Transfer Station is small satellite facility that transfers waste to CTS.	Receives commercial and self-haul MSW. Utilizes a Badger two ram baler for compacting MSW into bales. MSW is arranged into 40-foot intermodal containers for transportation and ultimate disposal at Roosevelt Regional Landfill. Transfer station facility also has a recycling center to receive source separated recyclables and HHW.	Not Applicable	Alaska Waste operates the small open air transfer station facility. Facility utilizes a MSW baler and loads baled MSW into 40-foot intermodal containers with average loads of 26.1 tons. MSW within intermodal containers is transported to Roosevelt Regional Landfill for disposal. Operating costs include the recycling drop-off center.	Publicly operated transfer station that receives self-haul and commercial MSW. MSW is baled and loaded into 40-foot intermodal containers with an average load of approximately 25 tons. MSW within intermodal containers is transported to Roosevelt Regional Landfill for disposal.	Fairbanks North Star Borough opperates 11 satelite transfer station facilities where waste is then transferred to the Central Fairbanks Solid Waste Facility and Landfill. Transfer station operations are not representative of the facilities being considered for CBJ (satellite drop-off locations transferred to central landfill with transfer station onsite).

Parameter	Anchorage	Ketchikan	Kodiak	Sitka	Skagway	Fairbanks
Landfill Operation Information						
Landfill within Jurisdiction	Yes, Anchorage Regional Landfill	Yes, Deer Mountain Landfill	Yes, Kodiak Island Borough Landfill (KIB Landfill)	Sitka Yes, Sitka Granite Creek Landfill	Yes, Skagway Ash Landfill	Yes
Landfill Owner	Municipality of Anchorage	City of Ketchikan	Kodiak Island Borough	City and Borough of Sitka	Municipality of Skagway	Fairbanks North Star Borough
Landfill Operator	Municipality of Anchorage	City of Ketchikan	Kodiak Island Borough	Marble Island, LLC	Municipality of Skagway	Fairbanks North Star Borough
Landfill Description	Class I Landfill utilized for MSW and C&D disposal equipped with landfill gas and leachate collection systems. Landfill gas is used to power a 7 megawatt generator which provides power to part of Joint Base Elmendorf-Richardson. Leachate is trucked to Anchorage wastewater treatment plant. Landfill is located on 275 acres with 12 total individual cells at full build out.	Class III Landfill utilized for C&D disposal. Landfill is unlined. Landfill property includes aerated static pile composting operation, recycling center building, and transfer station.	Class I Landfill utilized for MSW disposal equipped with a leachate collection and treatment facility. Leachate treatment facility utilizes a pre-assembled skid mounted ultrafiltration membrane system to treat leachate to EPA drinking water standards. Recently received a grant to expand existing landfill via a cell 2 design and estimated expenditure of $3,000,000.	Class III unlined landfill utilized as overburden pit for inert materials such as C&D, condemned boats, crushed glass, etc. that are not feasible to ship for disposal. Disposal of construction debris must be approved by Public Works Director.	Class III Landfill utilized to dispose of incinerator ash. Landfill is unlined. The incinerator is primarily used for MSW, biosolids, and medical waste.	Class I landfill with 88 acres of construction and demolition debris disposal area and 164 acres of MSW disposal area for a total of 252 acres.
Material Received at Landfill in 2024 (Tons)	301,000	4,500	11,700	Unknown	Unknown	107,725
Landfill MSW Gate Rate/Tipping Fee (2025$/Ton)	$85.11 (MSW) $120.00 (C&D)	$201.70 (C&D only)	$400	Asbestos $77.80/CY, Asphalt & Concrete $17.18/CY, Construction Debris $12/CY	Unknown	$145
Landfill Staffing (Full Time Equivalent, FTE)	26.0	3.5[7]	5 FTE at landfill, and 2 FTE at leachate treatment facility	Staffed by contractor	2.5	22.0

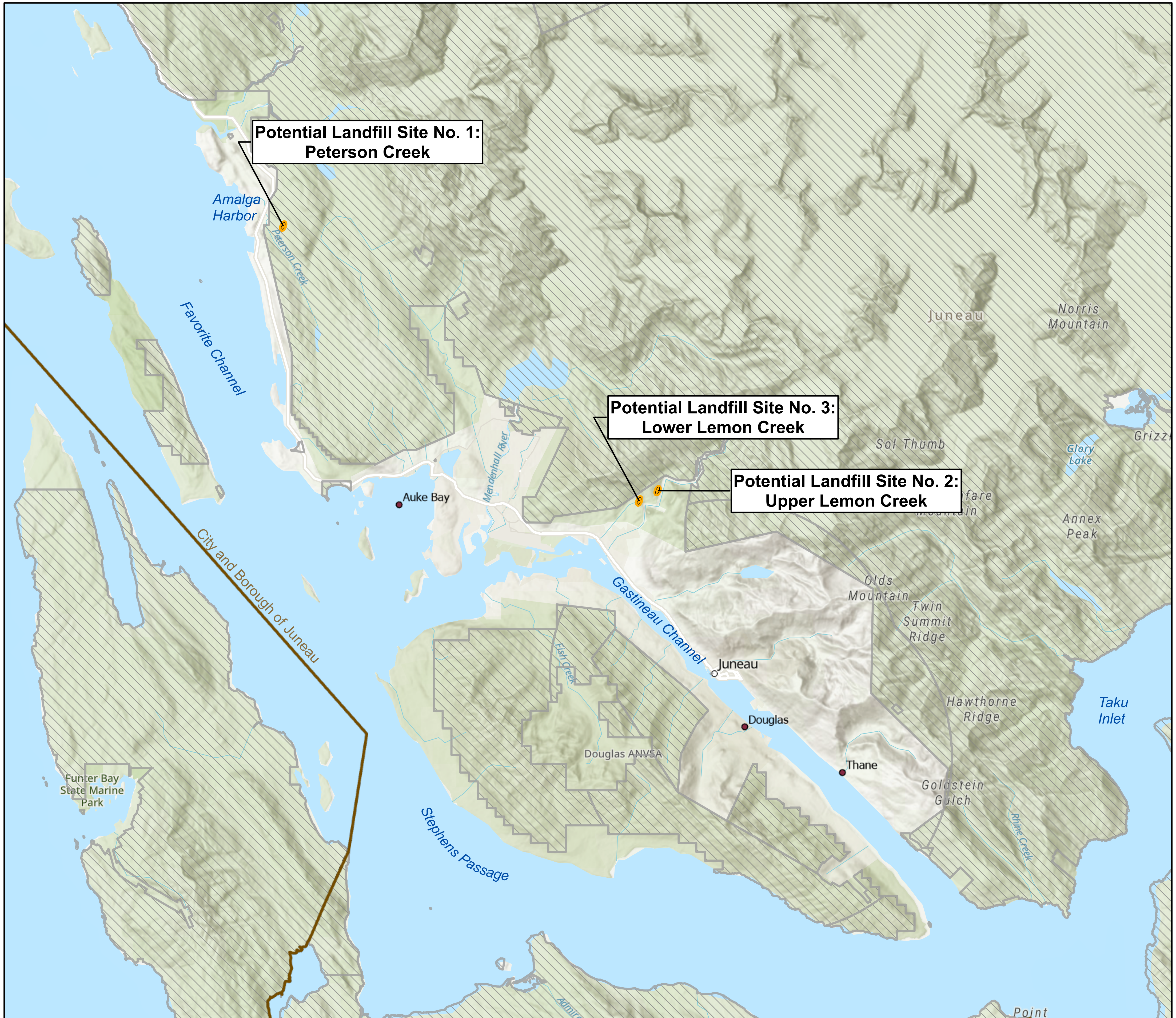
Parameter	Anchorage	Ketchikan	Kodiak	Sitka	Skagway	Fairbanks
Landfill Operation Information						
Landfill Operating Costs (2025$)	$18,484,000	Unknown	$3,154,000	$204,000	Unknown	$10,269,200
Landfill Operating Costs per Ton (2025$/Ton)	$61	Unknown	$270	Unknown	Unknown	$95
Landfill Remaining Capacity	~35 years	~30 years	900,000 Cubic Yards	Unknown	Unknown	~55 years
Leachate Processing Methodology	Unknown	Unknown	Leachate collection and treatment performed onsite using ultrafiltration membrane.	Unknown	Unknown	Lagoon for treatment and storage. Leachate is then recircualted in landfill.
Leachate Treatment Operating Costs	Unknown	Unknown	$1,451,000	Unknown	Unknown	Uknown

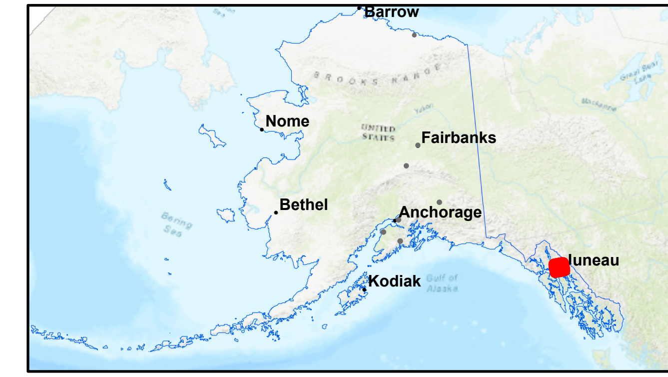
Parameter	Anchorage	Ketchikan	Kodiak	Sitka	Skagway	Fairbanks
MSW Transport and Disposal Information						
MSW Transported Out of Jurisdiction for Disposal	No	Yes	No	Yes	Yes	No
Final Disposal Location of Exported MSW	Not Applicable	Roosevelt Regional Landfill	Not Applicable	Roosevelt Regional Landfill	Roosevelt Regional Landfill	Not Applicable
Entity Responsible for Disposal	Not Applicable	Republic Services	Not Applicable	Republic Services	Republic Services	Not Applicable
Entity Responsible for Transportation	Not Applicable	Alaska Marine Lines	Not Applicable	Alaska Marine Lines	Alaska Marine Lines	Not Applicable
Type of Barge Service Provided by Alaska Marine Lines	Not Applicable	Southeast Alaska Main Line Barge	Not Applicable	Shuttle Barge in conjunction with southeast Alaska Main Line Barge	Southeast Alaska Main Line Barge	Not Applicable
Total MSW Exported for Disposal in 2024 (Tons)	Not Applicable	8,500	Not Applicable	8,200	1,300	Not Applicable
Intermodal Container Size	Not Applicable	40-feet	Not Applicable	40-feet	40-feet	Not Applicable
Average Tons per Intermodal Container (Tons)	Not Applicable	29	Not Applicable	26	25	Not Applicable
Number of Intermodal Containers Shipped per Week	Not Applicable	6	Not Applicable	2	1	Not Applicable
One way Transportation Time to Port of Seattle	Not Applicable	~3 days	Not Applicable	~6 days	~6 days	Not Applicable
Approximate Nautical Miles to Port of Seattle	Not Applicable	750	Not Applicable	1,100	1,150	Not Applicable
Transport and Disposal Cost per Ton (2025$/Ton)	Not Applicable	$177	Not Applicable	$269	$360	Not Applicable

Note: Populations, waste tonnages, annual operating costs, and averages are approximate and rounded.

[1] Data obtained from Census Reporter: https://censusreporter.org/ via 2023 American community survey data
[2] Anchorage 2024 Approved Utility/Enterprise Budget
[3] Interview with City of Ketchikan
[4] Interview with Kodiak Island Borough
[5] Interview with City and Borough of Sitka
[6] Interview with Municipality of Skagway
[7] A total of 3 full-time employees operate the transfer station, recycling, and landfill operations, with an addition 1-2 temporary employees at the landfill during busy months.

Appendix D
Potential Landfill Sites Identified in the 1993 Technical Reconnaissance Study for the City and Borough of Juneau





LEGEND

- Alaska Communities
- Boroughs and Census Areas
- Potential Landfill Site
- USA Federal Lands

0 2.5 5 7.5 10
Miles
1 inch = 6 miles
N

Potential Landfill Sites Identified in the 1993 Technical Reconnaissance Study (Brown et al. 1993)

City and Borough of Juneau

Date: 1/2/2026

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